INFANT AND CHILD MORTALITY IN NEPAL:
SOCIO-ECONOMIC, DEMOGRAPHIC AND CULTURAL FACTORS

By

Prakash Dev Pant

A thesis submitted for the degree of Doctor of Philosophy

at the Research School of Social Sciences,

the Australian National University

January 1995

Declaration

This thesis, except where acknowledged, is the original work of the author as a research scholar in Graduate Studies in Demography, the Research School of Social Sciences at the Australian National University.

Prakash Dev Pant

January 1995

ACKNOWLEDGEMENTS

This study was made possible by an award from the Australian International Development Assistant Bureau, study leave from my employing organization, the Centre For Economic Development and Administration, my admission to the Demography Programme at the Australian National University, and access to the Nepal Fertility Survey 1976 and Nepal Fertility and Family Planning Survey 1986 data sets provided by the Nepal Family Planning and Maternal Child Health Care project of His Majesty's Government of Nepal. I hereby express my gratitude to these institutions. I am also thankful to UNICEF/Nepal for the partial funding to collect the data, part of which are used in the earlier sections of this study, as well as in explaining the results where appropriate.

I owe a sincere debt of gratitude to my supervisors Dr. Habte Tesfaghiorghis, Dr. Alan Gray and Dr. David Lucas who have made considerable contribution to this work at its various stages. Alan's inspiration, encouragement, support, technical advice, assistance in the solution of the methodological problems and sincere guidance throughout my study period, resulted in significant improvements to this thesis. Habte's prompt reading of drafts, and comments and suggestions at various stages of this work were very helpful in clarifying many issues. David's intellectual remarks and academic advice were invaluable for the smooth progress of this thesis.

I have also benefited from the sharp comments of Professor Gavin Jones and Dr. Lorraine Corner which were valuable in shaping the direction of this thesis in its early stages. Professor Geoffrey McNicoll supervised for me for a short duration in the absence of Dr. David Lucas. I owe all these individuals a sincere debt of gratitude.

I am very grateful to Ms. Marian May who, despite her heavy work load, painstakingly read the draft of this thesis and edited to bring it to its present form. Marian has always made herself available to discuss my academic as well as personal problems. I am also grateful to Chris McMurray who edited the last two chapters of this thesis. I would also like to acknowledge the help of Ms. Yvonne E. Pittelkow in interpreting some of the results.

My special thanks go to the academic and administrative staff of the Graduate Programme in Demography. I wish to express my thank to Chris Patterson and Hugo Byrne for helping me with computer jobs. I wish to express my sincere thanks to my colleagues Aree Prohmmo, Socorro Abejo and Richard Makalew for their generous help of varied nature and excellent friendship.

Finally, I am indebted to my wife Sangita, daughters Ruja and Rajani, and son Prasang, for their emotional and moral support as well as sharing the pain of separation.

ABSTRACT

This study examined the differentials in infant and child mortality in Nepal according to socio-economic, demographic, cultural and health-related determinants. It also explored factors that account for the higher infant and child mortality levels in certain parts of the country as well as the role of the change in the value of explanatory variables versus the change in the structural relationship between variables in explaining the decline in infant and child mortality from the 1960s to the 1980s. The data for this thesis came from the nationally representative sample surveys, the 1976 Nepal Fertility Survey (NFS) and the 1986 Nepal Fertility and Family Planning Survey (NFFS). The direct estimation technique for infant and child mortality levels and logistic regression were the major tools of data analysis in this study.

The length of the preceding birth interval and the survival status of the preceding child from both the NFS 1976 and NFFS 1986 were the most important demographic determinants of infant and child mortality in Nepal. Most of the influence of mother's age at childbirth and birth order of the child on infant and child mortality was due to the length of birth interval. Sibling competition for mother's care, tangible resources and health care as a path through which birth spacing is likely to influence child survival prospects is not ruled out in this study. However, the correlation between the deaths of siblings in a family suggested the existence of other possible mechanisms where the influence of the survival status of the preceding child could be working through repetitive biological, behavioural, household socio-economic and environmental factors common to all children born to the same mother.

Ever use of contraception emerged as an important factor in influencing infant mortality. Its role in explaining the decline in both infant and child mortality was impressive. The influence of contraceptive use on infant and child mortality, however, was mediated neither through mother's age at childbirth nor through length of birth interval. It was thus hypothesized that this effect on infant mortality was working through the maternal and child health care services delivered in conjunction with the family planning services.

The important socio-economic factors influencing infant and child mortality were whether or not mothers worked outside the home, urban or rural place of residence, the number of cows possessed by households, and the size of land-holding of the households. Mother's education as a determinant of child mortality was more important for the period 1971-80 than 1961-70. The effect of maternal education on child mortality is attributed to the better position of women with some education as against women with no education in terms of resources and socio-economic situation rather than to education *per se*.

Much of the inter-regional variation in infant and child mortality was due to the differences in the variable values rather than the difference in the structure in relationship between the regions, but this was more true for infant than child mortality. The small proportion of women with second and third order births, the small proportion of births 37 months or more after the birth of the preceding child, the low average level of education of mothers, the small proportion of ever users of contraception and the small proportion who spoke Nepali at home in the high mortality region (HMR) were factors contributing to the higher average infant mortality in the HMR. The analysis also suggested that the implied structural differences in the determination of child mortality were cultural in nature to a much greater extent than was the case in the analysis of infant mortality. It is also clear in this study that, although demographic factors were more important than socio-economic, cultural and health-related factors in explaining the cross-sectional differentials in infant and child mortality, socio-economic, cultural and health factors were much more important than demographic factors in explaining the decline in infant and child mortality over the two periods in this study.

Intervention to increase spacing between births, raising the age at marriage, increasing the use of contraception, increasing the level of health knowledge and awareness among women, and dissemination of health-related messages through the media using local languages will contribute to further improvement in the child survival prospects in Nepal.

Table of contents

List of tables

CHAPTER ONE

INTRODUCTION

The present study is designed to measure and compare the influence of socio-economic and demographic factors on infant and child mortality in Nepal using two cross-sectional survey data sets, the 1976 Nepal Fertility Survey (NFS) and the 1986 Nepal Fertility and Family Planning Survey (NFFS). The analysis is further extended by examining how the change in socio-economic, demographic, health-related and cultural factors between the 1960s and 1980s have influenced the change in the infant and child mortality rates. This analysis is based on the pooled 1976 NFS and 1986 NFFS data sets. In addition, for the first time in the context of Nepal, this study using the 1986 NFFS data constructs high and low mortality regions and explores factors which explain difference between the infant and child mortality between these two regions.

The subsequent sections of this chapter provide a context for the background of the study, country background with a brief description of the demographic and socio-economic context, and health care delivery and its utilization along with a general review of literature on determinants and differentials in infant and child mortality. This is followed by the description of the sources of demographic data in Nepal, levels of infant and child mortality in Nepal, rationale, objectives and organization of the study. This background is important for the interpretation of the results.

1.1 Background of the study

Mortality constitutes one of the important components of change in human populations. Life expectancy at birth in Nepal was estimated at 45.3 years for 1971 (Central Bureau of Statistics (CBS), 1987a: 266-268) and 53.3 years for 1986 (CBS 1987: 64). The infant mortality was estimated at 108 per 1000 live births and child mortality was estimated at 56 per 1000 children for the year 1984 by the Nepal Family Planning and

Maternal Child Health Project (NFPMCH, 1987: 187). The total fertility rate (TFR) was estimated at a fairly constant rate at about 6.3 children per woman for the period 1971-1986 (CBS, 1987a: 266; Cleland and Shah, 1988: 21). These figures indicate that the Nepalese demographic situation is still marked by high birth and death rates. As in other developing countries, Nepal is trying to accelerate the pace of development with a poor resource base. The problem is further compounded by a persistently high population growth rate (Table 1.1). The persistence of high fertility, resulting in accelerated population growth, could be both the cause and consequence of high infant and child mortality. High levels of infant mortality are likely to be a cause of rapid population growth in a society where the survival prospects of a child are poor due to low levels of socio-economic development, and because the insurance effect of child loss is high due to the high economic value of children. However, a general improvement in socio-economic conditions can be expected to increase child survival prospects, contributing to higher life expectation at birth.

It is contended that disease leading to a child's death is a phenomenon of a biological nature at the individual level and is determined by historical characteristics of the society in which the child is born and living. These characteristics define the material condition of life at home and care given to the child (Behm, 1983: 25). This indicates that survival prospects of children in a society are related to a variety of factors. Thus understanding the determinants of child survival becomes rather complicated. In this context Anthony (1979: 66-69) argued that the presence of diseases and poor nutritional status acting together explain childhood deaths. Anthony further argued that either or both of these determinants are affected by factors such as food intake, birth weight, child spacing, child care practices and medical care which in turn are significantly affected by family income, education, health and the number of children born to the couple. These arguments of Anthony seem to be clear in explaining how various socio-economic and health-related factors are likely to influence child survival prospects in a developing society. However, there is no single explanation that can fit the child survival situation in every society. The strength and weakness of a particular variable in influencing child survival across societies as well as at different points of time are likely to differ. This has lead to the emergence of studies of child survival in different societies as well as at different times in relation to a variety of explanatory socio-economic, demographic, biological and health-related factors.

For example, children in Nepal are born and brought up in a diverse socio-cultural and geographical environment. People in the country live in a range of natural environments, varying from the high cold Himalayan region to the hot *terai* (plains area). The culture, ethnicity, caste, language, beliefs and living styles of the people vary from place to place (CBS, 1987). In such a circumstance, exposure to death among children can also vary according to their place of residence and socio-cultural setting. Past studies in Nepal (Shrestha et al., 1987; Gubhaju, 1984; CBS, 1987a) have revealed marked variations in infant and child mortality levels across geographical and administrative units as well as according to the child care practices adopted by parents (Levine, 1987).

Socio-economic factors could have a significant effect on mortality. These include education, occupation, residence, ethnicity and socio-cultural setting. Household and community factors, such as housing conditions, sanitation, nutritional level, public health services, medical services, and beliefs are equally important determinants of infant and child mortality (CBS, 1987a: 303). The Government of Nepal has recognised that the well-being of the people and development of the country can be achieved only by improving its people's health status, socio-cultural and economic conditions (National Planning Commission (NPC), 1986: 36-41; UNICEF, 1987: 156). In this context, various programmes to enhance health status in general and child survival in particular have been formulated and are being implemented (His Majesty's Government of Nepal (HMG), 1987; NPC, 1992: 79-82). Given the poor resource base in the country, it is important that the potential impact of specific interventions be identified, so as to make judicious use of the resources at hand. A single intervention programme with greater impact could be more efficient than numerous smaller intervention programmes with small impact. Limited information on the effect of geographic, socio-economic and demographic factors on child survival creates serious problems for the design of effective intervention programmes to improve the well-being and survival prospects of the children in Nepal. The proposed study like this is needed not only for the intrinsic academic interest but also to provide insights to the Government in designing future programmes by highlighting the high risk groups. This study thus is expected to serve the Government of Nepal in formulating future policies in achieving some of the demographic targets expressed, for example in the Eight Development Plan, such as a reduction of infant mortality rate from 102 in 1991 to 80 per 1000 live births in 2000 and under five mortality rates from 165 to 130 per 1000 (NPC, 1992: 103).

1.2 Country background

Nepal, with an area of 147,181 square kilometres is one of five land-locked countries of the Asian Continent. The country is situated between the People's Republic of China to the north and the Indian provinces of Utter Pradesh, Bihar, and West-Bengal to the west, south and east respectively.

Ecologically, the country is divided into three broad regions running east to west: the *terai*, a flat low-land belt; the hills, area between the altitudes of 610 and 4877 meters above sea level; and the mountains, a high Himalayan area lying between 4877 and 8848 meters above sea level. The *terai* ecological belt occupies about 23 per cent, the hill ecological belt occupies about 42 per cent, and the mountains ecological belt occupies about 35 per cent of the total land area of the country (CBS, 1987: 18). The hills ecological belt, situated in the middle part of the country, comprises several valleys and basins, while the *terai* ecological belt, situated to the southern part of the country, forms a low flat land and includes most of the fertile land and dense forests. As the setting of the country ranges from nearly sea level in the south to the high Himalayas in the north within a short distance of about 241 kilometres, the country has a great variety of topography. The temperature in the *terai* and mid-hills of Nepal from summer to the late spring ranges from more than 40^{o} Celsius to about 28^{o} Celsius. During the winter, the average maximum temperature in the *terai* ranges from 7^{o} to 23^{o} Celsius while the central valley experiences chilly temperatures. At higher elevation, much colder temperatures prevail. The rainfall is concentrated in the monsoon period (June-July) and it varies between 1000 to 2000 millimetres. The end of the monsoon is followed by a dry winter which reaches its coldest temperature from December to February, and after this the temperature gradually becomes warmer until the beginning of the next monsoon (CBS, 1987: 203-226; CBS, 1987a: i).

1.2.1 Population, density and distribution

Available demographic data show that Nepal's population has been increasing since the 1930s (Table 1.1). The total population of the country between 1961 and 1991 has almost doubled. The population growth rate based on different censuses of the country for the period before 1961 shows erratic trends. The decline of about one per cent in the enumerated total population between 1911 and 1920 was explained as a consequence of a world-wide influenza epidemic in 1918, the heavy casualties suffered by Nepalese men serving with the Allied Forces during the First World War, and under-enumeration in the 1920 Census. The negative growth between 1920 and 1930 is attributed to the problem of under-reporting in the 1930 Census (CBS, 1987a: 9).

Table 1.1 Enumerated population and change by census years: 1911-1991, Nepal.

Census year	Population size	Absolute (%) change from previous values+	Annual geometric growth rate (%)
1911	5 638 749		
1920	5 573 788	-1.2	-0.13
1930	5 532 574	-0.7	-0.07
1941	6 283 649	13.6	1.16
1952/54	8 256 625	31.4	2.30
1961	9 412 996	14.0	1.65
1971	11 555 983	22.8	2.07
1981	15 022 839	30.0	2.66
1991	18 491 097*	23.1	2.10

Notes: +Calculated as, [(5573788 / 5638749)-1] * 100 = 1.2.
Sources: CBS, 1985: Table 1.2, *CBS, 1993: 7, Table 3.

The Government of Nepal has recognised population growth as a barrier to the socio-economic development of the country. As a consequence, the need to control the population growth in the country has been clearly expressed in different national development plan documents of Nepal since 1965 (NPC), 1965: 48-55, 1970: 21-30, 1975: 35-43, 1980: 703-722, 1986: 143-160). A population conference was organised in 1976 to identify ways and means of implementing the population policy expressed in the Fifth Plan document to achieve the desired level of population growth in the country (Population Policy Coordination Board et al., 1976). However, an explicit formal national population policy and strategy emerged in Nepal for the first time in 1983 (National Commission on Population, 1983). The major thrust of the population policy expressed in both the plan documents and in the 1983 'Population Policy and Strategy' was on reducing the existing fertility rates through strengthening the family planning programme and expanding the family planning services and delivery system.

It has been contended that a decline in fertility and higher demand for contraception in a country can only be achieved after a substantial gain in child survival level (Cochrane, 1981: 29). Although improved child survival prospects were identified as a factor in reducing fertility in the national population policy of 1983, the strategy to improve these prospects was neglected in Nepal. Even the UNFPA representative in Nepal (Gonzalez, 1990: 11-28), while suggesting a comprehensive population strategy for Nepal, mainly focused on strategies to strengthen the family planning programme to reduce the level of fertility without suggesting how the high infant mortality rate of 108 per 1000 live births (NFPMCH, 1987: 81) estimated for the year 1984 could be reduced further. However, steps such as establishment of a separate nutrition branch under the Ministry of Health with the aim of increasing the food production and strengthening the distribution of food, activating an expanded immunisation programme to immunise children against diseases such as tetanus, polio, measles, whooping cough and tuberculosis, and implementing a diarrhoeal disease control programme (NPC, 1980: 629, 632) are nevertheless among the project endeavours of the Government of Nepal to improve the child survival situation.

Nepal's population density increased from 56 persons per square kilometre in the 1952/54 Census to 102 persons in 1981. Although the population density of the country appears quite low in comparison to many countries of the world, that two-thirds of the total land of Nepal falls under the snow-covered high Himalayas and the high hills ecological belt, where cultivable lands are scarce. The population density measured per hectare of land in the country shows a gloomy picture because three persons per hectare of cultivable land in 1952/54 doubled to six in 1981 (CBS, 1987a: 14-15).

The population density measured for the three ecological belts shows varying densities. The *terai* region had the highest population density of 193 persons per square kilometre. The density is lowest in the mountains. However, the density per hectare cultivable land shows the mountains to have the highest population density of 10.6 persons per hectare of cultivable land followed by 7.6 in the hills and 4.7 in the *terai.* The reason has been thought to be the scarcity of cultivable land in the mountains and hills in comparison to the *terai.* The higher population density in the *terai,* however, is partly explained by the large exodus of people from the mountains and hills to the *terai* (CBS, 1987a: 15-16). The total fertility rate of 6.2, 6.5 and 6.2 children per woman in the mountains, hills and *terai* respectively (Karki, 1984, cited in Risal and Shrestha, 1989: 49) further supports the argument that the increase in the population density in the *terai* area is not only due to the persistence of the high fertility but also due to internal migration from other regions of the country.

Table 1.2 shows the population distribution for the three ecological belts and census years. Table 1.2 also shows the higher pace of increase in the population of the *terai* between the three intercensal periods in comparison with the other two ecological belts. Table 1.2 shows that the population in the *terai* which accounted for only 35 per cent of the total population in the 1952/54 Census had increased to 44 per cent of the total population in the 1981 Census. The population decline in the hills and mountains has been thought to be due to the heavy exodus of people to the *terai* in search of cultivable land and a relatively easy life (CBS, 1987: 2).

Table 1.2 Percentage distribution of population by ecological belts: census years 1952/54 to 1981, Nepal.

	Population by ecological belt (percentage)				
Year	Mountains	Hills	Mountains and hills	*Terai*	Total (number)
1952/54	- -	- -	64.8	35.2	8,256,625
1961	- -	- -	63.6	36.4	9,412,996
1971	9.9	52.5	62.4	37.6	11,555,983
1981	8.7	47.7	56.4	43.6	15,022,839

Sources: CBS, 1975: Table 1, CBS, 1984: Table 3, CBS, 1984e.

Besides the three ecological belts, Nepal has been administratively divided into 75 districts, 14 zones and five development regions (eastern, central, western, mid-western and far-western development regions). These development regions bear no relation to the mountains, hills and *terai*, because every one of them includes the three components of the ecological classification. The population distributions according to the development regions for the years 1971 and 1981 are presented in Table 1.3.

Table 1.3 reveals that the mid-western development region which occupies the largest area (about 29 per cent of the total land area of the country) stands on the fourth rank with its share of population, which accounted for only 13 per cent of the total population in 1981. The total population of the western development region for the period 1971 to 1981 has actually increased, but its share in the country's population has remained the same. Table 1.3 shows that the share of the total population of the eastern development region has increased marginally from 24.2 per cent in 1971 to 24. 7 per cent in 1981. The central development region, which covers about 18 per cent of the land area has the largest share of the total population. The far-western development region occupying about 13 per cent of the total area of the country had nearly 9 per cent of the national population in 1981 (CBS, 1987a: 19-21).

Table 1.3 Distribution of population and land by administrative development regions: census years 1971 and 1981, Nepal.

Administrative development region	Percentage distribution of population and land area		
	Population 1971	Population 1981	Land (Sq.km.) 1981
Eastern	24.2	24.7	19.3
Central	33.4	32.7	18.6
Western	21.2	20.8	20.0
Mid-Western	12.9	13.0	28.8
Far-Western	8.3	8.8	13.3
Total (percentage)	100.0	100.0	100.0
Total (numbers)	11,555,983	15,022,839	147,181

Sources: CBS, 1975: Table 1, CBS, 1984: Table 3, CBS, 1984e.

1.2.2 The economy

Nepal was closed to the outside world until 1952. Development activities were correspondingly limited. Even after 1952 the pace of economic development was slow because most resources were invested in building infrastructure and institutions. The limited natural resources, the mountainous nature of the terrain and the landlocked position of the country have further delayed the overall development of the country. In addition, the increasing population pressure is aggravating problems of environmental deterioration leading to soil exhaustion and declining agriculture production. Urban growth has also been allowed to absorb highly productive agricultural land (UNICEF, 1987: 13).

The Nepalese economy is overwhelmingly dominated by agriculture. This sector alone contributes about 60 per cent to the Gross Domestic Product and gives employment to about 90 per cent of the total economically active population. Furthermore, this sector also accounts for about 60 per cent of the total export earnings (NPC, 1991: 15; HMG and WHO, 1988: 3). Agricultural production in Nepal is divided into two broad groups - food grain crops and cash crops. About 82 per cent of the total cultivable land is used to produce food crops. The major food crops grown in Nepal are rice, maize, millet, wheat and barley among which wet-rice production occupies a prominent place, with 50 per cent of the total land used for food crop production during the decade. The leading cash crops produced in Nepal include oil seeds, sugar-cane, jute, tobacco, potato, tea, cardamom and fruits (CBS, 1991: 79-104; Shrestha, 1989: iii). Rice is mainly produced in the *terai* while maize and millet are basically hill crops. Livestock farming in the mountains, dairy and fruits in the hill region and fish farming in the *terai* region are associated with the crop farming, but only on a limited scale and in a scattered form (CBS, 1991: 60-63).

Because of the limited irrigated land area in the country, food production is highly dependent upon nature. In the past, the failure of monsoon rain to come on time has resulted in a sharp decline in food grain production in some years. The information on the food balance sheet for the period 1979 to 1989 provided by the Central Bureau of Statistics of Nepal (CBS, 1991: 170) shows a food deficit in the country for the fiscal years 1979/80, 1982/83 and 1986/87.

The growth in the industrial sector in the past has been slow. The Census of Manufacturing Entities, a census of establishments employing at least 10 individuals, carried out in 1986 by the Central Bureau of Statistics (CBS, 1987), showed 4903 manufacturing units employing 73,718 people. The major products of these manufacturing units were jute goods, sugar, cigarettes, cotton textiles, cements and leathers, most of which are based on agricultural products (HMG and WHO, 1988: 3).

The rapid population growth in Nepal has affected almost every aspect of the economy. It has led to increased pressure on the cultivable land and created shortages of food (primarily in the mountains and hills), depletion of forest resources, and frequent soil erosion and land slides. Meeting the growing needs of the people for education, health, drinking water and other basic needs has proved difficult (National Commission on Population, nd: 1). An estimated 43 per cent of the population in the country live below the poverty line as assessed by the Government at about US$ 500 per family per year (UNICEF, 1987: 16). A 1983 survey shows that the richest 10 per cent of Nepal's population earns about 47 per cent of the total income while the poorest 40 per cent earn only 9 per cent (NPC, 1983 cited in UNICEF, 1987: 16). In addition, access to the market, resources, and infrastructure also have had an impact on disparities in different parts of the country. Nepal's economic life is self-evident from its per capita income and land-holding. The per capita income as shown by the World Bank for Nepal is US$ 140 per annum which ranks the country sixth last in the list of the countries of the world in 1984 (World Bank, 1986) as against 13th last in 1976 (World Bank, 1978). The average household size according to the 1981 Census was six (CBS, 1991) and the per capita land-holding 0.2 hectares, with about 80 per cent of the holdings below one hectare (Shrestha, 1989: iii). There is a substantial difference between maximum and minimum land-holding in the *terai* and hills. Only seven per cent of the hills population are in the highest land-holding category, but in the *terai* there are 27 per cent. On the other hand, the landless in the *terai* make up 23 per cent compared to one per cent in the hills (Pant, 1987: 2).

1.2.3 Literacy and education

Education has been considered as one of the major prerequisites for the overall development of a country. With this point in mind, the Government of Nepal has been continuously trying to develop the infrastructure to provide education to the maximum possible number of people of the country. The slogan of universal primary education to all was declared by the Government in the Third Development Plan of Nepal in 1965 (NPC, 1965: 124).

The total number of 3000 primary schools in 1965, each of which was served by only one teacher, (NPC, 1965: 124) increased to 14907 in 1982 (CBS, 1987a: 141). The national literacy rate of virtually nil in 1950 (Luhan, 1992: 11) increased to 5 per cent in 1952/54 and 35 per cent in 1981. Similarly, the corresponding figure for the female literacy rate which was 1 per cent in 1952/54 increased to 12 per cent in 1981 (CBS, 1987a: 140). The enrolment of primary school children increased from 8000 in 1960 to roughly 2.5 million in 1990 (Luhan, 1992: 11). An adult education programme was initiated in 1956 which converted about 100,000 illiterate adults into literate adults by the year 1965 (NPC, 1965: 126). Despite these efforts Nepal has not been successful in achieving the goal of 'primary education to all children by the year 1980' which was expressed in the Third Development Plan. About 61 per cent of the population are still illiterate. Furthermore, the data on primary school enrolment in 1981 show that 34 per cent of the primary school aged children[1/] do not attend school.

The development of the education sector in Nepal during the last four decades clearly has accorded emphasis to the quantity of education rather than the quality. Even now schools are poorly equipped, with most of the teachers untrained and curriculum mismatched with rural needs. In addition, most of the school buildings have little more than four walls and a roof. Desks, benches and even blackboards are luxuries (Luhan, 1992: 11-13). In such a situation the Government of Nepal has again set its goal to reduce

---

1/ The primary school level includes grades 1-5 with a minimum age of six for entry into grade 1. According to this classification a total of 2116499 children aged six to ten years in 1981 were attending school (CBS, 1987: 283, 1987a: 139).

the illiteracy rate from 61 per cent in 1991 to 33 per cent by the year 2000. Moreover, there is also a commitment to education for all by the year 2000 (NPC, 1991: 46) which is less than a decade away. Whether the Government of Nepal will be able to achieve this target within this short time with the poor resource base of the country remains questionable.

1.2.4 Urbanisation and migration

Nepal is basically a rural country with the majority of its people living in the rural areas. The settlement of Nepal is widely dispersed because of the physical nature of the country and the economic requirements of the people. Although the urban population is increasing rapidly, about 94 per cent of its total population still live in the rural areas. There are no urban centers in the mountains, while many have recently emerged in the *terai.*

The level of urbanisation in the country, as compared with the other contemporary developing countries, is very low. The urban population in 1952/54 was only 2.4 per cent of the total population; this increased to 3.6 per cent in 1961 and 6.3 per cent in 1981 (CBS, 1987a: 180). These figures are not directly comparable due to the varying definition of 'urban areas' adopted by different censuses. However, they give a reasonable idea of the low development of the urban areas in Nepal during different census periods.

The 1971 Census of the country has defined urban areas as 'having a population of 1000 and more'. Applying this definition to all censuses shows that 2.4 per cent of the population in 1952/54, 2.9 per cent in 1961, 3.7 per cent in 1971 and 6.2 per cent in 1981 were living in urban areas. Following the same definition the urban population shows an increase of 116 per cent during the 1971-1981 intercensal period leading to an urban population growth rate of 8.0 as against the national growth rate of 2.1 per cent (CBS, 1987a: 180). The increase in the urban population in recent years in Nepal is attributed to the increase in the number of urban centres from 16 in 1971 to 23 in 1981, a high level of rural to urban migration, annexation of rural areas to the urban areas and designation of new urban areas (Acharya, 86: 66). In addition, urban growth in Nepal is also attributed to the increase in the flow of international migration as a consequence of the open border with India, and the inter-regional flow of migrants from the hills and mountains to the *terai* where better services, employment opportunity, education, health and other economic activities are expected (CBS, 1987a: 12, 156, 200, 170-172).

1.2.5 Family planning, fertility and contraception

The Government of Nepal has emphasised reducing the high fertility rate experienced in the country in the last 30 years by implementing a family planning programme. The family planning programme was first introduced in 1959 by the Family Planning Association of Nepal, a non-governmental voluntary organisation. In the beginning this association provided family planning services and information on the methods of family planning to the people of Kathmandu, the capital of Nepal. In 1965, the Government of Nepal proposed that this programme should be an integral part of the National Development Plan and should function in a more organised way (Pant and Acharya, 1988: 213). Consequently the Third Development Plan (1965-1970) called for the creation of a separate family planning programme within the Ministry of Health (NPC, 1965: 132-13; Joshi and David, 1983: 3). In 1968 a Family Planning and Maternal Child Health Board was established and the Family Planning and Maternal Child Health Project was finally instituted under this Board (CBS, 1987a: 317-318). After this, in 1978 a Contraceptive Retail Sales Company came into existence which started to sell pills and condoms through retail outlets (Pant and Acharya, 1988: 213). The Family Planning and Maternal Child Health Project, until 1985, administered family planning services in 52 out of 75 districts of Nepal. Also, an Integrated Health Services Development Project established in 1969 to deliver a community oriented health service, is rendering family planning services to the people of 23 districts. Along with this, the Family Planning Association of Nepal is providing family planning services to the people of 17 districts (Schuler et al., 1985: 261; NFPMCH, 1987: 10-11; CBS, 1987a: 319-321). Other social organisations such as mothers' organisations, the Red-Cross society, and youth clubs were also involved to motivate people to use contraception and to provide information on various available family planning methods. Pills and condoms were distributed free of charge through the clinics of the family planning services. Vasectomy and IUD services were offered in those centres where doctors were available. In addition, vasectomy and laparoscopy services were delivered through mobile camps. Depoprovera and Norplant have been made available since 1973/74 (Pant and Acharya, 1988: 216-217).

Despite all these efforts, the fertility rate in Nepal remained constant during the period 1961 to 1981. For example, the total fertility rate of 5.8 children per woman in 1971 slightly increased to 6.3 by the year 1974-75 and remained almost constant till 1981 (CBS, 1987a: 284), but then slightly declined to 6.0 by the year 1986 (NFPMCH, 1987: 76). The increase of half a children between 1971 and 1974-75 is dubious because reliable data on fertility in Nepal began to be collected since the 1976 Nepal Fertility Survey.

The level and nature of contraception use is perhaps still too low to substantially influence fertility. The knowledge of contraceptive methods among currently married women steadily increased from 21 per cent in 1976 to 56 per cent in 1986. The percentage of currently married women who knew at least one method of family planning as well as its service outlets increased from six in 1976 to 33 in 1986. Use of contraception among currently married and non-pregnant women of reproductive age increased from 3 per cent in 1976 to 15 per cent in 1986 (NFPMCH, 1977: 63, 1987: 137). The increase in contraception use over the period has been attributed to an increase in the acceptance of permanent methods (Tuladhar, 1989: 18-19). For example, the 1986 NFFS (NFPMCH, 1987: 137) revealed that sterilisation was chosen by about 86 per cent of family planning acceptors and the prevalence of contraception use was higher among the older and high parity women who did not want to have any additional children. This suggests that the family planning programme in Nepal has not yet reached the potential users for services.

Tuladhar (1989: 2) argued that the persistence of high fertility in Nepal is due to the slow increase in the knowledge and access to contraception, particularly the reversible methods. Tuladhar further noted that, except in urban areas and among some sections of the population, the rise in contraception use and decline in fertility has been slower than expected by the policy makers.

1.2.6 Modern health care services in Nepal: historical perspectives

Development of and access to health services could have a direct bearing on the lifestyle as well as the overall development of a society. This is because the levels of development are likely to be largely dependent on the mental and physical health of its population.

Nepal embarked upon implementing a modern health system at the end of the nineteenth century when Bir hospital was establishment in Kathmandu. The vaccination against smallpox was available for the first time in the country after the First World War when a bacteriological department was established in Bir hospital (Kansakar, 1981: 192, cited in Shah, 1987: 32). However, until 1955 there were only 34 hospitals with a total of 623 beds, 24 dispensaries and 63 *ayurvedic* dispensaries in the whole country (Pandey, 1980: 108). About 50 per cent of all the services delivered through these institutions were concentrated on the Kathmandu valley (Shah, 1987: 32). The majority of the people in the country before 1955 were served by the traditional healers and traditional birth attendants (Pant and Acharya, 1988: 144) and to some extent through *ayurvedic*, Unani and indigenous systems (which use herbal treatment) (Pandey, 1980: 108).

The planned development of a modern health care system in Nepal dates back to 1955/56 when health programmes were incorporated in the First Development Plan document of the country (Pant and Acharya, 1988: 144; Shah, 1987: 32; Pandey, 1980: 108). Several efforts were made after this to improve the health status of the people in the country. For example, a Malaria Control Programme was launched by the Ministry of Health in 1955. The initiation of a Leprosy and Tuberculosis Control Project in 1966, the Smallpox Eradication Programme launched in 1968, and the establishment of the Family Planning and Maternal and Child Health Board in 1968 can be considered as some of the significant steps taken by the Government of Nepal to improve the health situation of the people through modern health care delivery (CBS, 1989: 211-313). In 1971 the division of basic health services was formed within the Department of Health with an aim to provide at least minimum health services to the maximum number of the people (Justice, 1986: 53). In 1977 the successful smallpox project was converted to the expanded programme for immunisation. Similarly, other vertical programmes such as nutrition support and diarrhoeal disease control programme were integrated with this programme in 1980 (World Bank, 1989: 54).

Table 1.4 Indicators of health services in Nepal between 1975 and 1990.

Indicators	End of 4th plan 1975	End of 5th plan 1980	End of 6th plan 1985	End of 7th plan 1990
Mortality indicators:				
Infant mortality rate (per 1000)	200[a]	150[b]	112[c]	*102[k]
Life expectancy at birth (years)	44[e]	46[b]	51[c]	54[d]
Health facilities:				
Number of hospitals	62[h]	73[f]	89[f]	111[i]
Total number of hospital beds	2294[h]	2679[f]	3767[f]	4768[i]
Number of health posts	403[h]	583[f]	814[f]	816[i]
Number of health centres	31[h]	27[f]	20[f]	18[i]
Number of *ayurvedic* dispensaries	82[h]	85[f]	145[f]	145[i]
Health personnel:				
Number of doctors	350[j]	562[f]	734[f]	1196[i]
Number of nurses+	834[j]	1910[f]	2587[f]	2980[i]
Number of *kaviraj / vaidya*	172[j]	219[f]	282[f]	370[i]
Number of health assistants**	822[j]	#1418[f]	1659[f]	3248[g]
Number of health workers	- -	1522[l]	5090[f]	24457[i]
Ratio of health personnel to population:				
Doctors/100,000 population	2.7	3.8	4.5	6.6
Nurses/100,000 population	6.5	13.1	15.9	16.5
Kaviraj-vaidya/ 100,000 population	1.3	1.5	1.7	2.0
Health assistants/100,000 population	6.4	9.7	10.2	18.0
Health workers/100,000 population	- -	10.4	31.2	135.2
Total population:	12,834,617	14,633,802	16,314,113	18,085,386

Notes: + Include number of assistant nurse. # Indicate the period 1979. * Indicate the period 1989. ** Indicate senior auxiliary, auxiliary health workers and health assistant. Total populations are interpolated figures based on the annual exponential growth rate.

Sources: [a]NPC (1975: 506) [b]NPC(1980: 626)
[c]NPC (1986: 742) [d]CBS (1990)
[e]World Bank, (1978: 108), Table 17 [f]CBS (1989: 214-219) Tables, 6.1-6.6
[g]CBS (1991: 218) Table 6.5 [h]CBS (1982: 218) Table 99-100
[i]HMG (1991: 45-49, 75), Tables 28-32 & 60 [j]Pandey, (1980: 115)
[k]New Era, IIDS and VaRG (1992: 121) [l]NPC, (1980: 635)

The data in Table 1.4 clearly show that during the period 1975-1990 health infrastructure as well as health personnel in the modern health sector in Nepal have considerably improved. The total number of 62 hospitals with 2294 beds in 1975 increased to 111 hospitals with 4768 beds by the end of 1990. Similarly, the number of health posts during the period increased by 2 times. A World Bank (1989: 54) study noted that the existing district hospitals and health posts theoretically offer primary health services to almost two thirds of the population. On the other hand the population of the country during the same span of time has also increased rapidly. The rapid increase in the population has no doubt been a barrier to producing a favourable ratio of population to health facility and personnel. However, the decline in the infant mortality rate from 200 to 102 per 1000 and the increase in the life expectancy at birth from 44 to 54 years achieved between 1975 and 1990 can be partly attributed to the positive aspects of the development in the modern health care delivery system in the country. Despite this, it can not be denied that Nepal has one of the highest infant mortality rates among South Asian countries (UNICEF, 1988: 64, 78). The situation in some hill and mountain areas of Nepal in 1987 was seen to be more alarming when the infant mortality rate was observed to be 180 per 1000 live births and the child mortality rate at above 300 per 1000 children aged one to five years of age (World Bank, 1989: 53).

1.2.7 Health services delivery and utilisation

The delivery of health services and their utilisation are likely to depend on a varieties of factors such as the nature of the health problem, the quality of health care services, the need and demand for the services, and the availability of the alternatives. A single study such as this cannot incorporate and discuss all possible aspects of the health care delivery and utilisation in a society. This is partly because of limited time and resources and partly because of the unavailability of the information. Thus the following sections of this chapter will mainly focus on the health care delivery system and its utilisation with focus on children's health in Nepal.

Despite the progress in the modern health care system, the majority of the population living in the rural parts of the country have very little access to it. Most children do not receive treatment when they are sick or in need. This is attributed to the lack of knowledge, inaccessibility or lack of medical facility as well as lack of confidence in modern medicine (UNICEF, 1992: 16). Prevailing poor nutritional status, low haemoglobin levels, anaemia, vitamin A deficiency, iodine deficiency disorder, infectious and parasitic diseases, diarrhoeal diseases and other preventable diseases such as measles, whooping cough, tuberculosis and acute respiratory infections among children are some of the major health problems in the country (UNICEF, 1992: 17-74; Tribhuvan University (TU) and HMG, 1985: 4-5). Diarrhoeal disease alone kills 44,000 children under five years of age every year. This accounts for about 45 per cent of the total child deaths in a year. Acute respiratory infection is estimated to kill another 30,000 to 40,000 children of this age group (MOH, 1989-90: 1). In this respect, UNICEF (1992: 70) noted that although the vast majority of women in the country recognise the symptoms of pneumonia, the antibiotics are far away.

The modern health care service (western medical technology) in Nepal is known as allopathic. The modern health care service delivery in the context of Nepal can be classified into three broad components: preventive, curative and promotive. Control of malaria, tuberculosis, leprosy, and immunisation of infants and children, are categorised as preventive services. Such services are generally provided by various projects under the Ministry of Health. On the other hand, curative care is delivered through hospitals, health centres and health posts that are distributed throughout the country (Pant and Acharya, 1988: 147-148). Health posts are the primary units of the health services supported by district hospitals and a number of vertical projects (TU and HMG, 1985: 1). The Sixth Development Plan of the country set an objective to reach rural people with a package of curative, preventive and promotive health services through health posts (Pant and Acharya, 1988: 148). In addition, child immunisations in most part of the country were also carried out by mobile teams of vaccinators employed under the expanded programme for immunisation. However, the coverage of immunisation until 1985 was limited to a small proportion of eligible people, often at district headquarters or nearby health institutions (UNICEF, 1992: 62).

The *ayurvedic* treatment service is delivered through either *ayurvedic* hospitals or *ayurvedic* centres distributed in different parts of the country. Pant and Acharya (1988:

148) noted that *ayurvedic* centres in rural Nepal provide traditional herbal treatment to their patients. In some instances, *ayurvedic* treatment is more widely accepted than modern medical services. For example, Durkin (1988) noted that the majority of the people in Nepal, even in Kathmandu, the capital city of the country, preferred to take *ayurvedic* treatment over modern medical services for the problem of viral hepatitis, despite the fact that the modern health care service in this area is highly developed and more easily accessible than in other parts of the country.

Another health care service is delivered by the local healers known as faith healers, spiritual healers and astrologers. A recent study in Nepal (Shrestha and Lediard, 1990, cited in UNICEF, 1992: 123) estimated the number of various traditional health care providers to be between 400,000 and 800,000. The type of health services delivered by each of these traditional healers largely depends on what the health seekers believe to be the type and cause of the illness. Many people in rural Nepal believe that sickness and death are often caused by ghosts, demons, evil sprits, planetary influences or displeasure of ancestors. To protect against these dangers a variety of precautions such as 'wearing of charms, the avoidance of certain food or sights during pregnancy, and or propitiation of ghosts and gods with sacrificial gifts' are taken (Harris et al., 1973: 85-86). In this context, Stone (1976: 75) noted that the question of which specialist is consulted is a function of illness itself. Stone further noted that minor discomfort, wounds and sores are treated with herbs; for more serious injuries the hospital is usually used; and fits of trembling will inevitably bring forth a god-invoking *janne manche* (traditional or faith healer). The significant roles of traditional functionaries of health care such as *jhankri* (faith healers), *dhami* (magic healers) and *sudini* (traditional birth attendants) in meeting the health care needs of the people of Nepal is also noted by Pandey (1980: 113), Blustain (1976: 84), Okada (1976: 107) and Wake (1976: 118-119). UNICEF (1992: 123) noted that the majority of the rural people in Nepal eventually visiting the health post had first consulted a traditional healer. A study in the central-east region of the country also found that the majority of the women in the study area were using the services of the traditional birth attendants (Reissland and Burghart, 1989: 44). In addition, Reissland and Burghart also noted that women in this region prefer to deliver a baby at home. Pandey (1980: 112) estimated that over 75 per cent of the people in Nepal receive treatment in their village from *vaidya* or traditional healers.

Overall the traditional healing system in Nepal constitutes an integral part of the health service delivery and utilisation. The discussion so far also suggests that the prevailing modern health care services in the country are inadequate. In such a situation, identification of the high risk groups of children as well as factors underlying the higher level of mortality can prove to be important for policy formulation and for better understanding of the existing child survival situation in the society.

1.3 Infant and child mortality differentials: a review of literature

The infant mortality rate is the probability of dying during the first year of life. It is generally considered a sensitive indicator of the general health and well-being of the people in a country. Similarly, the child mortality rate is defined as the probability of dying between one and five years of life (Ruzicka and Hansluwka, 1982: 92; Rutstein, 1983: 7; Figa, 1984: 134; Jain and Visaria, 1988: 23; Dutta and Kapur, 1982: 215;).

In economically developed countries the infant and child mortality rates have steadily declined since the turn of the century or before and have been reduced to very low levels at present. Although infant and child mortality rates in developing countries at present are similar to those of pre-industrial Europe (Figa, 1984: 31), a substantial decline in the rates has been observed. The infant mortality rates estimated by the United Nations (1982: 93,124) for the period 1945 to 1975 for 35 African countries and for 1950 to 1975 for 24 Asian countries clearly show a decline. In addition, UNICEF (1990: 76) also shows a decline in infant and child mortality rates in developing countries for the period 1960 to 1988. Yet, children under five in 30 developing countries were still experiencing levels of mortality of over 170 per 1000 and a further 29 countries were experiencing mortality rates of 95 to 170 per 1000. These data clearly show the persistence of a high level of infant and child mortality in many of the poorest developing countries of the world.

The age of mother at childbirth, the birth order and the length of the previous birth intervals are all important demographic correlates of infant mortality (Sathar, 1985: 354; Rutstein, 1983: 27; Chidambaram et al., 1985: 21). A U-shaped or J-shaped curvilinear relationship was observed between infant mortality and the age of mother at the time of childbirth (Jain and Visaria, 1988: 38; Visaria, 1985: 1358; Kanitkar and Murthy, 1988: 36). This relationship is sharper for neonatal[2/] deaths than for post-neonatal deaths. The World Fertility Survey (1984: 36) and Amin et al. (1986: 36) found that children born to very young mothers and mothers over the age of 35 were more likely to die during infancy. Similarly, Khan (1988: 232) and Jain and Visaria (1988: 38) for India, DaVanzo (1984: 313) for Malaysia and Chidambaram et al. (1985: 22) for developing countries reported that mortality tended to be high for children born to teenage mothers, lower for mothers aged 20-30 and again increasing for those born to mothers beyond 34 years of age.

The differentials in infant mortality by age of mother are attributed to biological factors (Sathar, 1985: 354; Visaria, 1985: 1358; Tsui et al. 1988: 70). Young mothers are inexperienced, biologically immature and less able to take care of their children; this increases mortality among their children. Similarly, beyond age 30 the risk of pregnancy complications begins to increase because of the increasing inflexibility of the female organs leading to higher numbers of infant deaths (Visaria, 1985: 1358).

Infant mortality is strongly associated with birth order. It is high for the first order birth, declines slowly up to the third order and then again moves upward for higher order births. Khan (1988: 233) in Uttar Pradesh, India, and Sathar (1985: 354) in Pakistan noted that the first order birth is associated with a higher chance of infant death. Chidambaram et al. (1985: 22) suggested that the risk increases only after the sixth order, while Jain and Visaria (1988: 38) and Kanitkar and Murthy (1988: 304) found that the risk of infant death increases after fourth order births. Infant mortality and birth order are connected through economic and biological factors. The firstborn child is more likely to be born to a mother who is both biologically and mentally less prepared to bear and bring up a child. High

---

2/ Neonatal mortality is the death of a child before one month (28 days) after the birth. Similarly post-neonatal mortality is the death of a child after one month and before one year of its life.

birth orders are more likely to be born to older mothers who are physically weak (World Fertility Survey, 1984: 36; Rutstein, 1983: 27).

Differentials in child survival in developing countries are strongly associated with the education of the mother (Caldwell, 1979: 396; Haines and Avery, 1982: 43; Schultz, 1984: 221; Ware, 1984: 195; Dasgupta, 1989: 23). Caldwell and McDonald (1981: 82-85) found a strong negative relation between education of mother and the level of child mortality. Hull and Gubhaju (1986: 116) in Java and Bali, Jain (1985: 424), Visaria (1985: 1399), Nag (1983: 887) and Dasgupta (1989: 20) in India, and Figa (1984: 146) in rural areas of developing countries found that education of the mother was the most significant factor in reducing infant and child mortality.

It has been suggested that the theoretical link between maternal education and infant and child mortality is that education develops the capability of mothers to adopt modern medicine, breaks traditional practices and creates the capacity to manipulate the world in the interests of their child (Caldwell, 1981: 75-76). Caldwell also suggested the examination of maternal education as an independent force for general social and economic change. Caldwell explained that education of women generally changes the traditional balance within familial relationships with profound effects on child care that lead to increased child survival. Similarly, Sathar (1985: 358) for Pakistan and Dasgupta (1989: 20-21) for Punjab, India, argued that education of the mother makes her able to avail herself of various services such as health facilities and other means of saving her children from death. Caldwell (1981: 75) and Figa (1984: 146-147) argued that the step from primary to secondary schooling of a mother has more impact on infant and child mortality than that from illiteracy to primary schooling. For Andhra Pradesh, India, Sandhya (1986: 95) suggested that mother's education will show a negative correlation with infant mortality only after crossing a transitional stage, defined as middle level schooling. Ware (1984: 195) argued that the differentials in infant mortality by education will be much more significant in the latter half of the first year of life when the child starts to eat solid food than in the first half where the child is solely dependent on breast milk. Figa (1984: 147), Amin et al. (1986: 42) and Ramanujam (1988: 266) argued that the education of the father emerges as an important factor in reducing infant and child mortality only in those countries where the majority of adult women are illiterate.

Socio-economic status is a combination of various social and economic characteristics, such as income of household, education, occupation and the type of house, which reflects the rank of an individual or a group in the social hierarchy of a community (Sandhya, 1986: 89). The economic conditions of a household, which can be measured in terms of the assets it holds and the various services and facilities it enjoys, have a significant effect on infant and child mortality (Amin et al., 1986: 37; Meegama, 1980: 30-31; Kanitkar and Murthy, 1988: 307). Jain (1985: 422) argued that for India the condition of the household appears to have an independent effect on infant and child mortality. Similarly, Jain (1985: 424) and Ruzicka and Kane (1985: 333-334) argued that poverty and infant and child mortality are positively associated. In the United States Gortmaker (1979: 285) observed that poor families lose their children during infancy due to poor sanitation and housing conditions.

Family economic status has long been identified as a major determinant of infant and child mortality (Woodbury, 1925 cited in Stockwell and Wicks, 1984: 32). Occupation, income: both at aggregate levels and at the individual family levels, and type of house are close correlates of infant and child mortality (Ruzicka and Hansluwka, 1982: 104; Figa, 1984: 145; Sandhya, 1986: 96). On the basis of information from 46 countries, Flegg (1982: 446) documented the distribution of income as a determinant of infant and child mortality. The occupation of the mother is also considered to be an important variable affecting infant and child mortality, as it determines the amount of care that a mother can render to a child (Ramanujam, 1988: 267; Sandhya, 1986: 96; Visaria, 1985: 1499; Hobcraft et al., 1984: 196). Visaria (1985: 1499) and Hobcraft et al. (1984: 196) added that infant and child mortality is adversely allied with women's working, particularly outside the home. For selected East and South Asian countries Arriaga and Hobbs (1982: 173) emphasised that infant and child mortality varies according to the occupation of the mother. They also found a higher infant mortality rate in those families where the husband was working in agriculture rather than in urban occupations such as professionals and clerical and sales workers. Kanitkar and Murthy (1988: 307) documented a negative association between land-holding and infant and child survival in India.

Before the twentieth century, large urban areas in most of the developed countries had higher mortality than rural areas (Arriaga and Hobbs, 1982: 162-164). In contrast, urban mortality in developing countries in this century has been lower than rural mortality (Jain, 1985 : 416; Visaria, 1985: 1399; Farah and Preston, 1982: 373) because of differentials in the standard of living and access to public health facilities (Chidambaram et al., 1985: 23). Dutta and Kapur (1982: 222) and Visaria (1985: 1399) for India, Amin et al. (1986: 40) for Bangladesh, and Caldwell and Ruzicka (1985: 300) for South Asian countries attributed urban-rural infant mortality differentials to differentials in health-related practices. Visaria (1985: 1399) also emphasised the type and place of delivery and the practice followed with respect to the care of new born infants as the components of place of residence associated with infant mortality. Visaria argues that availability and practice of health-related factors are closely associated with rural-urban infant and child mortality differentials. However, Hull and Gubhaju (1986: 116) for Java and Bali argued that the threat of mortality to infants which comes from infectious diseases of the respiratory and digestive system is about same among the people of similar economic class, whether they live in urban or rural areas.

Lasker (1981: 157-162) from a study in the Ivory Coast and Weisberg (1982: 1507-1517) from a study in Thailand have identified various factors in relation to the parents' health-seeking behaviour for the well-being and survival of their children. It is suggested that childhood diseases such as neonatal tetanus, whooping cough, polio and measles, which could be prevented through immunisation, significantly contribute to the high level of childhood mortality in developing countries (Foster, 1984: 119; Morley and Lovel, 1986: 272-283; Rahman et al., 1982: 264, cited in Bhuiya, 1989: 5-6). For Guatemala Annis (1981: 515) suggested that improved quality of services delivery motivates people for higher utilisation of available health services which are likely to reduce morbidity and ultimately mortality. However, Reddy (1989: 2) argued that the provision of health services, though necessary, is not a sufficient condition for the improvement in the health status of people as its utilisation is influenced by cultural, social and behavioural factors.

Other studies (Lasker, 1981: 158-166; Weiss, 1988: 5-6; Bhardwaj and Paul, 1986: 1003-1004) have discussed societies in which access to different types of traditional health services is available alongside modern health services. The choice of a healer by the parents of an infant is also considered to be a complex process which depends upon a variety of conditions, such as infant's health status, relative proximity of the healer, cost for health care, transport facilities, infant's gender, parents' attitude towards different system of medicine and their experience (Bhardwaj and Paul, 1986: 1003; Weiss, 1988: 5). Weiss (1988: 6) further argued that preference for medical help seeking varies according to the nature of the illness, socio-demographic characteristics of an individual and access to source of medical help. However, Chernichovsky and Meesook (1986: 619) found low household income to be a barrier to the utilisation of modern primary medical services in Indonesia even when they were publicly provided.

1.4 Infant and child mortality differentials in Nepal: the literature

Previous studies that examined the infant and child mortality differentials in Nepal focused on the effect of demographic variables such as maternal age, birth order, sex of child, year of birth and socio-economic variables such as education of mother, education of father, ecological belts and place of residence (Gubhaju, 1984, 1985, 1985a, 1986; Hobcraft et al., 1984; Rutstein, 1983; Shrestha et al., 1987; Thapa and Retherford, 1982). Factors such as maternal age, parity and birth interval are found to be the major correlates of infant and child mortality in Nepal. The risk of infant death was found to be higher among extreme birth orders (Thapa and Retherford, 1982: 68-69; Gubhaju, 1985a : 20). However, the cause of higher risk of infant death among first born infants was noted as being the result of the higher proportion of younger women having a first birth rather than the first birth *per se* (Gubhaju, 1986: 445). Children born within short birth intervals as well as those born to high parity women were also identified as being vulnerable to excessive risk of dying during infancy and childhood (Gubhaju, 1985a: 20-21). In addition, higher rates of infant deaths were also found among children born to mothers below ages 20 and above 40 years of age (Rutstein, 1983: 27).

The socio-economic characteristics identified as being related to infant and child mortality differentials in Nepal are mother's education, father's education, rural-urban residence, and geographical regions of residence. The education of parents appears to have some effect on infant and child mortality. Children born to mothers with no education have a higher infant mortality rate compared to those born to mothers with some education (CBS, 1987a: 310). Similarly, lower infant mortality was found among the children of literate fathers. The level of education of the mother was much more significant for infant mortality differentials than the level of education of the father (Gubhaju et al., 1987: 27-28).

Shrestha et al. (1987: 17), Gubhaju et al. (1987: 27) and Thapa and Retherford (1982: 73-76) found large variations in infant mortality rates by geographical region and area of residence categorised as urban and rural. Infant mortality in the rural areas was substantially higher than in urban areas (CBS, 1987a: 309; Gubhaju et al., 1987: 27). The highest infant mortality was also found in the mountain region followed by the *terai* and hills region (Thapa and Retherford, 1982: 76; Gubhaju et al., 1987: 27). The excessive infant mortality rate in the mountains and rural areas is due to the lack of health services and low level of socio-economic development (CBS, 1987a: 310). Similarly, urban-rural infant mortality differentials are attributed to the differentials in public health facilities (Thapa and Retherford, 1982: 66).

1.5 Sources of demographic data in Nepal

The history of census taking in Nepal goes back about 80 years (the first census for which exact data are available was the 1911, see Table 1.1). However, the data collected before 1952/54 by the so-called censuses are not considered to be a good source of data to estimate the demographic parameters as they were confined to certain definite and limited purposes. Demographic parameters for Nepal have thus been estimated by using the census data that were collected from 1952/54 and onwards (Vaidyanathan and Gaige, 1973;

UNICEF, 1990; Worth and Shah, 1969; Gubhaju, 1974; CBS, 1974; 1976; 1977a; 1978; NFPMCH, 1977; 1987; New Era, 1986).

The data collections for the study of demography using survey research techniques began in Nepal in 1966 when, for the first time, the National Health Survey was carried out by the Department of Health of His Majesty's Government of Nepal. However, the demographic parameters based on the statistics from this survey were considered to be unreliable because 20 per cent of the sampled villages were not approached. Several other longitudinal as well as retrospective surveys were carried out in Nepal after this survey. Some of these are: the Family Planning Knowledge, Attitude and Practice (KAP) and Fertility Survey, 1974 to 1978, which was a longitudinal survey undertaken by His Majesty's Government of Nepal and the Family Planning and Maternal Child Health Project; the Nepal Fertility Survey, 1976, carried out jointly by His Majesty's Government of Nepal, the Family Planning and Maternal Child Health Project and World Fertility Survey staff; the Second National Family Planning Follow-up Survey, 1978, undertaken by the Nepal Family Planning and Maternal Child Health Project; the Nepal Contraceptive Prevalence Survey, 1981, undertaken by the Family Planning and Maternal Child Health Project in collaboration with Westinghouse Health Systems; the Fertility and Mortality Survey, 1984 carried out by New Era with financial and technical assistance from the National Population Commission of Nepal; and the Nepal Fertility and Family Planning Survey, 1986, undertaken by the Family Planning and Maternal Child Health Project. Among these, the Demographic Sample Survey, 1974-78, the Nepal Fertility Survey, and the Nepal Fertility and Family Planning Survey are considered to be the best nationally representative sample surveys of Nepal. However, the demographic estimates based on the Nepal Fertility Survey 1976 have been considered to be the best and most reliable. The data and quality of the 1986 NFFS have not yet been analysed in detail (CBS, 1987a: 329-338).

Although vital registration was introduced in 1962 in Nepal, it was confined to only about 40 districts of the country until 1981. In addition, the coverage of the birth and death registrations are not complete. An estimate of the coverage of vital events by the vital statistics registration system, prepared by the Central Bureau of Statistics of Nepal, reveals that about 23 per cent of the total births and 10 per cent of the total deaths were covered in the fiscal year 1978/79, which increased to a coverage of 25 per cent of births and 12 per cent of deaths in 1985/86 (CBS, 1987a: 339).

1.6 Levels of infant and child mortality in Nepal

In the absence of a vital registration system, levels of infant and child mortality in Nepal have to be estimated using indirect techniques. Table 1.5 presents various estimates of infant mortality rates in Nepal. Despite the fact that estimated infant mortality rates for different periods are not consistent in ascertaining the level, they in general indicate the vulnerability of Nepalese children to higher risk of death (Table 1.5.)

Table 1.5 Estimates of infant mortality rates: 1954-1984, Nepal.

		Infant Mortality Rates/1000		
Sources	Reference period	Male	Females	Both sexes
[a]Vaidyanathan and Gaige (1973)	1954	260	250	-
UNICEF (1990)	1960			215
[a]Worth and Shah (1969)	1965-66	-	-	152
[a]Gubhaju (1974)	1961-71	200	186	-
CBS (1974)	1971	-	-	172
CBS, (1976)	1974-75	141	112	133
CBS, (1977)	1976	128	138	134
CBS, (1978)	1977-78	110	98	104
NFPMCH (1977)	1976			152
Gubhaju (1984)	1973-74	-		172
CBS(1985)	1981			144
New Era (1986)	1981	136	111	117
NFPMCH (1987)	1984			108
New Era; IIDS and VaRG (1992)	1989			102

Source: [a]CBS, 1987a: 300, Table 13.2.

The infant mortality rates estimated by Vaidyanathan and Gaige (1973: 287) for the period 1952-54 was 260 for males and 250 for females. Worth and Shah (1969, cited in CBS, 1987a: 300) estimated the infant mortality rate at 152 for the period 1965-66 based on the data collected by the Nepal Health Survey. CBS (1987a: 300) estimated the infant mortality rate at 104 per 1000 live births for the period 1974-75 based on the Demographic Sample Survey of 1977/78. Among these, estimates made by Worth and Shah and CBS are noted to be underestimate due to data limitations (CBS, 1987a: 300-301). The latest infant mortality estimate of 108 for 1984 was made by NFPMCH (1987: 80) and was based on the data collected by the Nepal Fertility and Family Planning Survey 1986.

So far there has been little information on child mortality rates in Nepal. The child mortality estimated by Goldman et al. (1979: 32) for the periods 1957-61, 1962-66 and 1967-71 are 143, 109 and 100 respectively. Both the infant and child mortality estimates made for different periods tend to suggest that infant and child mortality in Nepal has declined steadily. However, the infant mortality rate in Nepal remains one of the highest among the South Asian countries (UNICEF, 1988: 64, 78).

1.7 Rationale for the study

The Nepal Fertility Survey (NFS) 1976 and Nepal Fertility and Family Planning Survey (NFFS) 1986 data sets allow analysis of the differentials of infant and child mortality according to the demographic and socio-economic variables of interest over the two periods of time. As both surveys are nationally representative and most of the variables in both the surveys are similar, this allows an opportunity for comparative analysis. An examination of the role of socio-economic and demographic factors and their association with infant and child mortality in Nepal over two periods of time allows assessment of the extent of the effect of changes in socio-economic structure of the population on infant and child mortality as well as factors that are associated with higher level of infant and child mortality. These issues have not so far been covered in the context of Nepal.

1.8 Objectives of the study

The review of the literature showed that while there is consistency in the relationship of some socio-economic and demographic variables with infant and child mortality differentials, there is also wide variation in explanations for differences as the populations under study differ. Socio-economic factors such as education, income, occupation and place of residence, and demographic factors, such as age of mother at childbirth, birth order and birth intervals, are very important in the examination of the levels and differentials of infant and child mortality. There is very little known in the context of Nepal about how various socio-economic, health-related and demographic factors operate in influencing infant and child mortality. It is also likely that these characteristics themselves may change with time. In addition, the relationship between the socio-economic, demographic, cultural and health-related factors, and the infant and child mortality (structural difference) is also likely to differ at different time.

The earlier discussion on the level of estimated infant mortality for Nepal (section 1.6) clearly showed that infants' exposure to death in the country during recent past has declined. This decline in infant mortality can be hypothesized as an effect of either the change in the value of the explanatory variables or an effect of the structural differences. However, in the context of Nepal, it is not clear whether the decline is due to the change in the value of explanatory variables or due to the structural differences. In line with this, the broad objective of this study is to compare and analyse the infant and child mortality differentials according to demographic, socio-economic and health-related variables based on two cross-sectional fertility surveys from Nepal. This analysis is extended further to explore factors associated with the rates of change in infant and child mortality using the pooled 1976 NFS and 1986 NFFS data sets. The details of the methodology are discussed in the concerning chapters.

The specific objectives of the study are:

- To assess the net effects of the age of the mother at childbirth, the birth order of the child, the preceding birth interval, the sex of the child and the child's year of birth (birth cohort) on the mortality risk during infancy (under one year of life) and childhood (one to five years of life).

- To analyse the influence of selected socio-economic (mother's education, father's education, mother's work status, place of residence, size of land-holding and number of cows and buffalo possessed by a household) and health-related factors (access to health care services and ever use of contraception) on the mortality risk during infancy and childhood.

- To explore whether the effects of the selected socio-economic (mother's education and place of residence) and health-related variables (ever use of contraception) on infant mortality are mediated through mother's age at childbirth and the length of the preceding birth interval (these last two variables represent one of the sub-groups of the proximate determinants described in the frame work suggested by Mosley and Chen (1984: 27-29) for the analysis of child survival prospects).

- To evaluate the association between the survival status of the immediately preceding sibling and the mortality risk of the index sibling, and to examine the extent to which the influence of the length of preceding birth interval on infant and child mortality is exaggerated in the absence of control for the survival status of the preceding child.

- To explore factors that explain the reasons why infant and child mortality in certain parts is higher than in other parts of the country.

- To determine the extent to which the changes in infant and child mortality observed for two points in time (1960s and 1980s) are due to the change in the values of explanatory variables of interest, and so assess the impact of structural change.

1.9 Organization of the study

This study is organised into eight chapters. Chapter One has presented the background to the study, a brief description of the demographic and socio-economic context and health care service delivery and its utilization along with a brief review of literature on determinants of and differentials in infant and child mortality. Chapter Two examines the quality of data and sets out the analytical framework and analytical approach. Chapter Three examines the effects of demographic variables on the mortality risk during infancy and childhood. Chapter Four examines the influence of socio-economic and health-related factors on the mortality risk during infancy and childhood. This chapter also explores the mechanism through which selected socio-economic and health-related factors influence infant and child mortality in Nepal. Chapter Five examines the influence of the survival status of the preceding child on the mortality risk of the index sibling. This chapter also assesses the extent of exaggeration of the effect of the length of the previous birth interval on infant and child mortality in the absence of control for the survival status of the preceding child. Chapter Six explores factors that explain the higher infant and child mortality in certain parts of the country as against other parts of the country. Chapter Seven examines the role of change in the values of explanatory variables as against the role of change in the structure in relationship between independent and dependent variables in explaining the change in the infant and child mortality that took place between the two points of time considered in this study. Finally, Chapter Eight consists of the conclusion, future research prospects and policy implications.

CHAPTER TWO

METHODS AND MATERIALS

2.1 Introduction

Various conceptual frameworks have been proposed and developed for the study of child survival in developing countries. Yet there is no universal general theory to study mortality during childhood and the mechanisms through which various determinants operate to influence child survival (Behm, 1991: 9). The need for a conceptual framework to guide the analysis cannot be denied. In this respect, Wunsch and Duchene (1985: 209) noted several phases that have to be considered in the process of building an analytical framework. Usually, the general theory is expressed in a verbal form as the first phase of the model building. This is followed by operationalization of a theoretical relationship between abstract concepts using indicators which are expressed by a causal diagram. The causal diagram then presents the relevant concepts in the theory and their mutual dependence or independence. Indicators expressed by a hypothetical causal diagram are then analysed through statistical models for empirical verification. These requirements are not met in most of the studies on determinants of mortality (Behm, 1991: 7). Considering these points, this chapter discusses the theoretical framework and proposed statistical models for the study, and the quality of the 1976 NFS and 1986 NFFS data.

2.2 Theoretical framework for the study

The available literature suggests that the survival prospects of children in the developing countries at present are similar to those in pre-industrial Europe. About 21 to 30 per cent of the children in many developing countries in 1990 died before they reached age five. On the other hand only about 2 per cent of the children in most of the developed countries die before they reach age five (UNICEF, 1992a: 72-73). These figures indicate clearly a marked variation in the survival prospects of the children between the developed and developing nations.

The literature reviewed in the preceding chapter also suggests that the most frequently observed patterns in the studies of infant and child mortality are the higher rates of death for the children born to uneducated mothers and mothers from rural areas in comparison to children of educated mothers and mothers from urban areas respectively. A higher risk of death is also observed for children born to high parity women, younger women and first and fourth or higher order births than for children born to low parity women, women aged above 20 years and second or third order births, respectively. The variation in infant and child mortality by socio-economic and demographic factors is also noted in the literature. However, the influence of a variable and the way it operates to influence child survival is likely to be different as the population of the study differs. In this context, Mosley (1985: 190) argued that

> Any diminution in the biological potential is a direct consequence of physical and biological assaults on the individual which can have their origins with the mothers even before conception, and which continue during pregnancy, childbirth, and throughout early childhood. These hazards do not occur randomly however, but are the consequence of the physical environment and socio-economic setting where the child was conceived and matured.

The persistence of variation in infant and child mortality in developing countries by socio-economic conditions is of particular importance 'because of their great magnitude, because the groups with the highest risks of dying are numerically large and because the differences occurs in a context of high mortality' (Behm, 1991: 7). Along these lines, Ruzicka (1985: 187) noted that variations in infant and child mortality among strata of a given society, and the association with levels of family income or other indicators of wealth or poverty and parent's educational level, provide an assessment of the extent of health problems and identification of the most vulnerable groups.

Mosley (1985: 189) citing Walsh and Warren (1980) and Caldwell et al. (1983) noted a lack of dialogue between the social scientists and bio-medical scientists. In an effort to bridge this disciplinary gap in the study of the determinants of mortality, particularly infant and child mortality in developing countries (Mosley, 1984: 4), Mosley and Chen (1984) proposed an analytical framework for the study of child survival in developing countries. This framework identified three classes of variables: socio-economic variables, proximate or intermediate variables, and the outcome or dependent variable(s). In proposing the framework, maternal factors, environmental contamination, nutrient deficiency, injury and personal illness control have been classified as five sets of intermediate or proximate variables affecting the health of the child rather than these being a simple cause of mortality. Mosley and Chen (1984) further argued that all the social and economic variables must operate through these five sets of proximate variables to affect child survival rather than the direct effect of socio-economic variables as the outcome variable.

Mosley (1985) proposed a new analytical framework as a continuation of the effort to develop a conceptual framework for research on child survival in developing countries and to re-define a set of proximate determinants of mortality which can link the biologically-determined disease process in children to their social determinants in the family and wider community. The major development presented in this framework was an extension of the proximate determinants framework to encompass the fertility, the relationship among the anthropometric measurement of child growth, the demographic measure of child survival and an illustration of how child growth and child survival may be used as dependent variables. In the framework, the risk factors are divided into proximate determinants (basic bio-social mechanisms that directly influence the risk of morbidity and mortality) and underlying determinants (which represent all other social and environmental determinants) that operate indirectly through the proximate determinants to influence child survival. The most important point in this framework is the inclusion of political and institutional factors such as health programs which are classified as the underlying factors operating through either the individual factors, cultural factors or proximate factors to influence child survival.

Norren and Vianen (1986) proposed a new model for the study of the malnutrition-infection syndrome and its demographic outcome (survival or death of children up to the age of five). Their model is based on the work on fertility by Bongaarts and Potter (1983) and the work of Mosley (1985) on health and under-five mortality. The new model is proposed for developing countries, and the contents of the model

> are confined to social and biological determinants of childhood mortality which (a) explain a large proportion of the phenomenon's variation among socio-economic and cultural groups and which (b) may be affected substantially by primary health care measures. And its penultimate dependent variable is the malnutrition-infections syndrome which precedes the great majority of deaths (Norren and Vianen, 1986: 3).

These three frameworks suggested for the study of child survival in the developing countries tend to encompass both the socio-economic and biological variables and suggest that the socio-economic variables are the indirect cause of the outcome variables which operate through a set of proximate variables.

This study of infant and child mortality in Nepal has major objectives. Firstly, it examines the effect of socio-economic and demographic factors in order to identify the key determinants of infant and child mortality in Nepal for the period covered by the 1976 NFS and the 1986 NFFS data sets. In this context, this study will view infant and child mortality as an outcome of a process in which the socio-economic and intermediate variables form an interactive chain of influences on the risk of infant and child death. The framework of this study is based on the proposed framework for the study of child survival in developing countries by Mosley and Chen (1984), Mosley (1985) and Norren and Vianen (1986) which show that the socio-economic conditions of life are the major determinants influencing the survival chances of the infants and children in a society through a set of proximate mechanisms.

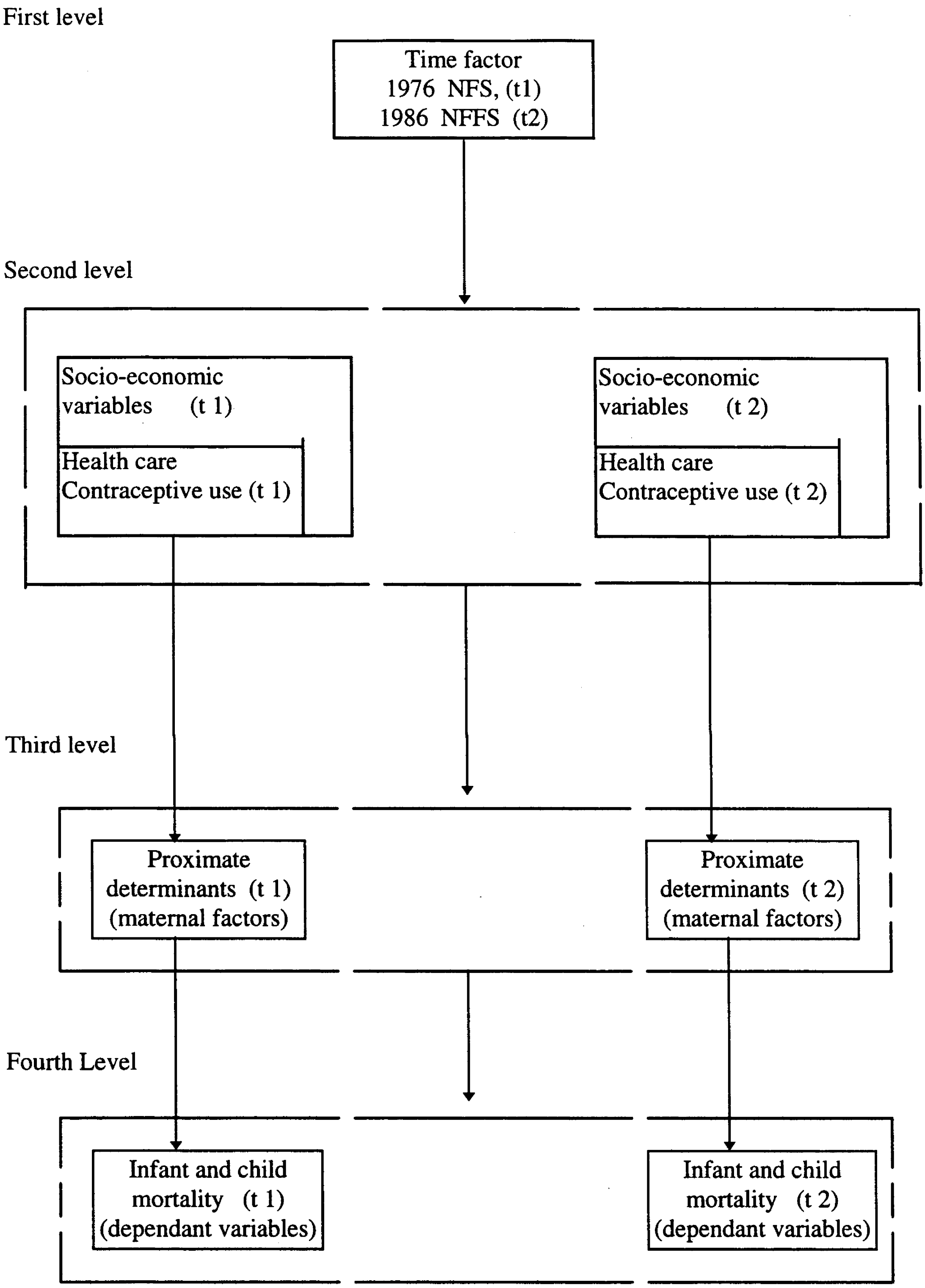
Secondly, this study examines whether there have been any changes in the socio-economic and demographic characteristics of the population under study in the past, and if there are, what are the effects of such changes on infant and child mortality. The theoretical framework for this objective is based on the view that most of the socio-economic characteristics of individuals are likely to change with time. Accordingly, the influences of the socio-economic variables are also likely to be different for the survival prospects of a child at different points of time. While proposing this analysis, the same structure of relationships between independent and dependent variables is assumed to assess the contribution of the differences in explanatory variables over two time periods. Thus change over time in the explanatory variables is assumed to be the only reason for the change in the level of mortality. In addition, the changing structure in relationships is assumed to assess the contribution of the change in the structural relationship between the independent and dependent variables on infant and child mortality (DaVanzo and Habicht, 1986: 197). However, to test this assumption empirically, every variable that is likely to influence the results needs to be included in the model. This task, although not impossible, is very difficult to carry out in a single study, partly because of the limitations of data and partly because of the familiarity with possible explanatory variables that have changed over time. Keeping this point in mind, this study, while examining the change in the explanatory variables over time and their effects on infant and child mortality, is confined to only those variables that are available from the two successive surveys employed in this study. The causal links of the model are presented diagrammatically in Figure 2.1.

Although the analytical frameworks suggested by Mosley and Chen (1984), Mosley (1985) and Norren and Vianen (1986) are well designed, they are not applicable to research in the context of the change in the socio-economic factors over time. So the first level in the proposed framework for this study (Figure 2.1) indicated by 'time factor' has been added to the analytical framework suggested by Mosley and Chen (1984) in order to analyse the effect of the change in the socio-economic characteristics of the population on infant and child mortality in Nepal over two time periods. In the proposed framework, the first level of the framework refers to the time. The second level of the framework refers to the characteristics of the household and its individual members, particularly parents of the children under study. The third level refers to the biological variables[1/] and the last level refers to the survival of children.

Socio-economic factors, maternal factors and dependent variable(s) in the framework suggested for this study are retained from the framework suggested by Mosley and Chen (1984: 27). The differentials and determinants of infant and child mortality rates

[1/]A behavioural variable also could be included at this level, as suggested by Norren and Vianen (1986). However, this study has not included any behavioural variables at this level.

Figure 2.1: Proposed framework for the analysis of infant and child mortality



Key: (t 1) indicates the NFS 1976 and (t 2) indicates the NFFS 1986.

Notes: (t 1) represent the time period 1966-75 in the infant mortality analysis and the period 1961-70 in the child mortality analysis. Similarly, (t2) represent the period 1976-1985 in the infant mortality analysis and 1971-80 in the child mortality analysis.

from the second level to the fourth level (as shown in Figure 2.1) will be analysed separately for the 1976 NFS and 1986 NFFS data sets and the results will be compared and discussed where appropriate. Thus, (t1) and (t2) in Figure 2.1 refer to the information employed respectively from the 1976 NFS and 1986 NFFS data sets. For example, the 'socio-economic variables (t1)' in Figure 2.1 are the socio-economic variables employed from the 1976 NFS while the 'socio-economic variables (t2)' are the socio-economic variables employed from the 1986 NFFS data set. Moreover, the assumed direction of the relationship between the socio-economic variables and maternal factors in influencing infant and child mortality rates has been shown in Figure 2.1 by the arrow that connects the boxes in the second, third and fourth levels.

As mentioned earlier, the time factor (as shown in the first level in Figure 2.1) is a new variable created to study the influence of the change in socio-economic factors on infant and child mortality in Nepal over the periods covered by the two data sets employed in this study. This variable is created after pooling two data sets and is categorised as survey-1 and survey-2 where, for example, the corresponding infant mortality rates to survey-1 represent the overall infant mortality rates for the period covered by the 1976 NFS while the corresponding infant mortality rates to survey-2 represent the overall infant mortality rates for the period covered by 1986 NFFS. The analysis of infant and child mortality rates after inclusion of the variable shown in the first level of the suggested analytical framework (Figure 2.1) for this study assumes the direction of relationship between the variables in the first second, third and fourth levels as shown by arrows which link the boxes with broken lines.

The use of health services in the framework of Norren and Vianen (1986) has been considered to be a parallel factor to socio-economic variables. Similarly, programs such as health and family planning are considered as parallel variables to socio-economic factors by Freedman (1975: 15) in an analytical framework for the study of fertility. Thus, for this study health care and contraception use variables shown in the second level of the proposed framework are considered as parallel factors to socio-economic variables.

2.3 Statistical techniques

The use of logit models in exploring the relationship of a dichotomous dependent variable to one or more independent variables has been described in Goodman (1978), Little (1978), Haberman (1978), Fienberg (1977) and Knoke and Burke (1980). The logit models are the basis of the data analysis in this study because this study is designed to explore the relationship of a dichotomised dependent variable (survival status of an infant/child categorised as dead or alive) to categorised socio-economic, demographic and health-related independent variables.

2.3.1 The logit model

In a multivariate regression analysis, a selected dependent variable is assumed to be a continuous series following a normal distribution pattern around the regression line and is estimated as a function of one or more explanatory variables (Magidson, 1978: 27). This tool, if used when the dependent variable of interest is dichotomous, violates the assumption of the method (Goodman, 1978: 5), because the regression equation is not necessarily a linear function of explanatory variables or always additive (Magidson, 1978: 27). Thus, when assessing the effect of categorical independent variables on the dichotomous dependent variable, it is appropriate to form the logit-model, a special case of the log-linear model (Fienberg, 1977: 79; Morgan and Teachman, 1988: 929).

Knoke and Burke (1980) have suggested two major approaches to log-linear modelling of contingency table data: first, the general *log-linear model* which 'does not distinguish between independent and dependent variables', and where 'all variables are treated alike as "response variables" whose mutual associations are explored'; second the *logit-model* where 'one variable is chosen as the dependent variable. The criterion to be analysed is the expected odds Ω_{ij} (omega) as a function of the other, independent variables' (Knoke and Burke, 1980: 11-12). Thus, the logit-linear model or the logit model is a modified multiple regression analysis especially designed for use with qualitative categorical data (Goodman, 1978: 5). This multivariate analysis technique, as with other multivariate techniques, allows the statistical control of the effect of each of the independent variables and determines the net effect of each category variable on a dependent dichotomous variable.

The multiplicative form of a logit model with two independent variables can be expressed in the form of an equation as

$$\mathbf{F_{ij1}/F_{ij2} = A\ B_1\ C_j} \qquad (1)$$

$$\mathbf{i= 1, 2, ...I;\ \ j = 1, 2, ... J,}$$

where F_{ij1} denotes the number of children who are expected to die during their infancy with the i-th category of variable B and j-th category of variable C, and F_{ij2} denotes the number of all infants. Additionally, F_{ij1}/F_{ij2} denotes the odds that a child is dead before completing one year of age. The quantities of the right hand side of the equation are the parameter to be estimated from the observed data where A provides a measure of overall effect, B provides a measure of effect of the i-th category of variable B with $\Pi_i\ B_i = 1$ and C_j provides a measure of the effect of the j-th category of variable C with $\Pi_i\ C_i = 1$ on the odds that a child dies rather than survives. As equation (1) does not include every possible effect of independent variables on odds, analogous to the usual analysis of variance, it is known as a main effects model (Goodman, 1978: 10; Majumder, 1989: 51). The model which considers the interaction effects of two independent variables comprising all possible effects is known as a saturated model. The saturated model can, thus, be expressed as

$$\mathbf{F_{ij1} / F_{ij2} = A\ B_1\ C_j\ (BC)_{ij}} \qquad (2)$$

$$\mathbf{i= 1, 2, ...I;\qquad j = 1, 2, ... J,}$$

where $\Pi_i\ (BC)_{ij} = 1$; $\Pi_j\ (BC)_{ij} = 1$.

Furthermore, let Q_{ij} denote the total expected frequency in a row (ij) for which the survival status of an infant takes the value 1, denoting the expected proportion of children dying during infancy. Symbolically this can be expressed as

$$\mathbf{Q_{ij} = F_{ij1} / N_{ij2},} \qquad (3)$$

where $N_{ij2} = F_{ij1} + F_{ij2}$.

Similarly, let P_{ij} denote the expected frequency in a row (ij) for which the dichotomised variable survival status of an infant takes value 2, that is, the expected proportion of children surviving during infancy. This can be expressed as

$$\mathbf{P_{ij} = F_{ij2}/N_{ij2} = 1 - Q_{ij}} \qquad \mathbf{(4)}$$

Taking equations (1), (3) and (4), a new multiplicative equation can be written as

$$\mathbf{Q_{ij} / P_{ij} = F_{ij1}/F_{ij2} = A\ B_i\ C_j} \qquad \mathbf{(5)}$$

To make the estimation job relatively easy it is necessary to convert the multiplicative model to an additive model. The transformation from multiplicative model to additive model can be performed by logarithmic transformation on both sides of the equation (5). The equation for the additive model from equation (5) thus can be written as

$$\mathbf{Logit\ \Omega_{ij} = a + b_i + c_j} \qquad \mathbf{(6)}$$

This model corresponds to a linear additive model of the usual analysis of variance with $\Sigma_i b_i = 0$, $\Sigma_i c_i = 0$ where log Q_{ij}/P_{ij} =logit Ω_{ij}, $\log_e A = a$, $\log_e B_i = b_i$ and $\log_e C_j = c_j$. Equation (6) which expresses logit Ω_{ij} in terms of three parameters a, b_i and c_j is equivalent to equation (1) which expresses the corresponding F_{ij1}/F_{ij2} in terms of corresponding parameters A, B_i and C_j. Furthermore, the parameters a, b_i and c_j in equation (6) describe the main effect on the logit Ω_{ij} of the general mean.

As with equation (1) and equation (4), the multiplicative saturated model expressed in equation (2) can also be transformed into the equivalent additive saturated model. This can be expressed as

$$\mathbf{Logit\ \Omega_{ij} = a + b_i + c_j + (bc)_{ij},} \qquad \mathbf{(7)}$$

where $\Sigma_i (bc)_{ij} = 0$; $\Sigma_j (bc)_{ij} = 0$. Once parameters on equations (6) and (7) are estimated they can be transferred back in a form of equivalent multiplicative model described by equation (1) and equation (2) by taking the exponential of the estimated logit parameter (for further detail see Goodman, 1978: 9-15).

2.3.2 Test of hypothesis

In this study univariate analysis will be carried out as a first step in applying the logit model. The purpose of the univariate analysis is to identify the association of each of the independent variables of interest with the dichotomised dependent variable of this study. Following this, a multivariate analysis technique, that is a logit model, will be used to calculate the parameters described by the right hand side of the additive equations discussed in the preceding section. The expected frequencies F_{ij} under the hypothesis will be estimated to test whether the hypothesis described by the model fits the data. These estimates will then be compared with the corresponding observed frequency f_{ij} by calculating the likelihood ratio statistic (L^2):

$$\mathbf{L^2 = \Sigma_{ijk} f_{ijk} \ln (f_{ijk}/ F_{ijk}),} \qquad \textbf{(8)}$$

where i=1, 2,...I; j=1, 2,...J; K=1 if the child is dead; K=2 if the child is alive; f_{ijk}=observed frequencies in the i j k-th cells in the contingency table; ln=the natural logarithm; and F_{ijk}=corresponding expected frequencies to f_{ijk}.

The maximum likelihood statistics (L^2 or LRX^2 hereafter) have large-sample properties similar to those of chi-square. Thus, L^2 is approximately distributed as a chi-square random variable, where the approximation becomes increasingly accurate as N increases (Haberman, 1978: 5). One of the properties of maximum likelihood estimates is that they are asymptotically normally distributed. This leads to the asymptotic chi-square distribution of the test statistics which are used to test the goodness of fit of a model to set observed counts (Fienberg, 1977: 129).

Although the assessment of the goodness of fit of logit models can be tested by using either of the tests, that is, the usual chi-square test-of-fit statistic or the corresponding Pearson chi-square (χ^2) based on the likelihood statistic (Goodman, 1978: 15), in this study the L^2 is selected to test the fit of the model. This is so because Knoke and Burke (1980: 30) noted that L^2 is preferable to χ^2 on the grounds that the expected frequencies are based on the maximum likelihood method and L^2 can be partitioned uniquely for more powerful tests of conditional independence in a multiway table. Additionally, although the significance of interaction factors or the relative fit of two models can be tested by using the F-statistic (Majumder, 1989: 53), the chi-square statistic is suggested to be more powerful than the F-test, particularly when the degrees of freedom are small (Little, 1978: 36).

One of the problems in analysing multidimensional contingency tables is the appearance of cells with zero entries. Observed zero frequencies generally appear in two circumstances and are known as sampling zeros and fixed or logical zeros. Sampling zeros occur due to the small probabilities for some categories in a situation where several variables are cross-tabulated. Such a zero entry does not mean that such cases do not exist in the population. The other situation which produces zero frequency in a cell, known as fixed zero, is due to the logical unavailability of such specified cases in the population. This type of zero is also known as the true zero (Knoke and Burke, 1980: 33). For example, in this study also, certain cells may appear to be zero because either no-one died during the specified time or because there was no-one who was exposed to the risk of death. In the case of structural zero, the zero frequency found in a cell is the true zero. One of the most powerful properties of a linear model and method of estimation, including the logit linear model used in this study, is that cells with zero entries due to sampling variation can have a non-zero expected value (Fienberg, 1977: 108). However, Fienberg further noted that zeros appearing in the marginal total should be handled in a special way. In this context he suggested:

> In order to test the goodness-of-fit of a model that uses an observed set of marginal totals with at least one zero entry, we must reduce the degrees of freedom associated with the test statistic. The reason for this is quite simple. If an observed marginal entry is zero, both the expected and the observed entries for all cells included in that total must be zero, and so the fit of the model for those cells is known to be perfect once it is observed that the marginal entry is zero. As a result, we must delete these degrees of freedom associated with the fit of the zero cell values (Fienberg, 1977: 109).

A general formula for computing the degree of freedom in a situation where some of the margins fitted contain sampling zero suggested by Fienberg (1977: 110) is

$$\mathbf{d.f = (T_e - Z_e) - (T_p - Z_p),} \qquad \mathbf{(9)}$$

where T_e = cells in the table that are being fitted, T_p = parameters fitted by model, Z_e = cells containing zero estimated expected value and Z_p = parameters that cannot be estimated because of zero marginal totals.

The main purpose of the statistical model is to define precisely conditions under which the associated analysis is the best possible (Little, 1978: 19). Among the three types of models -- the fully saturated model, the unsaturated model and the main effects model,-- the fully saturated model, which appears to be best fit, is of very little interest. This is so because this model reproduces an expected cell frequency which is exactly the same as the observed cell frequency (Trussell and Hammerslough, 1983: 5). Majumder (1989: 54) noted that the addition of two- or higher-order interactions may improve the explanatory power of the model. On these grounds he suggested that the selected model ideally should include all effects which possess significant explanatory power. It is also argued, however, that models which include a large number of parameters most often fit the data more closely than simpler models; a simple model is often preferred over a model with a large number of parameters (Fienberg, 1977: 47). Similarly, Trussell and Hammerslough (1983: 10-11) appealed to the principle of parsimony and suggested selecting a simpler model than the complicated model if the simple model is understandable and draw a similar conclusion as the complicated model. Trussell and Hammerslough further argued that even if interaction effects are statistically significant, they are sometimes unimportant in practice. On these grounds they suggested that a main effects model may still be preferred because of the researcher's trade-off between simplicity and goodness of fit.

For this study, the main task is to identify the optimal model which provides the explanation of the observed relationship between the independent variables and infant and child mortality in Nepal. Considering that the interpretations of the interaction effects are suggested to be very complicated and since the interaction effects in comparison to the main effects are considered to be unimportant, the analysis in this study is confined to the main effects model. However, the significance of certain two-factor interaction effects was tested and discussed.

2.4 Available data and quality

Variables associated with the dating of events such as age of mother, and birth and death of child are considered to be some of the major variables in demographic analysis. The quality of the research result based on these variables depends heavily on the accuracy of the reported date of respective events. In the developed countries which have a strong system of registering vital events, there may not be a problem in obtaining good data on the variables related with dating. However, in most of the developing countries, where births and deaths are not very often registered, people do not seem to need to know their correct age. In such a situation an effort to make the respondents estimate their age as precisely as possible (Chidambaram and Sathar, 1984: 7) is likely to introduce in different types of errors. It is thus worthwhile to assess the types of errors and the magnitude of their likely impact on the outcome of the research before entering into the analysis.

2.4.1 The data

The data sets used in this study come from the Nepal Fertility Survey (NFS) 1976 and Nepal Fertility and Family Planning Survey (NFFS) 1986. The major objective of both these surveys was to collect the necessary and relevant data to estimate demographic parameters for Nepal. The data collection methods and the population of the surveys are discussed in detail in the following sections.

2.4.2 Population and sampling procedure in the 1976 NFS

The Nepal Fertility Survey 1976 (NFS) was carried out within the World Fertility Survey program and was the first nationally representative survey of the country. The aim of the survey was to include approximately 5000 households with an expectation that 5000 women would be eligible for the interview. The eligible women for the survey were defined as ever-married women between the ages 15 and 49 years who were defacto residents of the sample households on the night before the enumeration. However, a total number of 5940 ever-married women were successfully interviewed for the whole country (Nepal Family Planning and Maternal/Child Health Project (NFPMCH), 1977). The 1976 NFS is a cross-sectional survey which collected information on reproductive and contraceptive behaviour of the women studied. The sample design was such that the expected sample size in the three main ecological belts (*terai*, hills and mountains) was proportional to their population size (PPS) (NFPMCH, 1977: 17). This survey was based on a multi-stage area sample design which was applied successively to selected districts, *panchayat*[2/] and *ward* from the ecological belts. The ultimate numbers of area units (clusters) were kept to approximately 100 (96 rural and 5 urban). The urban and rural samples were drawn separately to represent their respective areas.

2.4.3 Rural sampling

First of all, the 75 districts of Nepal were arranged in a serpentine sequence and out of the 75 districts, 33 districts were selected with probability proportional to size (PPS) according to the 1971 Census population (also see Map 2.1). The urban *panchayat* were eliminated in the rural sample selection procedure. At the second stage, two *panchayat* were systematically drawn from each district. *Ward* from each *panchayat* were selected at the third stage of sampling. In the *ward* selection procedure, all *ward* with 20 or fewer households were excluded because of the considerable variation in the size of the *ward*. In addition, *ward* with more than 100 households were split into sub-*ward* in order to have no sub-*ward* comprising more than 70 households. A total of 96 *ward*, one or two in each *panchayat*, were selected at random. All households in the selected *ward* were listed and a systematic sampling procedure was used to select households. All ever-married women between the ages 15 and 49 years in the selected households were included in the sample for individual pre-structured questionnaire interview.

2.4.4 Urban sampling

The first stage of the urban sampling selection was the same as the rural sampling in which 33 districts were selected. Only nine out of the 33 selected districts have town

---

[2/]The lowest administrative unit of the country is known as a *ward* and the village *panchayat* were the administration divisions formed by 9 *ward*. The Village *panchayat*, after the re-installment of the multi-party system in Nepal in 1990, are known as *gawn bikas samiti* (Village Development Committees).

panchayat[3/], and were therefore defined as urban areas. These nine districts were thus separated for urban sampling. From these selected districts 200 households were then drawn into 10 groups of 20 households each with constant probability (NFPMCH, 1977: 18). The methodology of sampling is discussed in more detail in the Nepal Fertility Survey, 1976 (NFPMCH, 1977: 17-25)

2.4.5 The 1976 NFS data

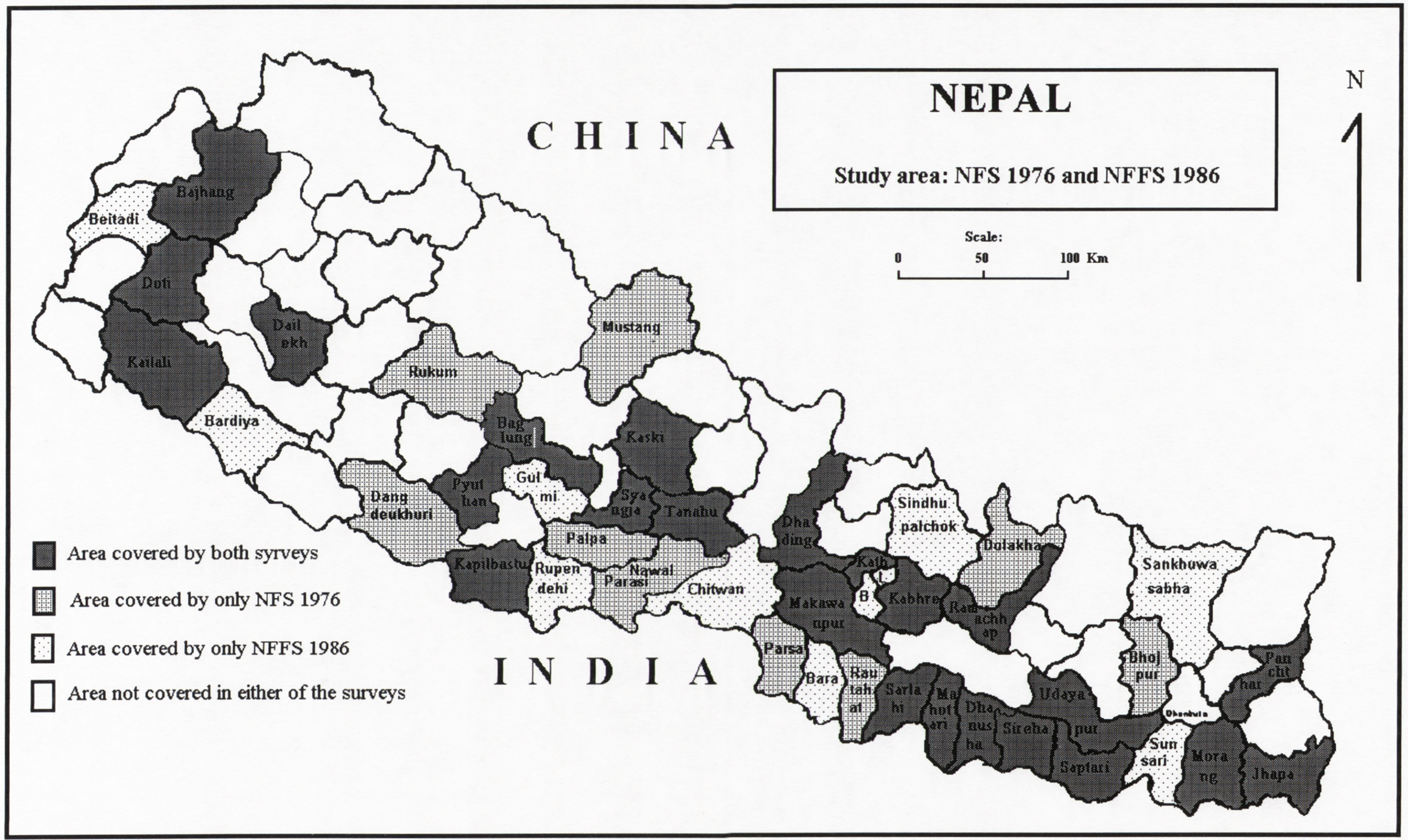
The data in the 1976 NFS were collected in two stages. In the first stage the pre-structured questionnaire covering basic household information was administered in the sampled households. The information collected from the household questionnaire was then used to identify the eligible women for pre-structured individual questionnaire interview. The individual questionnaire covered information on the following broad areas:

a. Respondent's background
b. Maternity history
c. Contraceptive knowledge and use
d. Marriage history
e. Fertility regulation
f. Work history
g. Current and last husband's background

2.4.6 Population and sampling procedure in the 1986 NFFS

The Nepal Family Planning and Maternal and Child Health project (NFPMCH, 1987) collected detailed information on reproductive and contraceptive behaviour from 5150 currently married women in Nepal under the 1986 Nepal Fertility and Family Planning Survey (NFFS), a follow-up survey of the 1976 NFS. The NFFS was a cross-sectional survey based on a multistage probability sample of rural and urban areas. Districts and town *panchayat* were arranged in serpentine fashion (from east to west covering all districts in the *terai* region, then from west to east covering all the hill districts, and again from east to west covering all the mountain districts) to ensure regional representation in the sample. In this way 27 of the 75 districts were selected for the rural sample (also see Map 2.1). Two *panchayat* from each selected district and two *ward* from each *panchayat* were selected for the rural sample on the basis of probability proportional

[3/]Areas defined as urban before 1990 and known as *nagar bikas samiti* (Urban Development Committee) after that.



Source: NFS 1976 and NFFS 1986 data tapes.
Notes: Kath=Kathmandu, B=Bhaktapur and L=Lalitpur districts.

MAP 2.1

to size (PPS). Approximately 40 households from each selected *ward* were then selected for the survey through systematic random sampling. Similarly, 16 town *panchayat* out of the 29 were selected for the urban sample. From each town *panchayat* three *ward* were selected on the basis of PPS. A total of 3774 households in the rural areas and 1255 households in the urban areas were selected. Of the total of 5150 currently married women aged between 15 and 49 years in the sampled households, 5133 were successfully interviewed. The sample design and sampling procedure of the 1986 NFFS is discussed in more detail in the main report (NFPMCH, 1987: 18-29).

2.4.7 Sampling weights

The sample design was self-weighting for the rural and urban areas separately, but the urban areas were over-sampled by about five times to facilitate separate analysis and estimation. To achieve the national sample, a weight factor based on the urban-rural ratio observed in the 1981 Census was applied for the urban area. The weight was 0.1892620 for the national urban areas for currently married women aged 15-49. The sampling weight for the rural areas was 1.0 (NFPMCH, 1987: 21).

2.4.8 The 1986 NFFS data

The 1986 NFFS data included information on various aspects of fertility and family planning and their determinants at household, individual and community levels. Household information was collected to identify the eligible individual respondents who were currently married women aged 15-49 years. The topics covered in the individual questionnaire were:

a. Respondent's background
b. Spouse's background.
c. Birth history
d. Marriage
e. Family planning
f. Fertility preference
g. Breast-feeding

The data on the selected variables required for this study come from the information on the birth history and the respondent's background collected from both the 1976 NFS and 1986 NFFS.

2.5 Quality and limitations of data

The data, especially from the retrospective questions, should be evaluated for their quality and limitations before they can be used for analysis. This is because the data collected both in the complete enumeration and in the sample surveys passed through several stages, such as editing, data processing and tabulation before it appeared in a ready-to-analyse form. As there are a number of coding and editing steps and processes involved between the point of data collection to the preparation of the clean data set, various types of errors can occur at any stage. Moreover, cross-sectional demographic surveys employing the method of retrospective inquiries ask questions of the interviewees about events which occurred in the recent past as well as in the distant past. In such a situation the reply of the respondents could conceivably be subject to lapse of memory (United Nations, 1971: 133).

The purpose of the birth history questionnaire used in the 1976 NFS and 1986 NFFS was to elicit a complete chronological record of all children ever borne by the respondents of the respective surveys. The information on the birth and death of a child expressed in terms of years and months collected in both the surveys is based on the response of the interviewees. As this study is concerned with risk of infant and child death, the main concern here is with the accuracy of the reported number of births and deaths along with the timing of events. Omission and misreporting of dates of the births and deaths are likely to distort the final research findings of this study. Thus the presence of errors in the reported age of the respondent, reported date of live births and deaths of children, age at death and omission of births and deaths from both the 1976 NFS and 1986 NFFS are assessed and discussed in the following sections.

It has been suggested that the evaluation of data quality should include comparison with external sources as well as internal consistency checking (Singh, 1987: 619). However, as there is no good vital event registration system and as there are very few studies on infant and child mortality in Nepal, the possibility of evaluating the quality of the current data sets by comparing with the estimates of external sources is rarely present. Thus assessment of the quality of the data used in the current study is mainly confined to internal consistency assessment, although external comparison will also be pursued where possible.

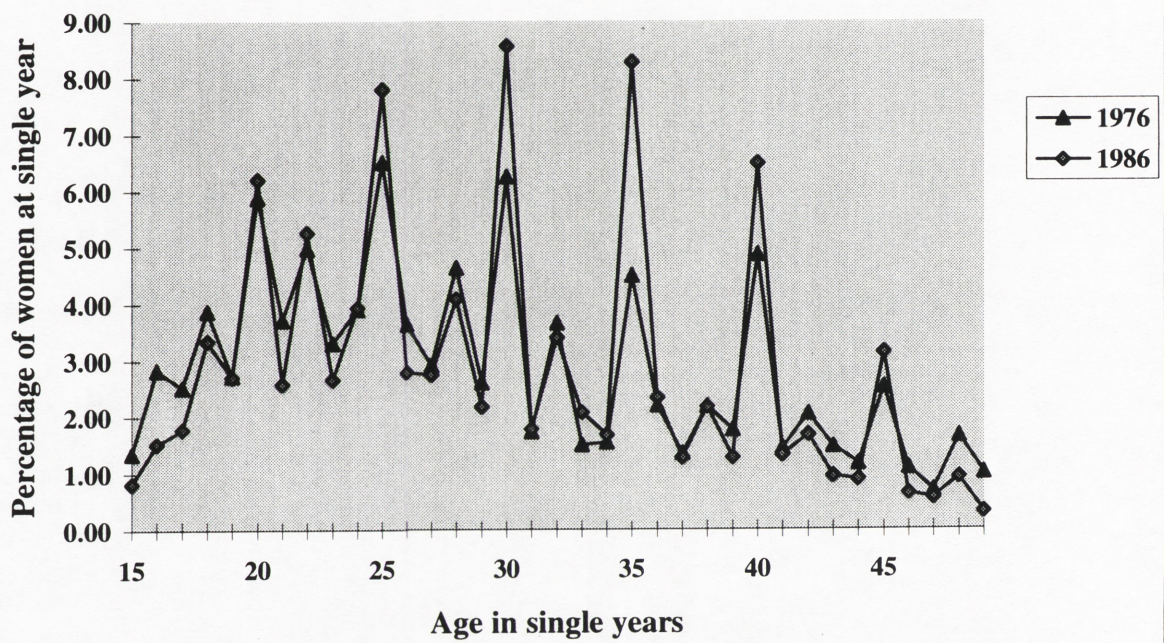
2.5.1 Age reporting

Age is considered to be one of the most important variables in demographic analysis. Almost every demographic survey has collected information on age. Nevertheless, data with good age reporting is very rare (Çhidambaram and Sathar, 1984: 7). Nepal is no exception to this situation as most of the births in the country are not registered. As a result, as in many other developing countries, a large number of the people of Nepal do not know their precise date of birth (Central Bureau of Statistics (CBS), 1987a: 332). In such a situation, the only alternative for obtaining data with fairly good age reporting is by taking extra care when data are collected (Chidambaram and Sathar, 1984).

The 1976 NFS and the 1986 NFFS both took care to collect good data on the age of the respondents. The questions used to collect this information in both the surveys were 'In what year and month were you born?' If the respondents were not able to answer this question then the next question put to them was ' How old are you? ' The intention of this question was to collect the age of the respondents in completed years. In addition, Nepalese calendar years and months were used in the questions to help respondents respond correctly. Despite all these efforts, only 13.4 per cent of the 5940 ever-married women in the 1976 NFS and 32.1 per cent of the 5133 currently married women interviewed in the 1986 NFFS were able to report their date of birth.

The single-year distribution of the women interviewed in the 1976 NFS and 1986 NFFS (Figure 2.2) clearly shows pronounced heaping on ages ending with digits 0 and 5 and a subsidiary heaping on ages ending with digits 2 and 8. Besides, the quality of age data as assessed using Myer's Blended Index gives values of 18.2 for the 1976 NFS and 25.7 for the 1986 NFFS. The value of Myer's Index ranges from 0 where there is no age heaping to 90 where all respondents report ages as one terminal digit. This suggests that the lower the value of the index the better the quality of data. The comparison of the value

Figure 2.2 Percentage distribution of women by single years of age, 1976 NFS and 1986 NFFS



Sources: 1976 NFS and 1986 NFFS data tapes of the Myer's index obtained for the two successive surveys and the percentage of women in both

surveys who reported their dates of birth in months and years suggests that the percentage of women who reported their date of birth in the 1986 NFFS is higher than in the 1976 NFS. However, the quality of reported age seems to be more accurate in the 1976 NFS than the 1986 NFFS. There was more pronounced heaping for the reported ages ending with 0 and 5 for the women from the 1986 NFFS than from the 1976 NFS (Figure 2.2). The possibility of the errors in the main analysis likely to result from heaping in the preferred ages in both the surveys, however, has been minimised by grouping the women into unconventional five-year age groups (for example 18-23 years) .

2.5.2 Quality of reported date of birth of children

The most important part of both the 1976 NFS and 1986 NFFS was the collection of information on complete birth histories with the objective of recording all the births a woman had had within the reproductive span of her life and to locating each of the reported births according to the timing of events. A series of questions was developed and asked in both surveys to ensure the most accurate date of birth possible. The first question put to the respondent was 'In which year/month was your (first, second) child born?'. If the respondent was not able to answer this question, another question asked to her was 'How old is the child?'. If the respondent was not able to answer this question either, then she was asked to report 'How many years ago was that child born?'. The last question, designed to be asked of the respondents who were not able to answer any of the above questions was 'How old were you when you had that child?'. The wording and the style of the question on the date of birth in both surveys were the same.

It is argued that women in a society who are not able to remember their own date of birth are likely to fail to report the date of birth of the children borne by them (Chidambaram and Sathar, 1984: 10). However, in both Nepalese surveys the dates of birth of all children were reported in calendar years. The strikingly complete reporting of months and years of birth in the 1976 NFS was attributed to the particular variant of birth history used, where the form for recording births consisted of columns representing all possible calendar years prior to the surveys in a chronological order with the equivalent number of years ago. This forced the interviewer to record the details of the births in the column for the corresponding calendar year even when the date of birth was reported as 'years ago', which later was transferred into calendar years (Chidambaram et al., 1980: 25). The same procedure was followed in the 1986 NFFS.

2.5.3 Reported age at death

Infant and child mortality can only be studied when the dates of death, preferably in months, are reported in the survey. As both the 1976 NFS and 1986 NFFS collected this information in the birth histories, this allows the analysis of infant and child mortality in Nepal. The information on the date of death in the two surveys was collected by asking the respondent to report the date of death in calendar year and month. The subsequent question put to those who were not able to give the date of death of the child in calender year and month was 'How old was the child when he/she died?'. As in the case of recording the date of birth of the child, the question for recording deaths also consisted of columns representing all possible calendar years prior to the surveys in chronological order with the equivalent number of years ago. This was used in both surveys in recording the death of a child.

Errors in the reported age at death are likely to produce biased results. For example, errors in the reported dates brought about by misplacement of age at death is likely to lead to underestimation or overestimation the infant and child mortality level. Figure 2.3 shows the distribution in months, from both the 1976 NFS and 1986 NFFS, of deaths of children reported to have died between the ages of 1 and 60 months. A strong tendency to report the infant and child deaths with numbers representing whole years, that is, 12, 24, 36, 48 and 60 months and to a lesser extent with the numbers representing half years, that is, 6 and 18 months is evident. However, there was less heaping of deaths at age 12 months in the 1986 NFFS than in the 1976 NFS (Figure 2.3).

In the Nepalese language half-a-year, one year, one-and-a-half years and two years can each be expressed in one word and are terms used very commonly by most of the ethnic groups. One-and-a-half years in Nepali is expressed as *dhedh* and two-and-a-half years is expressed as *adhai*. The respondents in both the 1976 and 1986 surveys might have used this rounded expression creating heaping of reported deaths at ages 6 and 18 months, as was argued by Majumder (1989: 41-43) for Bangladesh. The heaping of deaths reported at ages 12, 24, 36, 48 and 60 months could be because some of the children who had died either before or after the exact 12, 24, 36, 48 and 60 months were reported as having died at the corresponding exact age.

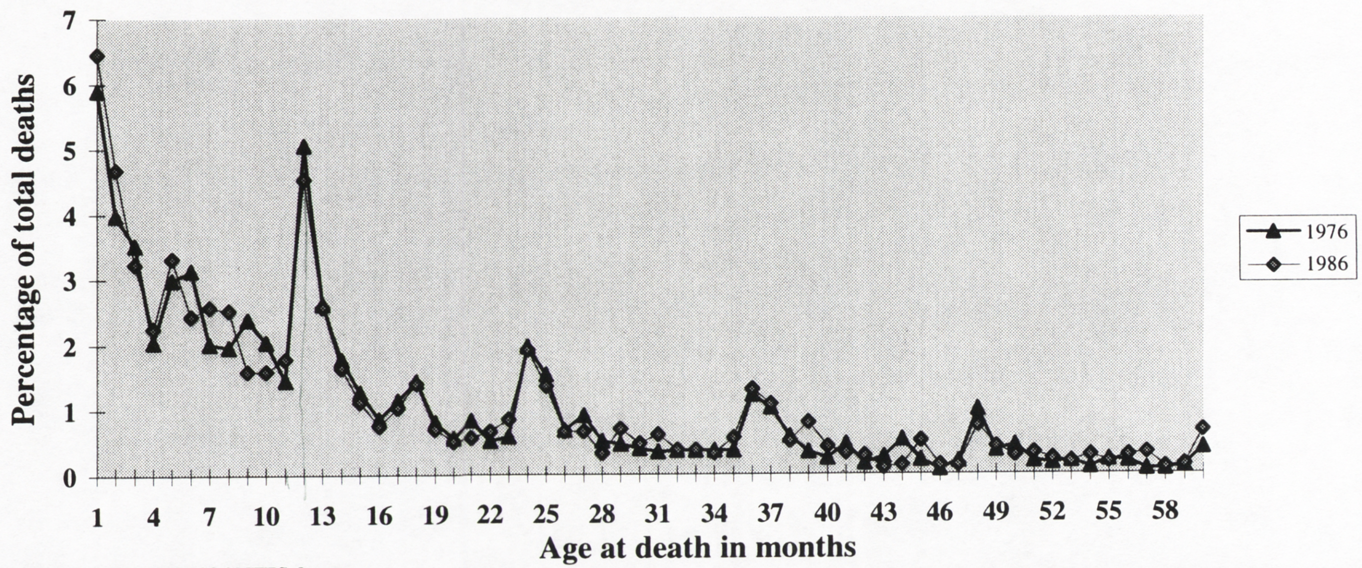
The main concern here is the heaping which is evident on the reported ages at death corresponding to 12 months because this is the cut-off point which separates the infant and child deaths. In this situation if a substantial number of children who have died before exact age one year are reported to have died at exactly one year then the estimates derived from such data sets are likely to underestimate the infant mortality rate and consequently over-estimate the child mortality rate which refers to the deaths which occurred between one and five years of life. Thus the heaping on reported age at death found in both the 1976 NFS and 1986 NFFS (Figure 2.3) is likely to create problems if infant mortality rates are to be estimated from this information. However, the task of estimating the level of infant mortality from these data sets is not the primary concern of this study. The influence of heaping of reported age at death for the study of differential mortality (Majumder, 1989: 43) can be expected to be negligible if deaths are uniformly distributed among different sub-groups of children selected for study.

Demographers have suggested crude methods to correct the problem of heaping on reported deaths at age 12 months. Goldman et al. (1979: 32), while evaluating the quality of data from the 1976 NFS, suggested distributing the heaping in two consecutive years, for example, half of the deaths reported at 12 months to the first year and the remaining half to the second year of age. Momba (1987: 19) suggested redistributing the reported deaths at 12 months to the surrounding ages using a distribution pattern of deaths from another population with a similar level of mortality and fairly good quality data. However, Majumder (1989: 43) suggested that it is essential to redistribute the reported deaths at 12 months with heaping only when the purpose of the study is to estimate the overall mortality rate and it is not necessary to do so when the analysis is carried out for the study of differential mortality. He further suggested that it is worth examining whether the number of deaths reported at age 0-11 months is more plausible as a measure of infant mortality than the number of reported deaths at age 0-12 months or vice versa (Majumder: 1989: 44).

In the current study estimates of the infant mortality rate are based on both the reported deaths at ages 0-11 months and 0-12 months using a direct estimation technique and comparing the result with the estimates for corresponding years derived from external sources. For the purpose of the current analysis this test will mainly be based on internal consistency assessment because the infant mortality rates estimated for Nepal using other sources of data are limited.

The infant mortality rate based on the reported deaths at age 0-11 months and 0-12 months for the cohort born during the period 1966 to 1975 from the 1976 NFS data set and for the cohort born during the period 1976 to 1985 from the 1986 NFFS are calculated using direct methods (Table 2.1). The purpose of this exercise is to assess which of the figures for reported deaths, the one at age 0-11 or the one at age 0-12, is a better measure for infant mortality. For comparison purposes, the q2, q3 and q5 estimates along with their corresponding mortality rates from both the data sets are calculated employing the Palloni and Heligman (1985) method using the United Nations (1982a) South Asian mortality pattern, the Trussell (1975) method employing the Coale and Demeny (1966) West and South mortality pattern, and by the Feeney (1980) method (Table 2.1). The rates which refer to 1973 appear to be closer to the direct estimates of infant mortality rates for the corresponding year based on the deaths reported at age 0-12 months than the infant mortality rate based on the deaths reported at age 0-11 months. However, the corresponding value estimated by employing Trussell's method and the South mortality pattern is closer to the direct estimates of the number of deaths reported at ages 0-11 months. Besides, the indirect estimates of IMR corresponding to q3 values derived from the 1976 NFS using the three methods shown in Table 2.1 are closer to the direct estimates

Figure 2.3 Percentage distribution of children by age at death in months, 1976 NFS and 1986 NFFS (Deaths at age 0 and 60+ months excluded)



Sources:1976 NFS and 1986 NFFS data tapes of the corresponding year based on the deaths reported at age 0-11 months in comparison to the deaths reported at age 0-12 months. Similarly, the indirect estimates of IMR corresponding to q2 values derived by using the Palloni and Heligman method, the Trussell method and the Feeney method from the 1986 NFFS data (Table 2.1) for 1983 are closer to the direct estimates of the corresponding year based on the number of deaths reported at age 0-11 months in comparison to the direct estimates based on the number of deaths reported at age 0-12 months. The situation is quite the reverse when the direct and indirect estimates corresponding to the year 1981 are compared. In addition, the IMRs corresponding to q5 values are also closer to the direct estimates of the IMR based on number of deaths reported at age 0-12 months.

The CBS (1987b: 74) estimated 110 infant deaths per 1000 live births for the year 1983 from the Demographic Sample Survey, which is exactly the same as the direct estimates of IMR for the corresponding year calculated from the deaths reported at age 0-11 months from the 1986 NFFS data sets (Table 2.1). The infant mortality rate derived by Thapa and Retherford (1982: 63) for the reference years 1971-74 from the 1976 NFS data using the adjustment technique suggested by Goldman et al. (1979: 32) and using a ratio method to correct the truncation effect has produced three different estimates of infant mortality rates as unadjusted, uncorrected and corrected. One of the three different estimates, 156 infant deaths per 1000 live births, was derived by adjusting for heaping of reported deaths and correction for the truncation bias. This estimate if compared with the average of the infant mortality rate corresponding to the period 1971-1974 (Table 2.1) based on both the reported deaths at ages 0-11 months and 0-12 months falls almost in the middle of the IMRs corresponding to the reported death at age 0-11 months and 0-12 months. The comparison of the direct and indirect estimates of IMR derived from 1976 NFS and 1986 NFFS thus do not provide any sound basis to conclude which number of reported deaths, the one at age 0-11 months or the one at age 0-12 months, is a better measure of infant mortality rate. However, to avoid the problem of evident heaping of reported deaths at age 12 months, this study will use deaths reported at 0-11 months as a measure of the probability of dying during infancy (q0) where the age 11 months refers to the age in completed months.

Table 2.1 Estimates of infant mortality rates based on the reported deaths at age 0-11 months and 0-12 months: 1976 NFS and 1986 NFFS, Nepal.

				Indirect estimates of IMR/1000				
					Trussell method			
Reference year	Number of cases for direct estimates	IMR/1000 based on reported death at age 0-11 months	IMR/1000 based on reported death at age 0-12 months	Palloni Heligman method UN, SA mortality model	West mortality model	South mortality model	Feeney method	Index c/
a/ 1966	920	170	182					
a/ 1967	907	178	187					
a/ 1968	953	174	187					
a/ 1969	1050	137	150		196	153	161	5 a/
a/ 1970	1098	151	160	157				5 a/
a/ 1971	1142	161	173		162		156	3 a/
a/ 1972	1128	152	162	153		148		3 a/
a/ 1973	1127	155	167	163	170	154	166	2 a/
a/ 1974	1135	127	135					
a/ 1975	694	130	137					
b/ 1976	733	93	104					
b/ 1977	603	114	124					
b/ 1978	787	114	121				106	5 b/
b/ 1979	741	96	103	114	116	113		5 b/
b/ 1980	761	95	104					
b/ 1981	871	85	88	111	113	109	105	3 b/
b/ 1982	791	92	110					
b/ 1983	826	110	115	108	109	104	104	2 b/
b/ 1984	796	95	102					
b/ 1985	690	75	80					

Notes: a/ Calculated from 1976 NFS and b/ calculated from 1986 NFFS tapes.
c/ In the index columns, 2, 3 and 5 are respectively equivalent to q2, q3 and q5 and corresponding IMR figures are based on the information from mothers aged 20-24, 25-29 and 30-34.

Sources: NFS, 1976 and NFFS, 1986 data tapes.

Some heaping is also evident in the deaths reported at 60 months (Figure 2.3). The reason for this heaping could be that the deaths reported as having occurred at exact age 60 months in fact might have occurred either before or after exact age 60 months. A similar situation, as discussed above for the infant mortality rate, is likely to appear in estimates of the child mortality rate which is a measure for the deaths of children between ages 1 and 5 years. Thus, a similar assessment has been carried out to select the most plausible measure of child mortality between the deaths reported at age 12-59 months and 12-60 months.

The deaths reported at age 12-59 months will be taken as a measure of the child mortality for the purpose of this study where the 12-59 months implies completed months of life. This will help to avoid the problem of heaping observed for the deaths reported at 60 months. For example, the direct estimates of child mortality rates derived from the 1976 NFS and 1986 NFFS data sets, based on both the reported deaths at age 12-59 months and 12-60 months (Table 2.2), show a wide range of child mortality during the period 1961 to 1980. Although a decline in the child mortality rate between 1961 and 1980 based on both the reported deaths at age 12-59 months and 12-60 months is evident, the trend is fluctuating (Table 2.2). Moreover, the child mortality rate calculated for the period 1961 to 1981 based on the deaths reported at age 12-59 months is quite close to the estimates of the corresponding years based on the reported deaths at age 12-60 months. It is even identical for the years 1965, 1967, 1971, 1973, 1974 and 1978. The indirect estimate of the child mortality rate calculated by employing the Palloni and Heligman (1985) method using the United Nations (1982a) South Asian mortality pattern and by the Trussell (1975) method using the Coale and Demeny (1966) West and South mortality pattern presented is quite different (Table 2.2). The CMRs estimated using the Palloni and Heligman method for q2, q3 and q5 are higher than the corresponding figures based on Trussell's method. The evident differences could be due to the different underlying assumptions of methods as well as the sensitivity of the result to the choice of model life tables.

Still there is no evidence that the deaths reported at ages 12-59 months are a better measure than the deaths reported at ages 12-60 months or vice versa. As the child mortality rates based on both the deaths reported at ages 12-59 months and 12-60 months are quite close, accepting either of them as a measure of child mortality is unlikely to have any influence on the analysis. However, Majumder (1989) noted that the influence of deaths which occurred before or after age 12 months and have been reported as having occurred at exact age 12 months and the deaths which occurred between the ages 4 or 5 years reported as having occurred at exact age 5 (60 months) is likely to be less in the analysis if the number of deaths reported at age 12-59 is selected as a measure of child mortality. Thus, this study has used the deaths reported at age 0-11 months as a measure for infant mortality and deaths reported at ages 12-59 months as a measure for child mortality.

Table 2.2 Estimates of child mortality rates based on the reported deaths at age 12-59 months and 12-60 months: 1976 NFS and 1986 NFFS, Nepal.

Reference year	Number of cases for direct estimates	CMR/1000 based on reported death at age 12-59 months	CMR/1000 based on reported death at age 12-60 months	Indirect estimates of CMR/1000: Palloni Heligman method UN, SA mortality model	Trussell method: West mortality model	Trussell method: South mortality model	Index c/
a/ 1961	551	120	122				
a/ 1962	518	149	151				
a/ 1963	574	117	118				
a/ 1964	645	91	93				
a/ 1965	690	113	113				
a/ 1966	764	116	118				
a/ 1967	746	105	105				
a/ 1968	787	107	108				
a/ 1969	906	86	87		101	94	5 a/
a/ 1970	932	106	107	123			5 a/
b/ 1971	370	86	86		96	114	3 a/
b/ 1972	412	83	85	118			3 a/
b/ 1973	384	94	94	131	102	105	2 a/
b/ 1974	562	69	69				
b/ 1975	459	83	92				
b/ 1976	664	57	59				
b/ 1977	534	86	88				
b/ 1978	697	57	57				
b/ 1979	671	70	73	71	60		5 b/
b/ 1980	689	51	52				

Notes: a/ Calculated from 1976 NFS and b/ calculated from 1986 NFFS data sets.
c/ In the index columns, 2, 3 and 5 respectively are respectively equivalent to q2, q3 and q5 and corresponding CMR figures are based on the information from mothers aged 20-24, 25-29 and 30-34.
Sources: NFS, 1976 and NFFS, 1986 data tapes.

2.5.4 Omission of births and deaths

Events such as children moving away or dying, the birth of illegitimate children and the birth of a girl (Potter, 1977: 337; Brass, 1980: 31) are more likely to be omitted from the birth histories information. The women in the older reproductive ages, because of memory lapse, are also likely to under-report the number of children ever borne by them and subsequent deaths (Brass, 1980: 31). Nepal is no exception to this phenomenon. There is also a common reluctance in the Nepalese society to talk, especially with a mother, about the children who have died because no one wants to remember sorrowful events. This is also likely to affect the reported number of births and deaths of children in the birth history information collected in the surveys of Nepal. Moreover, omission of events and misplacement of dates of events in the data derived from the retrospective surveys can to some extent be expected, as most of them depend heavily upon the recall of events as well as dates of event in the past (Singh, 1987: 619-620).

Various methods have been developed to detect omission of the reported live births in a data set. One method is to estimate the reported number of children ever born by age of mothers at the time of survey. The measurement criterion suggested to assess the omission of births using this technique is that in the absence of error in the data and in the absence of a change in fertility in the past, the average number of reported children should increase with the increase in the age of the mother (Singh, 1987: 627).

The results in Table 2.3 suggest that neither the data from 1976 NFS nor from 1986 NFFS suffer from substantial omission of births. The average number of children ever born (CEB) based on both surveys has been increasing with the increase in the age of mother, as expected. However, the assessment of the omission of births in the 1976 NFS carried out by Goldman et al. (1979: 21-30) by comparing the average number of children born with the cumulation of the current fertility based on the births in past 12 months suggested a distorted fertility history for the older women, with a combination of omission of remote birth and displacement of births towards the present. At the same time, based on overall assessment, Goldman et al. (1979:33) concluded that births, marriages and infant deaths for the recent past in the 1976 NFS were all apparently reported with negligible error. Singh (1987: 628) also noted that the test for omission of live births did not disclose severe problems in any of the surveys under the World Fertility Survey (WFS).

Table 2.3 Average number of children ever born (CEB): 1976 NFS and 1986 NFFS, Nepal.

Age	Average CEB 1976 NFS	Number of women	Average CEB 1986 NFFS	Number of women
15-19	0.32	741	0.44	399
20-24	1.44	1226	1.61	816
25-29	2.90	1146	2.81	774
30-34	4.10	855	3.90	690
35-39	5.06	736	4.85	605
40-44	5.53	720	5.49	445
45-49	5.74	516	5.95	219

Sources: NFS, 1976 and NFFS, 1986 data tapes.

Goldman et al.'s (1979) approach of comparing the average number of CEB with the cumulation of current fertility based on births in the past 12 months was also carried out for the 1986 NFFS. The examination found a higher number of reported CEB in comparison to the synthetic estimates. These differences were then attributed to the combination of omission of births and a recent decline in fertility among the women in older cohorts. However, the need for further assessment was proposed to confirm the findings of fertility decline among the cohorts of women at older ages (NFPMCH, 1987: 44-46).

Another method suggested to detect the omission of deceased children in survey data is to examine the proportion of dead children among all the children ever born by age of mother. The notion behind this technique is that the proportion of deceased children among all the children born should increase with mother's age in a situation where the childhood mortality has not been increasing because the offspring of the older women have had more exposure to the risk of dying. The absence of an increase in the proportion of deceased children among children ever born by age of mother suggests the omission of dead children in the data. However, it may not be true for the women between the ages 15-19 because the children born to these women are associated with a higher risk of death (Singh, 1987: 626-627).

Table 2.4 shows the proportion of dead children and average number of children dead by the age of the mother classified into conventional five-year age groups from the 1976 NFS and 1986 NFFS data. As an increase in the proportion of dead children is evident in Table 2.4, this suggests that neither the data from the 1976 NFS nor the data from the 1986 NFFS suffer from substantial omission of births. The pattern of the percentage of dead children among the reported children ever born in both surveys is found to be as expected. Besides, the mean number of children ever born and dead corresponding to all cohorts of women in the 1986 NFFS appeared to be greater than the figure corresponding to the same cohorts of women 10 years younger in the 1976 NFFS. For example, the average number of children ever born to women aged 35-39 in the 1986 NFFS was 4.85, greater than 2.90, the figure for the same cohort of women when they were aged 25-29 in the 1976 NFS (Table 2.3). Similarly, the average children dead for the corresponding age groups were respectively 0.955 and 0.698 (Table 2.4). On the basis of the assumption that the mean number of children ever born and children dead increase, consistent with fertility and mortality trends, among cohorts of women between the two surveys, reporting of births and deaths in both the 1976 NFS and 1986 NFFS can be consider as of good quality.

Table 2.4 Proportion of children dead among children ever borne by age of mother: 1976 NFS and 1986 NFFS, Nepal.

	1976 NFS			1986 NFFS		
Age of mother	Proportion dead	Mean children dead	Number of CEB	Proportion dead	Mean children dead	Number of CEB
15-19	0.178	0.057	236	0.131	0.058	176
20-24	0.212	0.304	1761	0.140	0.224	1310
25-29	0.223	0.648	3327	0.157	0.458	2174
30-34	0.249	1.021	3505	0.171	0.668	2698
35-39	0.272	1.378	3727	0.197	0.955	2935
40-44	0.304	1.681	3981	0.211	1.157	2441
45-49	0.311	1.785	2961	0.237	1.411	1302

Sources: NFS, 1976 and NFFS, 1986 data tapes.

The indirect technique known as the P/F ratio method, originally developed by Brass (1964, 1964a: 11-12) and further elaborated by Brass and Coale (1968: 88-104) to estimate recent fertility from the data on children ever born (P) and cumulative fertility in the past

12 months (F), both classified by age of mother, has been suggested as a tool to assess the omission of births in pregnancy history data (Goldman and Hobcraft, 1982: 15; Hobcraft et al., 1982: 291). This method compares the reported cumulative fertility with synthetic cohort estimates of cumulative fertility which are generally calculated from the fertility rate for the most recent period (Brass and Coale, 1968: 90).

Although the conventional P/F ratio is convenient to use when the source of data is from a census or vital registration, cohort-period specific fertility rates are recommended as a better method of examining the change in fertility and the extent of error in data if the information is available from the maternity histories. Besides, the choice of the cohort-period fertility rates also avoids the use of the model age-specific fertility curve that is required in the conventional method (Hobcraft et al., 1982: 291-292). Thus the cohort-period fertility rate method is used to examine the reporting errors as both the 1976 NFS and 1986 NFFS have collected complete maternity histories. The cohort-period method suggested for the evaluation of the reported errors in the data and the changes in fertility has been described in Hobcraft (1980), Goldman and Hobcraft (1982) and Hobcraft et al. (1982).

The diagonals in Tables 2.8 and 2.9 refer to the information on the cohorts of women in the same group which corresponds to the period when they were in different five-year age groups. Similarly, the row data from right to left refers to the information with respect to different cohorts of women at equivalent five-year age groups. Thus Tables 2.8 and 2.9 can be arranged in two different ways to examine the fertility trend and errors in reported births. Tables 2.5, 2.6 and 2.7 are thus re-constructed from Tables 2.8 and 2.9 to simplify the comparison of cohort-period fertility rates and P/F ratios from two successive surveys at equivalent ages.

The increase in the cumulative cohort fertility with the increase in the age of the women is clearly evident for all cohorts of women from the 1976 NFS and 1986 NFFS (Table 2.5) . Moreover, the higher cumulative cohort fertility rate for the cohorts of women from the 1976 NFS in comparison to the cohorts of women from the 1986 NFFS at

Table 2.5 Cumulative fertility of cohorts: 1976 NFS and 1986 NFFS, Nepal.

	Cohorts aged 45-49 in 1986		Cohorts aged 40-44 in 1986	
Age group	1986 NFFS	1976 NFS	1986 NFFS	1976 NFS
45-49	6.000			
40-44	5.643		5.578	
35-39	4.788	5.165	4.933	
30-34	3.529	4.058	3.746	4.151
25-29	2.255	2.618	2.328	2.732
20-24	0.918	1.200	1.016	1.269
15-19	0.196	0.226	0.171	0.216
	Cohorts aged 35-39 in 1986		Cohorts aged 30-34 in 1986	
35-39	4.912			
30-34	3.987		3.961	
25-29	2.547	2.922	2.794	
20-24	1.134	1.400	1.364	1.546
15-19	0.207	0.248	0.239	0.255
	Cohorts aged 25-29 in 1986			
25-29	2.842			
20-24	1.466			
15-19	0.281	0.320		

Sources: NFS, 1976 and NFFS, 1986 data tapes.

equivalent ages is also evident by looking at rows of Table 2.5. This phenomenon clearly indicates fertility decline in the country and does not produce any evidence of problems in the data. A similar result is evident in Table 2.6 when the data are examined by the cumulative period rates. Besides, the P/F ratios in Table 2.7 examined for the equivalent ages from the 1976 NFS and 1986 NFFS show higher P/F ratios for all cohorts of women, except the cohort aged 35-39 and 45-49 in 1986 who were at ages 15-19 and 30-34 respectively in 1976, in comparison to the P/F ratios corresponding to the equivalent ages from the 1986 NFFS. This indicates higher reported parity by the women in the earlier survey in comparison to the later survey and again suggests a decline in fertility in Nepal in the recent past.

Three main criteria are suggested to be considered in examining the P/F ratio to evaluate the reported births and the fertility trend. Firstly, P/F ratios should appear near to unity in the absence of change in fertility and reporting errors; secondly, the ratio will tend

Table 2.6 Cumulative fertility within periods: 1976 NFS and 1986 NFFS, Nepal.

	10-14 years before 1986 and 0-4 years before 1976		15-19 years before 1986 and 5-9 years before 1976	
Age group	1986 NFFS	1976 NFS	1986 NFFS	1976 NFS
15-19	0.297	0.317	0.247	0.252
20-24	1.422	1.608	1.174	1.403
25-29	2.835	3.131	2.486	2.867
30-34	4.253	4.550	3.761	4.307
35-39	5.512	5.657		5.502
40-44		6.391		6.395
45-49		6.702		
	20-24 years before 1986 and 10-14 years before 1976		25-29 years before 1986 and 15-19 years before 1976	
15-19	0.206	0.254	0.173	0.214
20-24	1.051	1.307	0.895	1.189
25-29	2.388	2.724		2.541
30-34		4.118		3.880
35-39		5.342		
	30-34 years before 1986 and 20-24 years before 1976			
15-19	0.198	0.230		
20-24		1.134		
25-29		2.469		

Sources: NFS, 1976 and NFFS, 1986 data tapes.

to decrease with an increase in the age of women if the reported births are affected by omission; and, thirdly, a sequence of P/F ratios that increase with the age of women indicates a recent decline in fertility (Brass and Coale, 1968: 90-91). Further examination of the P/F ratio in Table 2.7 shows quite different results than those derived from Tables 2.5 and 2.6 discussed in the preceding sections. For example, the P/F ratios at age 20-24 for the cohorts of women aged 45-49 in 1986 from the 1986 NFFS show a value greater than unity and are also greater than the P/F ratios at any other ages corresponding to the same cohort of women. The P/F ratios of this cohort of women are neither increasing nor declining gradually with the increase in their ages. In fact, they are fluctuating at different ages which suggests a problem in the data. A similar trend in the P/F ratio based in both the 1976 NFS and 1986 NFFS classified according to the age in 1986 is also evident for all other cohorts of women except for the ratio from the 1976 NFS corresponding to the

Table 2.7 P/F ratios: 1976 NFS and 1986 NFFS, Nepal.

Age group	Cohorts aged 45-49 in 1986: 1986 NFFS	Cohorts aged 45-49 in 1986: 1976 NFS	Cohorts aged 40-44 in 1986: 1986 NFFS	Cohorts aged 40-44 in 1986: 1976 NFS
45-49	0.978			
40-44	0.872		0.965	
35-39	0.869	0.913	0.878	
30-34	0.983	0.942	0.881	0.912
25-29	0.944	0.961	0.936	0.953
20-24	1.025	1.010	0.966	0.971
15-19	0.989	1.001	0.984	1.006
	Cohorts aged 35-39 in 1986		Cohorts aged 30-34 in 1986	
35-39	0.957			
30-34	0.899		0.941	
25-29	0.898	0.933	0.934	
20-24	0.966	0.997	0.959	0.961
15-19	1.003	0.971	0.970	1.010
	Cohorts aged 25-29 in 1986			
25-29	0.935			
20-24	0.938			
15-19	0.944	1.009		

Sources: NFS, 1976 and NFFS, 1986 data tapes.

cohorts of women who were at age 40-44, 35-39 and 30-34 in 1986 and from the 1986 NFFS corresponding to the women who were at age 25-29 in 1986. This again indicates a problem in reported births in both the data sets.

Tables 2.8 and 2.9 show the cohort-period fertility rates, cumulative cohort fertility (P), cumulative period fertility (F) and P/F ratios from the 1976 NFS and 1986 NFFS data. Panel B in Table 2.8 shows that the parity of 0.133 children achieved by cohorts of women aged 45-49 when they were 15-19 years old is lower than the reported parity corresponding to other cohorts of women at equivalent ages. The cumulative parity by cohorts of women in Panel B of Table 2.8 shows a gradual decline in the reported parity with the increase in time, except for the parity corresponding to 10-14, 15-19 and 20-24 years before the survey for the cohorts of women at equivalent ages 15-19 and the parity corresponding to 0-4 and 5-9 years before the survey for the cohorts of women at equivalent ages 40-44. This situation prevails only when the reported parity of younger cohorts is higher than for the older cohorts and thus suggests an increase in fertility in the recent past.

Table 2.8 Cohort-period fertility rates, cumulative cohort and period fertility, and P/F ratio by age at survey: 1976 NFS, Nepal.

Age group of cohort at survey	Number of women in cohort	Years before survey 0-4	5-9	10-14	15-19	20-24	25-29	30-34
A. Cohort-period fertility rate								
10-14	0	0.000	0.001	0.001	0.000	0.000	0.000	0.000
15-19	732	0.063	0.050	0.050	0.043	0.045	0.030	0.027
20-24	1119	0.258	0.230	0.211	0.195	0.177	0.163	
25-29	1116	0.304	0.293	0.283	0.270	0.267		
30-34	807	0.284	0.288	0.279	0.268			
35-39	659	0.222	0.239	0.245				
40-44	605	0.147	0.179					
45-49	383	0.062						
B. Cumulative fertility of cohorts at end of period (P)								
10-14		0.000	0.003	0.005	0.000	0.001	0.002	0.000
15-19		0.320	0.255	0.248	0.216	0.226	0.149	0.133
20-24		1.546	1.400	1.269	1.200	1.033	0.948	
25-29		2.922	2.732	2.618	2.385	2.285		
30-34		4.151	4.058	3.779	3.624			
35-39		5.165	4.974	4.849				
40-44		5.707	5.742					
45-49		6.052						
C. Cumulative fertility within periods (F)								
10-14		0.000	0.003	0.005	0.000	0.001	0.002	0.000
15-19		0.317	0.252	0.254	0.214	0.226	0.150	0.133
20-24		1.608	1.403	1.307	1.189	1.110	0.965	
25-29		3.131	2.867	2.724	2.541	2.447		
30-34		4.550	4.307	4.118	3.880			
35-39		5.657	5.502	5.342				
40-44		6.391	6.395					
45-49		6.702						
D. P/F Ratio								
10-14		0.000	1.000	1.000	1.000	1.000	1.000	1.000
15-19		1.009	1.010	0.979	1.006	1.001	0.990	1.000
20-24		0.961	0.997	0.971	1.010	0.931	0.982	
25-29		0.933	0.953	0.961	0.939	0.934		
30-34		0.912	0.942	0.918	0.934			
35-39		0.913	0.904	0.908				
40-44		0.893	0.898					
45-49		0.903						

Source: 1976 NFS data tape.

Table 2.9 Cohort-period fertility rates, cumulative cohort and period fertility, and P/F ratio by age at survey: 1986 NFFS, Nepal.

Age group of cohort at survey	number of women in cohort	Years before survey						
		0-4	5-9	10-14	15-19	20-24	25-29	30-34
A. Cohort-period fertility rate								
10-14	0	0.000	0.002	0.006	0.002	0.001	0.001	0.000
15-19	400	0.088	0.074	0.054	0.047	0.040	0.034	0.039
20-24	815	0.245	0.237	0.225	0.185	0.169	0.144	
25-29	773	0.275	0.286	0.283	0.262	0.267		
30-34	689	0.233	0.288	0.284	0.255			
35-39	605	0.185	0.237	0.252				
40-44	445	0.129	0.171					
45-49	255	0.071						
B. Cumulative fertility of cohorts at end of period (P)								
10-14		0.000	0.008	0.028	0.012	0.004	0.005	0.002
15-19		0.448	0.399	0.281	0.239	0.207	0.171	0.196
20-24		1.623	1.466	1.364	1.134	1.016	0.918	
25-29		2.842	2.794	2.547	2.328	2.255		
30-34		3.961	3.987	3.746	3.529			
35-39		4.912	4.933	4.788				
40-44		5.578	5.643					
45-49		6.000						
C. Cumulative fertility within periods (F)								
10-14		0.000	0.008	0.028	0.012	0.004	0.005	0.002
15-19		0.440	0.378	0.297	0.247	0.206	0.173	0.198
20-24		1.665	1.563	1.422	1.174	1.051	0.895	
25-29		3.041	2.993	2.835	2.486	2.388		
30-34		4.208	4.432	4.253	3.761			
35-39		5.134	5.619	5.512				
40-44		5.778	6.474					
45-49		6.135						
D. P/F Ratio								
10-14		0.000	1.000	1.000	1.000	1.000	1.000	1.000
15-19		1.017	1.055	0.944	0.970	1.003	0.984	0.989
20-24		0.975	0.938	0.959	0.966	0.966	1.025	
25-29		0.935	0.934	0.898	0.936	0.944		
30-34		0.941	0.899	0.881	0.938			
35-39		0.957	0.878	0.869				
40-44		0.965	0.872					
45-49		0.978						

Source: 1986 NFFS data tape.

The cumulative-period fertility in panel C of Table 2.8 also shows higher period fertility corresponding to the period closer to the survey which suggests low fertility in the past or a recent fertility rise. For example, 0.965 period fertility for the women of equivalent ages of 20-24 during the period 25-29 years before survey has gradually increased to 1.608 by the period 0-4 years before the survey. The same phenomenon persists for women in all cohorts corresponding to their equivalent ages except for the age group 15-19 corresponding to the period 10-14 and 15-19 years before the survey as compared with their peers. Values based on the 1986 NFFS in Table 2.9 also show a similar trend as found from the 1976 NFS in Table 2.8. An examination of the P/F ratios clearly discloses the persistence of the problem of displacement and omission of births in both the data sets. In this respect Suhaimi (1991: 18), while examining the fertility change in Indonesia, noted that the fluctuation in P/F ratios for different periods could be interpreted as a problem of displacement in the reported births. This situation is evident in Panel D of both Tables 2.8 and 2.9. Moreover, a decrease in P/F ratio with an increase in the age of mother is also evident in both Tables 2.8 and 2.9. However, the decreases are not gradual but fluctuating between the equivalent ages corresponding to different cohorts. For example, the P/F ratio of 0.979 in Table 2.8 corresponding to the women aged 15-19 in the period 10-14 years before the survey is less than the P/F ratios of 1.010 and 1.006 for equivalent ages of the women during the periods 5-9 and 15-19 years before the survey. This clearly provides evidence of the errors in reported births from both the 1976 NFS and 1986 NFFS. Panel D of both tables also suggests that the older cohorts of women from the 1976 NFS have omitted to report some of the children born to them during their later life. In contrast, the older cohorts of women from 1986 NFFS have omitted some of the children born to them during their earlier life.

The decline in fertility found and discussed in the preceding section is thus not a real decline but could appear to be a decline because of errors in the data. However, the purpose of this exercise is not to examine the fertility change in Nepal but to assess the errors in the reported births in the 1976 NFS and 1986 NFFS data sets.

2.5.5 Sex ratios at birth

Sex ratio at birth is the another method to assess the quality of the survey data because it could be affected by the accuracy of reported births. Why parents prefer one sex over another could be different across societies. For example, Caldwell (1976: 343) divided Nigerian society into three: primitive, traditional and transitional, and noted that the flow of benefit in the primitive or nearly traditional society is from children to parents. Caldwell further noted that

> Children have demonstrable values of several different types in primitive and traditional societies. They do a great deal of work for or with their parents not only when young but usually during adulthood as well; they accept responsibility for the care of parents in old age; they eventually bolster the family's political power and hence give economic advantages; they ensure the survival of the lineage or family name and in many societies undertake the necessary religious services for the ancestors. (Caldwell 1976: 343)

This point noted by Caldwell can be applied to Nepal by replacing the word 'children' by 'sons'. This is because over 80 per cent of the total population are Hindus by religion. The birth of a son for a Hindu is significant in several ways. Firstly, the security and the status of a married Hindu woman, who lives in her husband's parents' house, is likely to increase after she gives birth to a boy child. Secondly, married away daughters may not be very helpful as a source of insurance in the time of economic crisis to her parents. Thirdly, in Hindu religion, there is a common belief that having a son will open the door of heaven for parents, saving them from going to hell (for detail see Stone, 1978; Shrestha, 1986). In this respect, Singh (1987: 639) noted that a strong preference for children of one sex in a society is likely to lead to different degrees of omission of the less preferred sex. So the pronounced religious significance of having a son and the economic value of the son in Nepalese society arouses suspicion about the omission of births of girls who might have died early in life. This omission might have produced errors in the data for Nepal.

The sex ratio at birth has been commonly observed to be around 105 male births per 100 females in countries with reasonably good data (United Nations, 1973). One of the direct tests to assess the omission of births by sex of the child in the pregnancy history data is to verify the overall sex ratio at birth and the sex ratio by period (Brass, 1980: 40). Table

2.10 reveals the sex ratio at birth by cohorts of five years for the children ever born between 1946 and 1975 reported in the 1976 NFS and the cohort born between 1956 and 1985 reported in the 1986 NFFS. The sex ratios at birth for the cohort born between 10 and 15 years before the survey from both the 1976 NFS and 1986 NFFS are also presented in Table 2.10 to examine whether the women interviewed in the surveys have reported all the children ever born to them or not.

Table 2.10 Sex ratios at birth, 1976 NFS and 1986 NFFS: Nepal.

Birth Cohort Table	Sex ratio at birth, 1976 NFS	Birth cohort	Sex ratio at birth, 1986 NFFS
1946-50	107.9		
1951-55	117.4		
1956-60	107.3	1956-60	122.7
1961-65	103.4	1961-65	141.8
1966-70	99.2	1966-70	129.9
1971-75	105.6	1971-75	102.8
		1976-80	107.6
		1981-85	104.2
1961-75	102.5	1971-85	105.3
1966-75	102.7	1976-85	105.8

Source: 1976 NFS and 1986 NFFS data tape.

A tendency to under-report female births from both data sets is evident in Table 2.10. The situation becomes worse further back from the date of survey. The tendency to under-report female births for the cohorts of children born 20 to 30 years before the 1986 NFFS appears to be more severe compared to the cohorts of children born 20 to 30 years before the 1976 NFS. However, the sex ratio at birth for the cohorts born between the survey date and 10 to 15 years before the survey based on both the 1976 NFS and 1986 NFFS, which are the main concern of the analysis in this study, appears to be fairly acceptable. The sex ratio at birth for both 10 years before the survey as well as 15 years before the survey from both the 1976 NFS and 1986 NFFS is not statistically significant with the standard sex ratio of 105 at birth when it was tested at the critical value of ±1.96.

So errors in the analysis in this study due to the omission of births in the survey can be expected to be negligible.

This chapter has discussed the methodology of this study and has examined the quality of data in detail. The subsequent chapters will concentrate on analysis of data and interpretation of the results.

CHAPTER THREE

DEMOGRAPHIC DETERMINANTS OF INFANT AND CHILD MORTALITY

3.1 Introduction

Specific characteristics of women's reproductive behaviour such as age of mother at childbirth, birth order and the preceding birth interval of an index child have received prominent emphasis in the study of child survival. Studies based on WFS data from many countries have attributed infant and child mortality differentials to the differences in the demographic characteristics among mothers. Generally, women in the higher age groups, high parity women and women with more closely spaced children are noted to be more likely to experience infant loss. For example, DaVanzo et al. (1983: 388) in Malaysia found an elevated risk of death to children born to mothers below 18 and above 40 years of age. Martin et al. (1983: 429) in Pakistan, Indonesia and the Philippines reported a higher risk of death to offspring of mothers under age 20 years than those born to mothers aged 20-34 years. On the other hand the risk of death to the offspring of women aged 35 years and above in Indonesia and Pakistan, was lower than for mothers under age 35 years. Similarly, Bhuiya and Streatfield (1992: 454) noted that higher ages of mothers at the time of birth in Bangladesh were associated with lower risks of child deaths. Ahmad et al. (1991: 322) also noted an unexpectedly lower risk of death associated with children born to mothers at older ages in Liberia.

Generally, second and third order births are associated with lower risk of death during infancy. However, this phenomenon also seems to be different as the countries or the societies in question differ. Bhuiya and Streatfield (1992: 454) observed that first, sixth and higher order births in Bangladesh were associated with a higher risk of death while Momba (1987: 37) in Malawi observed first, fifth and higher order births associated with higher risk of death. Although Martin et al. (1983: 429) in Indonesia observed first order birth as subject to a higher risk of death in the univariate model (but not at a statistically significant level), in the multivariate model they were found to be subject to a lower risk of death. Hobcraft et al. (1985: 369) in a study of 39 WFS countries also noted that first-born children were exposed to a higher risk of death. However, these authors also noted that their study did not produce sufficient evidence to support the view that higher age of mother and higher parity cause poor child survival prospects.

Although the studies reflect varying geographical settings, different methodological approaches and different quality of data, short birth intervals are particularly noted to be associated with elevated risk for infant and child mortality. In addition, different patterns of relationship between birth interval length and child survival prospects have also been established in different populations. Cleland and Sathar (1984: 409) in Pakistan, DaVanzo et al. (1983:400) in Malaysia, DeSweemer (1984: 55) in Punjab, India, Pebley and Stupp (1987: 50) in Guatemala, Hobcraft et al. (1985 : 370) in 39 WFS countries and Palloni and Millman (1986: 222) in 9 out of 12 Latin American and Caribbean countries reported the adverse effect of short birth interval on survival prospects of infants. Besides, Hobcraft et al. (1985: 370) observed the strong association of births less than two years before the index birth with poor child survival prospects for the index child even when order of birth and mother's age at childbirth were held constant.

A study based on DHS data from 17 countries (Boerma and Bicego, 1992: 249-250) suggested a different pattern of relationship between the length of birth interval and mortality risk among children. In African and Asian countries and two Latin American countries, an index child born within a short interval after the birth of a preceding child had a higher risk of death during its neo-natal period. Likewise, in three of the five Sub-Saharan countries post-neonatal births which occurred under 18 months after the birth of a preceding sibling were found to have a higher risk of death. In their study of 12 Latin American countries, Pebley and Millman (1986: 75) suggested a declining risk of death to index children during their neo-natal period of life with increasing preceding birth interval. A similar pattern was observed for toddler children (aged 1 to 4 years) in eight countries.

However, results from four countries did not show any further improvement in child survival prospects of toddler children with an increased length of interval.

Just as mortality risk can vary between societies, the mechanisms may vary too. Moreover, as the reproductive behaviour of women in one society differs from that in another society, variables related to the reproductive behaviour can also be expected to exert their influence on child survival prospects in different ways. In general, the literature suggests that the observed higher risk of death for infants and children of high parity women, younger and older women, and short as well as longer intervals between siblings is partly due to biological factors (endogenous) and partly due to varying socio-cultural and child care practices among mothers (exogenous factors). Tsui et al. (1988: 70) and Pebley and Stupp (1987: 42) noted that pregnancy among younger mothers, due to their immature reproductive system, could lead to deterioration in the child's pre-natal and post-natal development which in turn could expose children borne by mothers during their younger ages to a higher risk of death. A higher risk of death for children born to mothers during later ages, however, could be due to the decline in the efficiency of their reproductive system as well as declining fecundity and a higher rate of fetal loss, all of which are associated with higher frequency of chromosomal abnormalities (Leridon, 1977: cited in Pebley and Stupp, 1987: 43).

Different mechanisms emerge for the first order birth and higher order births in exerting their influence on child survival. Martin et al. (1983: 429) argued that first order births are likely to occur among younger mothers and are more likely to involve pregnancy complications leading to a higher risk of death. Tsui et al. (1988: 710) suggested that stress due to unprepared reproductive systems could be one of the mechanisms for explaining the higher risk of deaths among first-born children. Similarly, Rutstein (1983: 29) noted that first-order births are more likely to occur to younger mothers who are 'biologically, mentally, socially and economically unprepared to bear and bring up a child' resulting in elevated exposure to death. DaVanzo et al. (1983: 394) suggested that although detrimental biological influence is the reason for higher risk of death to first-born infants, the elevated risk among higher order births is due to behavioural child care factors.

As the distribution of birth interval and the reasons for the short and the long intervals differ from population to population, the effects of birth interval on child health and survival also cannot be expected to be the same for all populations (Winikoff, 1983: 232). Consequently, different mechanisms for the way in which birth interval exerts its influence on child survival have been suggested in the literature. Potter (1988: 447) and DeSweemer (1984: 50) suggested maternal depletion syndrome (purely biological) and sibling competition (purely socio-economic) as two possible mechanisms for the relationship between closely spaced births and poor child survival prospects. Palloni and Millman (1986: 216) suggested that the adverse effect of closely spaced births on child survival prospects operates through inadequate child care aggravated by competition among siblings for their mother's attention and tangible resources. Depletion of women's reproductive and nutritional resources leading to low birthweight, competition among children for food, clothing, living space and parental time, resulting in poor health, as well as decreased survival chances of children as the consequence of a short birth interval, is also suggested in the study from 12 Latin American countries (Pebley and Millman, 1986: 71) and in Guatemala (Pebley and Stupp, 1987: 43).

Trussell et al. (1985: 145) argued that the risk of death according to interval differs between populations because the feeding practices, contraception use, incidence of abortion, fecundity, reproductive behaviour and proportion of women cohabiting differs across populations. Fedrick and Adelstein (1973: 754-755), DaVanzo et al. (1983: 392), Palloni and Millman (1986: 216) and Cleland and Sathar (1984: 402) suggested low birth-weight caused by retarded fetal growth and weakened milk production for the last-born children as the mechanism for the adverse effect of short birth interval on child survival prospects. Breastfeeding is also argued to be a mediating factor in the higher risk of death for closely spaced births (Buchanan, 1975: 64). Hobcraft et al. (1985) suggested that a different propensity for breastfeeding among mothers and premature birth could be the mechanisms that explains the association between higher child survival chances and closely spaced births. However, this mechanism is argued to be more suitable in explaining the risk of death for the early (subsequent interval) child rather than for the later (preceding interval) child (Wolfers and Scrimshaw, 1975: 482; DeSweemer, 1984: 63 and Pebley and Millman, 1986: 72).

The adverse effect of closely spaced births on child survival is also attributed to over-crowding which in turn leads to favourable conditions for disease transmission among siblings of similar ages. Pebley and Stupp (1987: 44), Thapa and Retherford (1982: 72) and Pebley and Millman (1986: 71) argued that infectious diseases are more likely to spread among siblings of similar ages because of their likely physical closeness during early life. Evidence of a higher case fatality rate due to measles was noted by Aaby et al. (1984: 52) in households with many children in Guinea Bissau.

The discussion in the preceding section suggests that studies on three reproductive variables, mother's age at childbirth, birth order and birth interval, have centred on three causal mechanisms in explaining child survival prospects: biological effects related to maternal depletion syndrome and mother's physical capability to conceive; behavioural effects associated with competition between siblings for tangible resources and parental care; and disease transmission. The literature also suggests the persistence of varying levels and magnitude of the effects of demographic factors on infant and child mortality across societies and geographical settings. The effect of demographic factors on infant and child mortality for Nepal has yet not been explored adequately. This chapter thus examines the demographic differentials and determinants of infant and child mortality in Nepal using the 1976 NFS and 1986 NFFS data[1/] sets.

3.2 Description of demographic variables used in this study

Maternal age at childbirth, order of birth, length of interval preceding the birth of index child, sex of the child and birth cohorts are the independent demographic variables of interest employed from both surveys to assess their influence on infant and child mortality in Nepal. Maternal age at childbirth has been categorised into below 24, 24-33 and 33 plus

---

1/ The 1976 NFS covers the period 1966-75 for the study of infant mortality and 1961-70 for the child mortality. Similarly, the 1986 NFFS covers the period 1976-85 for the study of infant mortality rates and 1971-80 for the study of child mortality rates.

age groups. The purpose of adopting unconventional age groups in this study is to minimise the influence of heaping on preferred terminal maternal age observed and discussed in Chapter Two. Birth order is the other variable of interest categorised as 1, 2-3, 4-5 and 6 plus.

The *preceding birth interval* variable in general is associated with a number of problems. First, the length of interval for certain index children cannot be defined. For example, the first births are left out of the analysis because they do not have a preceding interval. Second, length of interval in the literature has been used in various ways. Some studies (Thapa and Retherford, 1982; Gubhaju, 1991; Majumder, 1989; Gondotra and Das, 1988; Talwar, 1988) have used the length of interval as the period between two consecutive births. Miller et al. (1992) used two different types of intervals: preceding birth interval and conception interval. Similarly, Wolfers and Scrimshaw (1975) analysed preceding interval and survival status of children using birth interval as the period between two consecutive pregnancies. Fedrick and Adelstein (1973) used the interval between preceding delivery and date of last menstrual period. Pebley and Millman (1986: 71) suggested that an interval defined as the period between two consecutive births is less likely to be affected by errors due to omission of still births and abortion in pregnancy histories. Thus in this study the length of the preceding birth interval is used as the interval between two consecutive births.

The subsequent child whose survival is of interest is termed the *index child* in this study. The child immediately preceding the index child is the *preceding child.* Consequently, the time elapsed between the birth of two siblings is termed the *preceding birth interval.* The preceding birth interval is categorised as less than 19 months, 19-36 months and 36 plus months. In addition, the dependent variable for the analysis of infant mortality is the probability of dying between birth and exact age one year (in this study this is based on infant deaths reported at 0-11 months). Similarly, the dependent variable for the analysis of child mortality is the probability of dying between exact age one year and before exact age five years (recall from Chapter Two that this variable in this study is based on child deaths reported at ages 12-59 months). The approach adopted in categorising the independent demographic variables in this study is likely to minimise analytical problems.

3.3 Analytical approach

All the variables of interest employed from the 1976 NFS and 1986 NFFS in this chapter are categorised in a similar manner to make the data and the results comparable. The results in this chapter are compared in two different ways. A result corresponding to a sub-group of the sample, such as mortality risk among male children versus female children, is discussed when the analysis is confined to one data set. For cross-survey comparisons, the results of similar sub-groups, for example risk of death to male children from the 1976 NFS versus risk of death to male children from the 1986 NFFS, are compared, analysed and discussed.

In the analysis, the cohorts of children born up to 10 years before the survey from both the 1976 NFS and 1986 NFFS is included in order to study the differentials and determinants of the infant mortality rate. Similarly, the cohort of children born 10 years before the survey are included in order to study the differentials and determinants of the child mortality rate. However, in order to minimise the truncation effects, children born less than one year before the survey for the analysis of infant mortality and children born less than five years before the survey for the analysis of child mortality are excluded.

Since the urban population of the country constituted 6.4 per cent of the total population in the 1981 Census (Central Bureau of Statistics (CBS), 1987: 1), urban areas in the 1986 NFFS were over-sampled by about five times in order to enable separate analysis for urban sectors. Thus to estimate national demographic indicators the data has to be adjusted by using a weighting factor. The purpose of this study, however, is not to estimate the national mortality level, but rather to examine the determinants and differentials of mortality. Thus analysis, except where mentioned, is based on the unweighted data. There is also controversy about whether or not to weight data from a complex data file. In this respect Skinner et al. (1989: 286) noted that if the differences between the inclusion probabilities are a function only of known design variables, such as stratum identifiers or size measures, and if these design variables are included as independent variables in the models and the model is correctly specified then un-weighted model based inference is appropriate.

Cross-tabular bivariate analysis is carried out at the preliminary stage to assess the demographic differentials in infant and child mortality from both surveys. The logit linear main effects model, as described in Chapter Two, is fitted to derive the level of statistical association between the independent and dependent variables as well as for further assessment of infant and child mortality differentials. Both univariate and multivariate models are fitted. The results in the univariate model describe the gross effects while the results in the multivariate model describe the net effects, that is the effects after controlling for the effects of other variables in the model. Results derived from logit models are presented in the form of odds ratios by exponentiating the parameters.

3.4 Approach to interpreting the results of a logit model

The dependent variable in the analysis of infant mortality in the logit models [$\log_e ({}_1q_0/ 1-{}_1q_0)$] in this study is derived from the proportion of infants who died during infancy. Similarly, the dependent variable for the study of child mortality in the logit models [$\log_e ({}_4q_1/ 1-{}_4q_1)$] is the proportion of children who died between one and five years of age. The logit model produces the logarithm of odds (log-odds) of dying during infancy or childhood as a result of membership in a particular category. The major purpose of the logit model analysis in this chapter is to estimate the main effects of demographic variables on the risk of infant and child deaths.

The results of a logit model can be interpreted in two ways: in terms of 'odds of dying' and 'the risk of dying'. For example, the value corresponding to sex of child in the multivariate analysis (net effects column) in Table 3.9 indicates the odds of dying for male infants as being 1.030 times the odds of dying of all infants. Similarly, the value for female infants in Table 3.9 indicates their odds of dying as being 0.971 times the odds of dying of all infants included in the model. Thus the odds of dying for male infants is 1.06 times (1.030/0.971) or 6 per cent higher than the odds of dying for female infants.

'Risk of death' can be calculated from the odds of dying. For male infants (Table 3.9), [Exp { ln(0.174)+ln(1.030)}] / [1+Exp {ln(0.174)+(ln(1.030)}] yields a risk of 0.152. Similarly, the risk of dying for female infants from the Table 3.9 can be calculated from the expression [Exp {ln(0.174)+ln(0.971)}] / [1+Exp {ln(0.174)+(ln(0.971)}] which yields a value of 0.144. These figures thus indicate that the risk of death to male infants was 1.06 times higher (0.152/0.144) than that to female infants. If the risk of dying is higher, the odds of dying are also higher. Majumder (1989: 73) suggested that both the term 'risk of death' and 'odds of dying', though not exactly the same, can be used synonymously. 'Probabilities and odds are different units for expressing the same quantity, just as Fahrenheit and Centigrade scales are different units for measuring temperatures' (Magidson, 1978: 30). This study uses 'odds of dying' (loosely called 'risk of dying' or 'risk of death' hereafter) in interpreting the results from logit models.

The overall odds shown at the bottom of Table 3.9 can be converted into average infant mortality rates for the period of study from the expression [0.174] / [1+0.174]. The reduction in the likelihood chi-square (LRX^2) value along with its corresponding probability (P) shows the statistical significance of a particular variable in relation to infant mortality rates (when infants are the unit of analysis). The terms 'reduction of the LRX^2 values' and corresponding 'reduction in degrees of freedom (d.f)' used throughout the analysis in this as well as in subsequent chapters refer to the reduction in the LRX^2 values and its corresponding degrees of freedom when a variable is added into a model. Higher reduction of LRX^2 value (LRX^2 hereafter) corresponding to a variable indicates its importance in influencing infant and child mortality rates.

3.5 Demographic differentials in infant and child mortality rates

Table 3.1 shows infant mortality rates classified according to the demographic variables of interest from the 1976 NFS and 1986 NFFS data sets for the period 1966 to 1985. The observed differentials in infant mortality rates according to different categories of the independent demographic variables suggest the influence of demographic variables in determining the level of infant mortality in Nepal. Within each survey, Table 3.1 clearly shows that there is a higher risk of death to infants born in earlier cohorts, male infants, infants borne by mothers below 24 years of age and first as well as sixth and higher order births than the risk of death to infants in other categories of the respective variables. Similarly, the index child born within less than 19 months of the birth of the preceding child has an elevated risk of death in comparison to infants in other categories of this variable.

The direct calculation of the probability of death for infants born according to the five-year cohorts from both the 1976 NFS and 1986 NFFS surveys suggests a systematic decline in infant mortality in Nepal over the period. This suggests improvement in child survival prospects in Nepal during the period 1966 to 1985. A comparison of estimates based on different survey and census data for various periods carried out elsewhere also confirms the declining infant mortality level in Nepal during recent decades (see Table 1.5 Chapter One).

The male infant death rate from both surveys was higher than the female death rate. The risk of death for male infants from the 1976 NFS was 3 per cent higher than for females. The corresponding figure from 1986 had increased to 8 per cent. However, the effect of the sex variable on infant mortality in both surveys was not statistically significant in the multivariate analysis carried out later.

Table 3.1 shows that infants born to women under 24 years of age from the 1976 NFS were exposed to a higher risk of death than infants born to women aged 24-33 and 34 years or more. This was also true for the 1986 NFFS. In the 1986 NFFS data set infants borne by mothers over 34 years of age were exposed to the lowest risk of death while in 1976 NFS the lowest risk of death was for those borne by mothers in the 24-33 years age group. However, the effects of the maternal age at child birth on infant mortality based on both surveys show similar pattern in the multivariate analysis (Tables 3.9 and 3.10).

Infant mortality rate in relation to birth order from both surveys shows the usual pattern of a U-shaped relationship. A sharp decline in infant mortality rate for first as well as sixth and higher order births for the period 1966 - 1985 is also noticeable in Table 3.1.

This decline could be partly due to the overall decline in infant mortality rate (40 per cent). Moreover, the higher risk of death to first-born infants and infants born to mothers under 24 years of age could be due to the higher intensity of births to the younger mothers. Rapid childbirth during early ages could have resulted in closely spaced births where the mother's age as well as birth spacing could have worked simultaneously. Moreover, a birth to a younger woman is also likely to be associated with pregnancy complications leading to elevated risk of death during infancy.

Table 3.1 Infant mortality rates by demographic factors: 1966-1985, Nepal.

Variables	1966-75 a/ Number of deaths	Exposed births	IMR (1q0) /1000	1976-85 b/ Number of death	Exposed births	IMR (1q0) /1000	% change
Cohort born							
1966-70 A	737	4639	159				
1971-75 B	749	5101	147				
1976-80 C				437	4467	98	-38**A,C
1981-85 D				416	4840	86	-42**B,D
Sex of the child							
Male	766	4931	155	459	4812	95	-38**
Female	720	4809	150	394	4495	88	-42**
Maternal age at childbirth (years)							
< 24	700	4002	175	420	4204	100	-43**
24-33	567	4158	136	343	3991	86	-37**
34 +	219	1580	139	88	1095	80	-42**
Birth order							
1	354	2098	169	188	2031	93	-45**
2-3	499	3487	143	311	3580	87	-39**
4-5	322	2275	142	195	2156	90	-36**
6 +	269	1559	173	146	1473	99	-43**
Length of preceding c/ birth interval (months)							
< 19	280	1186	236	126	932	135	-43**
19-36	619	4059	152	355	3811	93	-39**
37 +	232	2515	92	147	2375	62	-33**
Overall	1486	9740	153	853	9307	92	-40**

Notes: a/ denotes results based on 1976 NFS data and b/ denotes results based on 1986 NFFS data. ** indicates significant at the 1 per cent level in the test of difference in two proportions. Figures may not tally to 100 per cent because of the missing cases. c/ indicates only second and higher order births.

Sources: a/ 1976 NFS and b/ 1986 NFFS data tape.

The results from both surveys have established a negative association between the length of preceding birth interval and survival status of index infant. This result contradicts the findings of other research which has found a stabilised U-shaped relationship between these two variables. An adverse influence of short birth interval on infant mortality could be due to the maternal depletion syndrome caused by a rapid succession of pregnancies and/or childbirths which in turn could have resulted in low birth weight affecting the growth as well as survival of the index child. The observed marked decline in death rates for infants born under 19 months of interval during the period 1966 - 1985, on the other hand, to some extent could be the effect of the decline in the proportion of births in this category in the later survey compared with the preceding survey[2/]. The declining risk of death with the increase in length of interval, which suggests better survival prospects for those born after a longer interval, could be due to adequate time for mothers to recover from the previous pregnancy and breastfeeding before their next conception. Moreover, this also explains the smaller number of children of similar ages for these mothers which in turn could allow them to provide proper time and resources to the newly born.

Table 3.2 shows the number of child deaths, the number of children exposed to death and cross-classified child mortality rates according to demographic variables from the 1976 NFS and 1986 NFFS data sets. From both the 1976 NFS and 1986 NFFS, the probability of death corresponding to different cohorts of children, as in infant mortality, suggests a gradual decline in child mortality rates in Nepal for the period 1961 - 1980. The death rate for the cohorts of children born during the period 1976-80 (from the 1986 NFFS) has sharply declined (50 per cent) from the mortality level experienced by the cohort of children born during the period 1961-65. This again suggests a marked improvement in child survival prospects in Nepal during recent decades.

2/ Proportion of births corresponding to less than 19 months, 19-36 months and over 37 months of interval from the 1976 NFS were respectively 15, 52 and 32 per cent while the corresponding proportions from the NFFS were respectively 13, 54 and 33 per cent.

The Table 3.2 confirms the findings of Gubhaju (1991: 103) based on the 1976 NFS data that child mortality was higher for females than for males. As in neighbouring countries, India and Bangladesh, preference for a son in Nepal does exist. In the 1976 NFS, 2,976 women said that they wanted additional children. Of these women 68 per cent indicated preference for a son, 7 per cent for a daughter and 25 per cent no preference for either sex. Similarly, 1,603 women in the 1986 NFFS desired an additional child; of these 63 per cent indicated a son preference, 12 per cent a daughter preference and 25 per cent did not suggest preference for either sex. All these are clear indications of a strong preference for sons among Nepalese women. The preference for sons could be associated partly with old-age security, and partly with religious values (for detail see Stone, 1978 and Levine, 1987). This to some extent could lead to differentials in child care and household resource allocation by sex resulting in a higher female death rate. However, in the multivariate analysis based on both data sets carried out in the later sections of this chapter, the effect of sex of child on child mortality was not statistically significant.

In both surveys maternal age at childbirth and length of preceding birth interval showed a negative association with survival status of children. Thus maternal age at childbirth from these data sets does not confirm the usual U-shaped relationship with child survival observed, for example, in Sri Lanka (Trussell and Hammerslough, 1983: 16) and the Philippines (Martin et al., 1983: 422).

As in the case of infant mortality analysis, closely spaced births show poor child survival prospects compared with births after 36 months of the birth of the preceding child. The adverse effect of a short interval on the survival of the index child could be a result of socio-economic factors such as competition for food and household resources among children. Moreover, the risk of death among those born within a short interval and who survived infancy could have extended to elevated risk throughout their childhood period. Because Nepal is a developing country where the majority of the people are surviving with limited resources, the problem could have been compounded. Those who enjoyed better survival prospects during their infancy due to the longer interval between births are likely to enjoy a better situation in childhood, too. This is because mothers who have given birth after a longer interval are likely to be responsible for a smaller number of children for whom they can provide more time and resources.

Table 3.2 Child mortality rates by demographic factors: 1961-1980, Nepal.

	1961-70 a/			1971-80 b/			
Variables	Death	Exposed children	CMR (4q1) /1000	Death	Exposed children	CMR(4q1) /1000	(%) change
Cohort born							
1961-65 A	305	2663	115				
1966-70 B	393	3902	101				
1971-75 C				205	2743	75	-35** A,C
1976-80 D				230	4030	57	-43** B,D
Sex of the child							
Male	341	3266	104	213	3526	60	-42**
Female	357	3299	108	222	3247	68	-37**
Maternal age at childbirth (years)							
< 24	287	2705	106	215	3277	66	-38**
24-33	345	3059	113	188	2934	64	-43**
34 +	66	801	82	30	536	56	-32
Birth order							
1	144	1541	93	90	1668	54	-42**
2-3	273	2461	111	164	2704	61	-45**
4-5	172	1522	113	107	1518	70	-38**
6 +	94	890	106	70	835	84	-21
Length of preceding c/ birth interval (months)							
< 19	79	510	155	48	497	97	-38**
19-36	306	2353	130	198	2484	80	-39**
37 +	131	1888	69	82	1816	45	-35**
Overall	698	6565	106	435	6773	64	-39**

Notes: a/ denotes results based on 1976 NFS data and b/ denotes results based on 1986 NFFS data. ** indicates significant at the 1 per cent level in the test of difference in two proportions. Figures may not tally to 100 per cent because of the missing cases. c/ indicates only second and higher order children.

Sources: a/ 1976 NFS and b/ 1986 NFFS data tape.

Birth order and survival status of child in this study were expected to show the usual U-shaped relationship. However, the 1976 NFS surprisingly shows a reverse U-shaped relationship between birth order and survival status of children, while the 1986 NFFS shows a positive association between these two variables. The relationship between birth order and child mortality is thus not very clear at this level of analysis.

Tables 3.3 and 3.4 show a detailed analysis of infant mortality rates according to birth order and maternal age at childbirth from both surveys after controlling for the effect of each independent variable on the other. Tables 3.3 and 3.4, in general, show a declining risk of infant death rate with increasing mother's age at childbirth after controlling for the order of births. In general, there is an increasing risk of infant death associated with the increase in the order of birth after controlling for the effect of mother's age at childbirth, except for the births to mothers in the 24-28 year age group. The results in Tables 3.3 and 3.4 also show that women who bore a large number of children at younger ages are more likely to lose their more recent child during infancy. This phenomenon is more pronounced in the 1986 NFFS than in the 1976 NFS (Tables 3.3 and 3.4).

The negative association between mother's age at childbirth and infant mortality after controlling for the effect of birth order in Tables 3.3 and 3.4 and the lower risk of death to infants born to mothers aged 34 and over noted in the overall column of Table 3.4 has various possible explanations. First, it is widely cited in the literature that older mothers are likely to forget to report births, especially those who died at an early age. Some omission and misreporting by older mothers was noted in the preceding analysis (see Chapter Two). This to some extent could have influenced the result. However, the error due to data can be considered negligible because the results of the analysis based on the most recent birth cohorts in Tables 3.7 and 3.8 do not change the pattern of the relationships observed between the variables of interest. So, the most likely reason here is that frequent births among mothers in early ages are likely to be associated with closely spaced births leading to unfavourable survival status for those born to younger mothers. In contrast, births to older mothers are likely to be associated with a longer interval (see Appendix Table 3.2.).

In this circumstance the survival of both (preceding and subsequent) siblings is likely to benefit. For example, the earlier birth could have enjoyed a longer duration of breastfeeding while the later could have enjoyed the benefit of mother's good nutritional status before the conception of the next child, due to the longer interval between her children. This situation could have allowed the later child to be born within the average weight range with no gestational problems which in turn could have exposed it to lower risk of death. Thus the pace of childbearing and the age at delivery are the major

Table 3.3 Infant mortality rates by mother's age at childbirth and order of birth: 1966-75, Nepal.

Maternal age at childbirth (years)	Infant mortality rate						
	Order of births						Over-
	1	2	3	4	5	6	all
< 19	210	227	213	--	--	--	214
	(805)	(256)	(47)	--	--	--	(1110)
19-23	148	152	167	223	155	--	160
	(980)	(1005)	(600)	(238)	(58)		(2892)
24-28	146	114	137	150	143	212	144
	(233)	(448)	(615)	(554)	(349)	(208)	(2407)
29-33	49	86	100	110	128	164	127
	(61)	(128)	(230)	(318)	(359)	(555)	(1651)
34 +	--	78	47	97	133	167	139
		(51)	(107)	(186)	(211)	(785)	(1359)
Overall	169	147	139	146	136	173	153
	(2098)	(1888)	(1599)	(1298)	(977)	(1559)	(9419)

Notes: '--' indicates less than 30 cases.
Analysis considers children born between 1966-1975.
Figures in parentheses indicate number of cases.
Source: 1976 NFS data tape.

Table 3.4 Infant mortality rates by mother's age at childbirth and order of birth: 1976-85, Nepal.

Maternal age at childbirth (years)	Infant mortality rate						
	Order of births						Over-
	1	2	3	4	5	6	all
< 19	101	123	126	--	--	--	112
	(957)	(367)	(87)	--	--	--	(1426)
19-23	86	83	88	125	155	200	93
	(784)	(956)	(636)	(262)	(90)	(30)	(2758)
24-28	90	90	76	74	104	97	85
	(210)	(453)	(591)	(553)	(335)	(236)	(2378)
29-33	54	84	64	71	84	105	84
	(55)	(118)	(265)	(294)	(320)	(529)	(1581)
34 +	--	--	79	65	71	87	78
	--	--	(63)	(123)	(167)	(675)	(1082)
Overall	93	91	81	86	96	99	92
	(2021)	(1933)	(1642)	(1244)	(912)	(1473)	9225

Notes: '--' indicates less than 30 cases.
Analysis considers children born between 1976-1985.
Figures in parentheses indicate number of cases.
Source: 1986 NFFS data tape.

mediating factors in explaining the association between the higher risk of infant mortality with mother's age at childbirth and birth order.

In the case of Guatemala, Pebley and Stupp (1986: 43) suggested a decline in the efficiency of a mother's reproductive system with an increase in her age as the likely mechanism for the adverse effect of higher mother's age at childbirth on child survival. In contrast, Tables 3.3 and 3.4 in this study suggest a lower death rate for infants born to older mothers. So a third possible mechanism could be the longer experience of older mothers in terms of childbearing, rearing and care acquired during the care of previous siblings, which in turn could have contributed to improved survival prospects for children born to older mothers. Fourth, elder brides in Nepalese households[3/] are generally likely to have more control over the household resources as well as decision making in resource allocation among the family members. Children born to these mothers are more likely to enjoy the benefit which in turn could reduce their risk of dying. In contrast with general findings on this issue, this study does not support the proposition that in Nepal higher age at childbirth increases the risk factor for infant death.

Tables 3.5 and 3.6 show the child mortality rate by mother's age at childbirth and birth order of child from the 1976 NFS and 1986 NFFS data sets. Both Tables 3.5 and 3.6, in general, show a decline in the risk of child death with the increase in mother's age at childbirth after controlling for birth order. The overall column in both Tables 3.5 and 3.6 again does not show much difference in the influence of maternal age at childbirth on child mortality compared with what was observed in Table 3.2. The effect of birth order on child survival does not change much even after controlling for the mother's age at childbirth. In Tables 3.5 and 3.6, the mortality rate for children, in general, increases with the increase in order of birth after controlling for the effect of mother's age at childbirth and decreases with the increase in mother's age at childbirth after introducing a control for birth order.

3/ People in Nepal generally prefer to live in a joint family while their parents are alive. The above explanation thus could be more appropriate for those who are living in a joint family where at least two brothers are married with children and sharing the same household resources.

Table 3.5 Child mortality rates by mother's age at childbirth and order of birth: 1961-70, Nepal.

Maternal age at childbirth (years)	Child mortality rate						
	Order of births						Over-all
	1	2	3	4	5	6	
< 19	99	112	--	--	--	--	105
	(636)	(179)	--	--	--	--	(842)
19-23	89	107	126	141	97	--	107
	(630)	(657)	(396)	(142)	(31)	--	(1863)
24-28	88	98	119	117	136	125	113
	(205)	(337)	(436)	(368)	(220)	(144)	(1710)
29-33	105	122	96	113	110	121	112
	(57)	(131)	(198)	(265)	(263)	(365)	(1279)
34 +	--	129	57	84	64	85	85
	--	(31)	(70)	(107)	(125)	(374)	(720)
Overall	93	107	115	116	110	106	107
	(1541)	(1335)	(1126)	(883)	(639)	(890)	(6414)

Notes: '--' indicates less than 30 cases.
Analysis considers children aged one to five years of age between 1961-1970.
Figures in parentheses indicates number of cases.
Source: 1976 NFS data tape.

Table 3.6 Child mortality rates by mother's age at childbirth and order of birth: 1971-80, Nepal.

Maternal age at childbirth (years)	Child mortality rate						
	Order of births						Over-all
	1	2	3	4	5	6	
< 19	62	84	107	--	--	--	72
	(781)	(297)	(65)	--	--	--	(1160)
19-23	49	53	80	85	67		62
	(631)	(710)	(482)	(200)	(59)		(2099)
24-28	32	43	59	80	123	88	69
	(186)	(368)	(440)	(400)	(242)	(181)	(1817)
29-33	65	10	55	23	52	82	53
	(46)	(93)	(180)	(217)	(228)	(327)	(1091)
34 +	--	--	--	14	45	77	56
	--	--	--	(68)	(88)	(308)	(532)
Overall	53	54	68	63	80	83	64
	(1651)	(1496)	(1200)	(895)	(622)	(835)	(6699)

Notes: '--' indicates less than 30 cases or no death occurred in that particular category.
Analysis considers children aged one to five years of age between 1971-1980.
Figures in parentheses indicate number of cases.
Source: 1986 NFFS data tape.

Table 3.7 Infant mortality rates by maternal age at childbirth, birth order and birth cohorts: 1966-85, Nepal.

Variables	IMR 1966-70 [a/] cohort (A)		IMR 1971-75 [a/] cohort (B)		IMR 1976-80 [b/] cohort (C)		IMR 1981-85 [b/] cohort (D)	
Mother's age (years)								
> 19	226	(580)	200	(530)	130	(742)	90	(684)
19-23	166	(1383)	154	(1509)	102	(1327)	84	(1431)
24-28	143	(1072)	146	(1356)	89	(1168)	81	(1210)
29-33	126	(912)	123	(818)	85	(746)	83	(835)
34 +	156	(692)	125	(888)	61	(441)	90	(641)
Birth order								
1	166	(1040)	171	(1058)	107	(997)	79	(1024)
2	164	(912)	130	(976)	96	(966)	85	(967)
3	139	(777)	139	(822)	97	(788)	66	(854)
4	141	(616)	150	(682)	92	(593)	79	(651)
5	146	(453)	128	(524)	78	(431)	112	(481)
6 +	180	(704)	166	(855)	97	(649)	100	(824)

Notes: Analysis considers children born between [a/] 1966-75 and [b/] 1976-85.
Figures in parentheses indicate number of cases.
Sources: [a/] 1976 NFS and [b/] 1986 NFFS data tapes.

Table 3.8 Child mortality rates by maternal age at childbirth, birth order and birth cohorts: 1961-80, Nepal.

Variables	CMR 1961-65 [a/] cohort		CMR 1966-70 [a/] cohort		CMR 1971-75 [b/] cohort		CMR 1976-80 [b/] cohort	
Mother's age (years)								
< 19	102	(393)	107	(449)	85	(515)	62	(645)
19-23	117	(710)	101	(1153)	73	(908)	53	(1191)
24-28	121	(803)	106	(919)	79	(754)	62	(1063)
29-33	120	(540)	108	(797)	58	(409)	49	(682)
34 +	92	(217)	79	(584)	59	(118)	55	(414)
Birth order								
1	93	(674)	93	(867)	60	(761)	48	(890)
2	110	(573)	105	(762)	52	(623)	54	(873)
3	129	(457)	106	(669)	83	(489)	57	(711)
4	133	(354)	104	(529)	106	(357)	35	(538)
5	131	(252)	96	(387)	93	(225)	73	(397)
6 +	113	(353)	100	(688)	92	(249)	80	(586)

Notes: Analysis considers children aged one to five years of age between [a/] 1961-70 and [b/] 1971-80.
Figures in parentheses indicates number of cases.
Sources: [a/] 1976 NFS and [b/] 1986 NFFS data tapes.

The highest mortality rate corresponding to third order birth for mothers under 19 years of age in Table 3.6 could be due to competition among the children for food, resources and health care.

Gubhaju (1991: 97) based on the 1976 NFS data argued that as women aged 50 and above are usually excluded in surveys, it is likely that births which occurred to the mothers over 35 years of age disproportionately belong to the recent birth cohorts which had lower mortality. This argument suggests that analysis restricted to the most recent cohort is likely to yield the expected pattern of results. Thus further calculations were made for infant and child mortality for five-year cohorts from both surveys (Tables 3.7 and 3.8). Results for recent cohorts do not confirm this argument, except for features which were already observed in earlier results (Tables 3.7 and 3.8).

3.6 Effect of demographic variables on infant mortality

The analysis so far is bivariate, where the noted influence of a variable could be affected by the influence of the other variable. The subsequent sections of the analysis thus focus on the net influence of demographic variables of interest in infant and child mortality.

Tables 3.9 and 3.10 respectively present the results of the logit model of demographic variables in mortality during infancy from the 1976 NFS and 1986 NFFS data. The size of the LRX^2 and the P (probability) values in the net effects column of both Tables 3.9 and 3.10 suggests that maternal age at childbirth and birth order of the child have a significant influence on infant mortality after controlling for the effect of other variables of the model. Year of birth of the child, which did not show a significant influence on infant mortality in the net effects column of Table 3.9 was significant at the 10 per cent level in Table 3.10. In both surveys sex of child was not statistically significant in influencing infant mortality.

The larger LRX^2 values corresponding to maternal age at childbirth and birth order in the net effects column as compared with the gross effects column of both Tables 3.9 and

3.10 suggest that the influence of these variables is more pronounced when controls for the effects of other variables are introduced. On the other hand, the smaller LRX^2 value corresponding to birth cohort in the net effects column than in the gross effects column of Table 3.9 suggests that the effect of this variable is operating through other variables of the model.

Odds ratios for maternal age at childbirth in the gross effects column of both Tables 3.9 and 3.10 suggest a similar pattern of relationship with infant mortality to that which was observed in the bivariate analysis. However, odds ratios in the net effects column of both Tables 3.9 and 3.10 show a clear negative relationship between maternal age at childbirth and infant mortality, although this pattern did not appear from the 1976 NFS in bivariate analysis (Table 3.1) . The usual pattern of a higher risk of death for infants born to younger mothers is also confirmed in this study. This could be associated with a mother's biological incompetence to conceive and/or childbearing at an early age which in most cases results in pregnancy complication, low birth weight of newborn infants and so the higher risk of death to new born infants. Gribble (1993: 141) in a study in Mexico noted that children born to women under 25 years of age were 1.47 times more likely to be associated with low birth weight than those born to women over 25 years of age. However, the lower rate of infant death associated with higher maternal age at birth, also observed in the bivariate analysis of the 1986 NFFS (Table 3.1), still exists after controlling for other factors. The result of the multivariate analysis thus supports the findings of the bivariate analysis. The possible mechanism for the relationship between the lower rate of infant deaths and higher maternal age at childbirth has already been discussed in the preceding sections of this chapter.

Odds ratios pertaining to birth order of infants in both Tables 3.9 and 3.10 show the usual U-shaped relationship with infant mortality when the effects of other variables are present (gross effects column). In contrast, odds ratios in the net effects column of Tables 3.9 and 3.10 suggest a positive association between birth order and infant mortality. This study, although it confirms the association of higher birth order with higher risk of death, neither confirms the higher risk of death to first born children nor the lowest mortality to second and third order births. The results, however, do confirm the findings from an earlier study in Nepal based on the 1976 NFS (Gubhaju, 1991: 123) as well as in Indonesia (Hull and Gubhaju, 1986:112) and in Indonesia and the Philippines (Trussell and Hammerslough, 1983, 422-424) which all noted an elevated risk of death with the increase in birth order of infants.

Table 3.9 Results of the logit model of the effect on infant mortality of birth cohort, sex of the child, maternal age at childbirth and birth order of the child: 1966-75, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Cohort born		2.7	0.05		1.4	NS
1966-70	1.047			1.035		
1971-75	0.955			0.967		
Sex of the child		0.6	NS		1.1	NS
Male	1.022			1.030		
Female	0.978			0.971		
Maternal age at childbirth (years)		26.0	0.001		41.4	0.001
<24	1.209			1.432		
24-33	0.901			0.913		
34 +	0.918			0.765		
Birth order		13.4	0.01		30.4	0.001
1	1.099			0.863		
2-3	0.903			0.971		
4-5	0.892			0.999		
6 +	1.130			1.195		

n=9419 reduction in model LRX^2 and (d.f) = 36.41 (39) P=0.558 overall odds=0.174

Notes: The analysis is based on the children born between 1966-75.
Birth cohort and sex of the child each have 1, maternal age at childbirth has 2 and birth order of child has 3 degrees of freedom.
'NS' indicates not significant at the 10 per cent level.
Source: 1976 NFS data tape.

Generally, first order births are expected to be associated with higher risk of death during infancy. In contrast, this study shows progressively higher order births to be increasingly at a disadvantage during infancy. The mechanism again could be the association between birth order and birth interval. For example, Appendix Table 3.1

Table 3.10 Results of the logit model of the effect on infant mortality of birth cohort, and sex of the child, maternal age at childbirth, and birth order of the child: 1976-85, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Cohort born		3.7	0.05		3.4	0.10
1976-80	1.072			1.069		
1981-85	0.933			0.935		
Sex of the child		1.5	NS		1.5	NS
Male	1.045			1.046		
Female	0.957			0.956		
Maternal age at childbirth (years)		7.2	0.05		17.2	0.02
<24	1.151			1.347		
24-33	0.973			0.974		
34 +	0.893			0.763		
Birth order		2.1	NS		12.8	0.01
1	1.010			0.840		
2-3	0.934			0.853		
4-5	0.979			1.050		
6 +	1.084			1.329		

n=9225 reduction in model LRX^2 and (d.f) =57.6 (40) P=0.033 overall odds =0.094

Notes: The analysis is based on the children born between 1976-85.
Birth cohort and sex of the child each have 1, maternal age at childbirth has 2 and birth order of child has 3 degrees of freedom. 'NS' indicates not significant at the 10 per cent level.

Source: 1986 NFFS data tape.

suggests that about 8 per cent of the mothers in both surveys have borne three children before they were 19 years of age. Similarly, in the 23-33 year age group 25 per cent of women in the 1976 NFS and 21 per cent in the 1986 NFFS reported themselves to be the mothers of more than six children. This pattern clearly suggests a high intensity of childbearing and a large family norm in the country. Rapid childbirth among the women on the other hand also indicates poor birth spacing between their children. In the literature the influence of maternal depletion syndrome leading to a higher risk of death to the latest birth is widely recognised as the mechanism through which short birth intervals influence infant mortality. The nutritional level of Nepalese mothers could be further affected by rapid births during their reproductive life. This in turn could have exposed the most recent (higher order) births to higher risk of death. Hobcraft et al. (1983: 368) and Wolfers and Scrimshaw (1975: 442) also suggested that mortality associated with birth order could be due to the correlation between parity and other demographic factors such as maternal age at birth and birth interval. Winikoff (1983: 232) further suggested that effects attributed to short interval are likely to reflect the biological risk of high parity. The relationship between birth order of child and infant mortality is re-examined in this study by taking birth interval length into account in later sections of this chapter.

Odds ratios in the net effects column in Table 3.10 show a 14 per cent higher risk of death to infants born during the period 1976-80 as compared with the risk of death to infants born during the period 1981-85. The result suggests a systematic decline in infant mortality in Nepal during the recent past. One explanation for this decline could be the increase in the maternal and child health care delivery through family planning institutions, improvement in overall health care delivery services through the effort of the Ministry of Health and the increase in the number of health posts in the country after 1971 which provide easy access to people in rural areas.

3.7 Effects of demographic variables on child mortality

Odds ratios, LRX^2 values and corresponding P values derived from the main effects logit models of demographic variables in child mortality from the 1976 NFS and 1986 NFFS are presented in Tables 3.11 and 3.12, respectively. As in infant mortality, in both Tables 3.11 and 3.12 maternal age at childbirth and birth order of child show significant influence on child mortality after controlling for the effects of other variables in the model. Year of birth shows significant influence on child mortality only in 1986 NFFS (Table 3.12). The effect of maternal age at childbirth in both Tables 3.11 and 3.12, as in the bivariate analysis in the preceding sections, suggests a negative association with child mortality. The risk of death to children borne by mothers under 24 years of age (Table 3.11) is 7 per cent higher than the risk of death to children borne by mothers 24-33 years of age and 60 per cent higher than to those borne by mothers over 34 years of age. The corresponding figures from Table 3.12 were 42 and 97 per cent respectively.

Table 3.11 Results of the logit model of the effect on child mortality of birth cohort, sex of the child, maternal age at childbirth and, birth order of the child: 1961-70, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Cohort born		3.2	0.10		0.1	NS
1961-65	1.075			1.062		
1966-70	0.931			0.942		
Sex of the child		0.3	NS		0.1	NS
Male	0.980			0.986		
Female	1.020			1.014		
Maternal age at childbirth (years)		6.5	0.05		8.2	0.02
<24	1.070			1.196		
24-33	1.146			1.122		
34 +	0.815			0.746		
Birth order		4.0	NS		6.3	0.10
1	0.875			0.801		
2-3	1.055			1.003		
4-5	1.079			1.094		
6 +	1.004			1.137		

n=6414 reduction in model LRX^2 and (d.f) 33.41 (39) P=0.722 overall odds=0.110

Notes: The analysis is based on the children aged one to five years of age between 1961-70.
Birth cohort and sex of the child each have 1, maternal age at childbirth has 2 and birth order of child has 3 degrees of freedom.
'NS' indicates not significant at the 10 per cent level.
Source: 1976 NFS data tape.

The net effects column in both Tables 3.11 and 3.12, as in the bivariate analysis, once again shows an elevated risk of death with the increase in order of birth. The influence of maternal age at childbirth and birth order on child survival observed in this study is, as in the case of infant mortality, similar to that observed in earlier studies carried out in Nepal based on the 1976 NFS (Gubhaju, 1991: 126) and in Indonesia (Hull and Gubhaju, 1986: 112) which used a similar methodology to that used in this study. However, the mechanism here could be different from the mechanism suggested in those studies. The higher risk of death for children of mothers in the younger age group as well as the positive association between the order of birth and survival status of children could be due to the competition among children for food, resources, and health care.

Table 3.12 Results of the logit model of the effect on child mortality of birth cohort, sex of the child, maternal age at childbirth and birth order of the child: 1971-80, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Cohort born		8.5	0.01		9.3	0.01
1971-75	1.158			1.167		
1976-80	0.864			0.857		
Sex of the child		1.2	NS		1.1	NS
Male	0.948			0.950		
Female	1.134			1.053		
Maternal age at childbirth (years)		0.8	NS		11.2	0.01
<24	1.068			1.408		
24-33	1.022			0.992		
34 +	0.916			0.715		
Birth order		9.6	0.05		22.4	0.001
1	0.803			0.649		
2-3	0.904			0.819		
4-5	1.068			1.145		
6 +	1.290			1.643		

n=6699 reduction in model LRX^2 and (d.f) =31.91 (40) P=0.815 overall odds=0.065

Notes: The analysis is based on the children aged one to five years of age between 1971-80.
Birth cohort and sex of the child each have 1, maternal age at childbirth has 2 and birth order of child has 3 degrees of freedom.
'NS' indicates not significant at the 10 per cent level.
Source: 1986 NFFS data tape.

In addition, it is also likely that infants who survived their first year of life in a vulnerable situation could have transferred their risk of death to the childhood period. The situation could have further been compounded by the competition for resources among siblings of proximate ages in the household. This argument is further supported by the considerable attenuation leading to the disappearance of the statistically significant influence of mother's age at childbirth and birth order from the 1976 NFS and mother's age at childbirth from the 1986 NFFS after including the interval variable in the model (see Table 3.15 and 3.16).

The influence of year of birth in Table 3.12 is more pronounced as the effects of other variables are adjusted. Odds ratios corresponding to this variable in the net effects column show 36 per cent higher risk of death to the cohort of children born during the period 1971-75 than for those born during the period 1976-80. This result further confirms the results of the bivariate analysis in the preceding sections and suggests a systematic decline in child mortality in Nepal during past decades. A number of factors could be associated with this noted decline. First, the gradual increase in the number of health posts in the country after 1971 could enable an increased number of people to have access to basic health care services. Second, the increase in maternal and child health care services through family planning institutions in different parts of the country could have created some impact in reducing the child mortality during recent decades. Third, the immunization programme which was made more accessible to the rural people and the advertisement of oral rehydration therapy could have improved general knowledge in relation to child health which in turn could have reduced the risk of death to children. Koenig et al. (1989: 446) have documented the influence of immunization services provided through the extended programme for immunization on child survival in Bangladesh. The extended programme for immunization in Nepal is likely to have had the same effect. In this context Dasvarma (1990) argued that general implication of mortality decline in development are conveyed, with special reference to health planning and policy.

3.8 Effect of preceding birth interval on infant and child mortality

Tables 3.13 and 3.14 extend the analysis to include the interval between the birth of the preceding child and the birth of the index child, but at the cost of excluding first born infants. Among the five variables used to analyse infant mortality in the model, only three variables (mother's age at childbirth, birth order and length of preceding birth interval) indicate significant influence on infant mortality after controlling for the effect of other variables. Odds ratios for maternal age at birth in the net effects columns of both Tables 3.13 and 3.14, as noted in the earlier sections, show a decreasing risk of death with the increase in mother's age at childbirth even after introduction of the length of preceding birth interval as an independent factor in the model. Similarly, birth order of infant in the net effects column (Table 3.13) also shows a positive association with infant mortality. The result supports the argument of the preceding sections, but shows that length of birth interval does not explain all the variation associated with age of mother and birth order in the case of infant deaths.

As discussed in the preceding sections, the influence of short birth interval thus is more likely to be due to the mother's biological factors: maternal depletion syndrome due to rapid as well as closely spaced births and the infant's biological factors: in particular, low birth weight of infant. The association of closely spaced births and low birth weight is clearly demonstrated by Gribble (1993: 142) in Mexico. Gribble (1993) suggested that a short birth interval itself is sufficient to increase low birth weight. In this respect, Winikoff (1983: 232) argued that the influence of maternal age at childbirth and parity are likely to vary with birth intervals. The decline in the LRX^2 values corresponding to maternal age at childbirth and birth order after including preceding birth interval in the model suggests that the influence of these variables on infant mortality, to some extent, is mediated through birth spacing.

The overall result suggests that the effect of mother's age at childbirth and infant's birth order on the risk of infant death to some extent is confounded with closely spaced births between siblings and a succession of rapid births during the reproductive span of a woman in Nepal. This argument is further explained by the attenuation in the LRX^2 corresponding to mother's age at childbirth and birth order from both the 1976 NFS and 1986 NFFS data, after including length of interval in the model (LRX^2 before the introduction of preceding birth interval is shown in the notes of Tables 3.13 through 3.16). However, despite the attenuation in the LRX^2 corresponding to mother's age at childbirth and birth order after introduction of the birth interval variable in the model, the influence of these variables on infant mortality is still statistically significant. Thus it cannot be denied that mother's age at childbirth and birth order to some extent influence infant survival prospects on their own.

The most important demographic variable influencing infant survival prospects in this study, however, is clearly the length of birth interval. Widening the spacing between births thus could lead to further improvement in child survival prospects in Nepal.

Table 3.13 Results of the logit model of the effect on infant mortality of birth cohort, sex of the child, maternal age at childbirth, birth order of the child and length of preceding birth interval: 1966-75, Nepal.

Variables	Gross effects Odds ratio	Reduction in LRX^2	P	Net effects Odds ratio	Reduction in LRX^2	P
Cohort born		3.6	0.10		1.8	NS
1966-70	1.062			1.045		
1971-75	0.942			0.957		
Sex of the child		0.2	NS		1.0	NS
Male	1.014			1.035		
Female	0.986			0.967		
Maternal age at childbirth (years)		16.5	0.001		9.6	0.01
< 24	1.202			1.202		
24-33	0.907			0.917		
33 +	0.918			0.907		
Birth order		7.3	0.05		11.9	0.01
2-3	0.944			0.859		
4-5	0.918			0.942		
6 +	1.155			1.236		
Preceding birth interval (months)		134.2	0.001		115.7	0.001
< 19	1.733			1.746		
19-36	1.010			1.008		
36 +	1.000			0.568		

n=7279 reduction in model LRX^2 and (d.f) =88.37 (92) P=0.588 overall odds=0.186

Notes: The analysis is based on the children born between 1966-75.
Analysis in this table considers only second and higher order births.
Birth cohort and sex of the child each have 1, maternal age at childbirth, birth order of child and preceding birth interval each have 2 degrees of freedom.
'NS' indicates not significant at the 10 per cent level.
The reduction in LRX^2 values, reduction in degrees of freedom and P values corresponding to the four demographic variables used in this table before inclusion of the birth interval variables in the model are: Cohort (2.2, 1, NS); Sex of the child (0.6, 1, NS); Mother's age at childbirth (37.2, 2, 0.001); Birth order (30.7, 2, 0.001).

Source: 1976 NFS data tape.

Table 3.14 Results of the logit model of the effect on infant mortality of birth cohort, sex of the child, maternal age at childbirth, birth order of the child, and length of preceding birth interval: 1976-85, Nepal.

Variables	Gross effects: Odds ratio	Gross effects: Reduction in LRX^2	Gross effects: P	Net effects: Odds ratio	Net effects: Reduction in LRX^2	Net effects: P
Cohort born		0.5	NS		0.2	NS
1976-80	1.031			1.019		
1981-85	0.970			0.981		
Sex of the child		0.2	NS		0.3	NS
Male	1.002			1.025		
Female	0.998			0.976		
Maternal age at childbirth (years)		5.6	0.10		5.8	0.10
< 24	1.154			1.209		
24-33	0.949			0.959		
33 +	0.914			0.862		
Birth order		2.2	NS		5.6	0.10
2-3	1.076			1.166		
4-5	0.983			0.987		
6 +	0.946			0.869		
Preceding birth interval (months)		46.4	0.001		36.8	0.001
< 19	1.542			1.494		
19-36	1.005			0.997		
36 +	0.646			0.671		

n=7076 reduction in model LRX^2 and (d.f)=114.53 (96) P=0.096 overall odds=0.103

Notes: The analysis is based on the children born between 1976-85.
Analysis in this table considers only second and higher order births.
Birth cohort and sex of the child each have 1, maternal age at childbirth, birth order of child and preceding birth interval each have 2 degrees of freedom.
'NS' indicates not significant at the 10 per cent level.
The reduction in LRX^2 values, reduction in degrees of freedom and P values corresponding to the four demographic variables used in this table before inclusion of the birth interval variables in the model are: Cohort (0.8, 1, NS); Sex of the child (0.3, 1, NS); Mother's age at childbirth (15.5, 2, 0.001); Birth order (12.6, 2, 0.01).

Source: 1986 NFFS data tape.

Moreover, once the length of interval between births is sufficiently widened, it is possible that birth order and maternal age at childbirth could produce the usual U-shaped relationship with survival status of infants.

Tables 3.15 and 3.16 show the result of the logit model of the effect of length of preceding birth interval along with other demographic variables on child mortality. Only length of preceding birth interval and cohorts of birth from both Tables 3.15 and 3.16 and birth order, including these two variables, in Table 3.16 have significant influence on child mortality after controlling for the effect of other variables in the model. Odds ratios corresponding to birth cohorts in both Tables 3.15 and 3.16 show that children born during earlier cohorts are exposed to a higher risk of death. The positive association between birth order and child mortality observed in preceding sections still persists in the net effects column of Table 3.16.

The effect of length of interval on child mortality in both Tables 3.15 and 3.16 is shown to have significant influence whether the effects of other variables are controlled or not. Odds ratios of the categories of length of preceding birth interval in both Tables 3.15 and 3.16 establish a negative association with child mortality. The risk of death to children born within 18 months of the birth of preceding child in the net effects column of Table 3.15 is 154 per cent higher, and this effect for children born between 19 and 36 months after the birth of the preceding child is 97 per cent higher than the risk of death to those born more than 34 months after the preceding children. The corresponding figures in Table 3.16 are 110 per cent and 78 per cent higher respectively.

The declining risk of death with the increase in mother's age and the increasing risk to infants with the increase in the birth order noted in this study were also noted in the earlier study in Nepal based on the 1976 NFS (Gubhaju, 1991: 122-126). However, the interpretation regarding these variables in the earlier study does not seem to be adequate. The mechanism for child survival again is likely to be similar to that for infant survival discussed in the preceding sections. However, the mortality during childhood is likely to

Table 3.15 Results of the logit model of the effect on child mortality of birth cohort, sex of the child, maternal age at childbirth, birth order of the child, and length of preceding birth interval: 1961-70, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Cohort born		6.4	0.02		4.0	0.05
1961-65	1.127			1.102		
1966-70	0.887			0.908		
Sex of the child		0.2	NS		0.1	NS
Male	0.978			0.986		
Female	1.022			1.014		
Maternal age at childbirth (years)		7.2	0.05		3.1	NS
< 24	1.134			1.057		
24-33	1.121			1.117		
33 +	0.787			0.847		
Birth order		0.5	NS		0.3	NS
2-3	0.990			0.965		
4-5	1.047			1.033		
6 +	0.965			1.004		
Preceding birth interval (months)		54.6	0.001		50.3	0.001
< 19	1.448			1.484		
19-36	1.176			1.153		
36 +	0.587			0.584		

n=4564 reduction in model LRX^2 and (d.f) =81.20 (90) P=0.735 overall odds=0.124

Notes: The analysis is based on the children aged one to five years of age between 1961-70.
Analysis in this table considers only second and higher order births.
Birth cohort and sex of the child each have 1, maternal age at childbirth, birth order of child and preceding birth interval each have 2 degrees of freedom.
'NS' indicates not significant at the 10 per cent level.
The reduction in LRX^2 values, reduction in degrees of freedom and P values corresponding to the four demographic variables used in this table before inclusion of the birth interval variables in the model are: Cohort (2.7, 1, 0.10); Sex of the child (0.1, 1, NS); Mother's age at childbirth (8.2, 2, 0.02); Birth order (1.1, 2, NS).

Source: 1976 NFS data tape.

Table 3.16 Results of the logit model of the effect on child mortality of birth cohort, sex of the child, maternal age at childbirth, birth order of the child and length of preceding birth interval: 1971-80, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Cohort born		8.9	0.01		9.4	0.01
1971-75	1.189			1.197		
1976-80	0.841			0.835		
Sex of the child		2.3	NS		2.2	NS
Male	0.917			0.918		
Female	1.090			1.089		
Maternal age at childbirth (years)		2.0	NS		4.2	NS
< 24	1.136			1.262		
24-33	0.998			1.003		
33 +	0.882			0.790		
Birth order		5.8	0.10		10.6	0.01
2-3	0.843			0.755		
4-5	0.974			0.957		
6 +	1.219			1.383		
Preceding birth interval (months)		28.0	0.001		23.1	0.001
< 19	1.406			1.352		
19-36	1.147			1.149		
36 +	0.620			0.644		

n=4765 reduction in model LRX^2 and (d.f) =83.36 (90) P=0.676 overall odds=0.080

Notes: The analysis is based on the children aged one to five years of age between 1971-80.
Analysis in this table considers only second and higher order births.
Birth cohort and sex of the child each have 1, maternal age at childbirth, birth order of child and preceding birth interval each have 2 degrees of freedom.
'NS' indicates not significant at the 10 per cent level.
The reduction in LRX^2 values, reduction in degrees of freedom and P values corresponding to the four demographic variables used in this table before inclusion of the birth interval variables in the model are: Cohort (8.3, 1, 0.01); Sex of the child (2.0, 1, NS); Mother's age at childbirth (9.4, 2, 0.01); Birth order (14.9, 2, 0.001).

Source: 1986 NFFS data tape.

be explained to a greater extent by socio-economic factors while for infant mortality it could be mostly due to biological factors. Considerable attenuation in the LRX^2 corresponding to mother's age at childbirth and birth order variables (insignificant effects of both variables in Table 3.15 and of maternal age at childbirth in Table 3.16) after including preceding birth interval in the model further supports the argument. In the case of child mortality, the influence of birth order and maternal age at childbirth thus can be entirely attributed to the length of interval.

This result has significant implications for policy formulation. The overall results clearly show that the higher risk of death for children born to younger mothers and higher order births in the net effects columns of Tables 3.15 and 3.16 in this study, in general, is due to frequent births to mothers in younger ages leading to shorter intervals between births. Due emphasis and encouragement to increase the age at marriage (age at cohabitation)[4/] as well as proper spacing between births, especially among younger mothers, could significantly improve the child survival prospects in Nepal.

3.9 Two-factor interaction effects

Trussell and Hammerslough (1983: 11) in a study based on the World Fertility Survey data from Sri Lanka suggested a preference for the main effects model over a more saturated model (with interaction terms) on the grounds of simplicity. Trussell and Hammerslough further argued that selection of a complicated model, and adding many interaction effects to the model with the intention of searching for a better fit without regard to hypotheses grounded in theory is mere data mining and may lead to over-specification of the data. Similarly, Martin et al. (1983: 425) using World Fertility Survey data from the Philippines, Indonesia and Bangladesh tested a number of interaction effects and noted that most of the interaction effects estimates, although they contributed to the explanatory power of a model, were not statistically significantly different from zero. They

---

4/ As child marriage is still practiced in many parts of Nepal, age at marriage *per se* in the analysis of demographic studies could have no significance. Thus age at cohabitation rather than age at marriage should be the factor considered when policies regarding marriage are formulated.

further noted that the interaction estimates effects, although found to be statistically significant, were either small or inconvenient to interpret.

Certain two-factor interaction effects from both the 1976 NFS and 1986 NFFS data sets were examined. A model with the additional interaction terms in the main effects model was fitted to examine the two-factor interaction effects. The difference in the LRX^2 value of the main effects model and the model with interaction terms is the corresponding LRX^2 for the interaction terms. Similarly, the difference in the degrees of freedom between the two models (the main effects model and the model with interaction terms) is the degrees of freedom corresponding to the interaction terms.

Table 3.17 Size of likelihood chi-square for certain two-factor interaction effects on infant mortality: 1966-85, Nepal.

	1966-75 [a]			1976-85 [b]		
Variables	Reduction in LRX^2	Reduction in d.f	P	Reduction in LRX^2	Reduction in d.f	P
Matage by birth order *	5.3	6	NS	6.5	6	NS
Matage by birth interval **	9.2	4	0.10	5.5	4	NS
birth order by interval ***	3.4	4	NS	2.1	4	NS

Notes: Each of the interaction terms is an additional term to the main effects model.
The reference model for *, ** and *** in column [a] are Table 3.9, 3.13 and 3.13 respectively. Similarly, the reference model for *, ** and *** column [b] are Table 3.10, 3.14 and 3.14.
Matage stands for mother's age at childbirth.
Sources: [a] 1976 NFS and [b] 1986 NFFS data tapes.

The LRX^2 values, P values and the corresponding degrees of freedom for the selected two-factor interaction effects presented in Tables 3.17 and 3.18 did not produce statistically significant interaction effects. A joint variable of the mother's age at childbirth and the length of preceding birth interval was created in order to examine the joint effects of these variables. Although the interaction effects of these variables on infant mortality from the 1986 NFFS were not statistically significant, further assessment by creating a joint variable of the mother's age at childbirth and the length of preceding birth interval, as in the case of the 1976 NFS, was made to examine the consistency of the results observed from the two surveys.

Table 3.18 Size of likelihood chi-square for certain two-factor interaction effects on child mortality: 1961-80, Nepal.

	1961-70 [a/]			1971-80 [b/]		
Variables	Reduction in LRX^2	Reduction in d.f	P	Reduction in LRX^2	Reduction in d.f	P
Matage by * birth order	2.4	9	NS	4.4	16	NS
Matage by ** birth interval	5.0	4	NS	0.5	4	NS
Birth order by *** interval	1.4	4	NS	5.1	4	NS

Notes: Each of the interaction terms is an additional term to the main effects model. The reference model for *, ** and *** in column [a/] are Table 3.11, 3.15 and 3.15 respectively. Similarly, the reference model for *, ** and *** column [b/] are Table 3.12, 3.16 and 3.16.
Matage stands for mother's age at childbirth.
Sources: [a/] 1976 NFS and [b/] 1986 NFFS data tapes.

The joint influence of mother's age at childbirth and length of preceding birth interval (Table 3.19 and 3.20) shows interesting results. An index infant born after a short interval for each age group of mother in both Tables 3.19 and 3.20 was associated with a higher risk of death in comparison to those born after a longer interval to mothers in the same age group. For example, the risk of death to infants born less than 19 months after the birth of a preceding sibling to mothers under 24 years of age (Table 3.19) is 73 per cent higher than to those born between 19-36 months of the birth of preceding infants by women in same age group. The corresponding figure in Table 3.20 was 55 per cent higher. A similar pattern persists for other age groups. This supports the earlier finding that the higher risk of death for infants born to younger mothers is due to frequent childbirth by young mothers which leads to a shorter birth interval, exposing the second and higher order infants of these women to higher risk of dying. In this study, Tables 3.3 and 3.4 have already demonstrated the fact that considerable proportions of women in Nepal not only have their first birth at young ages but also have three births by 19 years of age. Tables 3.3 and 3.4 also show a higher risk of death with the increase in birth order after controlling for mother's age at childbirth. So in this study the higher risk of death to infants born to younger mothers can be attributed to the synergistic influence of mother's age at childbirth and shorter birth interval where the maternal depletion syndrome, low birth weight, and pregnancy complications, as well as child rearing inexperience among the younger mothers may worsen the survival prospects of infants.

Table 3.19 Results of the logit model of the effect on infant mortality of the joint variable preceding birth interval and mother's age at childbirth: 1966-75, Nepal.

	Gross effects			Net effects *		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Length of preceding birth interval < 19 (months) and maternal age at childbirth (years)		142.8	0.001		160.7	0.001
< 24	1.950			2.322		
24-33	1.636			1.711		
33 +	1.320			1.264		
Length of preceding birth interval 19-36 (months) and maternal age at childbirth (years)						
< 24	1.141			1.339		
24-33	0.910			0.939		
33 +	1.066			0.961		
Length of preceding birth interval 36 + (months) and maternal age at childbirth (years)						
< 24	0.563			0.465		
24-33	0.551			0.593		
33 +	0.691			0.597		

n=7279 reduction in model LRX^2 and (d.f) 79.22 (88) P=0.737 overall odds= 0.177

Notes: * Estimates are net of birth cohort, sex of child and birth order of child.
The joint variable has 8 degrees of freedom.

Source: 1976 NFS data tape.

Table 3.20 Results of the logit model of the effect on infant mortality of the joint variable preceding birth interval and mother's age at childbirth: 1976-85, Nepal.

	Gross effects			Net effects *		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Length of preceding birth interval < 19 (months) and maternal age at childbirth (years)		44.2	0.001		56.8	0.001
< 24	1.966			2.030		
24-33	1.231			1.379		
33 +	1.486			1.203		
Length of preceding birth interval 19-36 (months) and maternal age at childbirth (years)						
< 24	1.224			1.306		
24-33	0.923			0.950		
33 +	0.918			0.857		
Length of preceding birth interval 36 + (months) and maternal age at childbirth (years)						
< 24	0.529			0.596		
24-33	0.729			0.739		
33 +	0.695			0.634		

n=7076 reduction in model LRX^2 and (d.f) =108.99 (92) P=0.109 overall odds =0.100

Notes: * Estimates are net of birth cohort, sex of child and birth order of child.
The joint variable has 8 degrees of freedom.
Source: 1986 NFFS data tape.

The odds ratios in the net effects columns of Tables 3.19 and 3.20 reveal an inverse association between mother's age at childbirth and infant's survival after controlling for the preceding birth interval of under 19 months. The same is true for the length of preceding birth interval of 19-36 months except for infants born to mothers in the 24-33 year age groups as compared with those born to mothers over 33 years of age (Table 3.19). However, the difference is very small. The results thus suggest that infants born less than 19 months after the birth of the preceding sibling and 19-36 months after the birth of the preceding sibling have a lower risk of death with the increase in mother's age at childbirth. However, the results for births more than 36 months after the preceding birth seem to show the risk of dying rising with advancing maternal age at delivery, perhaps reflecting delivery difficulties associated with aging. In the case of younger mothers spacing seem to be associated with lower risk of dying for their children.

3.10 Further discussion of the results

During their reproductive life, women in Nepal on average tend to bear six children of which 12 per cent die before one year of age; 9 per cent of those who survive their infancy die before they turn five years of age (Tables 3.1 and 3.2). Thus only 79 out of 100 children born in Nepal survive their first five years of life, confirming the persistence of poor child survival prospects. However, the results based on birth cohort analysis suggest an optimistic scenario for systematic decline in infant and child mortality.

A higher risk of death to male infants due to the biological advantage of female infants, and the higher risk of death to female children was attributed to the parent's favouring of male children in India (Dasgupta, 1987: 88-96; Bourne and Walker, 1991: 207-218) and in Bangladesh (D'Souza and Chen, 1980: 259-268). Unlike in India and Pakistan, in this study the effect of sex of the child shows no statistically significant influence either on infant or child mortality. A similar result between sex of child and infant and child mortality was also found in an earlier study in Nepal based on the 1976 NFS data (Gubhaju, 1991). At first sight, this phenomenon is very surprising in a country where sons are preferred over daughters for several reasons: the high economic value of sons, old age security, religious significance and labour-intensive agriculture.

However, there are some plausible explanations for the evident insignificant influence of sex of child on infant and child mortality in Nepal. First, as forced dowry or groom price[5/] in most areas of Nepal is not a cultural practice, parents may not consider female children as an economic burden. Second, a son occupies a prominent place in Hindu religion because a son is believed to be the key to heaven and a grandson is believed to be the permit to stay in heaven for an unlimited period. However, a grandson born to a

---

5/ Groom price (*Tilak*) is an amount paid to the groom by the parents of the bride for accepting their daughter. This is a cultural practice only among some castes or communities. Dowry is the gifts given to the bride both in cash and kinds by the bride's parents.

son and a grandson born to a daughter possess equal status (Shrestha, 1986: 15). Third, marrying off a daughter is considered to be the gift of a virgin (*Kannya-dan*) which is perceived to bring religious merit (*Punnya*) to parents. All these factors could tend to equalize the importance of sons and daughters in Nepalese societies explaining the absence of difference in influence of the sex of child on infant and child mortality. On the other hand, there can be persistent son preference in the society when birth intervals are discussed.

Tables 3.3 and 3.4 suggest that typical childbearing in Nepal starts before 20 years and is completed by about 34 years. During the 15-year span women end up with about six children suggesting an average birth interval length of about two years. As a result of rapid births, mothers are continuously disadvantaged in terms of their depletion in health, nutritional and reproductive efficiency which ultimately are likely to drive these mothers towards a higher rate of child loss. Thus as suggested by Hobcraft et al. (1985), the influence of mother's age at childbirth and birth order on infant mortality in this study is largely attributed to birth interval. Very large attenuation in the LRX^2 value corresponding to maternal age at childbirth and birth order after including the interval variable in the model further supports this argument. At the same time, mother's age at childbirth might be partly influencing child survival through birth weight, which is not available in the data.

However, for child mortality the influence of mother's age at childbirth from both the 1976 NFS and 1986 NFFS becomes statistically insignificant after taking into account the preceding birth interval variable, so any age effect is entirely attributable to length of birth interval. This result supports the argument that sibling competition for mother's care, tangible resources and health care is the major cause of child mortality.

Length of preceding interval in this study emerges as the most important variable in influencing survival status of both infant and child. It is clearly evident in this study that short birth intervals lead to poor child survival prospects and increased birth interval between siblings provides better child survival prospects. Palloni and Millman (1986), in a study of 12 Latin American countries, noted this phenomenon in seven countries for child mortality (one to five years of life), in nine countries for 6-11 months of life and in six countries for 1-2 and 3-5 months of life. Pebley and Stupp (1986) and Hull and Gubhaju (1986) also noted this phenomenon for Guatemala and Indonesia respectively.

In the literature the adverse effects of closely spaced births on infant survival are widely attributed to maternal depletion syndrome and gestational immaturity leading to low birth weight (Fedrick and Adelstein, 1973: 754-755; DaVanzo et al., 1983: 392; Cleland and Sathar, 1984: 402). In contrast, the adverse influence of closely spaced births on child mortality is attributed to sibling competition for their mother's attention and tangible resources (Palloni and Millman, 1986: 216). In this study the observed favourable child survival associated with long birth intervals could be due to mothers having adequate time to recover their strength after the preceding pregnancy and lactation before the conception of the following child. Moreover, the possibility of disease communication for children close in age is minimised for those who are born after a longer interval.

This study has examined the influence of demographic variables of interest on infant and child mortality. Although the length of the preceding birth interval emerged as the major influential factor in determining child survival prospects, it was not possible to demonstrate its mechanism empirically because information on child care behaviour of mothers, mother's nutritional and health status was not collected in the survey. Moreover, length of birth interval is also likely to be correlated with other factors such as breastfeeding, gestational age of child and birth weight. Thus the association between length of interval and survival status of child is not entirely conclusive. As gestational age of a child was not collected in the survey and as breastfeeding information was available only for selected children, these variables are not explored in relation to child survival in this study. However, closely spaced births in Bangladesh and the Philippines (Miller et al., 1992: 315) and in Guatemala (Pebley and Stupp, 1987: 58) were noted to be associated with an elevated risk of deaths to infants even when potentially confounding effects of gestation were taken into account. Similarly, Cleland and Sathar (1984: 417) noted that the influence of the interval on child survival status in Pakistan was not the spurious consequence of early weaning. The same could be true for Nepal.

The association between survival status of children and length of interval is also argued to be the consequence of spurious association in those studies where the survival status of the preceding child is not taken into account (Winikoff, 1983: 232; DeSweemer, 1984: 50 and Cleland and Sathar, 1984: 401). This is because mothers who lose their children tend to conceive as soon as possible in order to recover the child loss. Households which lose an earlier child are also likely to lose subsequent children because the environment, resources and the socio-economic factors for the next child are also likely to be the same. Most of these hypotheses cannot be tested in this study because of the unavailability of the data. However, the effect of survival status of the preceding child along with other demographic, socio-economic and health-related variables on infant and child mortality is examined in Chapter Five.

CHAPTER FOUR

SOCIO-ECONOMIC AND PROXIMATE DETERMINANTS OF INFANT AND CHILD MORTALITY

4.1 Introduction

This chapter is designed to meet two major objectives. First, it aims to identify socio-economic and health factors that are significantly associated with infant and child mortality. Second, it aims to examine how far the socio-economic and health factors work through two maternal factors, mother's age at childbirth and length of birth interval in influencing infant and child mortality in Nepal (see the hypothesized causal model discussed in Chapter Two).

Studies in the past have focused on a broad set of socio-economic variables to explain the differentials in infant and child mortality rates. These studies have noted different magnitudes of the effect of similar variables across societies and geographical regions. In this context, Eberstein et al. (1990: 3) noted social factors as important determinants of childhood mortality. On the other hand, Dasgupta (1990: 489) noted insufficient understanding about the behavioural and social determinants of childhood mortality in comparison to the biological variables. Caldwell et al. (1983: 185) in a study from south India called for further research on the determinants of childhood mortality.

The available literature suggests that the social and economic factors at both the individual level (Schultz, 1984; Caldwell and McDonald, 1981; Hull and Gubhaju, 1986) and household level (Gortmaker, 1979; Jain 1985; Sandhya, 1986) have a strong influence on infant and child mortality. For example, father's education, mother's education and family income were found to have significant influence in determining the level of mortality during childhood in the United States (MacMohan et al., 1972: 3-4) and in Colombia (Schultz, 1979: 24-33). Similarly, the significant net influence of maternal education in lowering mortality during childhood was also observed in Nigeria (Caldwell, 1979: 407) and in Punjab, India (Dasgupta, 1990: 492). It has also been observed that nutrition, environment, sanitation, crowding, availability of medical care and maternal education are important determinants of mortality during childhood (Haines and Avery, 1982: 34). The influence of income on child survival, as suggested by Preston (1975: 239), is likely to work through factors such as medical and public health services and education. The differentials in child survival status suggested by Haines and Avery (1982: 32), however, are due to the different magnitude of the impact of variables such as nutrition, housing, standard of living, working through public health services and sanitation. Hobcraft et al. (1984: 196), in addition to the socio-economic variables discussed above, suggested work status of the mother as one of the important socio-economic determinants of child survival. Hobcraft et al. further argued that mother's involvement in work outside the home is likely to adversely reduce the amount of child care she renders to her child and may affect the child's survival chances.

Since the study of Caldwell (1979) in Nigeria, maternal education has been accorded a prime focus and is considered an independent determinant of child survival in its own right. In this context, Hobcraft et al. (1984: 221) using the WFS data from 28 countries found maternal education to be one of the net influential factors on the risk of death to infants and children. Similarly, Haines and Avery (1982: 42) found a strong negative effect of maternal education on infant and child mortality in Costa Rica. The strong association between maternal education and better chances of child survival was also observed for Hunan province, China (Streatfield et al., 1991) and for Korea (Kim, 1986: 5). Martin et al. (1983: 425), using WFS data, found maternal education to be one of the important factors in reducing childhood mortality in the Philippines and Pakistan, but father's education was found to be slightly more important in Indonesia. Regarding maternal education and its effects on child survival, Frenzen and Hogan (1982: 392) argued that mothers are more likely to be responsible for the child care than fathers where the role of education could have played an influential part in determining the level of childhood mortality. Similarly, Dasgupta (1990: 503) in a study of Punjab in India, empirically demonstrated the effects of maternal education working through child care in influencing childhood mortality. The hypothesized ways in which maternal education influences child survival are explained by Caldwell (1979) in the Nigerian study and Caldwell et al. (1983) in the Indian study.

4.2 Description of socio-economic variables used in this study

The 1976 NFS and 1986 NFFS have collected various information at household and individual levels. For example, the information on size of operational land-holding and possession of cows and buffalo are collected at the household level while the characteristics of individuals such as education, work status and literacy are collected at the individual level. Both the 1976 NFS and 1986 NFFS have covered a wide range of variables. Of these, this study employs five socio-economic[1/] variables: mother's education, father's education, mother's work status, ever use of contraception and place of residence from the 1976 NFS. There were eight socio-economic variables studied from the 1986 NFFS: mother's education, father's education, mother's work status, ever use of contraception, place of residence, size of operational land-holding, number of cows and buffalo possessed by a household, and health care services. However, in the multivariate analysis place of residence and health care variables from the 1986 NFFS were combined because all siblings from urban areas had access to health care services.

The literacy status variable for both the father and mother includes the individual's ability to either read a simple letter in Nepali or write his/her name, while education indicates the highest grade completed by an individual under a formal education institution. The data based on both surveys used in this study suggest that there are also people who are literate but have never been to school. The groups of people who have never been to school but are literate are more likely to belong to a household with a better economic situation. This is because better economic status could enable them to afford education at home. Thus the risk of death for the children of these people is likely to be different from the risk for those who are illiterate or literate with some experience of schooling. So,

1/ Use of contraceptives from the 1976 NFS and use of contraceptives and health care services from the 1986 NFFS, in this chapter, as described in the framework in Chapter Two, are considered as parallel to socio-economic variables.

father's education in this study is categorised into illiterate, literate with no schooling, and literate with some years of schooling. However, due to the small number of women with education, the education of mother is classified into only two categories: no education and some education. Literate mothers with no schooling are combined with the mothers with some education into one category.

It has been noted that women from the middle and high income groups in South Asian countries, generally, do not choose to work (ESCAP, 1987: 1, cited in Selvaratnam, 1987: 11). This also seems to be true in the case of Nepal because the 1981 Census showed that 55 per cent of the females aged 15 years and above were categorised as dependents. Furthermore, the labour force structure in Nepal is overwhelmingly dominated by agriculture. About 96 per cent of the working women in the 1981 Census were reported to be engaged in the primary sector[2/] with 0.2 per cent in the secondary sector, 3 per cent in the tertiary sector and the rest in the unclassified category (CBS 1987a: 202-224). Generally, women engaged in a primary sector occupation are likely to have fewer years of schooling. The types of work done by these women therefore are likely to be physical in nature and require low skills and thus have low productivity, low wages and consequently low status. Work involving physical exertion is likely to fatigue women at the end of the day. This in turn could worsen both the quality of child care as well as the survival status of children. However, women with education are likely to obtain a white-collar job and are likely to earn more. As an earning member of a household, such women may have a greater say in the household resource allocation. This could enable mothers to afford a child's health care, food, and other basic needs which in turn could produce favourable survival prospects for children borne by them. However, grouping of women according to nature of the jobs was not possible because of the small number in non-agricultural occupations. The work status of women in this study, thus, is categorised into working and not working where working indicates those involved in gainful employment (cash or in kind) after their marriage.

2/ Primary sector includes agriculture, forestry, hunting and fishing; the secondary sector includes mining, quarrying, manufacturing and construction; and the tertiary sector includes electricity, gas, water, transport, communication and other services (CBS 1987a: 224).

Since family members living in a house have to share all events that occur in the house, the household economy can be expected to influence child survival. The economy of Nepal is predominantly based on agriculture where about 90 per cent of the people earn their livelihood. This sector thus is characterised by small farms and small farmers (CBS, 1987a: Viii) where continuous fragmentation in size of land-holding due to the property inheritance from earlier to later generations has further compounded the difficulties of the household economy (Pant, 1987). The other problem is that land distribution is highly skewed. For example, about 51 per cent of the total households in 1981 had holdings of less than half a hectare of land which comprised about 7 per cent of the total cultivated land (CBS, 1987a: Ix). The size of land-holding thus could be a good indicator for household economy in explaining child survival prospects in Nepal. This variable is likely to explain child survival through the ability of a household to afford various services and satisfy needs such as food, clothing, health, environment and child care. Size of land-holding for the purpose of this study is categorised into no land-holding, under half a hectare, and half a hectare and above.

Another variable used as an indicator for household income in this study is the number of cows and buffalo possessed by a household. A survey in Nepal (NRB, 1988: 81) noted that 61 per cent of the total rural household income was earned from crops, horticulture and livestock. Households in the hills and mountains of Nepal which own cows and /or buffalo, in general, produce ghee from milk (purified butter used for cooking) for market. This product is accumulated for about six months to one year and is sold in the nearest market (for some people the nearest market could be one to two weeks' walk). The money from this sale is mostly utilized to purchase basic items such as cloth, salt, cooking oil, spices and other products that are not available in their local market, as needed for the next six months or a year. Ghee is also produced in the *terai* area. However, people in the *terai* are also likely to earn income by direct sale of milk which is less possible for the people in the hill. Therefore, since cows and buffalo are the sources of milk and milk is one of the sources of household income, this variable is likely to serve as an indicator of household income.

The other possible way in which cow and buffalo milk influences child survival could be through the nutritional status of children. This is because children in a household with cows and /or buffalo can be expected to have access to more nutritious food. Producing ghee is likely to yield more income and can be used to meet a wide range of household requirements in a situation where the majority of the people are living with limited resources; accordingly this mechanism is less likely to explain child survival prospects. However, cows' and buffalo milk as a source of nutritious food could be significant during infancy for those whose mothers are not capable of producing enough breast milk. So part of the effect of the cows and buffalo in the household on infant mortality is likely to be explained through the access to nutritious food. This variable in this study is categorised into: no cows and buffalo, 1-3 cows and/or buffalo, and 3 or more cows and / or buffalo, and will be named 'cows' hereafter.

In this study, ever use of contraception and the access to health posts are employed as an indicator for access to health services. Health care and family planning services in the country are briefly described in the following sections. This will help in explaining the results which are obtained subsequently.

The Government supported family planning programme in Nepal has been operating since 1968 with two broad components: family planning and maternal child health care delivery (MCH). The MCH component aims to provide services to surviving children with the expectation of building positive rapport for the promotion of family planning among clients (CBS, 1987a: 318-319). A similar approach to family planning policy was also adopted in Guatemala, Ecuador, Mexico and Peru (Isaacs and Fincancioglu, 1989: 104). By 1985, there were four institutions in Nepal: the Family Planning and Maternal Child Health Project and the Integrated Community Health Development Project, both with Government support; the Family Planning Association[3/], a non-governmental organization and the Contraceptive Retail Sales (CRS) company, that were involved in family planning

3/ The Nepal Family Planning Association was established in 1958. During its initial period it served in the Kathmandu valley by providing knowledge and information on family planning. Since the data used in this study cover only up to 1985, change in the health institutions and /or health care delivery after this period is not covered in the discussion.

service delivery. Except for the CRS company, all establishments were involved in delivering family planning services in conjunction with maternal and child health care delivery, health education, nutritional education and environmental health care. The concept of the village health worker, designed to provide door to door services for those who do not want to come to district headquarters for the family planning and MCH services has emerged since 1972. Village health workers were assigned a variety of jobs such as distribution of condoms, pills, motivating clients for sterilization, immunisation of children (limited only), distribution of R-D SOL (oral rehydration solution) and iron tablets to mothers, education about sanitary hygiene and referral of sick children to health posts, health centres or hospital.

The Ministry of Health embarked on establishing health posts in different parts of the country in 1966/67 with the objective of providing basic health service to a maximum number of people. Two types of health posts, 'primary integration' and 'full integration', were designated. The primary integration type was used in distribution of pills, condoms, motivating clients for sterilization, nutritional monitoring, education about health, nutrition, rehydration, environmental health, immunisation and treatment of common illness. Fully integrated health posts, on the other hand, delivered additional services: antenatal, delivery and post-natal services (for further detail see CBS, 1987a: 318-322; Tuladhar and Stockel, 1982: 275-276).

How far can family planning services delivered through family planning institutions and health institutions explain child survival prospects? If they can explain some of the differentials in child survival prospects, the next question is whether the differentials are due to the use of contraception or to the health services delivered in conjunction with family planning services. Unfortunately, this issue in the context of Nepal is neglected. Past studies (Tuladhar, 1987; Schuler and Goldstein, 1986; Ross et al., 1986; Thapa, 1989) in Nepal have mostly used information on family planning services in examining fertility, averted births, unmet need or service accessibility to contraceptors. In this respect, Potter, in reference to the paper of Palloni and Millman (1986), suggested that

> experience with a fertility survey conducted in rural Mexico has suggested that a mother's use of modern maternal health care is correlated with both breastfeeding and contraceptive use, that contraceptive use is inversely associated with both the initiation and the continuation of breastfeeding, and that contraception rather than breastfeeding has the dominant influence on the length of birth intervals. If in addition to these relationships, it were also true that access to and demand for maternal and child health care influenced infant and child mortality, several of the most relevant conclusions reached by Palloni and Millman would seem to be suspect (Potter, 1988: 447).

The way in which family planning services exert their influence on child survival is centred on the reproductive behaviour of a woman which is expected to change after contraceptive use. In this context Chen et al. (1983: 203) suggested that contraceptive use influences child survival through change in population age structure and alteration in the composition of births. Similarly, Trussell and Pebley (1984: 267) and Palloni and Pinto (1989: 363) argued that family planning reduces the births with high risk of death through changing the birth distribution by age of mother, birth order and inter-pregnancy interval. Potter in this respect argues that,

> Since contraception is surely the most important proximate determinant of interval length, not only in the Latin America and Caribbean surveys studied by Palloni and Millman, but also in many of the other surveys that were undertaken by the WFS, this association raises the question of whether it is health care rather than birth spacing that is, in reality, the major determinant of infant and child mortality (Potter, 1988: 448).

Effective practice of contraception, in theory, can be expected to reduce the proportion of births exposed to a higher risk of death by altering the reproductive behaviour of a woman. However, social scientists should not forget the socio-cultural values, norms and practices of the society in question. For example, of the total sampled women, 3.7 per cent from the 1976 NFS and 15.8 per cent from the 1986 NFFS reported themselves as ever users of contraceptives. Of those who have ever used contraceptives, 41 per cent from the 1976 NFS and 71 per cent from the 1986 NFFS were sterilization acceptors. These figures indicate that the role of contraceptive use in influencing child survival through length of birth interval is likely to be negligible. Moreover, a society guided by large family norms where elders bless the young invoking the wish 'may your children spread all over the hills and foothills' further suggests that the child survival differential captured by contraceptive use is less likely to be explained through spacing between siblings' births as a consequence of contraceptive use. If this[4/] is the case, the most plausible explanation of how contraceptive use affects child survival in Nepal can be the MCH component delivered in conjunction with family planning services rather than through birth spacing.

On the basis of the discussion in this section, considering the contraceptive use pattern in Nepal, and on the assumption that those who have ever used contraceptives are also likely to use health services delivered through the same facility, 'ever used contraceptives' in this study is used as the indicator for the utilization of health care services. This variable is categorised as ' never used contraceptives' and 'ever used contraceptives'. However, as the preceding birth interval emerged as the important determinant of child survival (Chapter Three), how far contraceptive use in Nepal enabled couples to lengthen their inter-pregnancy interval will also be examined in brief. This part of the analysis will further clarify whether contraceptive use is operating through health care utilization or through birth spacing in explaining child survival in Nepal.

In this study health posts, in the absence of other information on health utilization aspects, are used as an indicator for the health care programme and its utilization. This variable in this study is named 'health care' and is created by using the information on health posts by place and date of establishment published by His Majesty's Government of Nepal (1986). This document covers a complete list of health posts established in Nepal until 1985. There has been substantial growth in the number of health posts. By the year 1970/71, 150 health posts delivered basic health services to the people, increasing to 538 by the year 1979/80 (His Majesty's Government (HMG), 1986: 1-10). This indicates a 286 per cent growth in the number of health posts over 10 years. For the purpose of this study, first of all the sampled *panchayat* which have health posts and which do not have health posts were listed separately. Then, those children who were born after the establishment of the health posts were categorised as children 'having access to health services' and the rest

---

4/ Alan Gray argued that contraceptive use should never be used in an explanatory role for fertility and birth interval in a situation where family planning is not widespread. Contraceptive use is the result of high fertility, not the cause of low fertility. And in a situation where family planning is widespread, it is simply the universal mechanism whereby fertility is controlled or not (Gray, 1994: personal communication).

as 'having no access to health services'. Children from the sampled *panchayat* where there were no health posts until the time of survey were also categorised as children 'having no access to health services'. On the other hand, as most of the urban centres were close to the district hospital, children born in the urban sample area were classified as having access to health services. However, this variable examines the infant and child mortality differentials only by considering whether a household has any access to health services. The limitation of this variable is that it does not consider the extent of use of health care services delivered through health posts.

It is argued that educated women are likely to delay the timing of family formation and first birth (Cleland and Van Ginneken, 1989: 82; Lindenbaum et al., 1989: 121; Hobcraft, 1993: 161). On the basis of these premises it can be hypothesized that maternal education influences child survival through maternal age at childbirth and length of birth interval. Thus this chapter examines whether the two maternal factors, namely age of the mother at the time of childbirth and length of interval between births as described in the analytical framework of this study in Chapter Two, are operating as an intermediate factors between the socio-economic and outcome variables to influence child survival in Nepal. As contraception is likely to be one of the means of planning the timing of births, it is also worth examining whether educated women in comparison to those with no education are using modern contraception to avoid too closely spaced births.

4.3 Analytical approach

The preliminary analyses in this chapter which examine the direct effects of the socio-economic and health-related factors on infant and child mortality are based on cross-tabulations. The statistical significance of the differentials in infant and child mortality according to the independent socio-economic and health-related factors are assessed by using the same univariate and multivariate logit model technique used in Chapter Three. This part of the analysis identified the socio-economic and demographic factors that have net significant influence on infant and child mortality. This is followed by the inclusion of proximate variables (maternal factors) into a model to examine how far the effects of socio-economic and health-related factors are mediated through selected maternal factors in influencing infant and child mortality in Nepal. In the analysis a considerable attenuation in the estimates related to the social and health factors explaining their relationship with infant and child mortality can be expected after including the maternal factors in the model if the links among variables are working as hypothesized in the causal model shown in Chapter Two.

4.4 Socio-economic differentials in infant and child mortality

Table 4.1 shows the distribution of the number of infant deaths, the number of births exposed to the risk of dying, and infant mortality rates per 1000 live births classified according to socio-economic variables obtained from the 1976 NFS and 1986 NFFS data sets[5/]. The higher risk of death to infants of mothers with no education, illiterate fathers, working mothers, parents who have never used any contraception and those born in rural areas from both surveys is evident from Table 4.1. Infant mortality rates between 1966 and 1985 have declined by 41 per cent. The decline is statistically significant at the one per cent level of significance. The decline in infant mortality over the period according to categories of each variable is also statistically significant. Three variables used from the 1986 NFFS reveal the lowest exposure to death among infants of households which had more than three cows, owned half a hectare or more of land and had access to health posts. The risk of death among children in a household with 1-3 cows is marginally higher than for those which do not have any cows. The association between this variable and infant mortality in the multivariate analysis, however, appears to be more clear after controlling for the influence of other variables. The evident influence of socio-economic variables on infant mortality could be due to differences in nutrition, hygiene, health care and environment as a consequence of different household socio-economic status.

Table 4.1 suggests a higher risk of death among infants of working mothers as against not working mothers. In a study from 29 countries, using WFS data, Hobcraft et al.

5/ For infant mortality rates the 1976 NFS refers to the period 1966-75 and the 1986 NFFS refers to the period 1976-85.

(1984: 202-203) noted a higher risk of death for infants of mothers who worked outside the home in comparison to those who did not work, during the first months of life in 12 countries and beyond one month to one year of life in 14 countries in a. Furthermore, Hobcraft et al. (1984: 221) observed that the importance of the mother's work status was progressively declining in influencing child survival chances as the age of the child increased. The higher risk of death to infants of working mothers was also found in Lesotho (Banda et al., 1990: 7) and in India (Sandhya, 1986: 95). The evident differential in infant mortality according to work status of mothers in this study could be due to a different propensity for breastfeeding among working as against not working mothers. However this is largely unexplained because the information on breastfeeding was available only for selected births and is not explored further.

The influence of contraceptive use on child survival, as observed in this study, was also observed for Thailand (Frenzen and Hogan, 1982: 401). Frenzen and Hogan explained this result as the outcome of the length of birth spacing maintained by the use of contraception. Unlike the case of Thailand, the analysis for Nepal carried out in the later sections of this chapter did not produce any evidence of the influence of contraceptive use on birth spacing. Thus contraceptive use in this study may be explaining child survival prospects through utilization of health care services delivered in conjunction with family planning services. This seems to be possible on the grounds that parents who are contraceptive acceptors are also likely to use health services for their children from the same source as contraceptive services. The evident decline in infant mortality over the period could be due to the emergence of health posts in 1966/67 and the increase in health care delivery services through various institutions in many parts of the country after 1970. For example, Dasvarma (1984) for Indonesia argued that about 60 per cent of infant death and 71 per cent of death among children aged one to four could be avoided by the implementation of effective hygiene and preventive medical programs.

Table 4.2 shows the distribution of child deaths, the number of children exposed to the risk of death, and child mortality rates per 1000 (4q1) from the 1976 NFS and 1986

Table 4.1 Infant mortality rates by socio-economic variables: 1966-85, Nepal.

Socio-economic factors	(1966-75)[a/] Number of deaths	Exposed births	IMR /1000	(1976-85)[b/] Number of death	Exposed births	IMR /1000	% change
Mother's education							
None	1424	9190	155	760	7987	95	-39 **
Some	62	550	113	50	876	57	-50 **
Father's education							
Illiterate	851	5357	159	411	4280	96	-40 **
Literate / no schooling	389	2641	147	93	1120	83	-44 **
Literate / some schooling	246	1739	141	306	3463	88	-38 **
Mother's work status							
Working	173	951	182	48	517	92	-49 **
Not working	1313	8786	149	762	8346	91	-39 **
Contraceptive use							
Never used	1428	9122	157	692	6816	101	-36 **
Ever used	58	618	94	118	2047	57	-39 **
Place of residence							
Rural	1460	9502	154	675	6873	98	-36 **
Urban	26	238	109	135	1990	67	-39 *
Land-holding							
No land-holding				159	1681	94	
Under half a hectare				254	2706	93	
Half a hectare and above				397	4476	88	
Number of cows							
None				231	2479	93	
1-3				233	2395	97	
3 +				346	3989	86	
Health care							
Access				202	2677	75	
No access				608	6186	98	
Overall	1486	9742	153	810	8863	91	-41 **

Notes: Working category of the mother includes only those who worked after marriage in gainful employment.
** and * indicate significant at the one per cent and 5 per cent level respectively in the test of difference in two proportions.

Sources: [a/] 1976 NFS and [b/] 1986 NFFS data tapes.

NFFS[6/] according to the socio-economic variables of interest to this study. The patterns of relationship between the categories of the variables under study, except for cows possessed by a household from the 1986 NFFS, and child mortality rates based on both surveys (Table 4.2) are similar to those for infant mortality (Table 4.1). Mortality differentials according to socio-economic variables, as expected, are more pronounced for children than for infants. This could be due to differences in exogenous factors such as health, nutrition, food, shelter and environment which are more likely to be important for survival status of children than for infants (Cleland, 1989).

In the literature favourable survival prospects for children of mothers with education have been explained as the consequence of better ability to care for children enhanced by their educational qualifications (Caldwell, 1979; 1981; Caldwell and McDonald, 1981). As children during their first five years of life are likely to be more close to their mothers, every characteristic of mothers could influence the survival prospects of their children. The results in Appendix Table 4.4 suggest that women with some education in Nepal, in general, are likely to represent the higher socio-economic group. So, the influence of mother's education on child survival, in this study, is less likely to be the consequence of mother's ability to care for children enhanced by their educational qualifications. It could rather be a reflection of the favourable familial resources, environment, ability to afford better food, shelter, clothing, health and other child needs among mothers with some education. Similarly, differentials in child mortality by father's education, could also be the consequence of income differentials among the educated and un-educated fathers where those with education are likely to be associated with better income and could afford better services to their children.

The evident higher risk of death among children of working mothers could be the consequence of inadequate time allocated by mothers for child care because of their time commitment to the labour force. A Multipurpose Household Budget Survey (NRB, 1988: 68-69) in Nepal estimated that women in the labour force are likely to work five days less

6/ For child mortality rates the 1976 NFS refers to the period 1961-70 and the 1986 NFFS refers to the period 1971-80.

Table 4.2 Child mortality rates by socio-economic variables: 1961-80, Nepal.

Socio-economic factors	(1961-70)[a/] Number of death	Exposed children	CMR /1000	(1971-80)[b/] Number of death	Exposed children	CMR /1000	% change
Mother's education							
No education	682	6237	109	399	5832	68	-38 **
Some education	16	328	49	17	648	26	-47 **
Father's education							
Illiterate	461	3684	125	232	3178	73	-42 **
Literate / no schooling	169	1906	89	61	974	62	-30 *
Literate / some schooling	68	972	70	123	2328	52	-26
Mother's work status							
Working	82	610	134	53	409	129	-4
Not working	616	5953	103	363	6071	59	-43 **
Contraceptive use							
Never used	656	6025	109	318	4562	69	-37 **
Ever used	42	540	78	98	1918	51	-35 *
Place of residence							
Rural	693	6361	109	357	4925	72	-31 **
Urban	5	204	25	59	1555	37	+48
Land-holding							
No land-holding				93	1201	77	
Under half a hectare				146	1903	76	
Half a hectare and above				177	3376	52	
Number of cows							
None				137	1805	75	
1-3				98	1607	60	
3 +				181	3068	59	
Health care							
Access				69	1727	39	
No access				347	4753	73	
Overall	698	6565	106	416	6480	64	-40 **

Notes: Working category of the mother includes only those who worked after marriage in gainful employment.
** and * indicate significant at the one per cent and 5 per cent level respectively in the test of difference in two proportions.

Sources: [a/] 1976 NFS and [b/] 1986 NFFS data tapes.

than men every month due to their responsibility with domestic work, childbirth and child care. This survey further noted that maternity leave utilized by mothers in the hills was less than a month. The total working days in a year for women in rural areas were estimated to be 254 days (NRB, 1988: 68-69). This suggests that those women who are not working outside the home have an extra 254 days in hand which can be allocated for the care of children according to a child's needs. This pattern clearly indicates that children of working mothers are in a disadvantageous situation in terms of mother's time allocation for child care in comparison to children of mothers not working . On top of this, fatigue due to the long day's work, as discussed in the earlier sections of this chapter, could have further reduced the quality of child care rendered by mothers after work hours.

Favourable child survival prospects among urban dwellers could be due to the better access to health care and employment opportunity. Even women in the lower socio-economic stratum in the urban areas may have adopted some of the child care behaviour of educated women because the chances to observe the behaviour of educated women in the higher socio-economic stratum in the urban areas are likely to be greater than in rural areas. All these factors could have contributed to improved child survival prospects in the urban areas compared with the rural areas.

The differentials in child mortality by size of land-holding and cows possessed by a household, on the other hand, can be attributed to income differentials among these households where the households with higher income are likely to be in a better position in meeting the child's needs. Better child survival prospects among those in a household with more cows was also noted in Bangladesh (D'Souza and Bhuiya, 1982: 763).

Table 4.2 also shows that death rates from both surveys for children whose mothers had ever used contraception were lower than for those whose mothers had never used contraception. Similarly, the lower death rate among children from households which had access to health services is also shown from the 1986 NFFS.

4.5 The effects of joint socio-economic variables

In most societies, educated women tend to marry educated men and enjoy a higher standard of living (Cleland and Van Ginneken, 1989: 83). If both the mother and the father of a child are educated then their education could be operating jointly in influencing child survival. In this case the influence of parents' education on infant and child mortality could be working through income. Majumder (1989: 104) suggested that the effects of mother's education on child mortality rate after controlling for the effects of father's education should be negative if mother's education is influencing child survival through her knowledge and practice of child health care.

Table 4.3 reveals the higher rate of infant loss among mothers with no education after controlling for father's education. Father's education on the other hand does not show a consistent pattern of relationship with infant mortality from either survey after controlling for mother's education. For example, mortality rates among infants of mothers with no education from the 1976 NFS decrease with the increase in father's education while these two variables from the 1986 NFFS show a U-shaped association. Quite different patterns of relationship between father's education and infant mortality between the two surveys are also evident for infants of mothers with some education. However, the results in Table 4.3 suggest higher exposure to death among infants of illiterate parents as against infants of literate parents. This, in general, suggests the possibility of interaction between father's education and mother's education in Nepal in influencing infant mortality.

The higher risk of death for children born to mothers with no education as against those to mothers with some education, except to those with 'illiterate' fathers, is clearly evident after controlling for father's education (Table 4.3). Similarly, except for the mothers with some education from the 1976 NFS, the risk of death to children declines with the increase in father's education after controlling for mother's education. As is the case with infant mortality, there is a higher rate of child loss among parents with no education as compared to parents with some education.

It can be hypothesized that better educated women are more likely to participate in the labour force and earn more. In this situation the education and the work status of the mother are likely to operate interactively in influencing the infant and child mortality rates. Among infants of mothers with no education, results from both surveys suggest higher mortality rates where mothers are working than where mothers are not working (Table 4.4).

Table 4.3 Infant and child mortality rates by parents' education: 1976 NFS and 1986 NFFS, Nepal.

	Mother's education			
	IMR/1000, 1966-1975 [a/]		IMR/1000, 1976-85 [b/]	
Father's education	None	Some	None	Some
Illiterate	159	149	96	20
	(5310)	(47)	(4231)	(49)
Literate with no schooling	150	76	84	54
	(2536)	(105)	(1065)	(55)
Literate with some schooling	148	118	96	59
	(1341)	(398)	(2691)	(772)
	CMR/1000, 1961-70 [a/]		CMR/1000, 1971-80 [b/]	
	None	Some	None	Some
Illiterate	126	--	72	128
	(3665)	--	(3139)	(39)
Literate with no schooling	89	87	63	38
	(1837)	(69)	(922)	(52)
Literate with some schooling	79	42	63	17
	(732)	(240)	(1771)	(557)

Notes: Number of cases below 35 are excluded in the table.
Figures in parentheses indicate number of cases (number of births when the unit of analysis are infants and number of children aged one to five years of age when the unit of analysis are children).
Sources: [a/] 1976 NFS and [b/] 1986 NFFS data tapes.

A similar pattern emerges among infants of mothers with some education. Table 4.4 indicates that mother's work outside the home is unfavourable for the survival prospects of their children. This study thus does not produce sufficient evidence to support the hypothesis that women's education is likely to produce favourable child survival prospects in Nepal through an increase in their earnings. One possible explanation for the unfavourable survival prospects among infants born to mothers working outside home could be the consequence of inadequate breastfeeding. However, for child mortality this adverse influence could be due to smaller time allocated for child care by working mothers. The worst survival prospects among children of working mothers with no education could be due to the fact that 61 per cent (UNICEF, 1985:142) of the total population of the country were living below the subsistence level, where women are likely to be forced to work outside the home in order to earn a living. There is evidence of a substantially greater number of births to working women with no education as compared to working women with some education (Table 4.4). In such circumstances, children of these mothers were likely to be disadvantaged in terms of mother's time for their care as well as household resources and environment. The evident better survival prospects among children of mothers with some education as against mothers with no education, after controlling for work status of mothers, again could be the reflection of the household economic and environmental differentials among these two groups of mothers.

Table 4.4 Infant and child mortality rates by mother's education and work status, 1976 NFS and 1986 NFFS, Nepal.

	Mother's work status			
	IMR/1000, 1966-1975 [a]		IMR/1000, 1976-85 [b]	
Mother's education	Working	Not working	Working	Not working
None	188	151	99	94
	(914)	(8273)	(412)	(7575)
Some	--	119	66	55
	--	(513)	(105)	(771)
	CMR/1000, 1961-1970 [a]		CMR/1000, 1971-80 [b]	
	Working	Not working	Working	Not working
None	138	106	151	63
	(587)	(5648)	(336)	(5496)
Some	--	49	27	26
	--	(305)	(73)	(575)

Note: Figures in parentheses indicate number (number of births when the unit of analysis are infants and number of children aged one to five years of age when the unit of analysis are children).

Sources: [a]1976 NFS and [b]1986 NFFS data tapes.

4.6 Socio-economic determinants of infant and child mortality

Tables 4.5 and 4.6 show odds ratios based on the parameter estimates of the main effects models respectively from the 1976 NFS and 1986 NFFS data sets for mortality during infancy. Analysis of the 1976 NFS showed that mother's work status and contraceptive use had significant effects on infant mortality (Table 4.5). The significant variables from the 1986 NFFS were mother's education, contraceptive use, possession of cows by a household and place of residence/health care (Table 4.6). Attenuation in the LRX^2 value from the gross effects column to the net effects column corresponding to mother's education and place of residence suggests that much of the effect of these variables is working through other variables of the model in influencing infant mortality (Table 4.5).

The net effects column of Table 4.5 reveals that the risk of dying to infants born to working mothers was 1.25 times higher than to those infants born to mothers who did not work outside the home. The differentials in infant mortality by work status of mothers confirm the findings of the bivariate analysis carried out in the preceding sections. The influence of mother's work status on infant mortality based on the 1986 NFFS, however, was not statistically significant.

From the 1976 NFS, infants born to mothers who had never used contraceptives were exposed to 1.68 times or 68 per cent higher risk of death than those born to mothers who had ever used contraceptives (Table 4.5). The corresponding figure from the 1986 NFFS is 1.76 times higher (Table 4.6). The LRX^2 value corresponding to this variable suggests that it is highly significant (Tables 4.5 and 4.6). The profound influence of contraceptive use as well as the favourable association between ever use of contraceptives and infant mortality could be the result of the utilization of maternal and child health care services delivered collectively with family planning services through family planning and health institutions (Tables 4.5 and 4.6). This argument is complemented by the analysis outlined in the subsequent sections which failed to provide sufficient evidence to support the influence of contraceptive use on birth spacing.

The LRX^2 corresponding to mother's education from the 1986 NFFS in the net effects column of Table 4.6 shows significant influence on infant mortality. The odds ratio pertaining to this variable suggests that infants born to mothers with no education are exposed to 1.43 times higher risk of death than to infants born to mothers with some education. Infant mortality differentials according to mother's education are generally attributed to mother's knowledge enhanced through educational qualifications which could have contributed to improved child care (Caldwell, 1979; 1981; Caldwell and McDonald, 1981; Ware, 1984). In the absence of information on child care practices and quantity as well as type of resources allocated to children, how mother's education exerts its influence on child survival in this study is largely unexplained. However, given the low level of female literacy and considerable attenuation in the LRX^2 corresponding to mother's education observed after including other socio-economic variables in the respective models (Tables 4.5 and 4.6), there are sufficient grounds to argue that the effects of education on infant mortality observed in this study may not be the effects of education *per se*. They rather could be the reflection of the effect of socio-economic background where women with some education are likely to be in higher class families and in economically better-off households (see Appendix Table 4.4). This could have allowed mothers with some education to afford better child care, a better household environment, and better child health care which in turn could have produced favourable survival prospects for their children.

The favourable influence on infant mortality of increased number of cows in the household is evident in the net effects column of Table 4.6. The comparison of the LRX^2 in the gross effects column and net effects column of this variable suggests that the influence is more pronounced when the effects of other variables are held constant. The effects of this variable in infant mortality could be working through nutrition where infants born in a household with more cows are more likely to have better access to milk. This is possible in Nepal where most of the women, due to their poor economic situation, are likely to be undernourished and unable to produce sufficient breast milk for their infants. The mother's nutritional status could have been further worsened due to the higher intensity of births during their reproductive span (see Chapter Three). In this situation cow's milk could be an important source of food for infants, especially during their first six months of life.

Table 4.5 Logit linear model of the effect of socio-economic factors on infant mortality: 1976 NFS, Nepal.

Variables	Gross effects: Odds ratio	Gross effects: Reduction in LRX^2	Gross effects: P	Net effects: Odds ratio	Net effects: Reduction in LRX^2	Net effects: P
Mother's education		7.7	0.01		2.1	NS
No education	1.197			1.114		
Some education	0.835			0.898		
Father's education		3.9	NS		0.5	NS
Illiterate	1.077			1.022		
Literate/no schooling	0.986			0.974		
Literate/some schooling	0.942			1.004		
Mother's work status		6.7	0.01		5.7	0.02
Working	1.125			1.119		
Not working	0.889			0.894		
Contraceptive use		19.8	0.001		14.5	0.001
Never used	1.334			1.297		
Ever used	0.750			0.771		
Place of residence		3.9	0.05		0.7	NS
Urban	0.829			0.914		
Rural	1.207			1.094		

n=9734 reduction in model LRX^2 and (d.f)=38.93 (32) P=0.186 overall odds =0.129

Notes: The analysis is based on the cohorts born in the period 1966-1975.
Mother's education, mother's work status, contraceptive use and place of residence each have 1 and father's education has 2 degrees of freedom.
NS indicates not significant at the 10 per cent level.
Source: 1976 NFS data tape.

Infant mortality differentials by place of residence/health variable show an interesting result suggesting that much of the differential is due to place of residence rather than access to health (Table 4.6). Odds ratios corresponding to this variable suggest virtually no difference in infant loss among the rural households which have access to health and do not have access to health. Despite this result, the possible influence of health care services in the country cannot be minimised because the variable used here only takes into account the information on whether households have access to health care delivered through health posts or not. This variable does not takes into account the magnitude of the utilization of the health care services. However, the differentials in infant mortality by

Table 4.6 Logit linear model of the effect of socio-economic factors on infant mortality: 1986 NFFS, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Mother's education		15.5	0.001		5.2	0.05
No education	1.312			1.197		
Some education	0.762			0.836		
Father's education		2.5	NS		3.2	NS
Illiterate	1.086			0.973		
Literate/no schooling	0.929			0.926		
Literate/some schooling	0.991			1.109		
Mother's work status		0.0	NS		0.0	NS
Working	1.014			0.992		
Not working	0.986			1.008		
Contraceptive use		40.1	0.001		31.0	0.001
Never used	1.357			1.326		
Ever used	0.737			0.754		
Land-holding		0.8	NS		1.0	NS
No land	1.028			1.070		
Under half a hectare	1.018			0.982		
Half a hectare and above	0.956			0.952		
Number of cows		2.1	NS		6.7	0.05
None	1.011			1.135		
1-3	1.060			1.008		
3 +	0.934			0.874		
Place of residence and access to health		18.2	0.001		12.8	0.01
Urban	0.766			0.773		
Rural / access	1.141			1.136		
Rural / no access	1.144			1.139		

n=8863 reduction in model LRX^2 and (d.f)=257.37 (256) P=0.464 overall odds=0.070

Notes: The analysis is based on the cohorts born in the period 1976-1985.
Mother's education, mother's work status, contraceptive use each have 1 and father's education, land-holding, possession of cows and place of residence/health care each have 2 degrees of freedom. NS indicates not significant at the 10 per cent level.

Source: 1986 NFFS data tape.

rural-urban residence of mother clearly suggest favourable survival prospects for infants in urban areas.

All the socio-economic variables from the 1976 NFS and 1986 NFFS appeared to have gross significant influence on child mortality (Tables 4.7 and 4.8). However, the influence of contraceptive use in both surveys, mother's education in the 1976 NFS and father's education in the 1986 NFFS disappeared in the multivariate analysis. The LRX^2 corresponding to socio-economic variables in both Tables 4.7 and 4.8 also suggests that the influence of these variables on child mortality is more pronounced than for infant mortality. This could be due to higher exposure of children than infants to the environmental contamination determined by socio-economic factors.

Odds ratios pertaining to maternal education based on the 1976 NFS suggest 1.42 times higher risk of death to children of mothers with no education compared to those of mothers with some education (Table 4.7). The corresponding figure from the 1986 NFFS is 2.07 times higher (Table 4.8). However, the influence of this variable on child mortality from the 1976 NFS, after controlling for the effects of other variables in the model, did not appear to be significant (Table 4.7). In the 1986 NFFS, the influence of this variable attenuated considerably from the gross to net effects column after controlling for the effects of other variables in the model. However, mother's education still has a very major effect on child mortality even if the amount of attenuation is significant (Table 4.8). The result thus indicates that part of the profound influence of mother's education on child mortality shown in the multivariate model is working through other factors of the model. This again partly supports the explanation that the influence of mother's education is likely to be operating through the household socio-economic and environmental conditions according to educational status of mothers.

The influence of mother's work status on child survival from both surveys is highly significant. Table 4.7 suggests that those born to working mothers based on the 1976 NFS tend to experience 1.24 times higher risk of death than those born to not working mothers. This situation in the 1986 NFFS was worse, in that children born to working mothers tend to experience 1.99 times greater risk of death than those born to not working mothers. This part of the analysis confirms the findings of the bivariate analysis (see section 4.4 and 4.5).

Table 4.7 Logit linear model of the effect of socio-economic factors on child mortality: 1976 NFS, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Mother's education		14.6	0.001		1.7	NS
No education	1.525			1.192		
Some education	0.656			0.839		
Father's education		34.8	0.001		19.1	0.001
Illiterate	1.405			1.303		
Literate/no schooling	0.957			0.931		
Literate/some schooling	0.744			0.824		
Mother's work status		5.2	0.05		2.9	0.10
Working	1.162			1.114		
not working	0.861			0.898		
Contraceptive use		5.5	0.02		0.6	NS
Never used	1.197			1.066		
Ever used	0.835			0.938		
Place of residence		20.7	0.001		9.9	0.01
Urban	0.474			0.542		
Rural	2.109			1.844		

n=6560 reduction in model LRX^2 and (d.f)=29.56 (31) P = 0.540 overall odds =0.051

Notes: The analysis is based on the cohorts born in the period 1961-1970.
Mother's education, mother's work status, contraceptive use and place of residence each have 1 and father's education has 2 degrees of freedom.
NS indicates not significant at the 10 per cent level.

Source: 1976 NFS data tape.

Size of land-holding and cows possessed by a household from the 1986 NFFS, used as household economic indicators, suggest favourable survival prospects for children from a household which has more cows or larger land-holding (Table 4.8). The reduction in LRX^2 corresponding to number of cows possessed by a household is more pronounced for child than for infant mortality in the multivariate analysis. Odds ratios pertaining to both of these variables show a negative association with survival status of children. These results thus suggest that households with better economic situations are less likely to lose their children. The favourable influence of better household economic conditions on child mortality could be because these households are better able to fulfil the child's health, nutritional and care needs. One unexpected phenomenon in Table 4.8 is the slightly higher risk of death among children in the household with half a hectare of land than among children in the household with no land-holding. One explanation for this could be that those who do not have land may be earning from another sources such as services, industrial labour or business where their earnings could be higher than those who have half a hectare of land. However, in the absence of further information this explanation is merely a hypothesis which cannot be tested.

Table 4.8 Logit linear model of the effect of socio-economic factors on child mortality: 1986 NFFS, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Mother's education		21.5	0.001		8.4	0.01
No education	1.629			1.439		
Some education	0.614			0.695		
Father's education		9.3	0.01		0.1	NS
Illiterate	1.182			0.988		
Literate/no schooling	1.008			1.016		
Literate/some schooling	0.839			0.997		
Work status of mothers		24.9	0.001		14.0	0.001
Working	1.535			1.412		
Not working	0.651			0.708		
Contraceptive use		8.1	0.01		2.3	NS
Never used	1.178			1.098		
Ever used	0.849			0.911		
Land-holding		16.3	0.001		9.8	0.01
No land	1.154			1.080		
Half a hectare	1.141			1.154		
Half a hectare and above	0.759			0.803		
Number of cows		5.6	0.10		8.4	0.02
None	1.183			1.295		
1-3	0.937			0.865		
3 +	0.902			0.892		
Place of residence and access to health		26.7	0.001		23.6	0.001
Urban	0.677			0.626		
Rural / access	1.100			1.200		
Rural / no access	1.343			1.331		

n =6480 reduction in model LRX^2 and (d.f)=262.67 (233) P=0.088 overall odds=0.059

Notes: The analysis is based on the cohorts born in the period 1971-1980.
Mother's education, mother's work status and contraceptive use each have 1 and father's education, land-holding and possession of cows and place of residence/health care each have 2 degrees of freedom.
NS indicates not significant at the 10 per cent level.

Source: 1986 NFFS data tape.

Regarding the place of residence/health care variable, as in infant mortality, more of the differentials are explained by urban-rural residence compared with access to health care. For example, figures in the net effects column suggest that children in rural households who have access to health care tend to experience 1.92 times higher risk of death than those in urban households. This figure for households which do not have access to health services was 2.13 times higher than for urban households. However, the 1.11 times greater risk of death among children of rural households which do not have access to health services as against those which have access to health services does suggest a more favourable situation for children of rural households with access to health services.

Contraceptive use from both surveys in this study, as noted earlier, is used as the measure for the utilization of health care services delivered concurrently with family planning services. The influence of this variable on child mortality based on both surveys is significant when the effects of other variables are present (Tables 4.7 and 4.8). The effect of this variable after controlling for the effect of other variables in the model, however, disappears. This suggests that its influence in both surveys is working through other variables of the corresponding models.

4.7 Interaction effects on infant and child mortality

The analysis of socio-economic determinants of infant and child mortality in this chapter is mainly confined to the main effects models. However, some of the interaction effects from both the 1976 NFS and 1986 NFFS are calculated and presented in Table 4.9 in order to examine whether there are any interaction effects of the variables of interest. For this purpose a model is fitted by taking an interaction term of interest as an additional term to the corresponding main effects model. This exercise reveals significant two-factor interaction effects of 'parent's education', 'land-holding' and 'number of cows', as well as 'mother's work status' 'and ' number of cows' on child mortality from the 1986 NFFS. Similarly, 'mother's education' and 'mother's work status' from the 1976 NFS is also noted to have significant two-factor interaction effects on infant mortality. Joint variables of those which showed significant two-factor interaction effects were created in order to pursue further analysis. The results of the effects of joint variables are shown in Figures 4.1-4.4.

Figure 4.1 shows the influence of the joint variable 'mother's education' and 'mother's work status' on infant mortality from the 1976 NFS. The advantage of education is shown by the favourable survival prospects for infants born to working mothers. Among infants of mothers with no education, the risk of death to infants is favourable if the mother is not working. In contrast, the risk of death among infants of working mothers with some education is considerably lower than the risk of death to infants of not working mothers with some education. Figure 4.1 thus reveals a clear picture of infant mortality according to work status and education of mothers after controlling for the effects of other factors. As different patterns of risk of death emerge for different categories of the joint variable based on mother's work status and education, the possible mechanisms of their influence on infant mortality are also likely to be different. For example, first, risk of death among infants of mothers with no education could be due to different propensity for breastfeeding as well as time allocation for child care among working and not working mothers as explained earlier. Second, the evident advantage of education over no education, as discussed earlier, could be the consequence of mothers with some education being likely to be in economically and environmentally better-off households enabling them to afford better child care, food, health and environment to their infants, leading to the better survival of their infants. Third, working mothers, as earning members of a family, are likely to have better control over the household resources enabling them to allocate resources for the survival interest of their infants when needed.

Figure 4.2 suggests the lowest risk of death to children of working mothers who come from households which owned cows. The considerable differentials in child mortality among working mothers is also noted where a mother belongs to a household with cows and without cows. The evident slightly higher risk of death among infants of not working mothers from a household with no cows as against working and not working mothers from a house with cows could be due to economic disadvantage. This could also be the reason for the differential in child mortality for working and not working mothers from households which have cows. The worst survival prospects, among children of working mothers from a household without any cows, could be because women in these households were forced to work in order to meet the basic household needs; thus children were likely to be disadvantaged by limited household resources including mother's time for their care.

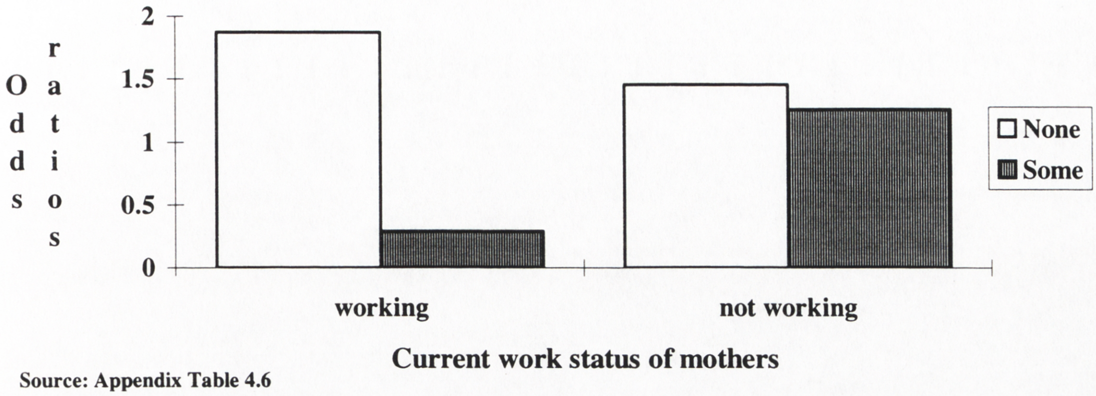
Table 4.9 Likelihood chi-square value and corresponding probability level for certain two-factor interaction effects on infant and child mortality: 1976 NFS and 1986 NFFS, Nepal.

Interacting variables	(1976-85), Infant mortality[a/] LRX^2	df	P	(1971-80), Child mortality[a/] LRX^2	df	P
Mother's education by father's education	2.0	2	NS	11.4	2	0.01
Mother's education by mother's work status	0.4	1	NS	0.8	1	NS
Mother's education by place of residence and access to health	1.5	2	NS	1.5	2	NS
Land-holding by number of cows	3.7	4	NS	10.5	4	0.01
Mother's work status by number of cows	2.4	2	NS	8.0	2	0.02
	(1966-75)[b/]			(1961-70)[b/]		
Mother's education by father's education	2.55	2	NS	4.5	5	NS
Mother's education by mother's work status	4.72	1	0.05	0.12	1	NS

Notes: Reference model are Table 4.5 to 4.8. NS indicate not significant at the 10 per cent level.
Sources: [a/] 1986 NFFS data tape and [b/] 1976 NFS data tape.

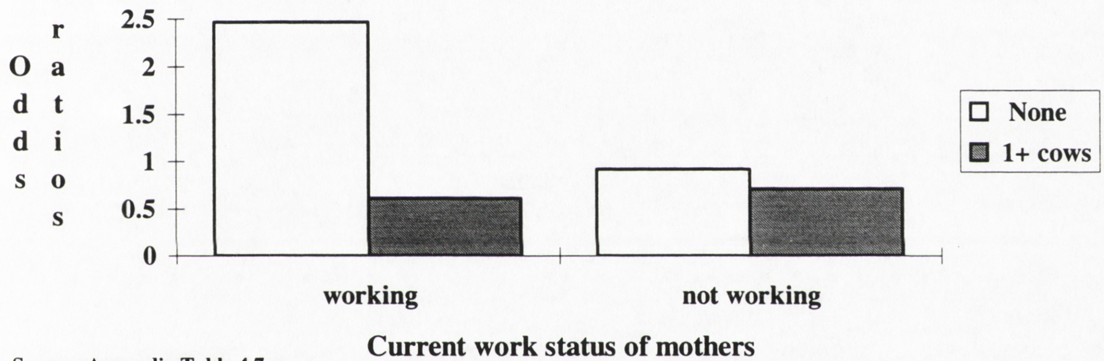
The favourable child survival prospects among the economically better households are also reflected in Figure 4.3 where possession of cows as well as land-holding is used as the household economic indicator. Children in a household with cows as well as some land experienced considerably lower risk of death. The possible way in which a better

Figure 4.1 Joint influence of mother's education and her current work status on infant mortality, 1976 NFS, Nepal



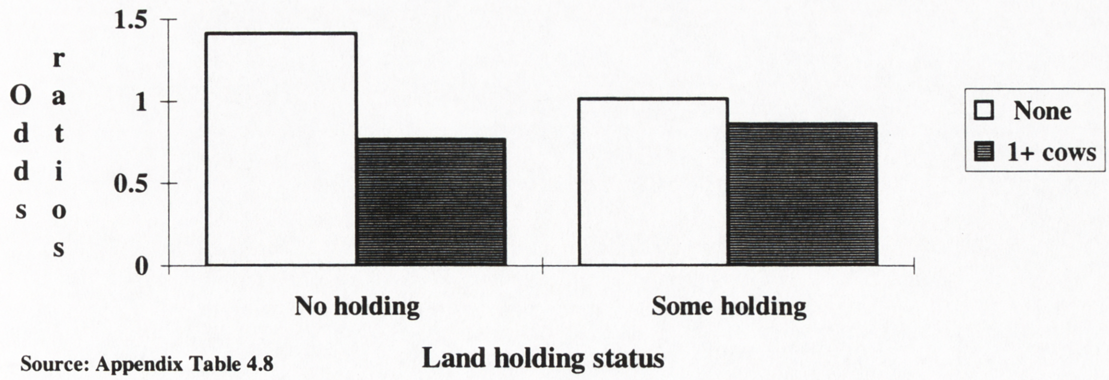
Source: Appendix Table 4.6

Figure 4.2 Joint influence of mother's work status and cows in the household on child mortality, 1986 NFFS, Nepal



Source: Appendix Table 4.7

Figure 4.3 Joint influence of household's size of land holding and number of cows on child mortality, 1986 NFFS, Nepal



Source: Appendix Table 4.8

household economy improves child survival has been already discussed in the preceding sections.

A joint variable based on the education of mothers and fathers is created to examine the joint influence of parents' education on child mortality. The 'fathers with no education and mothers with some education' category of the joint variable is excluded from the analysis since it is a very small number of cases (0.6 per cent of the total number). The result shown in the net effects column of Appendix Table 4.9 suggests 2.72 times greater risk of death to children where neither parent had education and 2.91 times greater risk where only fathers had some education as against the case where both parents had some education. The favourable survival prospects for children where both parents had some education could be the consequence of the higher economic status among these parents enabling them to afford to fulfil various child needs. The importance of household resources as a mediating factor for parents' education in influencing infant and child mortality was also noted in a study in urban Nepal (Pant, 1991).

4.8 Effects of socio-economic, health and maternal factors on infant and child mortality

One objective of this chapter is to examine whether the socio-economic variables are mediated through two maternal factors: maternal age at childbirth and length of the interval between two births (reproductive behaviour of the mother) in influencing infant and child mortality rates in Nepal. For this purpose, the socio-economic and health variables from the two surveys, mother's education, contraceptive use and place of residence (place of residence/health from 1986 NFFS) are further examined together with maternal factors.

The relationship of mother's education, contraceptive use and place of residence with the dependent variable is examined by observing the estimates of the effects of these independent variables before and after inclusion of the maternal factors in the model. If a considerable reduction in the effects of the independent variables on the dependent variable is observed after the introduction of the proximate variables in the model, the resulting interpretation will be that the effects of the socio-economic factors on the dependent variable of the model are mediated through the proximate variables. Of the seven main effects models fitted for this assessment, Model 1 is based on mother's education and contraceptive use. Model 2 introduces place of residence from the 1976 NFS and place of residence/health variables from the 1986 NFFS in Model 1. Similarly, Model 3 introduces mother's age at childbirth in Model 2. The other three main effects models, Models 4, 5 and 6, are analogous to Models 1, 2 and 3 except that first order births in these models are excluded. Model 7 is the model with all terms in Model 6 plus the length of the preceding birth interval.

Tables 4.10 and 4.11 show the parameter estimates for the mortality during infancy respectively from the 1976 NFS and 1986 NFFS. The LRX^2 corresponding to maternal education and contraceptive use in Table 4.10 suggests that these variables have a strong influence on infant mortality. Although maternal education from the 1986 NFFS shows its influence on infant mortality in the first three models, the effects disappear when first order births are excluded from the model (Models 4 through 7, Table 4.11). The same is true for the place of residence/health care variable in Table 4.11. This result further suggests that the evident influence of mother's education on infant mortality is not due to the level of education of the mother *per se*; rather to other factors such as better household resources, better ability to afford child health and care, reflected through mother's education, as discussed earlier.

In the literature, first births in general are noted to be associated with younger mothers, and, due to younger mothers' unprepared biological capability to conceive and bear children, their offspring are associated with an elevated risk of death. On these grounds it can be argued that the risk of death among firstborn infants can be considerably reduced by providing proper ante-natal, delivery and post-natal care to mothers. Mothers with some education, as argued in the preceding sections of this study, are likely to be members of economically better-off households where they are likely to be using health services. This in turn could have produced favourable survival prospects for firstborn infants of mothers with some education observed in Models 1 to 3 when all births were considered in the analysis. If education of the mother had an independent influence on

Table 4.10 Logit linear model of the effect on infant mortality of mother's education, contraceptive use and place of residence: 1976 NFS, Nepal.

All births

	Model 1			Model 2			Model 3		
Variables	Log odds	LRX^2	P	Log odds	LRX^2	P	Log odds	LRX^2	P
Mother's education		3.7	0.10		2.7	0.10		4.1	0.05
None	0.130			0.116			0.145		
	(0.070)			(0.072)			(0.073)		
Some	-0.130			-0.116			-0.145		
	(0.070)			(0.072)			(0.073)		
Contraceptive use		15.7	0.001		14.9	0.001		14.5	0.001
Never used	0.266			0.261			0.266		
	(0.072)			(0.072)			(0.074)		
Ever used	-0.266			-0.261			-0.266		
	(0.072)			(0.072)			(0.074)		
Place of residence					0.6	NS		0.5	NS
Urban				0.084			0.077		
				(0.110)			(0.110)		
Rural				-0.084			-0.077		
				(0.110)			(0.110)		

Second and higher order births

	Model 4	Model 5			Model 6			Model 7				
Variables	Log odds	LRX^2	P	Log odds	LRX^2	P	Par	LRX	P	Log odds	LRX^2	P
Mother's education		6.0	0.02		5.2	0.05		6.0	0.02		7.0	0.01
None	0.214			0.206			0.222			0.241		
	(0.092)			(0.095)			(0.095)			(0.098)		
Some	-0.214			-0.206			-0.222			-0.241		
	(0.092)			(0.095)			(0.095)			(0.098)		
Contraceptive use		15.0	0.001		14.6	0.001		16.4	0.001		17.0	0.001
Never used	0.296			0.293			0.311			0.322		
	(0.082)			(0.082)			(0.082)			(0.084)		
Ever used	-0.296			-0.293			-0.311			-0.322		
	(0.082)			(0.082)			(0.082)			(0.084)		
Place of residence					0.1	NS		0.1	NS		0.1	NS
Urban				0.036			0.043			0.028		
				(0.125)			(0.136)			(0.129)		
Rural				-0.036			-0.043			-0.028		
				(0.125)			(0.136)			(0.129)		

	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
Number	9740	9740	9419	7321	7321	7321	7279
Model LRX2	4.6	12.82	158.43	2.38	10.09	107.52	234.00
Degrees of freedom	1	4	168	1	4	0.125	268
P	0.032	0.012	0.69	0.123	0.039	0.868	0.934
Overall effects	-2.08	-2.1336	-2.257	-2.2012	-2.2274	-3.028	-2.2954

Notes: Model 1 is based on maternal education and status of contraceptive use, Model 2 adds place of residence to Model 1, and Model 3 adds mother's age at childbirth to Model 2. Models 4, 5 and 6 are analogous to Models 1, 2 and 3 except that these models exclude first order births. Model 7 is based on all the variables of Model 6 plus the length of preceding birth interval. Figures in parentheses are (SE) standard errors and NS indicates not significant at the 10 per cent level.

Source: 1976 NFS data tape.

Table 4.11 Logit linear model of the effect on infant mortality of mother's education, contraceptive use, place of residence/health: 1986 NFFS, Nepal.

All births

	Model 1			Model 2			Model 3		
Variables	Log odds	LRX^2	P	Log odds	LRX^2	P	Log odds	LRX^2	P
Mother's education		7.4	0.01		4.0	0.05		4.2	0.05
None	0.199			0.152			0.160		
	(0.077)			(0.079)			(0.081)		
Some	-0.199			-0.152			-0.160		
	(0.077)			(0.079			(0.081)		
Contraceptive use		32	0.001		27.9	0.001		34.3	0.001
Never used	0.280			0.265			0.305		
	(0.052)			(0.053)			(0.055)		
Ever used	-0.280			-0.265			-0.305		
	(0.052)			(0.053)			(0.055)		
Pl. residence/ health					6.3	0.05		5.6	0.10
Urban				-0.157			-0.166		
				(0.077)			(0.079)		
Rural access				0.061			0.089		
				(0.093)			(0.095)		
Rural no access				0.097			0.077		
				(0.060)			(0.062)		

Second and higher order births

	Model 4			Model 5			Model 6			Model 7		
Variables	Log odds	LRX^2	P	Log odds	LRX^2	P	Par	LRX	P	Log odds	LRX^2	P
Mother's education		1.7	NS		0.8	NS		0.8	NS		0.4	NS
None	0.112			0.079			0.079			0.060		
	(0.088)			(0.091)			(0.092)			(0.093)		
Some	-0.112			-0.079			-0.079			-0.060		
	(0.088)			(0.091)			(0.092)			(0.093)		
Contraceptive use		23.5	0.001		21.1	0.001		26.3	0.001		26.8	0.001
Never used	0.263			0.252			0.289			0.297		
	(0.057)			(0.057)			(0.059)			(0.060)		
Ever used	-0.263			-0.252			-0.289			-0.297		
	(0.057)			(0.057)			(0.059)			(0.060)		
Pl. residence/ health					2.2	NS		2.8	NS		2.0	NS
Urban				-0.116			-0.135			-0.114		
				(0.087)			(0.089)			(0.091)		
Rural access				0.064			0.080			0.059		
				(0.104)			(0.107)			(0.110)		
Rural no access				0.052			0.056			0.055		
				(0.068)			(0.070)			(0.072)		

	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
Number	8863	8863	8346	6881	6881	6516	6400
Model LRX2	4.85	10.97	246.12	7.57	12.14	179.55	369.42
Degrees of freedom	1	7	278	1	7	196	474
P	0.028	0.14	0.196	0.006	0.096	0.794	1
Overall effects	-2.638	-2.6332	-2.8308	-2.5594	-2.545	-2.6564	-2.606

Notes: Same as for Table 4.10. Pl. indicates 'place of'.
Source: 1986 NFFS data tape.

Table 4.12 Logit linear model of the effect on child mortality of mother's education, contraceptive use and place of residence: 1976 NFS, Nepal.

All births

Variables	Model 1 Log odds	Model 1 LRX^2	Model 1 P	Model 2 Log odds	Model 2 LRX^2	Model 2 P	Model 3 Log odds	Model 3 LRX^2	Model 3 P
Mother's education		11.7	0.001		5.7	0.01		5.6	0.02
None	0.402			0.295			0.293		
	(0.132)			(0.133)			(0.134)		
Some	-0.402			-0.295			-0.293		
	(0.132)			(0.133)			0.134		
Contraceptive use		2.6	NS		1.5	NS		2.0	NS
Never used	0.132			0.992			0.117		
	(0.084)			(0.842)			(0.086)		
Ever used	-0.132			-0.992			-0.117		
	(0.084)			(0.842)			(0.086)		
Place of residence					11.6	0.001		11.3	0.001
Urban				0.650			0.644		
				(0.232)			(0.232)		
Rural				-0.650			-0.644		
				(0.232)			(0.232)		

Second and higher order births

Variables	Model 4 Log odds	Model 4 LRX^2	Model 4 P	Model 5 Log odds	Model 5 LRX^2	Model 5 P	Model 6 Par	Model 6 LRX	Model 6 P	Model 7 Log odds	Model 7 LRX^2	Model 7 P
Mother's education		10.2	0.001		5.4	0.02		6.0	0.02		5.5	0.02
None	0.462			0.356			0.375			0.366		
	(0.165)			(0.168)			(0.169)			(0.171)		
Some	-0.462			-0.356			-0.375			-0.366		
	(0.165)			(0.168)			(0.169)			(0.171)		
Contraceptive use		1.9	NS		1.3	NS		1.5	NS		1.9	NS
Never used	0.123			0.100			0.110			0.126		
	(0.091)			(0.092)			(0.092)			(0.095)		
Ever used	-0.123			-0.100			-0.110			-0.126		
	(0.091)			(0.092)			(0.092)			(0.095)		
Place of residence					7.0	0.05		6.7	0.05		6.2	0.05
Urban				0.531			0.523			0.509		
				(0.234)			(0.234)			(0.236)		
Rural				-0.531			-0.523			-0.509		
				(0.234)			(0.234)			(0.236)		

	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
Number	6565	6565	6414	4873	4873	4873	4546
Model LRX2	0.03	6.91	87.18	0.24	8.34	58.42	152.84
Degrees of freedom	1	4	154	1	4	111	223
P	0.856	0.14	1	0.626	0.08	1	1
Overall effects	-2.62	-3.1158	-3.2508	-2.6216	-3.0126	-3.1002	-3.0406

Notes: Same as for Table 4.10.
Source: 1976 NFS data tape.

Table 4.13 Logit linear model of the effect on child mortality of mother's education, contraceptive use and place of residence/health: 1986 NFFS, Nepal.

All births

Variables	Model 1 Log odds	Model 1 LRX²	Model 1 P	Model 2 Log odds	Model 2 LRX²	Model 2 P	Model 3 Log odds	Model 3 LRX²	Model 3 P
Mother's education		16.6	0.001		8.5	0.01		9.5	0.01
None	0.460			0.351			0.393		
	(0.128)			(0.131)			(0.140)		
Some	-0.460			-0.351			-0.393		
	(0.128)			(0.131)			(0.140)		
Contraceptive use		3.3	0.10		1.7	NS		2.4	NS
Never used	0.108			0.079			0.097		
	(0.061)			(0.061)			(0.064)		
Ever used	-0.108			-0.079			-0.097		
	(0.061)			(0.061)			(0.064)		
Pl. residence/health					13.7	0.01		11.0	0.01
Urban				-0.264			-0.179		
				(0.145)			(0.155)		
Rural access				0.004			-0.111		
				(0.223)			(0.248)		
Rural no access				0.260			0.289		
				(0.124)			(0.136)		

Second and higher order births

Variables	Model 4 Log odds	Model 4 LRX²	Model 4 P	Model 5 Log odds	Model 5 LRX²	Model 5 P	Model 6 Par	Model 6 LRX	Model 6 P	Model 7 Log odds	Model 7 LRX²	Model 7 P
Mother's education		11.3	0.001		6.2	0.02		8.6	0.01		8.1	0.01
None	0.451			0.354			0.448			0.438		
	(0.152)			(0.155)			(0.170)			(0.171)		
Some	-0.451			-0.354			-0.448			-0.438		
	(0.152)			(0.155)			(0.170)			(0.171)		
Contraceptive use												
Never used		2.5	NS		1.3	NS		1.7	NS		3.1	0.10
	0.104			0.076			0.091			0.125		
Ever used	(0.067)			(0.068)			(0.071)			(0.073)		
	-0.104			-0.076			-0.091			-0.125		
	(0.067)			(0.068)			(0.071)			(0.073)		
Pl. residence/health					8.3	0.02		5.5	0.10		4.7	0.10
Urban				-0.308			-0.207			-0.190		
				(0.153)			(0.163)			(0.164)		
Rural access				0.152			0.028			0.020		
				(0.227)			(0.251)			(0.252)		
Rural no access				0.156			0.180			0.170		
				(0.128)			(0.140)			(0.141)		

	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
Number	6480	6480	6090	4816	4861	4602	4352
Model LRX2	2.68	5.98	196.93	0.17	4.31	149.99	273.61
Degrees of freedom	1	7	238	1	7	166	380
P	0.101	0.542	0.976	0.679	0.743	0.808	1
Overall effects	-3.127	-3.179	-3.450	-3.075	-3.047	-3.271	-3.244

Notes: Same as for Table 4.10. Pl. indicates 'place of'.
Source: 1986 NFFS data tape.

infant mortality, the influence of this variable for second and higher order births in Table 4.11 would not have disappeared (Models 4 to 7). This is not an argument against the independent influence of mother's education on infant and child mortality observed in other studies outside Nepal. The argument here is that, given the low level of female literacy, mother's education in itself in Nepal might not have achieved the level which is required to show its independent influence on infant mortality through better child care due to education, as suggested in the literature.

The LRX^2 and log odds corresponding to mother's education, except from Models 5 to 7 in Table 4.11, show either a similar or slightly increasing pattern from Models 2 to 5 as well as Model 5 to Models 6 and 7 in both Tables 4.10 and 4.11. A similar pattern persists for contraceptive use except for Model 2 to Model 3 in Table 4.10. Thus the results do not produce sufficient evidence to support the hypothesis that the influence of mother's education or contraceptive use is mediated through either of the two maternal factors namely mother's age at childbirth and preceding birth interval, in influencing infant mortality. This result further indicates that the influence of contraceptive use on infant mortality is more likely to be a reflection of the use of health care services delivered along with family planning services. The relationship between mother's education and contraceptive use with child mortality in Tables 4.12 and 4.13, indicated by the corresponding LRX^2 and log odds, suggests a similar pattern to that observed for infant mortality. Thus these results also do not support the hypothesis that mother's education and contraceptive use are working through mother's age at childbirth and birth interval in influencing child mortality. The evident influence of mother's education on child mortality in all models of Tables 4.12 and 4.13 could be the indication of the importance of socio-economic factors for better child survival prospects. In contrast, the evident insignificant influence of contraceptive use on child mortality in both surveys, except for the weak association in Model 1 and Model 7 in Table 4.13, could be because contraceptive use is unable to capture the child deaths from measles and other causes, and the curative services which are not delivered in conjunction with family planning.

4.9 Maternal education and contraceptive use: further analysis

This part of the analysis empirically examines whether maternal education or contraceptive use has any influence on the length of birth interval. The analysis, however, is limited to analysis of cross-tabulations.

Average age at first birth according to educational status of mothers from both surveys does not show any evidence that mothers with some education, due to their educational level, delay the timing of first births (Table 4.14). In each survey, the average age at first birth for both, that is, mothers with some as well as with no education, is almost similar for all age groups. Besides, age at first birth between the 1976 NFS and the 1986 NFFS seems to have remained constant for both mothers with some education and mothers with no education.

The evident practice of early childbearing among women of Nepal could be due to the practice of early age at marriage as well as due to cultural and religious values. Bearing a child, especially a son, in Nepal is likely to increase the status of women in the household. Children as a path for a woman to obtain the support and affection of her husband as well as of other family members is also noted in a study in Nepal (UNICEF, 1992: 16). Moreover, the importance of child, especially a son, in Nepalese societies, is also suggested by Stone in her study:

> Brahmans and Chhetris of Nepal are organized into exogamous patrilineages, and, like many patrilineal groups, they express a strong preference for male children. It is sons who will continue the line, whereas daughters will be given in marriage to other lineages. Upon marriage, the bride takes the thar (clan) name of her husband's family, and her natal group yields all rights to her domestic labour and her progeny (Stone, 1978: 11).

Despite the preference for a son among parents in Nepalese society, the ritual importance of a daughter explains the lack of sex difference in infant and child mortality (Chapter Three). The importance of a daughter as a surrogate son is also noted by Stone (1978: 7) in Nepal.

Childlessness is always a threat to a Nepalese woman because it has various consequences for her life. First, a childless woman may have to share her life with a cowife. Second, according to Hindu religion, it is a taboo for the bride's parents (grand-parents, brothers) to accept food and or/drink from their son-in-law's house until their daughter bears a child. Although this practice is dying, it could still have some psychological bearing upon women until they have borne a child. Third, in some societies of Nepal, childless women are prohibited from attending births because it is believed that

Table 4.14 Mean age of mother at first birth by current age of mother and educational status: 1976 NFS and 1986 NFFS, Nepal.

Mother's education		Current age of mothers (1976 NFS [a]) < 24	24-33	34 +	All
None	Mean	17.4	19.1	20.9	19.5
	Median	17.0	19.0	20.0	19.0
Number of mothers		(612)	(1456)	(1249)	(3317)
Some	Mean	17.1	18.9	19.6	18.5
	Median	17.0	19.0	19.0	18.0
Number of mothers		(74)	(105)	(43)	(222)
		(1986 NFFS [b])			
Mother's education		< 24	24-33	34 +	All
None	Mean	16.6	18.6	20.7	19.2
	Median	17.0	18.0	20.0	18.0
Number of Mothers		(455)	(1240)	(1109)	(2805)
Some	Mean	16.7	18.7	20.9	19.1
	Median	17.0	18.0	21.0	18.0
Number of Mothers		(90)	(192)	(80)	(364)

Notes: Figures in parentheses indicate number of mothers.
Results are based on all mothers who have had their first children during the periods [a] 1966-75 and [b] 1976-85

Sources: [a] 1976 NFS and [b] 1986 NFFS data tapes.

the presence of a childless woman could complicate the delivery. In this context, Reissland and Burghrat (1989: 46) in the case of Eastern Nepal noted that childless women are forbidden to attend births because their barrenness is believed to have deadly consequences for the neonate. Fourth, as the birth of a child establishes a couple as fertile, the birth of a daughter is considered to be far better than not having any child. In this context, Stone (1978: 7) noted that a woman's failure to conceive at all is more alarming than her having an initial miscarriage or still births:

> ...the threat of childlessness can never be totally circumvented by anyone. One's children may, after all, die at any point--a fact that becomes particularly relevant in areas like Nepal that have had a history of high infant mortality. Thus with the birth of her first child, a woman may escape the stigma of "barrenness" but she and her husband are quite aware that, unless they have several more children, they remain quite vulnerable to childlessness (Stone, 1978: 7).

All of the reasons discussed could have led to similarity in the timing of first births in Nepal between 1966 and 1985 overall as well as by mother's educational status.

Table 4.15 displays the mean length of birth interval according to mothers' education and birth order, after controlling for the current age of mother. Results in Table 4.15, in general, suggest a longer interval between the birth of children born to mothers with no education as compared with those born to mothers with some education, from both surveys. This result does not provide sufficient grounds to support the hypothesis that education among women leads to maintaining longer spaces between births. The evident shorter average length of interval between children corresponding to women of younger ages, on the other hand, suggests that closely spaced births are more prominent among younger cohorts of mother. The short duration of breastfeeding among women in recent cohorts and among mothers with some education (Appendix Table 4.1), leading to a short period of postpartum amenorrhoea (the average length of time it takes to resume the menstrual cycle after a birth in Appendix Table 4.2) could have led to shorter intervals between their children. John et al. (1987: 446) in a study in Bangladesh also noted greater exposure to the risk of conception for those mothers who wean their children early. This partly explains the shorter length of interval for children borne by the younger mothers and mothers with some education in comparison to children borne by women in older ages and mothers with no education.

Appendix Table 4.3 clearly indicates that mothers with some education are more likely to use modern contraceptives to control their pregnancies than those with no education. The increase in ever use of contraception among older women as against younger cohorts of women is also evident (Appendix Table 4.3). In contrast, among women with some education, irrespective of their age, the interval between births of those who have ever used contraceptives is relatively short (Table 4.16). A similar pattern

Table 4.15 Mean length of birth interval (months) by birth order of child, current age of mother and mother's education: 1976 NFS, Nepal.

1976 NFS [a]	Birth order of the child					
Mother's education	2	3	4	5	6 +	All
			Maternal age: < 24			
None	26.2	24.5	---	---	---	25.7
	(275)	(81)	---	---	---	(377)
Some	24.9	---	---	---	---	24.8
	(33)	---	---	---	---	(41)
			Maternal age: 24-33			
None	33.4	31.4	29.2	28.1	26.9	31.1
	(1226)	(996)	(656)	(351)	(254)	(3483)
Some	29.9	29.9	31.1	25.0	---	29.6
	(89)	(67)	(420	(23)	---	(230)
			Maternal age: 34 +			
None	49.5	45.2	42.2	36.7	33.1	38.2
	(242)	(419)	(547)	(566)	(1369)	(3143)
Some	---	40.6	41.6	32.3	33.7	35.9
	---	(11)	(19)	(20)	(44)	(101)

1986 NFFS [a]	Birth order of the child					
Mother's education	2	3	4	5	6 +	All
			Maternal age: < 24			
None	28.4	27.4	30.6	---	---	28.5
	(249)	(80)	(13)	---	---	(350)
Some	27.1	28.8	---	---	---	27.7
	(53)	(19)	---	---	---	(75)
			Maternal age: 24-33			
None	34.8	32.5	30.4	29.2	28.6	32.4
	(1099)	(918)	(574)	(295)	(203)	(3089)
Some	(33.5)	31.7	30.0	28.8	28.4	31.9
	(156)	(106)	(55)	(25)	(16)	(358)
			Maternal age: 34 +			
None	50.9	44.3	40.3	35.8	33.6	38.5
	(289)	(447)	(540)	(540)	(1185)	(3001)
Some	38.9	36.4	37.2	32.3	34.3	35.8
	(29)	(38)	(33)	(26)	(45)	(171)

Notes: Figures in parentheses indicate number of children.
Results are based on birth cohorts during [a] 1966-75 and [b] 1976-85.
(---) indicates less than 10 cases

Sources: [a] 1976 NFS and [b] 1986 NFFS Data tapes.

Table 4.16 Mean length of birth interval (months) by current age of mother, status of contraceptive use and mother's education: 1976 NFS, Nepal.

Status of contraceptives use	< 24 N	< 24 S	24-33 N	24-33 S	34 + N	34 + S	All N	All S
	1976 NFS[a/]							
Never used	36.4 (456)	43.8 (44)	32.2 (3348)	29.9 (166)	38.5 (2937)	38.0 (57)	35.2 (6741)	33.9 (267)
Ever used	27.3 (13)	24.3 (10)	28.5 (184)	29.8 (67)	34.8 (208)	33.1 (44)	31.7 (405)	30.5 (121)
	1986 NFFS [b/]							
Never used	28.6 (314)	29.4 (46)	32.9 (2320)	32.6 (155)	39.3 (2366)	38.9 (70)	35.7 (5000)	33.6 (271)
Ever used	26.3 (35)	25.5 (29)	30.9 (766)	31.3 (203)	35.3 (635)	33.7 (101)	32.7 (1436)	31.6 (333)

Current age of mother; Maternal education.

Notes: Figures in parentheses indicate number of children.
Results are based on birth cohorts during [a/] 1966-75 [b/]1976-85.
N= no education and S= some education.
Sources: [a/]1976 NFS and [b/]1986 NFFS Data tape.

emerged when the analysis as in Table 4.16 was focused for those who have ever used any temporary methods of contraception (Appendix Table 4.5) These results thus do not support the hypothesis that contraceptive use in Nepal is working to prolong the spacing between childbirths. The lack of influence of contraceptive use on length of birth interval could partly be due to the fact that a higher proportion of women acceptors was for sterilization. This suggests that contraceptive users in Nepal are more likely to be birth limiters than birth spacers. That is contraceptive use is a consequence of high fertility, not a cause.

The results in Table 4.17 partly explain why these women in Nepal did not like to use contraception. Even after achieving four or more children considerable proportions of respondents fall in the categories of 'desire more children', 'no need for family planning', 'desire sons' and 'not liked by their husbands'. Further explanations for these results can be provided only from further detailed study which is beyond the scope of this study.

Table 4.17 Percentage distribution of women by reasons for not using contraception and number of children ever born: 1986 NFFS, Nepal.

Reasons for not using contraception	Number of children ever born 1	2	3	4 +	Total
Desire more children	38	25	19	16	100 (384)
Health reason	2	13	16	67	100 (140)
Service not available	3	12	1	81	100 (55)
No need	18	20	15	45	100 (320)
Desire son	12	16	27	44	100 (122)
Desire daughters	20	28	22	28	100 (35)
Religious reason	7	15	14	63	100 (57)
Not liked by husband	4	13	13	67	100 (86)
Total	20 (242)	19 (237)	17 (211)	42 (509)	100 (1199)

Notes: Figures in parentheses indicate number of women.
The analysis considers the period 10 years before the survey.
Source: 1986 NFFS data tape.

4.10 Further discussion of the results

This chapter has examined the effects of socio-economic and health factors on infant and child mortality. Analysis was also carried out in order to examine whether socio-economic and health factors were mediated through the maternal factors (mother's age at childbirth and length of interval between births) in influencing survival status of infants and children.

Among the socio-economic and health variables used in this study, contraceptive use from both surveys, mother's work status from the 1976 NFS and mother's education, number of cows possessed by the household and place of residence/health from the 1986

NFFS had significant net influence on infant mortality. All of the socio-economic variables from both surveys were found to have significant influence on child mortality when the influence of other variables are present (gross effects column). However, only father's education, mother's work status and place of residence from the 1976 NFS, mother's education, mother's work status, size of land-holding, number of cows possessed by the household and place of residence/access to health variables from the 1986 NFFS were found to have significant influence on child mortality after controlling for the effects of other variables of respective models (Tables 4.5 to 4.8).

As discussed in this study, the path through which maternal education influences child survival prospects is likely to be different as the society in question differs. Jain (1985: 423) in India explained that the effects of maternal education on child survival is transmitted through the use of medical services by mothers during childbirth, and the pre-natal and post-natal periods. A similar explanation is also given by Cleland and Van Ginneken (1989: 85) using data from several developing countries. Takce and Shorter (1984: 269-277) in Jordan measured maternal education as the mother's resources and suggested multiple pathways such as immunisation, health services, child sickness care and nutrition, through which maternal education is likely to exert its influence on child survival. Lindenbaum et al. (1989:120) noted the advantage of literacy over illiteracy in Bangladesh and argued that the practice of cleanliness among educated women could be the mediating factor between maternal education and mortality during childhood. Yohannes and Streatfield (1988: 8) emphasized the use of modern medical facilities as one of the mediating factors in influencing childhood mortality in Ethiopia, while Tsui et al. (1988: 707) for Bas Zaire noted that the better ability of the educated mothers over the less educated mothers was important in identifying the symptoms of sickness of child. The effect of maternal education on child survival in countries with a high level of education (Palloni, 1981: 641-645) and with rising per capita income (Cochrane, 1980: 5) is also suggested to be negligible.

Studies in developing countries which have noted the significant influence of maternal education on favourable child survival prospects have suggested various mechanisms. Caldwell (1979: 409-410) in a study in Nigeria suggested three main paths to explain the causal link between maternal education and child survival. First, education helps to break with the traditional way of dealing with child illness, health, food and well-being; second, education enhance the capacity of mothers to use better health care services from among available alternatives; and third, education changes the traditional balance of familial relationships providing mothers with more power in decision making. In addition to these three explanations, Caldwell et al. (1983: 198) in a study in India added a greater role of educated mothers in the decision for balanced allocation of household resources and balanced distribution of foods among the family members.

Cleland and Van Ginneken (1989: 84), referring to UN and WFS studies, suggested that Nepal is one of the three exceptional countries where maternal education was not found to have significant influence on survival prospects of children. Gubhaju (1991: 136-139) also observed the insignificant influence of mother's education on infant mortality in Nepal from the 1976 NFS data. However, Gubhaju found the significant influence of mother's education on child mortality in the multivariate analysis. The lack of statistically significant influence of maternal education on infant and child mortality in this study based on the 1976 NFS (Table 4.7) supports the view of Cleland and Van Ginneken (1989) but contradicts the finding of Gubhaju (1991) with respect to child mortality. This could be because first order births, contraceptive use and mother's work status which were not considered in the multivariate analysis in Gubhaju's study are taken into account in the present study.

With regard to the influence of maternal education on infant and child mortality, results based on the 1986 NFFS data suggest a completely different scenario to that of the 1976 NFS context. The results clearly suggest net influence of mother's education on both infant and child mortality (Table 4.6 and 4.8). Despite these results and given the low level of female literacy as well as a number of other points raised in this study, there are sufficient grounds to suspect that the effect of mother's education is not due to the level of education *per se* widely explained in the literature as working through improved child care due to enhanced knowledge and capability derived from education. The influence in this study could be the reflection of better household socio-economic and environmental status among women with some education. First, Appendix Table 4.4 clearly indicates better access to electricity and toilets as well as better quality housing in terms of the material used for the roof and walls for women with a higher level of education. Second, the lack of influence of mother's education in the 1976 NFS and the considerable attenuation in the LRX^2 value corresponding to this variable with respect to both infant and child mortality, after controlling for the influence of other variables in the respective models, further suggests, that the influence is mediated through other factors (Tables 4.5 through 4.8). Third, the influence of mother's education on infant mortality is evident in Models 1 to 3 when all births were considered (Table 4.11). However, its effect in Models 4 through 7 disappears after excluding the first order births in the analysis. This could be because mothers with some education, being the members of economically better-off households might have been able to afford the modern ante-natal, delivery and post-natal services. These services, for the first order birth which in the literature has been widely accepted to be at higher risk, could have produced the favourable survival prospects which in turn could have reflected through the educational status of mothers when all births were considered in the analysis. On the other hand, the lack of difference in mortality according to mother's educational categories in Models 4-7 could be because mother's education is unable to capture the effect of higher intensity of births guided by large family norms resulting in closely spaced births between pairs of siblings as observed in Chapter Three. All the evidence thus leads to the conclusion that the evident favourable influence of mother's education on child survival in this study is not due to education *per se*. It is rather due to different household economic and environmental factors among women as a result of their educational status.

The assessment of the effects of joint variables (mother's education and her work status) indicate highest risk of death among infants of working mothers with no education followed by not working mothers with no education, not working mothers with some education and working mothers with some education (Figure 4.1). In this context, Behm (1991: 12) argued that women who are being forced to participate in the labour force to earn a living could lead to a deterioration in the health of the child who is already exposed to less favourable living conditions. The same could be true for the evident highest risk of death among infants of working mothers with no education observed in this study.

The favourable survival prospects of children in economically better-off households, measured by the number of cows possessed by the household and household size of land-holding, is also evident in Figure 4.3. In addition, the evident lowest risk of death among infants of working mothers from households with cows also suggests the favourable influence of a better household economic situation on child mortality (Figure 4.2).

Consideration of maternal factors in the analysis was not able to attenuate the influence of socio-economic and health-related factors in comparison to the influence of these variables where maternal factors were not considered (Tables 4.10 through 4.13). The results in this study thus did not produce sufficient evidence to support the hypothesis that socio-economic variables exert their influence on infant and child mortality through maternal factors.

Further analysis was carried out to examine the hypothesis that educated mothers are likely to delay their first birth and are likely to maintain a longer interval between their offspring compared to mothers with no education. The analysis suggested no difference in average age at first birth for mothers with some education and mothers with no education. Besides, the results from both surveys shows a longer mean birth interval for mothers with no education as against those mothers with some education. This could be partly because of the shorter duration of breastfeeding practised among mothers with some education as against mothers with no education (Appendix Table 4.1). Insufficient frequency of feeding and the increasing tendency to give up breast-feeding among urban and educated mothers in Nepal was also noted by UNICEF (1992: 60).

The analysis also examined whether or not the significant influence of contraceptive use on infant mortality observed in the multivariate analysis (Table 4.10 and 4.12) was working through longer birth spacing. The analysis clearly shows that educated mothers in Nepal are more likely to use modern methods of contraception than mothers with no education. Similarly, younger mothers are less likely to use modern contraceptives than older mothers. However, the shorter average interval between the births of offspring of parents who have ever used contraceptives as against those who have never used contraceptives suggests that contraceptive use has no effect in influencing the length of interval between births in Nepal. This result leads to the conclusion that most of the parents who were using contraceptives in Nepal were likely to be birth limiters rather than birth spacers. This indicates that the profound influence of contraceptive use on infant mortality could be due to the maternal and child health care services delivered in conjunction with family planning services. Gray (1985: 6) also noted medical intervention as one of the reasons for the decline in Australian Aboriginal infant and child mortality. Gray further argued that the relatively cheap component of medical care provided through maternal and child health care services could have had a greater impact in producing favourable child survival prospects. Schultz (1979: 3) also noted public health activities as one of the factors likely to reduce the exposure of the individuals to disease without substantially changing personal economic resources, relative price and individual behaviour. However, why contraceptive use did not affect the length of spacing between births is largely unexplained due to the limitations of the survey data as well as the lack of qualitative information that can supplement the explanation. In addition, how contraceptive use influences infant and child mortality through health care services in this study remains unexplained due to lack of data.

CHAPTER FIVE

SURVIVAL STATUS OF THE PRECEDING CHILD AND MORTALITY RISK TO THE INDEX SIBLING

5.1 Introduction

The effects of the length of the preceding birth interval on infant and child mortality, along with the other demographic and socio-economic variables, were examined in Chapters Three and Four, respectively. The survival status of the preceding child, however, was not taken into account in those chapters. The effect of the length of the preceding birth interval on child survival prospects without control for the effect of the survival status of the preceding child can be expected to be biased (Winikoff, 1983: 232; Boerma and Bicego, 1992; 245-246; Pebley and Millman, 1986: 71-72; DeSweemer, 1984: 55-56). These studies, in general, argue that the death of the elder of two siblings during infancy tends to shorten the interval between births by involuntary cessation of breastfeeding leading to an early resumption of ovulation, or because of the replacement effect, whereby parents seek to replace a child who has died. In this situation the short birth interval between children could be a result of the death of the preceding child, while the death of the index child could be due to the same factors that caused the death of its elder sibling rather than the short birth interval *per se* (Palloni and Millman, 1986: 317; Fedrick and Adelstein, 1973: 750; Winikoff, 1983: 232; Lantz et al., 1992: 222, Pebley and Stupp, 1987: 43-47). The association between closely spaced births and the death of the previous sibling in influencing the mortality risk of the index child was found in studies from Taichung, Taiwan (Jain, 1969: 423), Sire, Senegal (Cantrelle and Leridon, 1971: 529), three Bavarian villages in nineteenth century, Germany (Knodel, 1968; 310), and Indonesia, Nepal and Sri Lanka (Chandran, 1989: 220).

This chapter, thus, is designed to re-examine the effect of the length of the preceding birth interval on infant and child mortality in Nepal taking into account the survival status of the preceding child categorised as dead or alive. This assessment should indicate the net strength of the length of the preceding birth interval and the survival status of the preceding child as predictors of infant and child mortality when the influence of one variable has been eliminated. In addition, this chapter also examines the magnitude of the change in the effect of the survival status of the preceding child in the absence and presence of the control for selected indicators of socio-economic and health factors.

5.2 Background and significance

Past studies have shown that the deaths of siblings in a family are correlated for a variety of reasons and are likely to be independent of the length of the preceding birth interval. Such studies can be traced back as early as the 1930s when Gardiner and Yerushalmy (1939: 31), from New York data of 1936, found higher neonatal as well as still-birth rates among infants born to mothers with experience of a previous child loss than to those born to mothers with no experience of such loss. A follow-up of this study carried out by Schlesinger and Allaway (1955: 182-183) also noted that the risk of death during the prenatal period among those who had lost the previous sibling was 2.7 times greater than those who had not experienced such loss.

Hobcraft et al. (1985: 371) argued that studies related to these issues could indicate the level of mortality within a family. Hobcraft et al. using the data from 39 World Fertility Survey countries, noted the elevated risk of death for the index child when the older of the pair of children has died. Stockel and Chowdhury (1972: 119) found a higher probability of death among index siblings in Bangladesh when the older of the siblings was dead. Majumder (1989: 159) also observed that the survival status of the preceding child at age one had a net influence on the probability of death. However, Swenson and Harper (1979: 467) found higher probability of death to index siblings only when mothers in Bangladesh had experienced two or more foetal deaths. In a later study in Bangladesh, Swenson (1981: 302-303) also observed a higher risk of death among infants born to mothers with experience of two or more previous child losses as compared to those with no child loss or one previous child loss. Swenson found that this pattern was true for all lengths of preceding birth interval categories in the study. For Korea Kim (1986: 7) found that the risk of death to infants preceded by a dead child was more than two times greater than to infants preceded by a surviving child. These findings based on different studies discussed in this section show that previous foetal or sibling loss experiences among women of reproductive ages increases the probability of death to index siblings born to them.

The mechanism through which survival status of the preceding child operates in influencing the probability of death to the index sibling seems to be different in a situation where the elder of a pair has survived compared with where it has died. The death or survival of a sibling pair and its relation with the survival status of the index child is explained through the absence or presence of the competition between children for familial resources, care and disease transmission (Koenig et al., 1990: 250). Hobcraft (1987: 10) argued that the increase in the risk factor to index siblings preceded by a surviving child could be the consequence of the competition between the pair for resources. In contrast, Hobcraft also speculated that the increased risk of death to an index sibling preceded by a child who failed to survive could be the reflection of a combination of several biological factors such as prematurity, low birth weight, continuing social, economic and environmental deprivation or poor knowledge and health care.

Das (1975: 449) in a study in India argued that the survival or death of a child in a family determines the frequency of intercourse which in turn is likely to determine the length of birth interval between siblings in a family. The death of an infant could increase the frequency of intercourse as an effort to conceive to replace the loss which in turn is likely to result in a closely spaced birth contributing to elevated risk of death. Pebley and Millman (1986: 71) argued that the death of the elder of a pair may result in a shortened birth interval as a consequence either of the replacement effect or of truncated lactation which in turn could deplete a women's reproductive efficiency and nutritional reserves leading to the birth of a less healthy child and so to the higher risk of death. DeSweemer (1984: 56-59) puts forward a number of alternative hypotheses to explain the adverse influence of the death of the elder of the pair on the survival chances of the index sibling.

DeSweemer argued that this effect could be explained by common causes such as maternal depletion syndrome, higher environmental contamination, poor nutritional practices, prevalence of communicable diseases or diminishing quality of parental care because of grief on the death of the previous child. DeSweemer further argued that survival of the elder of a pair reflects effective parity or favourable conditions that also protect the index child from dying.

Past studies have also noted that the probabilities of dying for children within a family are correlated (Wolfers and Scrimshaw, 1975: 483; Winikoff, 1983: 232; Gubhaju, 1991: 106-118; Majumder, 1989:174-175; Pebley and Millman, 1986: 71). This indicates that a woman who has a history of at least one child loss is at higher risk of losing a succeeding child born to her. In this context, Winikoff (1983: 232) and Pebley and Millman (1986: 72) suggested that a family that has experienced a previous child loss may have the same biological or behavioural risk since children born in the same family presumably are exposed to a similar environment. In this respect, Boerma and Bicego (1992: 245-246) argued that interpreting the result of controlling for the fate of the preceding sibling is not an easy task due to two possible counteractive mechanisms. They are:

> (1) if mortality risks between successive children are correlated because of common familial characteristics, the effect of birth interval on child mortality could be reduced by controlling for previous child death and (2) if sibling competition is important, then the previous child removes the potential effects of sibling competition and disease transmission; therefore controlling for the survival status of the previous child could be expected to increase the effect of birth intervals on child survival.

5.3 Analytical approach

As in the preceding chapters, analyses in this chapter are mainly confined to cross-tabulation of bivariate and multivariate main effects logit models. The cross-tabulation analyses are performed to examine whether or not mortality differentials among index children exist according to the survival status of the preceding sibling, mother's age at childbirth, birth order, and sex of the preceding and index siblings. The main effects logit models are fitted for further analysis.

The survival status of the preceding child at the time of the birth of the index child was employed to examine infant mortality differentials in Nepal (Gubhaju, 1991) and in Indonesia (Hull and Gubhaju, 1986). In this context, Majumder (1989: 135) argued that the survival status of the preceding child at age one could be a better measure for this variable where the data are based on birth history information rather than pregnancy history. Majumder further argued that the survival status of the preceding sibling measured at the time of the birth of the index child from birth history information tends to produce biased results. This is because an index child following more than one pregnancy loss is likely to possess a longer preceding birth interval than where no such losses are experienced. Hobcraft (1987: 10), explaining how the survival status of the preceding sibling influences the survival status of the index sibling, used the results based on the survival status of the preceding sibling at two years of age. This study used the survival status of the preceding sibling at age one for the analysis of infant mortality and at age two for the analysis of child mortality.

5.4 Survival status of the preceding child and infant mortality

Table 5.1 shows infant mortality rates per 1000 live births of the index child according to birth order and survival status of the preceding child at age one. The probability of death to infants preceded by a child who died before its first year of life is considerably higher in both surveys as compared with those preceded by a surviving child. This is true for infants of all birth orders. This phenomenon persists even after controlling for the mother's age at childbirth (Table 5.2). The probability of death, except for infants preceded by a dead sibling born to mothers aged between 24-33 years based on the 1986 NFFS, tends to increase with the increase in the orders of births for both categories of the survival status of the preceding child. On the other hand, the probability of death to infants, in general, tends to decrease in both categories of the survival status of the preceding child, with the increase in the mother's age at childbirth.

5.5 Sex of an infant and infant mortality

The analysis in Chapter Three has clearly demonstrated that infant and child mortality differentials according to the sex of a child are not statistically significant. The analysis by sex of the preceding child and its survival status employed in this chapter is expected to further clarify the role of the sex of the child in Nepal in influencing the survival chances of infant and child mortality.

The effect of the sex of the child variable in a society where males are more highly valued than females can be expected to influence the survival prospects of children born in a family through differential parental care in favour of males. If this is the case, then the probability of death for a male index child should be lower than for a female index child, especially when the index male is preceded by a male sibling who has died. This is because parents who have lost a male child are likely to provide maximum effort and services in order to maximise the survival probability of the newly born male child. Second, the probability of death to a female index child of higher birth order and preceded by a surviving sibling should be higher than that of a male index child of similar order of birth and preceded by a surviving sibling. This is because, as suggested by Gubhaju (1991: 112), girls at higher order births are more likely to be unwanted because of the perceived lower value of females than males in Nepal. To examine these hypotheses, mortality rates for the index infant are calculated based on both the 1976 NFS and 1986 NFFS data sets by controlling for the sex and birth order of the index infants as well as the survival status and sex of the preceding child. The results are shown in Tables 5.3 and 5.4.

The results based on Tables 5.3 and 5.4 are compared and analysed from two perspectives: comparison of the mortality rates between the index male as against the index female infant, according to the sex of the index infant and survival status and sex of the preceding infant, shown in the individual order of births as well as in the overall column. An examination of the figures in Tables 5.3 and 5.4 suggests a mixed patterns of results regarding the sex differentials in infant mortality as a consequence of the differential parental care in favour of males. For example, the risk of death to the male index infant which was preceded by a dead male sibling was lower than to the female index infant

Table 5.1 Infant mortality rates by birth order and survival status of the preceding child: 1966-85, Nepal.

Birth order of the index infants	Survival status of the preceding child at age one: 1966-75 a/ Dead	Alive	Ratio (D/A)	1976-85 b/ Dead	Alive	Ratio (D/A)
2	223	129	1.7	185	77	2.4
	(349)	(1539)		(194)	(1697)	
3	199	127	1.6	177	69	2.6
	(271)	(1328)		(169)	(1467)	
4	281	119	2.4	177	75	2.3
	(210)	(1088)		(124)	(1120)	
5	194	125	1.6	213	81	2.6
	(155)	(822)		(103)	(809)	
6 +	295	146	2.0	131	94	1.4
	(275)	(1284)		(175)	(1298)	
Overall	240	130	1.9	173	79	2.2
	(1260)	(6061)		(765)	(6391)	

Notes: Rates are per 1000 live births. Ratio = ratio of rates.
Figures in parentheses indicate the number of live births.
The analysis considers children born between a/ 1966-1975 and b/ 1976-85.
Sources: a/ 1976 NFS data tape and b/ 1986 NFFS data tape.

Table 5.2 Infant mortality rates by maternal age at childbirth, birth order, and survival status of the preceding child: 1966-1985, Nepal.

Birth order of the index infants	Maternal age at childbirth (years): <24 Dead	<24 Alive	<24 Ratio (D/A)	24-33 Dead	24-33 Alive	24-33 Ratio (D/A)	34 + Dead	34 + Alive	34 + Ratio (D/A)
1966-75 a/									
2-3	231	150	1.5	180	110	1.6	----	----	----
	(424)	(1484)		(183)	(1238)		----	----	
4-5	250	194	1.3	248	114	2.2	----	108	----
	(250)	(222)		(254)	(1326)		----	(362)	
6 +	----	----	----	309	147	2.1	276	144	1.9
	----	----		(139)	(624)		(134)	(651)	
1976-85 b/									
2-3	157	81	1.9	242	66	3.7	--	40	--
	(261)	(1750)		(99)	(1315)		--	(99)	
4-5	211	128	1.7	188	70	2.7	--	59	--
	(52)	(312)		(154	(1348)		--	(268)	
6 +	--	--	--	153	95	1.6	102	85	1.2
	--	--		(98	(667)		(68)	607)	

Notes: Same as in Table 5.1. '----' indicates less than 20 cases.
Sources: a/ 1976 NFS data tape and b/ 1986 NFFS data tape.

preceded by a dead male sibling (244 as against 266)[1/]; the probability of death to the male index infant preceded by a dead female was lower than to the female index infant preceded by a dead female (213 as against 230); and the probability of death to the male index preceded by a dead female was lower than to the female index preceded by a dead male (213 as against 266) (overall row of Table 5.3).

These results suggest differential care in favour of male as against female infants. In contrast, phenomena such as the higher risk of death to the male infant preceded by a dead male than to the female index preceded by a dead female (244 as against 230) and the higher risk of death to the male index preceded by a dead male than to the male index preceded by a dead female sibling (244 as against 213) do not support the hypothesis that differential parental care in favour of males exists in the society in question. Had there been a differential in mortality as a consequence of the parental care in favour of males, the second set of observations would have been the other way around. This is because parents who had already lost a son would have provided maximum care and services to their ability in order to ensure the survival prospects of the newly born male compared with a newly born female as a consequence of the higher value attached to male children. However, this effect is not observed in the second set of observations.

The comparison of the risk of death to a male index infant as against a female index infant corresponding to the 'alive' category of the survival status of the preceding child based on the overall row of Table 5.3 also does not provide sufficient grounds to support the first hypothesis that parental care for their children differs according to the sex of the child. For example, the probability of death to a male index infant preceded by a surviving male is higher than to a female index infant preceded by a surviving female (146 as against 124). In addition, the risk of death to a male index infant preceded by a surviving female infant is higher than to a female index infant preceded by a surviving male (128 as against 122). These figures would be expected to be the other way around to support the hypothesis that differential parental care in favour of males is operating in explaining the

---

1/ These figures are rates per 1000.

Table 5.3 Infant mortality rates by birth order, sex of the child, and sex and survival status of the preceding child: 1966-75, Nepal.

Birth order of the index infant	Index child: male					
	Preceding child: male			Preceding child: female		
	Survival status of the preceding child at age one					
	Dead	Alive	Ratio (D/A)	Dead	Alive	Ratio (D/A)
2	218	126	1.7	213	127	1.7
	(101)	(421)		(89)	(377)	
3	224	144	1.6	229	94	2.4
	(67)	(262)		(61)	(320)	
4	314	135	2.3	255	135	1.9
	(51)	(281)		(47)	(266)	
5	256	136	1.9	88	143	0.6
	(39)	(206)		(34)	(210)	
6 +	246	191	1.3	240	145	1.7
	(57)	(314)		(50)	(325)	
Overall	244	146	1.7	213	128	1.7
	(315)	(1584)		(281)	(1498)	
Birth order of the index infants	Index child: female					
2	276	123	2.2	181	141	1.3
	(87)	(365)		(72)	(376)	
3	192	142	1.4	157	123	1.3
	(73)	(330)		(70)	(316)	
4	254	87	2.9	312	119	2.6
	(59)	(264)		(53)	(277)	
5	244	107	2.3	162	114	1.4
	(45)	(187)		(37)	(219)	
6 +	346	138	2.5	311	114	2.7
	(78)	(312)		(90)	(333)	
Overall	266	122	2.2	230	124	1.9
	(342)	(1458)		(322)	(1521)	

Notes: Rates are per 1000 live births.
Figures in parentheses indicate the number of live births.
The analysis considers children born between 1966-1975.
Ratio= ratio of rates (dead/alive).

Source: 1976 NFS data tape.

Table 5.4 Infant mortality rates by birth order, sex of the child, and sex and survival status of the preceding child: 1976-85, Nepal.

Birth order of the index infant	Index child: male					
	Preceding child: male			Preceding child: female		
	Survival status of the preceding child at age one					
	Dead	Alive	Ratio (D/A)	Dead	Alive	Ratio (D/A)
2	187 (48)	83 (480)	2.3	232 (43)	67 (462)	3.5
3	169 (53)	75 (397)	2.2	137 (29)	109 (347)	1.3
4	228 (35)	72 (290)	3.2	217 (23)	80 (286)	2.7
5	280 (25)	56 (194)	4.9	142 (21)	99 (221)	1.4
6 +	243 (37)	82 (327)	2.9	61 (49)	78 (319)	0.8
Overall	212 (198)	76 (1688)	2.8	151 (165)	85 (1635)	1.8
Birth order of the index infants	Index child: female					
2	180 (61)	74 (401)	2.4	142 (42)	87 (354)	1.6
3	162 (43)	31 (410)	5.1	227 (44)	67 (313)	3.4
4	128 (39)	78 (256)	1.6	148 (27)	72 (288)	2.0
5	230 (26)	66 (212)	3.5	193 (31)	104 (182)	1.9
6 +	71 (42)	97 (307)	0.7	170 (47)	118 (345)	1.4
Overall	151 (211)	67 (1586)	2.2	178 (191)	89 (1482)	2.0

Notes: Rates are per 1000 live births.
Figures in parentheses indicate the number of live births.
The analysis considers children born between 1976-1985.
Ratio= ratio of rates (dead/alive).

Source: 1986 NFFS data tape.

sex differentials in infant mortality. The analysis based on the 1986 NFFS in Table 5.4 suggests a similar patterns of results to those observed in Table 5.3 based on the 1976 NFS, except where the risk of death is higher to a male index infant preceded by a dead male sibling than to a female index infant preceded by a dead male sibling (212 as against 151) and the risk of death is lower to a male index infant preceded by a surviving male than to a female index infant preceded by a surviving female (76 as against 89).

The comparison of the probability of death for a son with that of a daughter, according to their individual order of births and the survival status of the preceding child, does not show straightforward results in either Table 5.3 or 5.4. However, the lower probability of death to fifth and higher order sons preceded by a dead daughter as against corresponding daughters preceded by a dead sibling irrespective of its sex (for example: 88 versus 162 and 244) partly supports the hypothesis that parents are likely to provide more favourable care to sons than to daughters (Table 5.3). A similar pattern of results emerges in Table 5.4.

The better survival prospects among the fourth and higher order daughters as against sons of corresponding order preceded by a surviving sibling irrespective of its sex (Table 5.3) do not support the hypothesis that higher order daughters as compared to sons of corresponding order are unwanted. However, the result based on the 1986 NFFS data (Table 5.4) suggests the reverse pattern from that observed in Table 5.3 for fifth and higher order births and partly supports the second hypothesis. On the basis of the results in Tables 5.3 and 5.4, it can be concluded that some indication of the sex differentials in infant mortality persists in Nepal after controlling for the survival status of the preceding child and sex of the preceding child.

Finally, it should be observed that the overall probability of death to index infants preceded by a sibling who died before the end of its first year of life, irrespective of its sex, in general, is substantially higher than to those preceded by a surviving sibling. This result was consistent in both the 1976 NFS and 1986 NFFS (Tables 5.3 and 5.4). It suggests that the adverse effect of previous child loss on the survival status of the index infant could be the consequence of the genetic relationship between successive infants born in the same family (Winikoff, 1983: 232) or be due to common environment and similar child care practices adopted by mothers for their children (Pebley and Millman, 1986: 72; Hobcraft, 1987: 33; Dasgupta, 1990: 489).

5.6 Infant mortality, birth interval and survival status of the preceding child at age one

Table 5.5 shows the mortality rates for index infants according to the survival status of the preceding child and the length of the preceding birth interval. Table 5.5 clearly shows a higher probability of death to index infants preceded by a dead as against surviving sibling at each group of length of birth interval. Moreover, irrespective of the survival status of the preceding child, a monotonic negative relation between birth interval and infant mortality rate is evident in Table 5.5. This result further confirms the negative association between the length of birth interval and survival status of infants observed in Chapter Three. It also suggests that the influence of the survival status of the preceding infant on the mortality risk of the index infant is independent of the length of the preceding birth interval.

Table 5.5 Infant mortality rates by length of the preceding birth interval (months) and survival status of the preceding child: 1966-85, Nepal.

Preceding birth interval (months)	Survival status of the preceding child at age one					
	1966-75 [a]		Ratio	1976-85 [b]		Ratio
	Dead	Alive	(D/A)	Dead	Alive	(D/A)
< 19	299 (347)	216 (753)	1.4	171 (233)	122 (692)	1.4
19-36	228 (646)	139 (3231)	1.6	173 (391)	83 (3399)	2.1
36 +	141 (249)	82 (2053)	1.7	129 (124)	57 (2237)	2.2
Overall	230 (1242)	129 (6037)	1.8	165 (748)	78 (6328)	2.1

Notes: Rates are per 1000 live births.
Figures in parentheses indicate the number of live births.
The analysis considers children born between [a] 1966-1975 and [b] 1976-85.
Ratio = proportion of dead to alive.
Sources: [a] 1976 NFS data tape and [b] 1986 NFFS data tape.

Table 5.5 also reveals that the mortality rates of dead to alive infants in each interval category tend to increase with increase in the length of birth interval. This result suggests that the influence of the death of a child for those born after longer intervals is greater than for those born after shorter intervals although the levels of mortality corresponding to longer intervals are much lower. A similar result was also evident in a previous study in Nepal (Gubhaju, 1991: 11) based on the NFS and in Bangladesh (Majumder, 1989: 139) based on the Bangladesh Fertility Survey. In the absence of other information, this result is largely unexplained. However, one possible explanation for this result could be the repetitive pregnancy loss experiences among women who have lost a child, associated with longer birth interval, as was postulated by Majumder (1989: 141) for Bangladesh.

5.7 Survival status of the preceding child and child mortality

Table 5.6 shows child mortality rates per 1000 live births according to birth order of a child and survival status of the preceding child at age two. In general, the probability of death to children preceded by a dead sibling, irrespective of their sex, was considerably higher than to those preceded by a surviving sibling. The slightly higher probability of death to children preceded by a surviving sibling as against those preceded by a dead sibling corresponding to the fifth order births based on the 1986 NFFS data is not very clear and is unexplained. However, one possible reason for this could be the small number of child deaths for that particular category.

The child mortality rates after controlling for mother's age at childbirth, birth order of the index child and survival status of the preceding child are shown in Table 5.7. The higher probability of death to children preceded by a dead as against a surviving sibling persists for each group of birth order, except fourth to fifth order births based on the 1976 NFS data. As in the case of infant mortality, irrespective of the survival status of the preceding child, the child mortality rates tend to increase along with the increase in the order of births. This indicates that the effect of birth order on the risk of death to the index child is independent of the survival status of the preceding child. However, the relationship between the mother's age at childbirth and child mortality where index children are preceded by a dead sibling seems to be different from a situation where they are preceded by a surviving sibling. For example, if the preceding child is alive, a monotonic negative relationship between the mother's age at childbirth and child mortality is shown. In contrast, this relationship, although it seems to be complicated when the elder of the pair has died, in general, suggests a positive association.

Table 5.6 Child mortality rates by birth order and survival status of the preceding child: 1961-80, Nepal.

Birth order of the index children	Survival status of the preceding child at age two					
	1961-70 [a] Dead	1961-70 [a] Alive	Ratio (D/A)	1971-80 [b] Dead	1971-80 [b] Alive	Ratio (D/A)
2	137 (290)	97 (1037)	1.4	73 (177)	52 (1277)	1.4
3	156 (205)	105 (911)	1.5	101 (148)	64 (1038)	1.6
4	149 (161)	109 (714)	1.4	140 (128)	50 (759)	2.8
5	206 (116)	89 (515)	2.3	54 (91)	83 (525)	0.7
6 +	127 (188)	97 (688)	1.3	121 (148)	76 (663)	1.6
Overall	150 (960)	100 (386)	1.5	100 (962)	63 (4262)	1.6

Notes: Rates are per 1000 children who survived their first birthday.
Figures in parentheses indicate the number of live births.
Analysis considers children aged one to five years of age between [a]1961-1970 and [b]1971-80. Ratio = proportion of dead to alive.
Sources: [a] 1976 NFS data tape and [b] 1986 NFFS data tape.

It is obvious that the duration of the exposure to the risk of pregnancy among currently married woman at older ages will be longer than to those at younger ages and so too the risk of childbearing. It is also likely that women who have experienced a child loss are more likely to lose a succeeding child as a consequence of the repetitive behavioural and household socio-economic environmental factors that are common to all children born in a family (Hobcraft, 1987: 10). The positive association between the mother's age at childbirth and child mortality where the elder of the pair had died thus suggests that an experience of child loss among those who have also experienced more pregnancies and/ or childbirths could have contributed to the higher probability of subsequent child loss. It is also possible that this phenomenon is the result of the child's birth weight and the mother's reproductive health status.

Table 5.7 Child mortality rates by maternal age at childbirth, birth order, and survival status of the preceding child: 1961-80, Nepal.

Birth order of the index children	<24 Dead	<24 Alive	<24 Ratio (D/A)	24-33 Dead	24-33 Alive	24-33 Ratio (D/A)	34 + Dead	34 + Alive	34 + Ratio (D/A)
1961-70 a/ (Maternal age at childbirth (years); Survival status of the preceding child at age two)									
2-3	129	108	1.2	159	98	1.6	----	44	----
	(301)	(946)		(182)	(913)		----	(89)	
4-5	86	149	0.6	188	103	1.8	----	61	----
	(46)	(127)		(212)	(892)		----	(210)	
6 +	----	----	----	138	116	1.2	115	72	1.6
	---	----		(108)	(395)		(78)	(288)	
1971-80 b/									
2-3	85	68	1.2	88	46	1.9	----	16	----
	(234)	(1280)		(90)	(976)		----	(59)	
4-5	111	68	1.6	111	67	1.7	----	35	----
	(63)	(205)		(143)	(937)		----	(142)	
6 +	----	----	----	112	79	1.4	131	73	1.8
	----	----		(107)	(388)		(38)	(260)	

Notes: Rates are per 1000 children who survived their first birthday.
Figures in parentheses indicate the number of live births.
Analysis considers children aged one to five years of age between a/ 1961-1970 and b/ 1971-80.
Ratio= ratio of rates (dead/alive). '---' indicates less than 20 cases.
Sources: a/ 1976 NFS data tape and b/ 1986 NFFS data tape.

For example, women who have lost a child may prefer to conceive as soon as possible to replace the loss. In such a circumstance they might not have fully recovered from the exhaustion caused by the previous pregnancy and may give birth to a baby with low birth weight. In fact this seems to be a more appropriate explanation for infant mortality. However, it can also be argued that not all children with low birth weight die during infancy. Some of them are also likely to survive infancy in a vulnerable situation and may not survive childhood. The child's health status due to their low birth weight as a consequence of the conception within a short interval after the birth of a child thus partly explains the child mortality differentials in this situation. However, a concrete conclusion cannot be drawn in the absence of information on the number of infants with low birth weight who survived infancy in a vulnerable situation. The negative association between mother's age at childbirth and child mortality, where the index child is preceded by a surviving sibling, could be a result of the favourable influence of the mother's enhanced child care practices from the care of a previous child. These results will be further assessed in the multivariate analysis in the later part of this chapter.

5.8 Child mortality and sex of the child

Mortality differentials among children aged one to five years of age can be a good measure to examine the differential child care rendered by parents in favour of one sex over the other. This is because the survival chance among children at these ages is more likely to be determined by socio-economic and environmental factors, the advantages of which could be partly governed by parents' behaviour. The child mortality rates according to sex of the child, controlling for birth order as well as survival status and sex of the preceding child, are shown in Tables 5.8 and 5.9. As in the case of infant mortality, the comparison based on the overall child mortality rates after controlling for the survival status of the preceding child shows, although not very distinctly, some indication of the differential care provided by parents in favour of male children. For example, the differentials in mortality in many instances show better survival for male children than for female children in Tables 5.8 and 5.9 (see Appendix Table 5.1 for a summary of the results).

The other important observation in Tables 5.8 and 5.9 is the differential in child mortality according to the two different groups of survival status of the preceding child. Both Tables 5.8 and 5.9 suggest that the overall probability of death to an index child preceded by a dead sibling than those preceded by a surviving sibling, irrespective of their sex, is considerably higher. The same, in general, is true for each order of births. This result further confirms that the deaths of succeeding children in a family are correlated.

Sex of the child, however, in the multivariate analysis (not shown here) was not statistically significant.

5.9 Child mortality, birth interval and survival status of the preceding child

Child mortality rates according to the length of the preceding birth interval and survival status of the preceding child are shown in Table 5.10. The results clearly indicate a higher risk of death to index children preceded by a dead sibling as against to those preceded by a surviving sibling, except for those born within 18 months after the birth of the preceding child. It appears here that the higher risk of death to index children born within 18 months after the birth of the preceding child preceded by a surviving as against dead sibling could be the consequence of competition. The level of competition for household resources and care among a pair of surviving children born during short interval is more likely to be intense than when the elder sibling had died. The risk of death to children born 19 months or more after the birth of the previous child preceded by a dead sibling, in contrast, is higher than to similar children preceded by a surviving sibling. These results suggest two different mechanisms: for those born within a short period and for those born after longer intervals. It seems here that the competition mechanism is more effective for those born within a short interval where both of the siblings are surviving. On the other hand the correlation between the mortality risks among children born in the same family seems to be true only for those children who are born after longer intervals to mothers who had experienced the death of their elder children.

The results in Table 5.10 also show a monotonic negative association between the length of the preceding birth interval and child mortality where the index child is preceded by a surviving sibling (as shown in the 'alive' column). In the case where the preceding child had died, the highest mortality risk for the index infant was observed for those born 19-36 months after the birth of the preceding child compared to infants born within 18 months or 36 months after the birth of the previous child. The reasons for this relationships are not clear.

Table 5.8 Child mortality rates by birth order, sex of the child, and sex and survival status of the preceding child: 1961-70, Nepal.

Birth order of the index children	Index child: male					
	Preceding child: male			Preceding child: female		
	Survival status of the preceding child at age two					
	Dead	Alive	Ratio (D/A)	Dead	Alive	Ratio (D/A)
2	148 (74)	100 (260)	1.5	141 (78)	88 (270)	1.6
3	129 (54)	118 (254)	1.1	204 (49)	103 (212)	2.0
4	200 (40)	105 (161)	1.9	138 (36)	98 (172)	1.4
5	142 (28)	115 (121)	1.2	161 (31)	61 (130)	2.6
6 +	42 (47)	129 (186)	0.3	155 (45)	83 (167)	1.9
Overall	132 (243)	113 (982)	1.2	159 (239)	89 (951)	1.8
Birth order of the index children	**Index child: female**					
2	112 (71)	81 (232)	1.4	149 (67)	116 (275)	1.3
3	120 (50)	103 (232)	1.2	173 (52)	93 (213)	1.8
4	111 (45)	117 (195)	0.9	150 (40)	112 (186)	1.3
5	307 (26)	107 (121)	2.9	225 (31)	76 (143)	2.9
6 +	125 (40)	109 (164)	1.1	178 (56)	64 (171)	2.8
Overall	138 (232)	103 (944)	1.3	171 (246)	96 (988)	1.8

Notes: Rates are per 1000 children who survived their first birthday.
Figures in parentheses indicate the number of live births.
The analysis considers children aged one to five years of age between 1961-1970.
Ratio = proportion of dead to alive.

Source: 1976 NFS data tape.

Table 5.9 Child mortality rates by birth order, sex of the child, and sex and survival status of the preceding child: 1971-80, Nepal.

Birth order of the index children	Index child: male					
	Preceding child: male			Preceding child: female		
	Survival status of the preceding child at age two					
	Dead	Alive	Ratio (D/A)	Dead	Alive	Ratio (D/A)
2	57	43	1.3	54	45	1.2
	(52)	(372)		(37)	(352)	
3	131	66	2.0	----	55	----
	(38)	(317)		(29)	(218)	
4	142	52	2.7	192	68	2.8
	(35)	(209)		(26)	(175)	
5	125	80	1.6	----	59	----
	(24)	(124)		(15)	(134)	
6 +	166	88	1.9	73	39	1.8
	(36)	(170)		(41)	(176)	
Overall	119	61	1.9	68	52	1.3
	(185)	(1192)		(148)	(1055)	
Birth order of the index children	**Index child: female**					
2	62	53	1.2	125	74	1.7
	(48)	(298)		(40)	(255)	
3	113	51	2.2	135	85	1.6
	(44)	(270)		(37)	(233)	
4	96	44	2.2	138	35	3.9
	(31)	(179)		(36)	(196)	
5	76	107	0.7	----	87	----
	(26)	(130)		(26)	(137)	
6 +	33	100	0.3	195	82	2.4
	(30)	(160)		(41)	(157)	
Overall	78	66	1.2	128	73	1.8
	(179)	(1037)		(180)	(978)	

Notes: Rates are per 1000 children who survived their first birthday.
Figures in parentheses indicate the number of live births.
The analysis considers children aged one to five years of age between 1971-80.
Ratio = proportion of dead to alive.
'----' indicates no death in the cell.

Source: 1986 NFFS data tape.

Table 5.10 Child mortality rates by length of the preceding birth interval (months) and survival status of the preceding child: 1961-80, Nepal.

Preceding birth interval (months)	Survival status of the preceding child at age two: 1961-70 [a/] Dead	Alive	Ratio (D/A)	1971-80 [b/] Dead	Alive	Ratio (D/A)
< 19	147 (237)	150 (433)	1.0	58 (204)	89 (456)	0.7
19-36	172 (509)	121 (2078)	1.4	139 (358)	72 (2324)	1.9
36 +	98 (214)	52 (1354)	1.9	53 (130)	38 (1482)	1.4
Overall	150 (960)	100 (3865)	1.5	99 (692)	62 (4262)	1.6

Notes: Rates are per 1000 children who survived their first birthday.
Figures in parentheses indicate the number of live births.
Analysis considers children aged one to five years of age between [a/] 1961-1970 and [b/] 1971-80.
Ratio = proportion of dead to alive.
Sources: [a/] 1976 NFS data tape and [b/] 1986 NFFS data tape.

5.10 Effect of the survival status of the preceding child on infant mortality: a multivariate analysis

The cross-tabular analyses carried out in the preceding sections suggested considerable differentials in the mortality rates among the two risk groups of children with preceding child dead and with preceding child alive. In addition, the effect of the survival status of the preceding child on infant mortality was present even after controlling for mother's age at childbirth, birth order, sex of the child and preceding birth interval. The subsequent sections of this chapter examine the effect of the survival status of the preceding child on infant mortality and its corresponding statistical significance after controlling for the effects of other factors of interest.

Table 5.11 shows the main effects model for the effects of the demographic variables of interest along with the survival status and sex of the preceding child at age one year. The net effects due to birth interval based on the 1976 NFS and 1986 NFFS in Table 5.11 are compared with the corresponding figures of Table 3.13 and 3.14 in Chapter Three. This comparison suggests that the effect of preceding birth interval on infant mortality, to some extent, is overestimated when survival status of the preceding child is not taken into account. For example, the result based on the 1976 NFS in Table 5.11 suggests 2.8 times higher risk of death to infants born within 18 months of the birth of the preceding child as compared with those born three years or more after the birth of the preceding child. The corresponding figure based on the 1986 NFFS is 1.9 times greater. The corresponding figures from Tables 3.13 and 3.14 (Chapter Three) were slightly higher (3.1 and 2.2 times, respectively) where the survival status of the preceding child was not taken into account.

The magnitude of the effects of maternal age at childbirth based on both the 1976 NFS and 1986 NFFS and of birth order based on the 1986 NFFS shown by the LRX^2 in the presence of control for the survival status of the preceding child has considerably attenuated (Table 5.11) compared with the absence of control for this variable (Tables 3.13 and 3.14). This indicates that survival status of the preceding child also influences infant mortality interactively with maternal age at childbirth and birth order. The size and significance of the two-factor interaction effects on infant mortality are examined and discussed in the later sections of this chapter.

Table 5.11 reveals considerably higher risk of death to infants preceded by a dead sibling than to those preceded by a surviving sibling after controlling for the effects of other variables in the model. This is true for both the 1976 NFS and 1986 NFFS data sets. The odds ratios based on the 1976 NFS data suggest 1.7 times greater risk of death to infants whose elder sibling had died during the first year of its life as against those whose elder sibling had survived. The corresponding figures based on the 1986 NFFS data show this figure as two times greater. This result confirms the finding based on the cross-tabular analysis carried out in the preceding sections that mothers who had lost a child were more likely to lose a subsequent child because of the biological and behavioural factors common to all children born in a family. This result also indicates that deaths of successive children in a family during infancy are inter-related. The comparison of the LRX^2 values corresponding to the variables used from both the 1976 NFS and 1986 NFFS data sets in Table 5.11 clearly indicates that the length of the preceding birth interval and survival status of the preceding child were the dominant determinants of infant mortality. A similar result was also evident in a study in Korea (Park, 1986: 996).

Table 5.11 Results of the logit model of the effect on infant mortality of maternal age at childbirth, birth order, preceding birth interval, survival status of the preceding child, sex of the preceding child and birth cohort: 1966-85, Nepal.

	Net effects [a]1966-75			Net effects [b]1976-85		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Maternal age at childbirth (years)		7.1	0.05		4.3	NS
< 24	1.171			1.178		
24-33	0.925			0.866		
34 +	0.923			0.980		
Birth order of the index infants		10.8	0.01		4.3	NS
2-3	0.864			0.873		
4-5	0.946			0.991		
6 +	1.224			1.156		
Preceding birth interval (months)		93.1	0.001		23.4	0.001
< 19	1.639			1.362		
19-36	1.028			1.023		
36 +	0.593			0.718		
Survival status of preceding child		42.5	0.001		35.5	0.001
Dead	1.307			1.421		
Alive	0.765			0.704		
Sex of the preceding child		3.4	0.10		1.9	NS
Male	1.064			0.943		
Female	0.940			1.060		
Birth cohort		1.6	NS		0.2	NS
1966-60	1.043					
1971-75	0.959					
1976-80				1.018		
1981-85				0.983		

[a] n=7279 reduction in model LRX^2 and df=182.73 (181) p=0.450 overall odds=0.215

[b] n=7076 reduction in model LRX^2 and df=197.80 (185) P=0.247 overall odds=0.130

Notes: The analysis is based on children born between [a]1966-75 and [b]1976-85.
Maternal age at childbirth, order of birth and length of the preceding birth interval each have 2 and survival status of the preceding child, sex of the preceding child and birth cohort each have 1 degree of freedom.
The analysis considers second and higher order births.

Sources: [a] 1976 NFS and [b] 1986 NFFS data tapes.

Among the socio-economic and health-related factors studied in Chapter Four, the effect of maternal education, except for the infant mortality based on the 1986 NFFS data (Model 7, Table 4.11), was statistically significant in influencing both infant and child mortality in a population of second and higher order births. The same was true for ever use of contraception, except for child mortality (Model 7, Table 4.12) based on the 1976 NFS data (see Tables 4.10 to 4.13 in Chapter Four). In addition, the influence of these two variables was also noted to be independent of mother's age at childbirth and preceding birth interval in Chapter Four.

As the survival status of the preceding child was not considered in the analysis in Chapter Four, it is imperative here to examine how far these two factors (mother's education and ever use of contraception) can alter the discernible effect of survival status of the preceding child and vice versa. For this purpose, two main effects models were fitted: one with survival status of the preceding child, other demographic variables, mother's education and contraceptive use, and the other with all these variables except the survival status of the preceding child. The results are shown in Tables 5.12 and 5.13.

A comparison of the results based on Table 5.12 with those in Table 5.13 showed clear picture of the effect of the variables of interest in the presence and absence of the control for the survival status of the preceding child in the model. Table 5.12 clearly shows that survival status of the preceding child is an independent and statistically significant determinant of infant mortality in spite of a small attenuation in the LRX^2 value as compared with the corresponding value in Table 5.11. The attenuation in the LRX^2 values corresponding to mother's age at childbirth and birth order observed in Table 5.12 as compared with Table 5.13 was due to the control for the effect of the survival status of the preceding child. This result suggests that these two demographic variables exert their influence on infant mortality not only independently but also interactively with survival status of the preceding child. The direction of the relationship of all variables with infant mortality in Table 5.12 after controlling for the effect of the survival status of the preceding child in the model, however, is the same as in Table 5.13, where a control for this variable was not used.

Table 5.12 Results of the logit model of the effect on infant mortality of maternal age at childbirth, birth order, preceding birth interval, survival status of the preceding child, sex of the preceding child, birth cohort, maternal education and contraceptive use: 1966-85, Nepal.

	Net effects 1966-75 [a/]			Net effects 1976-85 [b/]		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Maternal age at childbirth (years)		8.4	0.02		5.4	0.10
< 24	1.195			1.206		
24-33	0.929			0.975		
34 +	0.901			0.851		
Birth order of the index infants		12.3	0.01		4.8	0.10
2-3	0.852			0.864		
4-5	0.946			0.994		
6 +	1.241			1.164		
Preceding birth interval (months)		95.0	0.001		26.2	0.001
< 19	1.652			1.383		
19-36	1.030			1.092		
36 +	0.587			0.703		
Survival status of preceding child		38.4	0.001		30.3	0.001
Dead	1.289			1.384		
Alive	0.776			0.723		
Sex of preceding child		3.8	0.05		1.4	NS
Male	1.068			0.951		
Female	0.936			1.051		
Birth cohort		2.1	NS		0.7	NS
1966-70	1.051					
1971-75	0.951					
1976-80				1.037		
1981-85				0.964		
Maternal education		6.7	0.01		1.3	NS
None	1.264			1.103		
Some	0.791			0.906		
Contraceptive use		16.3	0.001		20.3	0.001
Never used	1.372			1.278		
Ever used	0.729			0.783		

[a/] n=7279 reduction in model LRX^2 and df=352.80 (417) P=0.991 overall odds=0.130
[b/] n=7072 reduction in model LRX^2 and df=438.85 (471) P=0.868 overall odds=0.101

Notes: The analysis is based on [a/]children born between 1966-75 and [b/]1976-85.
Maternal age at childbirth, order of birth and length of the preceding birth interval each have 2 and survival status of the preceding child, sex of the preceding child, birth cohort, maternal education and status of contraceptive uses each have 1 degree of freedom.
The analysis considers second and higher order births.

Sources: [a/] 1976 NFS data tape and [b/] 1986 NFFS data tape.

Table 5.13 Results of the logit model of the effect on infant mortality of maternal age at childbirth, birth order, preceding birth interval, sex of the preceding child, birth cohort, maternal education and contraceptive use: 1966-85, Nepal.

	Net effects [a]1966-75			Net effects [b]1976-85		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Maternal age at childbirth (years)		11.7	0.01		7.3	0.05
< 24	1.233			1.239		
24-33	0.919			0.970		
34 +	0.883			0.832		
Birth order of the index infants		14.0	0.01		5.8	0.10
2-3	0.844			0.854		
4-5	0.942			0.989		
6 +	1.258			1.184		
Preceding birth interval (months)		116.8	0.001		39.0	0.001
< 19	1.748			1.504		
19-36	1.013			1.006		
36 +	0.565			0.661		
Sex of preceding child		4.3	0.05		1.0	NS
Male	1.073			0.959		
Female	0.932			1.043		
Birth cohort		2.3	NS		0.9	NS
1966-70	1.053					
1971-75	0.950					
1976-80				1.041		
1981-85				0.961		
Mother's education		7.6	0.01		1.8	NS
None	1.281			1.121		
Some	0.780			0.892		
Contraceptive use		18.8	0.001		23.9	0.001
Never used	1.399			1.302		
Ever used	0.715			0.768		

[a] n=7279 reduction in model LRX^2= 238.54 df= 276 p=0.950 overall odds=0.110

[b] n=7072 reduction in model LRX^2= 278.53 df= 308 p=0.885 overall odds=0.080

Notes: The analysis is based on children born between [a]1966-75 and [b]1976-85.
Maternal age at childbirth, order of birth and length of the preceding birth interval each have 2 and sex of the preceding child, birth cohort, mother's education and contraceptive use each have 1 degree of freedom.
The analysis considers second and higher order births.

Sources: [a] 1976 NFS and [b] 1986 NFFS data tapes.

The comparison of the LRX^2 values corresponding to the length of the preceding birth interval (Tables 5.12 and 5.13) further supports the argument that the estimated effect of the preceding birth interval on infant mortality in the absence of the control for the survival status of the preceding child is exaggerated. The net effects of preceding birth interval and survival status of the preceding child, however, remain significant (Table 5.12) when both variables are simultaneously considered in the model. This is true irrespective of whether controls for other demographic factors are used or not. A similar result was also found in an earlier study in Nepal (Gubhaju, 1991: 128-129) and in Bangladesh (Majumder, 1989: 151).

The effect of mother's education based on the 1986 NFFS in both Tables 5.12 and 5.13, after controlling for the effects of other variables in the model, is not statistically significant. The net effects of contraceptive use based on both the 1976 NFS and 1986 NFFS in both Tables 5.12 and 5.13 are highly significant and suggest that the effect of this variable on infant mortality is strong, irrespective of whether the survival status of the preceding child is considered in the model or not. However, a small attenuation in the LRX^2 value corresponding to the contraceptive use and mother's education after controlling for the effects of the survival status of the preceding child in the model (Table 5.12 as against Table 5.13) suggests that the effects of these variables on infant mortality are partly mediated through the survival status of the preceding child.

5.11 Effect of survival status of the preceding child on child mortality

As was noted in the cross-tabulation analysis in the early sections of this chapter, the mortality risk for the index child preceded by a dead sibling as against by a surviving sibling is considerably greater. The odds ratios pertaining to this variable in Table 5.14 suggest that the risk of death to an index child preceded by a dead sibling was 1.4 times greater compared to the risk of death of an index child preceded by a surviving sibling. This differential is the same for children from both surveys. This result indicates that the influence of the survival status of the preceding child on child mortality is more likely to be working through the repetition of behavioural, household socio-economic and

Table 5.14 Results of the logit model of the effect on child mortality of maternal age at childbirth, order of birth, length of the preceding birth interval, survival status of the preceding child, sex of the preceding child and birth cohort: 1961-80, Nepal.

	Net effects [a]1961-70			Net effects [b]1971-80		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Maternal age at childbirth (years)		3.8	NS		2.0	NS
< 24	0.976			1.175		
24-33	1.143			1.013		
34 +	0.896			0.840		
Birth order of the index children		0.7	NS		6.7	0.05
2-3	1.045			0.800		
4-5	1.029			0.963		
6 +	0.930			1.297		
Preceding birth interval (months)		60.9	0.001		24.7	0.001
< 19	1.428			1.157		
19-36	1.295			1.322		
36 +	0.541			0.654		
Survival status of preceding child		11.0	0.001		6.2	0.02
Dead	1.200			1.207		
Alive	0.833			0.829		
Sex of preceding child		0.9	NS		0.1	NS
Male	1.045			1.022		
Female	0.957			0.979		
Birth cohort		2.5	NS		8.1	0.02
1961-65	1.078					
1966-70	0.928					
1971-75				1.179		
1976-80				0.848		

[a] n=4825 reduction in model LRX^2 and df=190.38 (175) P=0.202 overall odds=0.122

[b] n=4954 reduction in model LRX^2 and df=156.59 (170) P=0.762 overall odds=0.080

Notes: The analysis is based on children aged one to five years of age years between [a] 1961-70 and [b] 1971-80.
Maternal age at childbirth, order of birth and length of the preceding birth interval each have 2 and survival status of the preceding child, sex of the preceding child and birth cohort each have 1 degree of freedom.
The analysis considers second and higher order births.

Sources: [a] 1976 NFS and [b] 1986 NFFS data tapes.

environmental factors common to all children born in a family as explained by Hobcraft (1987: 10) and DeSweemer (1984:55-59) rather than through competition between siblings. Had the effect of this variable been working through competition between siblings, the mortality risk to those preceded by a surviving as against a dead sibling would have been higher, as observed in Bangladesh (Majumder, 1989: 159). The result obtained in this study regarding the survival status of the preceding child and its influence on child mortality confirms the result of a previous study in Nepal (Gubhaju, 1991: 131).

As in the case of infant mortality in the preceding sections of this chapter, one model with the socio-economic-health, demographic and survival status of the preceding child, and another with all these variables except the survival status of the preceding child were fitted in order to examine the change in the effects of other factors in the absence and presence of the effect of the survival status of the preceding child on child mortality. The results of this assessment are shown in Tables 5.15 and 5.16.

The attenuation in the influence of the length of the preceding birth interval based on both the 1976 NFS and 1986 NFFS data sets shown by the LRX^2 value in Table 5.15 as compared with that in Table 5.16 clearly suggests that its effect on child mortality in the absence of the control for the survival status of the preceding child is exaggerated. Besides, the risk of death to children born less than 19 months after the birth of the preceding child based on the 1976 NFS and 1986 NFFS data sets is 2.9 and 2.0 times respectively greater than to those born 36 months or more after the birth of the preceding child when controls for the survival status of the preceding child were not present (Table 5.16). These effects attenuate to 2.7 and 1.8 times respectively after controlling for the effects of the survival status of the preceding child (Table 5.15). However, the effect of both the length of the preceding birth interval and the survival status of the preceding child remains strong, irrespective of whether the effects of these variables are simultaneously controlled or not. As suggested by Boerma and Bicego (1992: 245-246), this could be due to the correlation in the mortality risks between successive children born in a family as a consequence of the familial characteristics common to all born in a family. However, this does not suggest that sibling competition does not operate in the population under study. It

Table 5.15 Results of the logit model of the effect on child mortality of maternal age at childbirth, birth order, preceding birth interval, survival status of the preceding child, sex of the preceding child, birth cohort, maternal education and contraceptive use: 1961-80, Nepal.

Variables	Net effects 1961-70 [a] Odds ratio	Reduction in LRX^2	P	Net effects 1971-80 [b] Odds ratio	Reduction in LRX^2	P
Maternal age at childbirth (years)		3.4	NS		3.5	NS
< 24	1.007			1.237		
24-33	1.135			1.021		
34 +	0.874			0.792		
Birth order of the index children		0.5	NS		6.9	0.05
2-3	1.036			0.797		
4-5	1.029			0.964		
6 +	0.938			1.301		
Preceding birth interval (months)		62.9	0.001		26.4	0.001
< 19	1.443			1.183		
19-36	1.297			1.322		
36 +	0.534			0.640		
Survival status of Preceding child		9.4	0.01		4.4	0.05
Dead	1.184			1.172		
Alive	0.845			0.853		
Sex of preceding child		0.9	NS		0.2	NS
Male	1.044			1.025		
Female	0.958			0.975		
Birth cohort		2.2	NS		8.1	0.01
1961-65	1.072					
1966-70	0.933					
1971-75				1.180		
1976-80				0.847		
Maternal education		9.7	0.01		12.1	0.001
None	1.579			1.597		
Some	0.633			0.626		
Contraceptive use		3.1	0.10		3.6	0.10
Never used	1.174			1.134		
Ever used	0.852			0.882		

[a] n=4825 reduction in model LRX^2 and df=294.47 (379) P=1.000 overall odds=0.069
[b] n=4954 reduction in model LRX^2 and df=336.82 (419) P=0.999 overall odds=0.049

Notes: The analysis is based on [a] children aged one to five years of age years during the period 1961-70 and [b] 1971-80. Maternal age at childbirth, order of birth and length of the preceding birth interval each have 2 and survival status of the preceding child, sex of the preceding child, birth cohort, maternal education and status of contraceptive uses each have 1 degree of freedom. The analysis considers second and higher order births.

Sources: [a] 1976 NFS data tape and [b] 1986 NFFS data tape.

Table 5.16 Results of the logit model of the effect on child mortality of maternal age at childbirth, birth order, length of the preceding birth interval, sex of the preceding child, birth cohort, maternal education and contraceptive use: 1961-80, Nepal.

Variables	Net effects [a/] 1961-70			Net effects [b/] 1971-80		
	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Maternal age at childbirth (years)		3.4	NS		4.4	NS
< 24	1.307			1.266		
24-33	1.131			1.022		
34 +	0.676			0.773		
Birth order of the index children		0.4	NS		8.0	0.02
2-3	1.029			0.783		
4-5	1.272			0.963		
6 +	0.764			1.326		
Preceding birth interval (months)		69.1	0.001		28.4	0.001
< 19	1.506			1.236		
19-36	1.281			1.303		
36 +	0.518			0.621		
Sex of preceding child		0.9	NS		0.2	NS
Male	1.045			1.027		
Female	0.957			0.973		
Birth cohort		2.1	NS		8.5	0.01
1961-65	1.071					
1966-70	0.934					
1971-75				1.184		
1976-80				0.844		
Mother's education		10.3	0.01		12.6	0.001
None	1.600			1.610		
Some	0.625			0.621		
Contraceptive use		3.7	0.10		4.3	0.05
Never used	1.188			1.145		
Ever used	0.842			0.873		

[a/] n=4825 reduction in model LRX^2 and df= 164.24 (242) P=1.000 overall odds=0.062

[b/] n=4954 reduction in model LRX^2 and df= 225.97 (269) P=0.974 overall odds=0.043

Notes: The analysis is based on children aged one to five years of age years during the period [a/] 1961-70 and [b/] 1971-80.
Maternal age at childbirth, order of birth and length of the preceding birth interval each have 2 and sex of the preceding child, birth cohort, mother's education and contraceptive use each have 1 degree of freedom.
The analysis considers second and higher order births.

Sources: [a/] 1976 NFS and [b/] 1986 NFFS data tapes.

rather suggests that the effect of increased intra-familial mortality risk is stronger than the effect of sibling competition.

The influence of mother's age at childbirth on child mortality in both Tables 5.15 and 5.16 is not statistically significant. The influence of the birth order of a child on child mortality based on the 1986 NFFS attenuates from a 2 per cent (Table 5.16) level of significance to a 5 per cent level (Table 5.15) after controlling for the survival status of the preceding child in the model. This result suggests that the effect of the child's birth order not only independently but also interactively exerts its influence on child mortality.

The influence of mother's education and contraceptive use shown by the size of the LRX^2 value in Table 5.16 slightly attenuates in Table 5.15 after controlling for the effect of the survival status of the preceding child. However, the net influence of both these variables on child mortality remains, irrespective of whether the effect of the survival status of the preceding child was controlled or not. This result indicates that contraceptive use and mother's education exert their influence on child mortality not only independently but also through survival status of the preceding child.

5.12 Two-factor interaction effects

Previous analyses of infant and child mortality based on the 1976 NFS in Nepal did not consider the interaction effects of some of the significant explanatory variables, except for the interaction effect between survival status of the previous birth and length of birth interval on child mortality, which was found significant at the one per cent level (Gubhaju, 1991: 132-133). A similar result was found for Indonesia (Hull and Gubhaju, 1986). An analysis of interaction effects provides considerable insight into the competing explanation for the effect of the survival status of the preceding child. Thus the two-factor interaction effects considered in this study include survival status of the preceding child with birth order, mother's age at childbirth and length of the preceding birth interval. The difference in the LRX^2 values based on the main effects model and the one with interaction term, each of which is added one at a time in the main effects model, is shown in Table 5.17.

Of the two-factor interaction effects examined, mother's age at childbirth based on the 1976 NFS data appears to influence both the infant and child mortality interactively with the survival status of the preceding child. The joint effect of birth order and the survival status of the preceding child is statistically significant only for infant mortality based on the 1986 NFFS data. In addition, the joint effect of length of birth interval and survival status of the preceding child is statistically significant in influencing only child mortality based on both the 1976 NFS and 1986 NFFS data sets. These statistically significant interacting variables and their effects on mortality are further examined by combining the two into a joint variable. These combined single joint variables are then introduced one by one into the main effects model, the results of which are shown in Tables 5.18 to 5.22.

Table 5.17 Size of likelihood chi-square for certain two-factor interaction effects on infant and child mortality: 1961-85, Nepal.

	1966-75 [a]			1976-85 [b]		
Variables	Reduction in LRX^2	Reduction in df	P	Reduction in LRX^2	Reduction in df	P
			Infant			
Sspc by bord	3.1	2	NS	6.8	2	0.05
Sspc by matage	4.6	2	0.10	3.8	2	NS
Sspc by interval	0.9	2	NS	2.9	2	NS
	1961-70 [c]			1971-80 [d]		
			Child			
Sspc by bord	0.3	2	NS	0.3	2	NS
Sspc by matage	7.7	2	0.05	0.8	2	NS
Sspc by interval	4.9	2	0.10	10.2	2	0.01

Notes: Each of the interaction terms is an additional term to the main effects model. The reference model for [a] and [b] is Table 5.12 and for [c] and [d] is 5.15.
Sspc stands for survival status of the preceding child, *bord* for birth order of the index child, *matage* for mother's age at childbirth and *interval* stands for length of the preceding birth interval.
Sources: [a],[c] 1976 NFS and [b],[d] 1986 NFFS data tapes.

Table 5.18 shows the influence of the joint variable: mother's age at childbirth and survival status of the preceding child on infant mortality based on the 1976 NFS. The risk of death to index infants preceded by a surviving sibling in each category of mother's age at childbirth is considerably lower than to corresponding infants preceded by a dead sibling. The mortality risk for index infants preceded by a dead sibling in each category of mother's age at childbirth differs only by a small margin. In contrast, the mortality risk for index infants preceded by a surviving sibling and born to mothers under 24 years of age is 1.4 times greater than to those born to mothers over 34 years. The greater than average risk of death among index infants preceded by a dead sibling and born to mothers in different age groups indicates that behavioural and biological factors related to mother, which are likely to be common to and repetitive for all born in a family, are important if she has lost her elder child. In contrast, the declining risk of death to infants preceded by a surviving sibling with the increase in the mother's age at childbirth could be due to a mother's enhanced child care practices compared with the care of the preceding child, contributing to the favourable survival prospects for the index child. This is because women who are older are also likely to bear and raise more children, where survival of the elder child indicates their better ability to take care of their children.

Table 5.18 Results of the logit model of the effect on infant mortality of the joint variable: survival status of the preceding child and maternal age at index childbirth: 1966-75, Nepal.

	Gross effects			Net effects*		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Preceding child dead and maternal age at childbirth (years)		103.4	0.001		54.6	0.001
< 24	1.402			1.310		
24-33	1.448			1.320		
34	1.504			1.275		
Preceding child alive and maternal age at childbirth (years)						
< 24	0.844			0.971		
24-33	0.614			0.960		
34 +	0.633			0.678		

n=7279 reduction in model LRX^2 and df =347.53 (415) P=0.993 overall odds=0.131

Notes: * Estimates are net of birth order, length of the preceding birth interval, sex of the preceding child, birth cohort, maternal education and contraceptive use.
The joint variable has 5 degrees of freedom.

Source: 1976 NFS data tape.

Table 5.19 shows the influence of the joint variable: birth order and survival status of the preceding child on infant mortality based on the 1986 NFFS. The mortality risk to an infant preceded by a dead sibling corresponding to each group of birth order is greater than the average infant mortality risk. In contrast, the mortality risk for infants preceded by a surviving sibling corresponding to each group of birth order is lower than the average infant mortality risk. Besides, a clear positive association between infant mortality and birth order is also evident when the elder of the pair is alive. This result again suggests that the death of the preceding child is the strongest determinant of mortality risk when the elder of a pair has died. In contrast, effective parity, better conditions for child survival and a mother's ability to take care of a child seem to be the detrimental factors in explaining the mortality risk of the infants where the elder of a pair has survived. The mechanism through which the birth order variable exerts its influence on infant mortality has already been described in Chapter Three and needs no further explanation here.

Table 5.19 Results of the logit model of the effect on infant mortality of the joint variable: survival status of the preceding child and birth order of the index child: 1976-85, Nepal.

	Gross effects			Net effects *		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Preceding child dead						
and birth order		70.3	0.001		43.0	0.001
2-3	1.659			1.335		
4-5	1.800			1.696		
6 +	1.144			1.041		
Preceding child alive						
and birth order						
2-3	0.594			0.631		
4-5	0.632			0.707		
6 +	0.780			0.951		

n=7072 reduction in model LRX^2 and df=430.0 (469) P=0.901 overall odds=0.099

Notes: * Estimates are net of maternal age at childbirth, length of the preceding birth interval, sex of the preceding child, birth cohort, maternal education and contraceptive use.
The joint variable has 5 degrees of freedom.

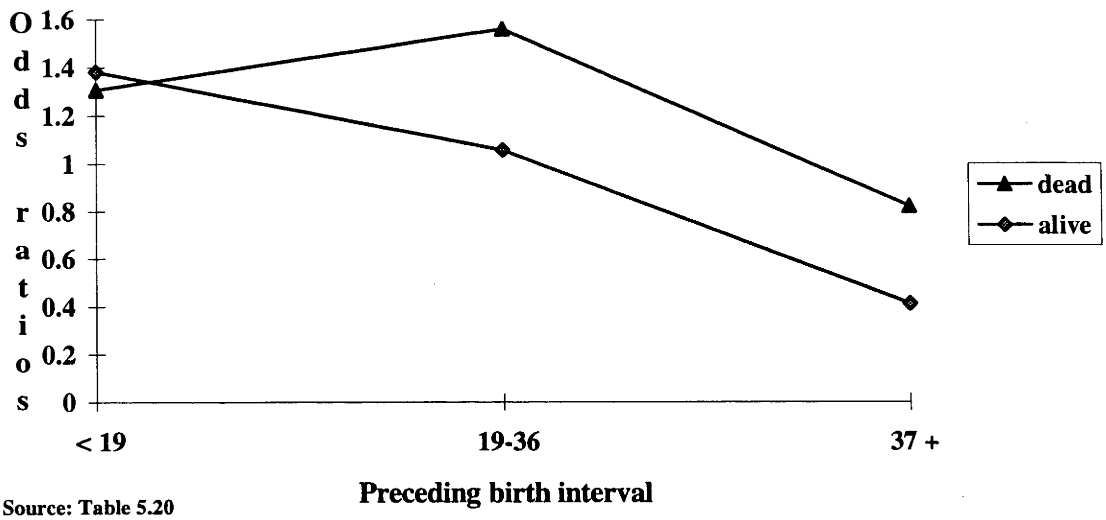
Source: 1986 NFFS data tape.

The result based on the joint influence of preceding birth interval and survival status of the preceding sibling on child mortality based on both surveys shown in Tables 5.20 and

5.21 respectively is very interesting. The graphic presentations of the results from Tables 5.20 and 5.21 are given in Figures 5.1 and 5.2 respectively. These results based on the 1976 NFS and 1986 NFFS data clearly show the similar pattern of the effect of this joint variable on child mortality. The mortality risk to the index child is the highest when the preceding birth interval is less than 19 months and the preceding sibling is surviving. The level of mortality risk is about the same on the basis of the 1976 NFS survey but higher if the preceding child survives on the basis of the 1986 NFFS. It appears here that the greater risk of death to those born within 18 months of the birth of the preceding child and whose elder sibling was surviving than to those whose elder sibling had died is due to the competition between the siblings for the mother's care and household resources. In contrast, if children were born more than 18 months after the preceding child, due to their difference in the ages, the competition effects were likely to be less. In this situation, the risk of death to these children seems to be determined by their mother's experience of previous child loss, which also explains the poor survival chances of a sibling born in such a family. The negative relationship between child mortality and the length of birth interval shown in Tables 5.20 and 5.21, where the elder of the pair had survived, supports this argument.

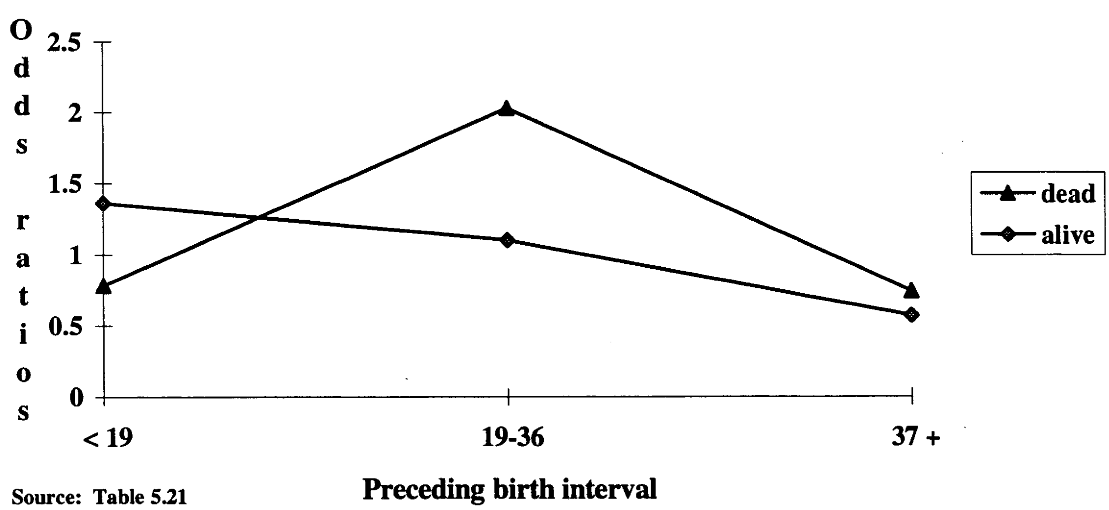
Table 5.22 shows the influence of the joint variable: mother's age at childbirth and survival status of the preceding child on child mortality based on the 1986 NFFS. Table 5.22 shows that the mortality risk of death to children born to mothers under 24 years of age preceded by a dead sibling was slightly lower than to those preceded by a surviving sibling. This result further supports the view of the competition mechanism. For example, the analysis in Chapter Three has clearly demonstrated that younger women have had a considerable number of higher order births. This situation is self-explanatory for the competition between children born to younger women where both of the pair have survived. The higher risk of death to children preceded by a dead sibling as against those preceded by a surviving sibling corresponding to other categories of the mother's age at childbirth is a usual phenomenon observed and explained in the preceding sections of this chapter. One interesting observation in Table 5.22 is the lower risk of death to an index

Figure 5.1 Odds ratio of the joint effect of the length of preceding birth interval and survival status of the preceding child on child mortality, 1976 NFS



Source: Table 5.20

Figure 5.2 Odds ratio of the joint effect of length of the preceding birth interval and survival status of the preceding child on child mortality, 1986 NFFS



Source: Table 5.21

Table 5.20 Results of the logit model of the effect on child mortality of the joint variable: survival status of the preceding child and length of the preceding birth interval: 1961-70, Nepal.

	Gross effects			Net effects *		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Preceding child dead and birth interval (months)		86.4	0.001		83.4	0.001
<19	1.315			1.307		
19-36	1.576			1.559		
37 +	0.834			0.821		
Preceding child alive and birth interval (months)						
<19	1.334			1.380		
19-36	1.037			1.054		
37 +	0.418			0.411		

n=4565 reduction in model LRX^2 and df=140.23 (159) P=0.855 overall odds=0.124

Notes: * Estimates are net of maternal age at childbirth, birth order, sex of the preceding child, birth cohort, maternal education and contraceptive use.
The joint variable has 5 degrees of freedom.
Source: 1976 NFS data tape.

Table 5.21 Results of the logit model of the effect on child mortality of the joint variable: survival status of the preceding child and length of the preceding birth interval: 1971-80, Nepal.

	Gross effects			Net effects *		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Preceding child dead and birth interval (months)		51.32	0.001		43.0	0.001
<19	0.846			0.782		
19-36	2.133			2.027		
37 +	0.791			0.740		
Preceding child alive and birth interval (months)						
<19	1.301			1.363		
19-36	1.024			1.100		
37 +	0.525			0.568		

n=4954 reduction in model LRX^2 and df=326.67 (417) P=1.000 overall odds=0.048

Notes: * Estimates are net of maternal age at childbirth, birth order, sex of the preceding child, birth cohort, maternal education and contraceptive use.
The joint variable has 5 degrees of freedom.
Source: 1986 NFFS data tape.

child preceded by a dead sibling and born to women under 24 years of age than to those preceded by a dead sibling and born to women over 24 years of age. In the analysis so far, it is quite clear that women who have lost a child are at higher risk of losing subsequent child. The risk of losing a child among women in higher ages is likely to be higher because with the increase in the age of women the risk of giving birth also increases and so does the probability of losing a child as a consequence of the previous child loss experience. This could have produced a monotonic positive association between the mother's age at childbirth and risk of death to children born to them where a previous child has died.

Table 5.22 Results of the logit model of the effect on child mortality of the Joint variable: survival status of the preceding child and mother's age at childbirth: 1961-70, Nepal.

	Gross effects			Net effects		
Variables	Odds ratio	Reduction in LRX^2	P	Odds ratio	Reduction in LRX^2	P
Preceding child dead and mother's age at childbirth (years)		32.7	0.001		20.4	0.01
< 24	1.064			0.877		
24-33	1.513			1.434		
33 +	1.418			1.511		
Preceding child alive and mother's age at childbirth (years)						
< 24	0.960			0.919		
24-33	0.868			0.903		
33 +	0.525			0.556		

n=4825 reduction in model LRX^2 and df=286.81 (337) P=1.000 overall odds=0.070

Notes: * Estimates are net of birth order, length of the preceding birth interval, sex of the preceding child, birth cohort, maternal education and contraceptive use.
The joint variable has 5 degrees of freedom.

Source: 1976 NFS data tape.

5.13 Further discussion of the results

This chapter has examined the influence of the survival status of the preceding child on infant and child mortality together with demographic and selected indicators of socio-economic and health[2/] factors. The main focus of this chapter has been on the strength of

2/ Recall that ever use of contraception in this study is used as an indicator for the utilisation of the health care services.

the inter-relationship between the death of the index child and the length of the preceding birth interval, and the extent to which the effect of the length of the preceding birth interval on infant and child mortality was exaggerated in the absence of control for the survival status of the preceding child. In addition, this chapter also examined the extent to which the effect of the survival status of the preceding child on infant and child mortality differed in the presence or absence of the control for the selected socio-economic and health indicators.

The cross-tabular analysis clearly showed a higher probability of death to infants whose previous sibling had died before its first birthday than to those whose preceding sibling had survived. The same is true for child mortality for those where the previous sibling had died before its second birthday as against those preceded by a surviving sibling. This result holds true irrespective of the mother's age at childbirth, birth order of the child, preceding birth interval and sex of the child.

The effect of the survival status of the preceding child on the mortality risk of both infants and children based on both the 1976 NFS and 1986 NFFS data sets was statistically significant after controlling for the effects of other demographic and selected socio-economic factors. The mortality risk to infants preceded by a dead sibling was 1.66 and 1.91 times greater than those preceded by a surviving sibling based on the 1976 NFS and 1986 NFFS data sets, respectively. The corresponding figures for children were 1.40 and 1.37 times, respectively. These results indicate that the influence of the survival status of the preceding child on the mortality risk of the index infant is much greater than on the index child. This finding suggests that the survival status of the preceding child is a better predictor of infant mortality where most of the deaths are likely to be related to mother's health or other biological factors. This, however, does not mean that the survival status of the preceding child does not capture variations in child mortality which most of the time are likely to be related to behavioural and socio-economic factors.

The higher risk of death to infants and children preceded by a dead sibling found in this study indicates that the death of subsequent child in a family is inter-related. There are analyses which show the survival status of the preceding child is working as a proxy for the clustering of deaths in the household (Gubhaju, 1991: 110-111, Dasgupta, 1990: 489; Hull and Gubhaju, 1986: 114; Kim, 1986a: 164-166; Cleland and Sathar, 1984: 408; Swenson and Harper, 1979: 467; Stoeckel and Chowdhury, 1972: 119). The effect of the survival status of the preceding child on infant mortality in this study appears to be working through repetitive biological factors, while this mechanism for child mortality seems to be due to repetitive behavioural, household socio-economic and environmental factors common to all children born to the same mother.

The supposition that the effect of the preceding birth interval on infant and child mortality is likely to be biased in the absence of control for the survival status of the preceding child holds true both for the mortality during infancy as well as during childhood. The influence of the length of the preceding birth interval on both the infant and the child mortality weakens as suggested by the LRX^2 value after controlling for the effect of the survival status of the preceding child. Hobcraft (1985: 374-377) also noted a small reduction in the deleterious effect of the short birth interval on childhood mortality after controlling for the effect of the survival status of the preceding child. Despite the attenuation in the effect of the preceding birth interval on infant and child mortality after controlling for the effect of the survival status of the preceding child observed in this study, the significant influence of the length of the birth interval on both infant and child mortality remains. A similar result was also found for Korea (Kim, 1986a: 192-193).

The influence of mother's education and contraceptive use based on both the 1976 and 1986 surveys weakens after controlling for the survival status of the preceding child in the model. This suggests that mother's education and contraceptive use also influence infant and child mortality through the survival status of the preceding child.

The assessment of the selected two-factor interaction effects suggests that survival status of the preceding child not only independently but also interactively acts with some other demographic factors in influencing infant and child mortality. The two-factor interaction effects of the survival status of the preceding child and mother's age at childbirth was statistically significant in influencing both infant and child mortality based on the 1976 NFS data set. The two-factor interaction effects of the survival status of the preceding child and birth order were statistically significant only for the infant mortality based on the 1986 NFFS data. In addition, survival status of the preceding child was also found to influence child mortality interactively with the length of the preceding birth interval.

Past studies on the effects of birth spacing and survival status of the preceding child on infant and child mortality have advanced several hypotheses on the mechanisms of their influence. The adverse influence of closely spaced births on infant and child mortality is often postulated to be through maternal depletion syndrome, competition between siblings for resources and the greater probability of disease transmission among children of proximate ages in a household (Swenson, 1981: 302; Winikoff, 1983: 239; Cleland and Sathar, 1984: 403, Hobcraft et al., 1985; Pebley and Elo, 1989: 404; Boerma and Bicego, 1992: 244-245). The death or survival of a pair of children and its relation with the survival status of the index child is explained through the absence or presence of competition between children for resources, care and disease transmission (Hobcraft, 1987: 10; Koenig et al., 1990: 250). In contrast, it is also hypothesized that the increased risk of death to an index child preceded by a child who failed to survive could be the consequence of the repetition of a combination of several factors such as prematurity, low birth weight, continuing social, economic and environmental deprivation or poor knowledge and health care (Hobcraft, 1987: 10). It is also argued that women who have a history of child loss are at higher risk of losing a succeeding child as a consequence of repetitive behavioural or biological risk for children born in the same family (Winikoff, 1983: 232; Pebley and Millman, 1986: 72).

The various two-factor interaction effects examined in this chapter by creating joint variables clearly provide different possible explanations under different conditions. It is quite clear in this study that the adverse effect of closely spaced birth on the index child where the preceding sibling is surviving is likely to be due to the competition between the two children for resources and mother's care. In contrast, the elevated risk of death to children born after 19 months of the birth of the preceding child who failed to survive seems to be due to the repetitive behavioural and environmental factors which could also have caused the death of the preceding child.

The joint influence of the survival status of the preceding child and mother's age at childbirth clearly indicates a higher than average risk of death to infants preceded by a dead sibling and a lower than average risk of death to infants preceded by a surviving sibling. The joint influence of the survival status of the preceding child and birth order also suggests a similar relationship. These results further confirm that deaths of successive siblings in a family are correlated and as a consequence a woman who has lost a child is also more likely to lose the subsequent child. This result, as already described, could be working through repetitive adverse biological factors and mother's health status as a common factor for all those born to the same mother. The negative association between the mother's age at childbirth and infant mortality as well as the positive association between birth order and infant mortality observed for those preceded by a surviving sibling could be the birth interval effect as described in Chapter Three.

Finally, the patterns of the relationship of the joint variable: the length of birth interval and survival status of the preceding child with child mortality based on both the 1976 NFS and 1986 NFFS data sets are similar. The higher risk of death to index children born within 18 months after the preceding child who is still alive as against those who have died shows this to be a consequence of the competition between the closely spaced surviving children for the mother's care and household resources. As the length of the birth interval increases, the index child might not need to compete vigorously for the resources with the preceding sibling as was the case where both children were born within a short interval. The higher risk of death to children preceded by a dead sibling born 18 months or more after the preceding child as compared to similar children preceded by a surviving sibling thus could be the consequence of the correlation in the death of succeeding children born in a family as a consequence of the poor resources, care and environmental factors common to all born in a family.

CHAPTER SIX

REGIONAL VARIATIONS IN INFANT AND CHILD MORTALITY

6.1 Introduction

Regional, urban and rural mortality differentials in the study of child survival emerge as an important area because they on the one hand help to explain underlying factors associated with mortality, while on the other hand they provide the framework for national policies. The lifestyle, perceptions, beliefs, norms and values, socio-economic, cultural, demographic and political activities of people are likely to be different according to the place where they live. On the basis of these characteristics populations in developing countries can be segmented into distinct groups which in turn are likely to provide a common denominator for scholars in examining the variety of socio-economic characteristics of the population in question (United Nations, 1985: 250). Behm (1991: 15) in a study on child mortality in developing countries suggested that urban and rural populations constitute two universe because of the different socio-economic characteristics and level of development associated with place of residence. These differentials are likely to influence child survival through different mechanisms. This chapter aims to address the regional variations in infant and child mortality in Nepal. It begins with the empirical evidence on regional variations in infant and child mortality, followed by the regions of the study, variables and data, analytical approach, socio-economic background of the population and the analysis of the data.

6.2 Regional variations in infant and child mortality: empirical evidence

Mortality differentials according to rural or urban place of residence for developed countries before the twentieth century and for developing countries during this century suggest quite different patterns. Condran and Crimmins (1980: 179) found a higher death rate for urban than for rural areas in the United States during period 1890-1900. Similarly, Knodel (1977: 371-373) for Germany and Davis (1973: 260-271) for European countries also observed higher mortality rates in the city than in the country during much of the nineteenth century. Considerable variations in infant deaths were also noticed between the administrative areas of Germany during the nineteenth century (Knodel, 1977: 371-372). Haines (1977: 317-326) using the New York States Census of 1865 and U.S. Census of 1900 found a 20 per cent higher risk of death to children in urban areas than in rural areas of New York. Preston et al. (1981: 238-239) using the U.S. 1900 Census of population, and 1911 Census of England and Wales also found a pattern of higher child mortality in urban than in rural areas. Similarly, Glass (1964: 264-267) noted higher mortality associated with the urban dwellers of England, Wales and Scotland compared with rural dwellers.

Benjamin (1965: 35-36, 50), Preston et al. (1981: 238-247), and Condran and Crimmins (1980: 201) suggested that the city environment, such as dark and damp housing units, lack of refuse disposal system, lack of sewerage system, poor water supplies, contaminated food supplies and over-crowding, aided in the spread of infectious diseases and contributed to the higher mortality levels in the urban areas of developed countries during the nineteenth century. In this century, however, due to the better knowledge of disease transmission, advancement in the health, sanitation and medical technology (Federici et al., 1976, cited in United Nations, 1985: 250), improved sanitary measures and faster decline in the urban mortality rate (Knodel, 1977: 371), urban and rural mortality gaps have not only closed but reversed the pattern observed during the nineteenth century (Behm and Vallin, 1980: 29).

In contrast to the experience of the developed countries during the nineteenth century, studies from developing countries in this century suggest a higher mortality risk among rural than urban dwellers. Behm and Vallin (1980: 26) observed that almost one-third of the developing world during the period 1970-1975 experienced a life expectancy at birth equal to or lower than that experienced by the Western European countries at the end of the nineteenth century. The infant mortality rates by regions of residence in developing countries ranged from 65 to 200 per 1000 live births in 1970 (Behm and Vallin, 1980: 27). Moreover, rural communities of developing countries were noted to be experiencing a higher mortality risk than urban communities. In a study of 12 Latin American countries, Behm and Primante (1978, cited in Behm, 1980: 5-6) noted 30 - 60 per cent higher risk of death to the rural population in two-thirds of the countries in comparison to the urban population. Behm and Primante also observed that a scattered rural population was exposed to 13 per cent higher risk of death as against a population in more concentrated areas. Mortality differentials have also been noted among geographical and administrative units and sub-divisions of population in tropical Africa (Gaisie, 1980: 24). This selection of findings indicates that while developing countries have seen rapid progress in the application of medical technology to reduce mortality, these populations are living under conditions similar to those that prevailed in Europe almost a century ago (Behm, 1980: 13). The rural and urban differentials in mortality in the developing countries are attributed to distribution of health technology, sluggish economic growth, and socio-economic factors such as poverty, malnutrition, poor housing, unhealthy environment, and a low levels of education which disadvantage rural inhabitants (Gaisie, 1980: 24).

Knodel (1977: 371-372) argues that the risk of death to infants before the late nineteenth century in developed countries, which was higher in the cities than in the countryside, reversed by the turn of this century. Knodel attributed this to the faster decline in infant mortality rates for cities. In this century the urban, rural and geographical variations in mortality in advanced countries, however, have tended to disappear (Behm and Vallin, 1980: 29; Knodel, 1977: 371). In contrast, empirical findings in developing countries in this century show a wide gap in infant mortality rates between rural areas and cities. For example, Farah and Preston (1982: 367) for Sudan, Jain (1985: 416), Visaria (1985: 1399), Tulasidhar (1993: 182), Singh (1989: 380) and Dutta and Kapur, (1982: 222) for India, Amin et al. (1986: 40) for Bangladesh, Caldwell and Ruzicka (1985: 300) for South Asian countries and Trussell and Hammerslough (1983: 16-17) for Sri Lanka observed lower infant mortality rates in urban as against rural areas.

Oya (1981: 255) argued that in Brazil the urban-rural differential in mortality was the result of the concentration of resources and social services in the urban areas. Other studies attributed this differential to better access to health care and a better standard of living in the urban areas (Dutta and Kapur, 1982: 222; Amin et al., 1986: 40; Caldwell and Ruzicka, 1985: 300). Visaria (1985: 1399) emphasised the type and place of delivery and practices followed in the case of newly born babies as the factors associated with infant mortality differences. Jain (1985: 424) suggested rural poverty and mother's education as major factors explaining regional variations in infant mortality for India.

In this context, Berrebi and Jacques (1981: 31) argued that cleanliness, effective medical practices, and less exposure to severe famine and killer epidemics all increase longevity. Modern technological and medical advances that have been made in developed countries and which are now readily available in the developing countries have further contributed to lengthening life (Davis, 1973: 276). In a study on child survival in 29 countries, Hobcraft et al. (1984: 199) suggested that place of residence can be an indicator for living conditions and also access to both public and modern medical services. Similarly, Behm and Vallin (1980: 29) argued that place of residence by itself does not explain mortality differentials. The differentials rather are indications of the differential socio-economic standards of the population in question. Trussell and Hammerslough (1983: 16-17) argued that past studies in child survival have ascribed too much credit to urban health facilities and too little to the higher social status of urban residence in accounting for the lower risk of death in urban areas. In this context, Oya (1981: 255-256) argued :

> Although part of the urban population may not benefit directly from these services and may live in inferior conditions with regard to housing and nutrition, it is commonly supposed that the urban population is better off than its rural counterpart, seen as living in a stagnant economy, largely beyond the reach of public services that reduce mortality. Consequently urbanisation is often thought to be a driving force behind mortality reduction.

Variations in infant and child mortality across geographical locations, administrative units and rural and urban areas have also been observed in Nepal. Thapa and Retherford (1982: 76) and Gubhaju (1991: 81) found the highest infant mortality rate for the mountains region of Nepal followed by the *terai* (the plains). The hills areas had the lowest infant mortality rate. The higher risk of death to infants and children was also noted for rural as against urban Nepal by the CBS (1987a: 309) and by Gubhaju (1991: 167). Variations in infant mortality rates among districts (administrative units) were also observed for Nepal (Shrestha et al., 1987: 27-30). These differentials in infant and child mortality according to place of residence were attributed to different socio-economic status and inequality in access to health care services (Gubhaju, 1991: 81: 167; Thapa and Retherford, 1982: 76). Moreover, lack of knowledge, widespread poverty and traditional beliefs were also suggested to have aggravated the health problem much further in rural areas, contributing to the wide gap between urban and rural mortality rates (Gubhaju, 1991: 167).

Empirical findings on childhood mortality differentials according to place of residence and the explanations for the observed differentials reviewed in this chapter clearly suggest a wide range of possible mechanisms as well as explanations for the differentials, as the society or the country in question differs. It is also noted that factors associated with infant and child deaths according to place of residence are not only manifold but are also directly related to cause of death; that is, they have a close association with simple causal mechanisms. The exposure of infants and children to a higher risk of death in developing countries cannot ignore the context of the prevailing higher mortality rates in rural areas where the majority of infants and children are likely to be living. This calls for further research in infant and child mortality differentials according to place of residence in order to broaden the understanding of the mechanisms and the intervening factors.

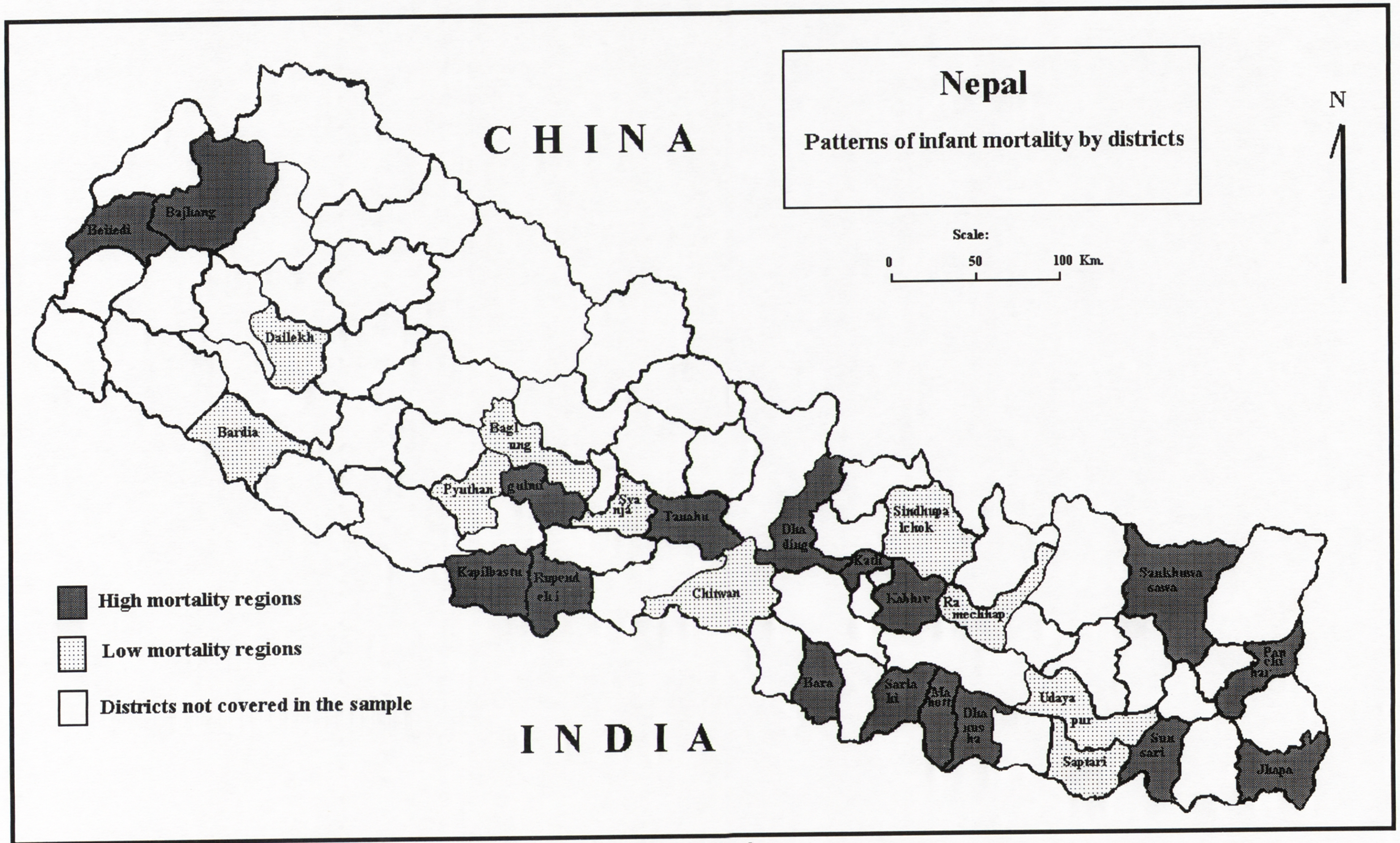
6.3 Regions of study

Gubhaju (1991: 168) using the 1976 NFS data analysed a limited number of demographic and socio-economic variables to assess the infant and child mortality differentials according to rural and urban place of residence in Nepal. However, his analysis was limited to a descriptive association. Gubhaju also noted an inconvenience in identifying the independent influence of each factor on infant and child mortality for urban areas due to the limited size of the urban sample, and called for further research in which a large urban sample would permit detailed analysis of the determinants of infant and child mortality in urban Nepal.

Although the 1986 NFFS covered a large urban sample, the inconsistencies in the observed urban-rural infant mortality levels (some of the rural areas show a lower levels of infant mortality than urban areas: Appendix Table 6.1) suggest that it may be necessary to create a variable which can segment the population into distinct homogeneous groups in order to address the issues raised in this study. In a country like Nepal which has a multi-lingual, multi-religious and multi-ethnic population, the task of forming homogeneous groups on the basis of the individual socio-economic, demographic and environmental characteristics is not very easy. For example, children in Nepal are born and brought up in a diverse socio-cultural and geographical environment. People in the country live in an extreme range of natural environments varying from the cold Himalayan regions to the hot *terai* (the plains). The culture, ethnicity, caste, languages, beliefs and living styles vary as the places of residence differ. The 1981 Census recorded 75 different ethnic groups of people speaking 50 languages in Nepal (CBS, 1987a: ii). They are broadly classified into two main groups: Indo-Aryan and Tibeto-Mongoloid. Moreover, there is a small population of Austric and Dravidian origin who are believed to be the aboriginal people of the country. Although different groups of people are living throughout the country, most Indo-Aryan people live the *terai* and Kathmandu valley while the bulk of Tibeto-Burmans people inhabit northern, eastern and central Nepal (CBS, 1987a: II-X). The rural-urban classification of the people in the country suggests that 90 per cent of the Indo-Aryans and 87 per cent of the Tibeto-Mongoloids are rural dwellers (KC, 1994: 7). While agriculture, maize and millet are the main crops in the hills of Nepal, rice and wheat are the main crops produced in the *terai* areas (CBS, 1987a: X). The staple food of the people is therefore associated with their place of residence. The age at marriage in 1981 in the 75 districts of Nepal (administrative units) varied from 13.7 years in Parsa District in the *terai* to 24.1 years in Manang district in the mountains (CBS, 1987a: 109).

Vallin (1980: 26) argued that climate and natural resources on the one hand and economic and social pattern of behaviour and cultural heritage on the other hand strongly influence the interplay of the biological determinants of human mortality. Behm and Vallin (1980: 14) also suggested that each individual is characterised by the geographical area he or she belongs to, which is itself characterised by socio-economic definitions. These arguments further support the possibility of a different role of independent variables in influencing infant and child mortality in a country with such diverse socio-cultural and natural environments. This may be a reason why earlier studies on infant and child mortality differentials according to the urban and rural dichotomy were not adequate for expressing the variety of socio-economic conditions associated with different groups of people in Nepal, and the influence of these conditions on infant and child mortality. Previous studies in Nepal have not addressed issues such as what accounts for the mortality differentials according to place of residence and why infants and children in one area are exposed to a higher risk of death than in other areas. This chapter aims to examine the infant and child mortality in Nepal from these perspectives.

To pursue the analysis in accordance with the issues already raised, a variable, *region of residence* with two categories, *high mortality region* and *low mortality region*, is computed on the basis of the mortality level experienced in the sampled districts (see Map 6.1). For example, those districts which had infant mortality rates lower than 80 per 1000 live births are categorised as low mortality region (LMR) and those experiencing infant mortality rates of 80 and over per 1000 live births are categorised as high mortality region (HMR). The HMR group is composed of eight *terai*, seven hills and two mountain districts, all of which are rural. The LMR group is composed of three *terai*, six hills and one mountain district, including all sampled urban areas in the 1986 NFFS. The cut-off point of 80 infant deaths per 1000 live birth chosen to separate the two mortality regions is based on the estimated infant mortality rates for urban Nepal for 1983. These rates varied from 78 to 80 per 1000 live births, and were based on various indirect estimates (CBS, 1987b: 73). This region of residence variable has been constructed to serve the purpose of this study.



Note: The infant mortality information in the map is only from rural Nepal

Source: Appendix Table 6.1

MAP 6.1

6.4 Variables used in this study

This study uses individual level retrospective information on infant and child mortality and its correlates from the 1986 NFFS data in order to examine factors that account for the mortality differentials according to regions of residence (HMR and LMR). The data collection procedures and the level of information available in the data have already been discussed in Chapter Two. As in the analysis in preceding chapters, infants born one year before the survey and children born five years before the survey were excluded from the analysis of infant and child mortality respectively in order to avoid truncation effects. The analysis in this chapter, however, considers only second and higher order births. The independent variables of interest considered in this chapter are:

Socio-economic factors:
- Mother's education: years of schooling completed
- Father's education: years of schooling completed
- Working mothers: those involved in paid employment after marriage
- At least one cow or buffalo in the house
- Ecological belt: *terai*

Health related factor:
- Ever use of contraception

Cultural Factors:
- Ethnicity: Indo-Aryan
- Language spoken at home: Nepali

Demographic factors:
- Mother's age at childbirth: < 24 years
- Preceding child: dead
- Length of preceding birth interval: ≥ 37 months
- Birth order of child: 2-3

These independent variables are utilised in this chapter to examine the inter- as well as intra-regional variations in infant and child mortality in Nepal. The detailed descriptions of the independent variables of interest, except for ethnicity, ecological belt (place of residence) and language spoken at home added in the analysis in this chapter, have already been discussed in Chapters Three to Five. However, parent's education in this chapter is used as number of years completed instead of the category of no education versus some education, used in previous chapters. In addition, land-holding and access to health variables are not considered in this chapter because these variables did not add any additional information to that obtained in Chapter Four. The dependent variables are infant mortality (${}_1q_0$): whether the child died in its first year of life; and child mortality (${}_4q_1$): whether a child who survived its first birthday died before its fifth birthday.

Language (mother tongue) in the context of Nepal can be used as a yardstick for caste/ethnicity as well as for place of residence of the Nepalese population. For example, people who are classified according to the Magar, Gurung, Rai, Limbu and Tamang languages can be classified under the Tibeto-Burman group while those who claim Nepali, Abadhi, Maithali and Bhojpuri as their mother tongue can be classified as belonging to the Indo-Aryan group. Although all groups of people can be found in different parts of the country, Nepali as well as Tibeto-Burman languages are predominantly spoken in the hills and mountain regions; Abadhi, Bhojpuri, and Maithali languages are predominantly spoken in the *terai* regions (CBS, 1987a: 67-75). Along with ethnicity/caste and place of residence, mother tongue is also, to some extent, associated with religion. For example, most of the Magar, Gurung, Rai and Tamang speaking people are Buddhist while the most of Nepali, Maithali, Abadhi and Bhojpuri speaking people can be classified as Hindus. Mother tongue, however, is not a very strong yardstick to measure the religion of the people because Muslims and other religious groups on one hand are likely to speak Maithali, Bhojpuri or Abadhi as their mother tongue; on the other hand Buddhists as well as Christians are also likely to speak Nepali as their mother tongue. Still, language spoken at home can be utilised in this study to classify the population under the broad ethnic groups Indo-Aryan and Tibeto-Mongoloid. This is because, according to the 1981 Census of Nepal, mother tongue is defined as the language spoken by the mother of a child (CBS, 1987a: 68). So in the absence of other better indicators, language spoken at home in the context of child survival in Nepal can be used as an explanatory variable to draw inferences on the religious and cultural beliefs, and values associated with the religion, caste/ethnicity and place of residence of the people.

Radio in the context of Nepal is the prime means of mass communication. During the past decades, the Ministry of Health, and Family Planning Institutions have extensively utilised this medium to communicate messages to the majority of the people of the country on child health, nutrition, diarrhoeal disease control and immunisation. These messages were communicated through radio in the Nepali language. Nepali, as the national language of the country, is spoken and understood by the majority of the people (CBS, 1987a: 68), although only 58 per cent of the people in the 1981 Census claimed it to be their mother tongue. In the absence of information on how many people were able to receive the broadcast messages, it is very difficult to conclude whether the effects on child survival due to this variable operate through the differences in ethnicity, place of residence and religions of the people, or from the health-related messages delivered through the media in Nepali language. However, the influence of the health messages on the favourable survival prospects of a child in the HMR can be assumed to be more effective than in the LMR. This is because the former group are the rural dwellers, and the health messages for those speaking Nepali language in this region are likely to increase their level of knowledge on the topic. Thus, if the Nepali language variable appears to show a favourable child survival effect only in the HMR then this effect will be interpreted as being due to the advantages of these messages only for the Nepali speaking group of the region. UNICEF (1987: 172) also suggested the idea that different messages spread through radio in Nepali language were less familiar to women in rural areas with no education. In addition, the proportions of the people who could not understand or speak the Nepali language in the HMR can be expected to be higher than in the LMR (which is composed in large part of the urban population).

In this study the ecological belt (place of residence), *terai* versus hills/mountains, is expected to serve as an indicator for the differential natural environment, altitude and climatic conditions of the country which considerably vary between these two places of residence. The third additional explanatory variable used in this study is ethnicity, categorised as Indo-Aryan versus Tibeto-Mongoloid and other groups. These two population groups differ in a number of ways. For example, the Indo-Aryan group which constitutes the Hindu population of the country encourages early marriage (Dahal, 1993: 3), so that the age at marriage for the Tibeto-Burman group is higher than for the Indo-Aryan group (Risal and Shrestha, 1989: 56-57). Levine (1987: 287) noted the considerable autonomy and high status of the Tibeto-Mongoloid women in their marital home while

Acharya and Bennett (1981: 222-236) noted less autonomy and economic independence among Hindu and Muslim women (Indo-Aryan group). Even among high caste Hindus, married women in the *terai* confine themselves to their houses, while the high caste groups in the hills are more relaxed in their pattern of marriage (Dahal, 1993: 4). This implies that marriage, family planning, autonomy and economic power of a woman in the traditional Nepali household are deeply embedded in the ethnicity of the people. Ethnicity, however, has been always neglected in the study of child survival in Nepal. The substantial evidence concerning the different practices and lifestyles of the people according to their ethnicity clearly suggests the need to address ethnicity as one of the explanatory variables in the study of child survival. This is not to suggest that ethnic origin itself determines survival and mortality risks, but its use provides a neat way of summarizing the cultural differences associated with ethnicity. In discussion of the observed effects, these differences figure prominently.

6.5 Analytical approach

The preliminary analysis in this chapter is carried out using simple cross-tabular bivariate techniques and ratio methods. This will assess infant mortality differentials according to variables of interest for each region of residence when controls for the influence of other variables are not introduced.

Further examination of infant and child mortality differentials according to regions of residence in this chapter are performed from three perspectives. Given the differences in socio-economic, health-related factors[1/], and cultural and demographic differentials among people according to their place of residence (Tables 6.1 to 6.8), the nature of relationships between the independent variables of interest and the dependent variable can be expected to differ for different regions of residence. So, the analysis is based first on the assumption that the structural relationship between the independent and dependent variables differs with the differences in the regions of residence (HMR and LMR). In order to examine the

1/ The ever use of contraception in this study is used as the indicator for the health care factor. The variable cows and buffalo indicates whether or not a household possesses cows and buffalo.

role of these structural differences, samples for two regions of residence (HMR and LMR) were pooled, and the logit regressions which allow for the different coefficients in two regions of residence were estimated. This exercise is performed by interacting each variable with a high mortality region dummy so as to yield the difference in mortality due to the difference between the regions of residence. The statistical significance of the effect of each factor is then assessed. The results from this part of the analysis thus yield evidence for the extent to which the differences in structural relationship account for the higher mortality rate in the HMR group. In addition, intra-regional infant and child mortality variations according to independent variables of interest are also analysed.

Second, the infant mortality rates for each region are predicted by assuming the observations of one region to be the same for the other region and vice versa. For example, the coefficients of the HMR were applied to the observations of the LMR in order to examine how far the coefficients of HMR would predict the mortality level of the LMR. The level of infant mortality is predicted by employing the coefficients of HMR (β HMR) and observations of LMR (X LMR) using the formula:

$$P_0 = 1 / (1 + e^{(-\beta \text{ HMR} * \text{X LMR})})$$

to yield a probability of dying for each birth in the LMR. The averages of these predicted probabilities are then compared with the actual infant mortality rate in the LMR to examine the role of structural differences in explaining the higher mortality rate in the HMR. This procedure is then repeated by applying the coefficients obtained for the LMR to the observations of the HMR to examine the extent to which the coefficients of the LMR can explain the level of mortality in the HMR. The difference between the observed infant mortality rate of a region and the predicted infant mortality rate derived by applying the observations of that region and coefficients of another region is the share attributable to the structural differences (Preston, 1980; DaVanzo and Habicht, 1984; Peterson et al., 1986).

Third, the contribution of a particular variable to the overall infant mortality differentials due to the differences in the explanatory variables between regions of residence is assessed. This part of the analysis yields the magnitude of higher or lower infant mortality rate in the HMR, had the HMR had as many births to the households with the particular characteristics of the LMR over the period, when other things are held constant. This exercise is performed for each explanatory variable. The reverse procedure is also performed to assess the magnitude of the level of infant mortality in the LMR, assuming as many births to the households in the region with the particular characteristics of the HMR. For this, the change in mortality implied by one unit of change in explanatory variable X for each sub-sample is computed when all variables are held constant at their mean values for the sub-sample $(\partial p/\partial x) = P_i \, P(1\text{-}P)$. Each of these first derivatives is multiplied by the actual differences between the means of variables between two regions of residence (Peterson et al., 1986). The results of the analysis will develop understanding of the role of a particular variable in contributing to overall mortality differences due to differences in explanatory variables between regions of residence. This is computed using the following formula, using contraception use as the explanatory variable:

$$\Delta = \beta_U \, P_{HMR} (1 - P_{HMR}) (U_{LMR} - U_{HMR})$$

where,

Δ	=	mortality differences due to differences in explanatory variables,
β_U	=	logit coefficient of contraception use,
P_{HMR}	=	average infant mortality rate in HMR,
U_{LMR}	=	mean value of contraception use in LMR
U_{HMR}	=	mean value of contraception use in HMR.

The results of this calculation will answer the question of how much higher or lower the mortality level would have been in a region had the region had the same value of a particular variable as the other region. All procedures are repeated to examine the variations in child mortality as well as infant mortality, according to region of residence. The analytical approach used in this study is outlined in detail in Westin (1974), Preston (1980, 1975a), DaVanzo and Habicht (1984, 1986), Merrick (1985) and Peterson et al. (1986).

6.6 Socio-economic background of the population according to mortality regions

Before the main analysis of the 1986 NFFS data, it is useful to discuss some of the socio-economic, cultural and demographic background of the Nepalese people according to their regions of residence. Table 6.1 shows the distribution of the economically active[2/] population aged 10 years and over according to their major occupational group, sex and region of residence from the 1981 Census of Nepal. The data show that the people in both the HMR and LMR were mainly in the agricultural sector. A higher proportion of female involvement in farming is also evident for both the HMR and LMR (Table 6.1). This is due to the heavy concentration of female unpaid family workers in the traditional labour-intensive farming practised in Nepal. A study in the middle hills of Nepal (Schroeder and Schroeder, 1979: 178-181) noted that women in Nepal are responsible for the greater share of agricultural and domestic work such as child-care, up-keep of the family house and preparing, cooking and serving meals. Vinding (1984: 51) found Nepalese women spending several hours a day collecting firewood and fetching water. The findings of these authors indicate the magnitude of the agricultural and household responsibilities borne by Nepalese women.

Table 6.1 also shows a greater proportion of males in all categories of occupational groups, other than farming, in both regions. This corresponds to the national pattern (CBS, 1987a: 226). The lower level of female participation in the blue- and white-collar jobs is because having the major responsibility for household jobs could mean that women had no time to participate in paid employment outside the home. A greater proportion of both males and females in the LMR are also engaged in blue-collar and white-collar jobs as compared to the HMR. This reflects better opportunities for work outside the home in the LMR, which contains the major urban areas of Nepal. As most of the production activities in Nepal are based on primary agriculture products, the returns from blue-collar jobs are likely to be low.

2/ The 1981 Census defined 'economically active' as those who worked at least eight months, either at a single stretch or in intervals, during the year before the census enumeration day, either for pay, profit or remuneration in kind. Unpaid family workers who helped in running operations with the joint co-operation of family members or those who helped during the peak agriculture seasons are also included in the economically active groups. No time criterion is applicable for the unpaid family workers to be included in the active labour force (CBS, 1987a: 201).

Table 6.1 Percentage distribution of the economically active population 10 years of age and over by major occupational groups, sex and mortality region: 1981, Nepal.

Major occupation groups	LMR		HMR*	
	Male	Female	Male	Female
White-collar **	7.0	2.0	3.4	0.9
Blue-collar ***	5.7	2.6	5.1	2.1
Farming/Fishing	82.1	93.8	89.1	96.2
Other	5.2	1.6	2.4	0.8
Total percentage	100	100	100	100
Total number	801574	443290	1166525	518587

Notes: * Information from Jhapa and Bara districts (districts in HMR) is not included in the table because separate information for urban areas of these districts was not available for adjustment. Urban areas of the districts in HMR are adjusted to reveal the background characteristics of the population which reflect the rural areas.
**includes people in professional, administrative, clerical and sales work.
*** indicates people working in production labour and service sectors.
Sources: CBS, (1984d: 128-222; 1984c: 308-331).

Table 6.2 shows the distribution of the population aged 10 years of age and over according to their employment status, sex and region of residence from the 1981 Census. Table 6.2 shows that the majority of the people, irrespective of their sex, fall in the self-employed category in both regions of residence. This is followed by the employee category. Greater proportions of males in all categories, except in the self-employed and unpaid family work categories, are also evident (Table 6.2). Most of the self-employed group in the HMR (comprised of only rural areas) are likely to be working on their own farms while these groups of people in the LMR (which include urban areas) are likely to be involved in various activities such as business, industry, sales, construction and transport.

The greater proportion of unpaid workers in both regions of residence again could be due to women's greater share of responsibility for work within the house and on their own farms. In addition, women in Nepal who belong to the affluent or high caste groups, in general, do not favour taking paid employment outside the home (Acharya and Bennett, 1981: 43-45). Working outside the home in Nepal is considered basically a man's occupation (Dahal, 1993: 11). In addition, work for men and women is divided according to the social norms (Schroeder and Schroeder, 1979: 182-183). Acharya and Bennett (1981: 43) also noted that women in Nepal consider cottage industry work as being for low caste groups. Acharya and Bennett further noted that no women from the top stratum like to work either in the domestic or non-organised service sectors. It appears here that most women in Nepal do not like to work outside the home unless to meet the household's economic requirements.

Table 6.2 Percentage distribution of the economically active population 10 years of age and over by employment status, sex and mortality region: 1981, Nepal.

Employment status	LMR		HMR*	
	Male	Female	Male	Female
Employer	1.0	0.4	1.3	0.5
Employee	14.5	4.9	15.0	4.1
Self-employed	80.4	89.8	79.4	90.4
Unpaid family work	1.5	3.2	1.8	3.2
Others	2.6	1.7	2.5	1.8
Total percentage	100	100	100	100
Total number	801574	443290	1166525	518587

Notes: *Information from Jhapa and Bara districts (districts in HMR) are not included in the table because separate information for urban areas of these districts was not available for adjustment. Urban areas of the districts in HMR are adjusted to reveal the background characteristics of the population which reflect the rural areas.

Sources: CBS (1984c: 103-150; 1984d: 318-349).

Education is the other indicator from the 1981 Census used to examine the differentials in socio-economic background of the population according to their region of residence. The LMR is composed of greater proportions of literate people, of both sexes. The data show that 40 per cent of the males and 18 per cent of the females in the LMR and 30 per cent of the males and 10 per cent of the females in the HMR were classified as literate (CBS, 1984a: 1-48; 1984c: 152-163).

Table 6.3 shows the proportion of population according to the language spoken at home (mother tongue) and regions of residence. Clear differentials are evident in the population between the regions of residence according to their mother tongue. The proportions of Nepali and Newari speaking people in the LMR are greater than in the HMR. In contrast, the proportions of Bhojpuri and Maithali speaking people are greater in the HMR. Proportions of other groups in both the HMR and LMR do not vary much.

Table 6.3 Percentage distribution of the population by mother tongue and mortality regions: 1981, Nepal.

Mother tongue	Percentage		Percentage	
	Low mortality region (LMR)		High mortality region (HMR)*	
a/Nepali		61.3		44.8
a/Maithali		11.5		23.0
a/Bhojpuri		0.1		10.0
a/Newari		7.5		2.4
Other Indo-Aryan		6.3		6.4
Abadhi	0.1		4.5	
Tharu	5.9		1.8	
Rajbansi	0.1		0.0	
Satar	0.0		0.0	
Sunwar	0.2		0.0	
Danuwar	0.0		0.1	
Santhal	0.0		0.0	
Tibeto-Burman		8.0		8.7
Gurung	1.2		0.6	
Tamang	3.8		4.2	
Magar	1.3		1.0	
Limbu	0.1		1.3	
Rai	1.2		1.4	
Bhote	0.4		0.2	
Thakali	0.0		0.0	
Others		5.3		4.7
Total percentage		100		100
Total number		2807703		3840896

Notes: *Information from Jhapa and Bara districts (districts in HMR) are not included in the table because separate informations for urban areas of these districts was not available for adjustment. Urban areas of the districts in HMR are adjusted to reveal the background characteristics of the population which reflect the rural areas.
a/ More likely to be Indo-Aryan groups.

Sources: CBS, (1984b: 25-214; 1984c: 103-150).

Table 6.4 shows infant mortality rates according to mother's socio-economic, household, demographic, cultural and region of residence characteristics, according to the 1986 NFFS. The last column of Table 6.4 shows the ratio of the infant mortality rates in the HMR to the LMR. A higher risk of death to infants according to each independent variable is evident in the HMR (Table 6.4). The infant mortality rate varies from 20 per cent (working mothers) to 130 per cent (preceding birth interval greater or equal to 37 months). In both regions of residence the risk of death to infants of mothers who have ever used contraception is considerably lower than to infants of mothers who have never used contraception. In both regions of residence, infants in a household which has cows and buffalo are exposed to a lower risk of death than in a household which does not have cows and buffalo. In addition, in both regions of residence Tibeto-Mongoloid infants born in *terai* are exposed to a higher risk of death than infants in other categories of the respective variables. Regarding demographic variables, infants born to mothers under 24 years of age and to those who have lost their preceding child in both regions of residence are exposed to a higher risk of death. However, second and third order births in comparison to other orders of birth, and infants born 37 months after the birth of preceding child in comparison to those born within 36 months after the birth of the preceding child, are exposed to a lower risk of death. The pattern of relationships of these variables with infant mortality rates in both regions of residence is consistent (Table 6.4). The work status of the mother, however, shows a higher risk of death to infants of working mothers only in the LMR, which show a different pattern of the relationship of this variable with infant mortality between the regions of residence. The same is true for the Nepali language with a very small difference.

In both regions of residence, children of mothers not working, who have ever used contraception or belong to Indo-Aryan ethnicity, born in the *terai* ecological belt, and in households with cows and buffalo in both regions of residence, were exposed to a lower risk of death than other categories of these variables. In both regions of residence, more favourable survival prospects are evident among children born to women of 24 years and over, second and third order children, children of mothers who had not experienced previous child loss, and to those born 37 months and more after the birth of the previous child, than for children of other categories of women. These results, however, are based on a bivariate analysis where the effects of other variables are not held constant. The net influence of each independent variable according to the region of residence is examined in the subsequent sections of this chapter.

Table 6.5 shows child mortality rates according to the socio-economic, health-related, cultural, household, demographic and region of residence variables. The third column of Table 6.5 shows that child mortality rates in the HMR were 70 (Nepali

Table 6.4 Infant mortality rates according to socio-economic and health-related characteristics for HMR and LMR: 1986 NFFS, Nepal.

Explanatory variables	HMR Total births	HMR IMR/1000	LMR Total births	LMR IMR/1000	Ratio
Work status of mothers					
Working	338	106	158	88	1.2
Not working	3746	120	4059	67	1.8
Cows and buffalo possessed by a household					
At least one	3235	114	2828	65	1.8
None	849	137	1389	74	1.9
Ecological belt					
Terai	1996	125	1840	69	1.8
Hills & mountains	2088	113	2377	66	1.7
Status of contraception use					
Ever used	902	82	1275	48	1.7
Never used	3182	129	2942	76	1.7
Ethnicity					
Indo-Aryan	1721	113	2131	67	1.7
Tibeto-Mongoloid	2363	123	2086	69	1.8
Language spoken at home					
Nepali	1855	108	2566	68	1.6
Other	2229	127	1651	67	1.9
Maternal age at childbirth (years)					
< 24	1392	135	1460	78	1.7
≥ 24	2692	110	2757	62	1.8
Preceding child at age one					
Dead	587	187	348	149	1.3
Alive	3497	107	3869	60	1.8
Preceding birth interval (months)					
≥ 37	1274	87	1441	38	2.3
< 37	2810	133	2776	83	1.6
Child's birth order					
2-3	1923	113	2284	64	1.7
> 3	2161	124	1933	71	1.7

Note: Rates are based on second and higher order children born between 1971 and 1985.
Source: 1986 NFFS data tape.

Table 6.5 Child mortality rates according to socio-economic and health-related characteristics for HMR and LMR: 1986 NFFS, Nepal.

	HMR		LMR		
Explanatory variables	Total children	CMR/ 1000	Total children	CMR/ 1000	Ratio
Work status of mothers					
Working	201	179	88	56	3.2
Not working	2062	87	2398	41	2.1
Cows and buffalo possessed by a household					
At least one	1806	86	1681	38	2.2
None	457	131	805	49	2.6
Ecological belt					
Terai	1077	93	1117	36	2.6
Hills & mountains	1186	97	1369	46	2.1
Status of contraception use					
Ever used	561	82	887	38	2.1
Never used	1702	100	1599	44	2.3
Ethnicity					
Indo-Aryan	1001	92	1306	29	3.1
Tibeto-Mongoloid	1262	98	1180	55	1.8
Language spoken at home					
Nepali	1083	73	1535	43	1.7
Other	1180	116	951	39	2.9
Maternal age at childbirth (years)					
< 24	839	106	873	45	2.3
≥ 24	1424	89	1613	40	2.2
Preceding child at age two					
Dead	416	117	248	64	1.8
Alive	1847	90	2238	39	2.3
Preceding birth interval (months)					
≥ 37	700	54	842	27	2.0
< 37	1563	114	1644	49	2.3
Child's birth order					
2-3	1130	93	1384	34	2.7
> 3	1133	97	1102	51	1.9

Note: Rates are based on second and higher order children born between 1971 and 1980.
Source 1986 NFFS data tape.

language) to 220 per cent (working mothers) higher than those in the LMR. The direction of relationships between independent variables, except for language spoken at home, and the dependent variable in both regions of residence shows a similar pattern.

Table 6.6 shows means of each independent variable for infants born during the period 1971-1985 according to region of residence from the 1986 NFFS data. The last column of Table 6.6 shows the t-statistics for the statistical significance of the difference between means in the HMR and LMR. All differences, except for maternal age at childbirth, are statistically significant. The remaining 11 independent variables and their differences are expected to explain the higher or lower level of mortality in one region of residence as against the other.

Among the significantly different mean values of socio-economic and health-related variables, the greatest differences between the regions of residence occur for mother's education followed by Nepali language, father's education, cows and buffalo in the house, working mothers, ever use of contraception, Indo-Aryan ethnicity, and the *terai* ecological belt. Similarly, the greatest differences in the mean values of demographic variables between the regions of residence occur for preceding child dead, followed by second and third birth order infants and infants born 37 months and more after the birth of the preceding child. The results in Table 6.6 further suggest the existence of statistically significant differentials in the socio-economic and demographic backgrounds of the population between the HMR and LMR.

Table 6.7 again shows the means of each independent variable for children born during the period 1971-1980 according to region of residence from the 1986 NFFS data, but for the different reference period for analysis of child mortality. Of the 12 independent variables, all except for mother's age at childbirth show statistically significant differences in the mean values between the regions of residence. Among the mean values of the socio-economic and health-related independent variables between the regions of residence, the greatest differences occur for mother's education followed by father's education, language spoken at home, cows and buffalo in the house, ever use of contraception, working mothers and Indo-Aryan ethnicity. Similarly, among the mean values of the demographic variables between the regions of residence, the greatest differences occur for preceding child dead followed by birth order and the length of preceding birth interval.

Table 6.6 Means of variables and statistical significance of differences between means by the HMR and LMR for infant mortality: 1986 NFFS, Nepal.

Explanatory variables	Mean HMR	Mean LMR	t-statistics for difference in means
Mother's education (years)	0.1677	0.7325	14.31***
Father's education (years)	1.8134	2.9208	13.36***
Working mother [D]	0.0828	0.0375	-8.69***
Cows and buffalo in house [D]	0.7921	0.6706	-12.62***
Terai ecological belt [D]	0.4887	0.4363	-4.79***
Ever use of contraception [D]	0.2209	0.3023	8.49***
Indo-Aryan ethnicity [D]	0.4214	0.5053	7.69***
Nepali language [D]	0.4542	0.6085	14.25***
Mother's age at childbirth < 24 years [D]	0.3408	0.3462	0.52
Preceding child: dead at age one [D]	0.1437	0.0825	-8.83***
Preceding birth interval ≥ 37 months [D]	0.3119	0.3417	2.89***
Birth order 2-3 [D]	0.4709	0.5416	6.46***
Mean dependent	0.1190	0.0681	-7.98***

Notes: [D] denote dichotomous variables. *** denotes significant at the 1 per cent level. Analysis includes second and higher order births born between 1971 and 1985.
Source: 1986 NFFS data tape.

6.7 Infant mortality variation due to structural differences between variables

The probability of an infant's death in the HMR is 119 per 1000 live births as against 68 per 1000 live births in the LMR. In addition, analysis of data from both the 1981 Census and 1986 NFFS in the preceding sections (Tables 6.1-6.7) has demonstrated considerable differences in the socio-economic, health-related and demographic characteristics of the population between the two mortality regions. In these circumstances the nature of the relationship between variables is likely to differ from one region to the other.

Table 6.7 Means of variables for child mortality in HMR and LMR: 1986 NFFS, Nepal.

Explanatory variables	Mean HMR	Mean LMR	t-statistics for difference in means
Mother's education (years)	0.1635	0.7116	10.80***
Father's education (years)	1.6757	2.7969	10.44***
Working mother [D]	0.0888	0.0354	-7.59***
Cows and buffalo in house [D]	0.7981	0.6762	-9.65***
Terai ecological belt [D]	0.4759	0.4493	-1.84*
Ever use of contraception [D]	0.2479	0.3568	8.24***
Indo-Aryan ethnicity [D]	0.4423	0.5253	5.74***
Nepali language [D]	0.4786	0.6175	9.69***
Mother's age at childbirth < 24 years [D]	0.3707	0.3512	-1.40
Preceding child: dead at age two [D]	0.1838	0.0998	-8.30***
Length of preceding birth interval ≥ 37 months [D]	0.3093	0.3387	2.16**
Birth order 2-3 [D]	0.4993	0.5576	3.96***
Mean dependent	0.0959	0.0422	-7.26***

Notes: [D] denotes dichotomous variables. ***, **, and * denote significant at the 1, 5 and 10 per cent levels respectively.
Analysis includes second and higher order children aged one to five years between 1971 and 1980.
Source: 1986 NFFS data tape.

Table 6.8 shows the results of logit models explaining mortality according to region of residence and the differences in mortality due to differences in the structure in relationship between variables in the two regions of residence. The first column of Table 6.8 shows the logit coefficients and corresponding t-statistics for the significant influence of a variable on infant mortality in the HMR. The corresponding figures for the LMR are shown in the second column. The third column of Table 6.8 presents logit coefficients which explain the differences in infant mortality due to differences in the structure in relationships between the two mortality regions and their corresponding t-statistics which explain whether the differences in coefficients were statistically significant or not.

Table 6.8 shows that the coefficients corresponding to working mothers and preceding birth interval greater or equal to 37 months are significantly different between the regions of residence (third column). The negative logit coefficient in the HMR and the positive logit coefficient in the LMR corresponding to working mothers reflect better survival prospects for infants of working mothers in the HMR. This result is consistent with the corresponding result in the bivariate analysis in Table 6.4. While the net influence of this variable is not statistically significant in either of the regions of residence, the difference in infant mortality rate due to the structural differences in the work status of mothers between the regions of residence is statistically significant (third column). It appears here that the structural difference in the mother's work outside the home between the regions of residence has contributed to a different level of infant mortality in the LMR. While the individual coefficients cannot be determined to be significantly different from zero, the direction of the significant difference between them indicates that work outside the home contributes more to infant mortality in the LMR than it does in the HMR. This could be due to the differences in direct involvement of mothers in infant care between the two regions of residence. For example, women in the HMR (since all of them are from rural Nepal) are more likely to work in agriculture and are likely to bring their infants with them when they work. In these circumstances working mothers in the HMR are more likely to breastfeed and take care of their infants themselves. In the LMR (where most of the women are from urban areas) this situation is less favourable, especially when women are working in white- or blue-collar jobs. The difference is therefore explicable, by inference, in terms of the differences in mothers' time allocation for infant care and the frequency of breastfeeding.

The length of preceding birth interval variable was found in Chapters Three and Five to be one of the most important determinants of infant mortality in Nepal. A statistically significant negative coefficient corresponding to infants born 37 months and more after the birth of the preceding child in both regions of residence further confirms the finding and

Table 6.8 Results of logit regression models explaining infant mortality, allowing for different coefficients for the HMR and LMR: 1986 NFFS, Nepal.

Explanatory variables	HMR logit coefficients (t-stat)	LMR logit coefficients (t-stat)	Difference due to change in the coefficients (structure) (t-stat)[1/]
Mother's education (years)	-0.0226 (-0.41)	-0.0383 (-1.02)	-0.0157 (-0.24)
Father's education (years)	0.0139 (0.85)	-0.0063 (-0.34)	-0.0202 (-0.81)
Working mother [D]	-0.3004 (-1.54)	0.3511 (1.16)	0.6515 (1.81)*
Cows and buffalo in house [D]	-0.2698 (-2.15)**	-0.2657 (-1.92)*	0.0041 (0.02)
Terai ecological belt [D]	0.0615 (0.51)	0.0220 (0.17)	-0.0394 (-0.22)
Ever use of contraception [D]	-0.5614 (-4.14)***	-0.5368 (-3.38)***	0.0247 (0.12)
Indo-Aryan ethnicity [D]	-0.0465 (-0.42)	0.0531 (0.41)	0.0996 (0.59)
Nepali language [D]	-0.0824 (-0.66)	0.0914 (0.69)	0.1738 (0.96)
Mother's age at childbirth < 24 years [D]	0.2532 (2.09)**	0.2638 (1.73) *	0.0106 (0.05)
Preceding child: dead at age one [D]	0.4930 (4.03)***	0.8243 (4.91) ***	0.3313 (1.60)
Length of preceding birth interval ≥ 37 months [D]	-0.3888 (-3.30)***	-0.7642 (-4.85) ***	-0.3754 (-1.91)*
Birth order 2-3 [D]	-0.2470 (-2.13)**	-0.1939 (-1.32)	0.0531 (0.28)
Intercept	-1.6165 (-9.70)***	-2.2587 (-12.36) ***	-0.6422 (-2.60)***
χ^2	216.68		

Notes: ***, ** and * denote significant at the 1, 5 and 10 per cent levels respectively.
Analysis includes second and higher order births during the period 1971-85.
[1/] Figures in this column are calculated by interacting each variable with a HMR dummy.

Source: 1986 NFFS data tape.

explanations of the result for this variable in Chapters Three and Five. However, Table 6.8 adds information. Although infants born 37 months and more after the birth of the preceding child show favourable survival prospects in both regions of residence, the odds of death to similar infants born in the LMR are 1.5 times lower. This difference in infant mortality rate due to the differences in the relationships between the length of preceding birth interval with survival prospect of infants between regions of residence is statistically significant (third column).

No other variables in the third column of Table 6.8 show statistical significance for the difference in infant mortality due to a difference in the structure of relationships between variables in the two regions of residence. However, there are statistically significant intra-regional variations in infant mortality for several of the independent variables. Among these are ever use of contraception and possession of cows and buffalo, which in both regions of residence show negative coefficients. Negative coefficients are also found for second and third order births. In contrast, mother's age at childbirth (below 24 years of age) and survival status of the preceding child (dead) in both regions of residence show positive coefficients. The other variables did not show statistically significant influence in determining infant mortality in either of the regions.

Cows and buffalo in Nepal are primarily raised for production of bullocks which are used for draught power and manure as fertilizer in agriculture production. In addition, cows and buffalo milk in a household is a major source of cash income. The profound effects of cows and buffalo in the household on infant mortality in both regions of residence could reflect higher household income. The earnings from the sale of cows and buffalo milk and milk products could enable parents to afford various infants' services and comforts. The influence of this variable on infant mortality, in a society with universal breastfeeding, is less likely to be working through infants' nutritional status in improving their survival.

The lower risk of death to infants of those who have ever used contraception is interpreted here as being due to the maternal and child health care services delivered through family planning institutions and the Ministry of Health, as explained in Chapter Four. The favourable survival prospects for the second and third order infants compared to higher order births in both regions of residence could be due to the higher risk of death to higher order births because of the exhaustion of the women's reproductive systems. The elevated risk of death to infants born to mothers under 24 years of age could be the result of underlying biological factors for mothers, because the reproductive system of the younger women may not be adequately prepared for the stress of pregnancy. The considerable number of higher order births among women at younger ages, as observed in Chapter Three, could have further aggravated this situation.

Trussell and Pebley (1984: 268) argued that the effects of mother's age at childbirth and birth order in infant mortality can produce exaggerated results where the socio-economic correlates and birth spacing patterns are not controlled to isolate the real effects of maternal age at childbirth. The influences of mother's age at childbirth and birth order on infant mortality observed in this study nevertheless seem to be genuine effects since the socio-economic, health-related and other demographic variables are controlled. It is of course possible that a more stringently-controlled analysis than permitted by those data sets would show attenuation or disappearance of the observed significant effects.

The effect of mother's experience of previous infant loss on the survival chance of the index infant in both regions of residence is positive and it is statistically significant. Mothers with experience of previous child loss are often argued to experience subsequent child loss because all children born to them are assumed to be exposed to similar socio-economic and environmental situations (Winikoff, 1983: 232; Pebley and Millman, 1986: 72). In addition, it is also argued that the influence of the preceding child who failed to survive on the survival status of the index child is likely to be working through low birth weight and prematurity (Hobcraft, 1987: 10).

Table 6.9 shows the relative roles of differences in values of covariates and differences in the structure of the relationship in accounting for the infant mortality differences between the two regions of residence. These results are derived by applying the coefficients of the HMR to the observations of the LMR and vice versa. The result indicates that 82 to 85 per cent of the variation in infant mortality rates between the HMR and LMR was due to the variation in the variable values rather than to the differences in the structure.

For example, when the coefficients of the LMR are applied to the observations of the HMR the average predicted mortality rate is 111.2 deaths per 1000 live births as against the observed infant mortality rate of 119 per 1000 live births (Table 6.9). This indicates that of the difference in infant deaths per 1000 live births of 50.9 (119.0-68.1) between the two regions of residence, the structural difference accounts for only 7.8 infant deaths per 1000 live births. When the procedure is reversed and the coefficients of the HMR are applied to the observations of the LMR, the predicted mortality rate for the LMR is 9.4 infant deaths higher than the observed infant mortality rate of 68.1 per 1000 live births. The estimated structural difference in this case thus accounts only for 9.4 infant deaths per 1000 live

Table 6.9 Predicted infant mortality rates using the coefficients of the HMR and variable values of the LMR and vice versa: 1986 NFFS, Nepal.

	Predicted IMR using values of explanatory variables from		Estimated change due to change in values of explanatory variables
	HMR	LMR	
Predicted IMR using HMR coefficients	119.0	77.5	41.5
Predicted IMR using LMR coefficients	111.2	68.1	43.1
Estimated change due to difference in relationship (structure)	7.8	9.4	

Notes: Predicted average infant mortality probability for each region of residence is the average of predicted probabilities for each individual, each calculated as $P_i = 1/(1+e^{-logit_i})$. Analysis includes only second and higher order births.
Source: 1986 NFFS data tape.

births of the differential of 50.9 infant deaths per 1000 live births between the two regions of residence. Thus on the basis of the results in Table 6.9 it can be concluded that the greatest part of the difference in infant mortality level between the two regions of residence is due to the difference in the values of explanatory variables considered in the model. The differentials in infant mortality due to differences in the structural relationship account only for 15 to 18 per cent of the total variations in infant mortality rates between the two regions of residence. Similar results were also found in a study in Malaysia (Peterson et al., 1986: 22).

6.8 Effects on infant mortality assuming characteristics of another region

Because the structural differences are small, it is possible to examine the effect of equalizing characteristics of mothers in the two regions. Table 6.10 shows the mean values, logit coefficients and the change in infant mortality in one region if that region had had the same mean values of the other region of residence and vice versa. The analysis indicates that if women in the HMR had had the same characteristics of education over the period 1971-85 as were found in the LMR, the infant mortality rate improvement in the HMR would have been a reduction of 1.3 points. Similarly, had the HMR had the proportion of contraception users as in the LMR, its infant mortality rate would have been 4.8 points lower. The other important variables shown in Table 6.10 are death of the preceding child, second and third order births and infants born 37 months and more after the birth of the preceding child. All of these could have reduced the level of infant mortality in the HMR had these variables had the same value as in the LMR. In addition, Table 6.10 also shows that had the HMR had the same values as the *terai* ecological belt, and Indo-Aryan ethnicity and Nepali language as in the LMR, the infant mortality rate (IMR) in this region would have been lower than the prevailing level. However, differences due to these variables are very small. The overall results in Table 6.10 suggest that the infant mortality level in the HMR would have been 12 per cent lower than the prevailing level if the HMR had the same mean values as in the LMR for all variables, except for father's education, working mothers, cows and buffalo in the house and mother's age at childbirth below 24 years of age.

An interesting result in Table 6.10 is the value for cows and buffalo in the house. This result suggests that the infant mortality rate in the HMR would have been 3.0 points higher than the observed level had this variable had the same value as in the LMR. This indicates that the presence of cows and buffaloes in the household in the HMR is more important than in the LMR for lowering infant mortality. The differences in infant mortality in the LMR derived by employing mean values of the independent variables corresponding to the HMR, in general, are smaller. The explanation for this result is simply that the prevailing infant mortality level in the LMR was lower.

Table 6.10 Differentials in infant mortality by regions had each variable had the value of the other region: 1986 NFFS, Nepal.

Explanatory variables	HMR n=4084 mean	LMR n=4217 mean	HMR logit coefficients	LMR logit coefficients	Change in IMR had HMR had same mean as LMR [a/]	Change in IMR had LMR had same mean as HMR [b/]
Mother's education (years)	0.1677	0.7325	-0.0226	-0.0383	-1.34	1.37
Father's education (years)	1.8134	2.9208	0.0139	-0.0063	1.61	0.44
Working mothers [D]	0.0828	0.0375	-0.3004	0.3511	1.43	1.01
Cows and buffalo in house [D]	0.7921	0.6706	-0.2698	-0.2657	3.44	-2.05
Terai ecological belt [D]	0.4887	0.4363	0.0615	0.0220	-0.34	0.07
Ever use of contraception [D]	0.2209	0.3023	-0.5614	-0.5368	-4.79	2.77
Indo-Aryan ethnicity [D]	0.4214	0.5053	-0.0465	0.0531	-0.41	-0.28
Nepali language [D]	0.4542	0.6085	-0.0824	0.0914	-1.33	-0.90
Mother's age at childbirth < 24 years [D]	0.3408	0.3462	0.2532	0.2638	0.14	-0.09
Preceding child: dead at age one [D]	0.1437	0.0825	0.4930	0.8243	-3.16	3.20
Length of preceding birth interval ≥ 37 months [D]	0.3119	0.3417	-0.3888	-0.7642	-1.21	1.45
Birth order 2-3 [D]	0.4709	0.5416	-0.2470	-0.1939	-1.83	0.87
Intercept			-1.6165 (-9.70)	-2.2587 (12.36)		
χ^2			71.07	81.27		
Mean dependent	0.1190	0.0681				
p* (1-p)	0.105	0.063				

Notes: Analysis includes second and higher order births born during the period 1971-85.
[a/] $Beta_{HMR} * [P_{HMR}(1-P_{HMR})] * (Mean_{LMR} - Mean_{HMR}) * 1000$.
[b/] $Beta_{LMR} * [P_{LMR}(1-P_{LMR})] * (Mean_{HMR} - Mean_{LMR}) * 1000$.
Source: 1986 NFFS data tape.

6.9 Difference in child mortality due to structural differences between variables

Table 6.11 shows results of the logit regression model explaining the intra-regional variations in child mortality according to the independent variables of interest and the inter-regional variations in child mortality rates due to the differences in the coefficients (structure) between the regions of residence. The results suggest that the structural relationships of father's education, Indo-Aryan ethnicity, Nepali language, and second and third order births with child mortality significantly differ between the regions of residence (third column, Table 6.11). It should be noted, even at this initial stage of the analysis, that the implied structural differences determining child mortality are cultural in nature to a much greater extent than was the case in the analysis of infant mortality. As a consequence, it will be more difficult to ascribe differences in child mortality as explicitly as for infant mortality.

The effects of father's education and Indo-Aryan ethnicity in the HMR are positive as against negative effects in the LMR. In contrast, Nepali language shows a positive coefficient in the LMR. The effects of father's education and Indo-Aryan ethnicity in the HMR and of Nepali language in the LMR are not significantly different from zero. Interpretation of these differences is possible. Fathers' education is likely to influence child survival through income which could enable parents to afford goods and services for their child. The more favourable survival prospects among children in the LMR due to father's education indicates that the influence of this variable in reducing child mortality becomes important with the level of overall development.

The favourable child survival prospects for those born in a Nepali speaking household in the HMR could reflect the effects of health education on primary health care, diarrhoeal disease control, and child nutritional messages delivered through mass communication media. Such knowledge is disseminated in Nepali which may be useless for those who cannot speak or understand the language. Justice (1984: 195) also noted language as a barrier for the assistant nurse midwife performing her duties in rural areas of Nepal. Even if Nepali speakers in both regions of residence understood these messages, their contribution to increasing the health knowledge of the people in the rural HMR is likely to be greater than in the mostly urban LMR.

Although cows and buffalo in the house shows a negative coefficient for both regions of residence, the coefficient is statistically significant only in the LMR. In contrast, mother's work status and mother's age at childbirth show positive coefficients, and second and third order births show a negative coefficient for child mortality in both regions of residence. Of these variables, the effects of all except mother's work status were statistically significant only in the LMR. The adverse effect of mother's work status on child mortality in the HMR stands in marked contrast to the effect observed in the case of infant mortality. The explanation is probably to be found in the synergistic effect of the household economic situation and the amount of time allocated by mothers for child-care. For example, as discussed earlier, women in Nepal, in general, are likely to work outside the home only when they are forced to do so to meet the household needs. In the HMR, the effect of agricultural work outside the home is, as argued previously, probably negligible for infant survival, but once a child passes infancy its activity makes it impossible to care for the child while working efficiently. Moreover, the higher proportion of working mothers in the HMR (Table 6.6) suggests that the households of these working women in these regions are economically weaker than in the LMR. Thus children in the HMR are likely to be vulnerable both in terms of their mother's direct involvement in their care, because most of the mother's time is allocated for work outside the home, and the vulnerable household economic situation which may not allow parents to meet the basic requirements of their children.

The lower risk of death to second and third order children and the higher risk of death for children born to mothers under 24 years of age, statistically significant only in the LMR, could be due to a disproportionate share of the higher order births being among younger women. These effects are parallel to those found in the case of infant mortality differentials, and in large part have the same explanation. The higher risk of death to children born to mothers under 24 years of age and the lower risk of death to second and third order births observed in Table 6.11 could be partly due to a shift of risk from those

Table 6.11 Results of logit regression models explaining child mortality allowing for different coefficients for the HMR and LMR: 1986 NFFS, Nepal.

Explanatory variables	HMR logit coefficients (t-stat)	LMR logit coefficients (t-stat)	Difference due to change in the coefficients (structure) 1/ (t-stat)
Mother's education (years)	-0.1068 (-0.98)	-0.0741 (-0.86)	0.0341 (0.24)
Father's education (years)	0.0253 (1.00)	-0.0814 (-2.18)**	-0.1065 (-2.36)**
Working mother [D]	0.7751 (3.40)***	0.377 (0.76)	-0.3979 (-0.73)
Cows and buffalo in house [D]	-0.2263 (-1.20)	-0.4886 (-2.20)**	-0.2621 (-0.90)
Terai ecological belt [D]	-0.4910 (-2.72)***	-0.3092 (-1.44)	0.1818 -0.65)
Ever use of contraception [D]	-0.3022 (-1.66)*	-0.0103 (-0.04)	0.2917 (1.00)
Indo-Aryan ethnicity [D]	0.1165 (0.72)	-0.5900 (-2.76)***	-0.7063 (-2.63)***
Nepali language [D]	-0.6435 (-3.52)***	0.2433 (1.11)	0.8867 (3.11)***
Mother's age at childbirth < 24 years [D]	0.1016 (0.58)	0.4873 (1.92)*	0.3853 (1.25)
Preceding child: dead at age two [D]	0.1085 (0.61)	0.2255 (0.78)	0.1169 (0.35)
Length of preceding birth interval ≥ 37 months [D]	-0.7625 (-4.00)***	-0.5634 (-2.29)**	0.1995 (0.64)
Birth order 2-3 [D]	-0.0698 (-0.41)	-0.5585 (-2.29)**	-0.4883 (-1.65)*
Intercept	-1.7521 (-8.05)***	-2.1312 (-7.63)***	-0.6249 (-1.68)*
χ^2	158.45		

Notes: ***, ** and * denote significant at the 1, 5 and 10 per cent levels respectively.
Analysis includes second and higher order children aged one to five years during the period 1971-80.
1/ Figures are calculated by interacting each variable with a HMR dummy.

Source: 1986 NFFS data tape.

infants who survived the vulnerable situation of infancy to higher risk during their childhood. Another explanation for the higher risk of death to higher order births is mothers' negligence in the care of these later children, whose value might be perceived to be less than those born earlier (Levine, 1987: 293).

A statistically significant negative coefficient corresponding to contraception use was found only in the HMR. The favourable effect of the gradual expansion in health care delivery services in Nepal after 1970 (HMG, 1986) is a likely explanation. The statistically significant influence of the *terai* ecological belt in lowering child mortality in HMR could be the effect of the different climatic and natural environments of the population within the regions of residence. The statistically significant favourable survival situation for children born in a household with cows and buffaloes in the LMR could be the reflection of the easy access to market where milk and milk products can be easily converted into cash income.

It is puzzling here why the structural effect of Indo-Aryan ethnicity in the two areas should be different. It seems that it is not the Indo-Aryan component that might have different cultural characteristics (although that might be a factor to some extent, given that some of the Indo-Aryan language groups are almost all entirely in the HMR) but that the non-Indo-Aryan component is very different in the two regions (see Table 6.3).

Table 6.12 shows the relative importance of the structural change versus change in explanatory variables in explaining the child mortality levels between the two regions of residence. The results in Table 6.12 indicate that the structural differences between the HMR and LMR explain more of the overall mortality differences between these two regions of residence than was the case with infant mortality. Yet most of the variation, as in the case of infant mortality, is still explained by the differences in the variable values. For example, the difference in child mortality due to the difference in the values of explanatory variables accounts for 76 to 88 per cent of the total variation while the differences in the structural relationship of the population in the two regions of residence account for 12 to 24 per cent of the total variation, depending on whether the effect is measured in the HMR or the LMR.

Table 6.12 Predicted child mortality rates using the coefficients of the HMR and variable values of the LMR and vice versa: 1986 NFFS, Nepal.

	Predicted CMR using values of explanatory variables from		Estimated change due to change in values of explanatory variables
	HMR	LMR	
Predicted CMR using HMR coefficients	95.9	48.4	47.5
Predicted CMR using LMR coefficients	82.9	42.2	40.7
Estimated change due to difference in relationship (structure)	13.0	6.2	

Notes: Predicted average child mortality probability for each region of residence is the average of predicted probabilities for each individual, each calculated as $P^i = 1/(1+e^{-logit_i})$.
Analysis includes only second and higher order births.
Source: 1986 NFFS data tape.

6.10 Effects on child mortality assuming characteristics of the other region

The discussion of child mortality so far has indicated strongly that the rather large structural differences are associated with cultural characteristics of the population of the two regions, which are not likely to be amenable to easy change. Table 6.13 shows the mean values, logit coefficients and the difference in child mortality assuming the variable values of one region of residence applied to the other. If the HMR had the same level of mother's education over the period 1971-1980 as in the LMR, the child mortality rates due to mother's education in the HMR would have been 5 points lower. A similar calculation would show that had the HMR had the same mean value for Nepali language as in the LMR, the child mortality rate in the HMR due to this variable would have been 8 points lower, but of course this is a highly misleading calculation for the reason that cultural differences cannot be treated in such a summary way. The other important variables producing lower child mortality in the HMR are working mothers, ever use of contraception and length of the preceding birth interval.

Omitting the effect of Nepali language, the results suggest that had the HMR had the same mean values of seven variables as in the LMR (mother's education, work status of mother, ever use of contraception, mother's age at childbirth < 24 years, preceding child

Table 6.13 Differentials in child mortality by regions had each variable had the value of other region: 1986 NFFS, Nepal.

Explanatory variables	HMR n=2263 mean	LMR n=2486 mean	HMR logit coefficients	LMR logit coefficients	Change in CMR had HMR had same mean as LMR [a]	Change in CMR had LMR had same mean as HMR [b]
Mother's education (years)	0.1635	0.7116	-0.1068	-0.0741	-5.08	1.64
Father's education (years)	1.6757	2.7969	0.0253	-0.0814	2.46	3.69
Working mother [D]	0.0888	0.0354	0.7751	0.377	-3.59	0.81
Cows and buffalo in house [D]	0.7981	0.6762	-0.2263	-0.4886	2.39	-2.41
Terai ecological belt [D]	0.4759	0.4493	-0.2455	-0.3092	0.57	-0.33
Ever use of contraception [D]	0.2479	0.3568	-0.3022	-0.0103	-2.85	0.05
Indo-Aryan ethnicity [D]	0.4423	0.5253	0.1165	-0.5900	0.84	1.98
Nepali language [D]	0.4786	0.6175	-0.6435	0.2433	-7.75	-1.37
Mother's age at child birth < 24 years [D]	0.3707	0.3512	0.1016	0.4873	-0.17	0.38
Preceding child: dead at age two [D]	0.1838	0.0998	0.1085	0.2255	-0.79	0.77
Length of preceding birth interval ≥ 37 months [D]	0.3093	0.3387	-0.7625	-0.5634	-1.94	0.67
Birth order 2-3 [D]	0.4993	0.5576	-0.0698	-0.5585	-0.35	1.32
Intercept			-1.7521 (-8.05)	-2.1312 (-7.63)		
χ^2			59.83	43.94		
Mean dependent	0.0959	0.0422				
p* (1-p) =	0.087	0.040				

Notes: Analysis includes second and higher order children aged one to five years during the period 1971-80.
[a] $Beta_{HMR} * [P_{HMR}(1-P_{HMR})] * (Mean_{LMR} - Mean_{HMR}) * 1000.$
[b] $Beta_{LMR} * [P_{LMR}(1-P_{LMR})] * (Mean_{HMR} - Mean_{LMR}) * 1000.$
Source: 1986 NFFS data tape.

dead at age two, length of preceding birth interval greater or equal to 37 months, and second and third order births), the child mortality level in the HMR would have been 15 per cent lower than the prevailing level. Similarly, had the LMR had the same values for all variables, except cows and buffalo in the house, *terai* ecological belt and Nepali language, as in the HMR, the child mortality rate in the LMR would have been 27 per cent higher than the prevailing level. While the results confirm the relative importance of the variable values in determining the mortality differentials between the two regions of residence, the importance of structural relationships between the independent and dependent variables between the two regions of residence also cannot be ignored. This is because the structural differences are clearly associated with cultural characteristics; the role of these same cultural characteristics in determining the levels of the other explanatory variables would need to be investigated before a firm conclusion could be made. It can, however, be seen that the contribution of the socio-economic and health-related variables in reducing child mortality seems to be more important than the contribution of the demographic variables.

6.11 Further discussion of the results

The preliminary analysis in this chapter, based on both the 1981 Census and the 1986 NFFS data, clearly indicates differences in the socio-economic, health-related and demographic background characteristics of the population by region of residence. Among the socio-economic and health-related variables considered in the multivariate analysis (Table 6.8), only two variables, ever use of contraception and possession of cows and buffalo by the household, are statistically significant in reducing infant mortality in both regions of residence. Among the demographic variables, birth 37 months or more after the birth of the preceding child, and second and third order births, are associated with lower infant mortality while children born to mothers under 24 years of age and mother's previous experience of child loss are associated with elevated risks of death in both regions of residence. However, the effect of second and third order birth in the LMR is not statistically significant.

Not only do these results indicate the importance of demographic factors in reducing infant mortality in both regions of residence in comparison to the socio-economic and health-related variables, but also the directions of the relationships between independent variables and the dependent variable, except those corresponding to ethnicity and language spoken at home, show a similar pattern, whether the effects of other variables are controlled for or not. The effects of language spoken at home and ethnicity variables, however, were not statistically significant in influencing infant mortality in either of the regions. Among the independent variables considered in the model, the differences in infant mortality between the regions of residence due to the difference in structural relationship between regions of residence for working mothers and index children born during 37 months or more after the birth of the preceding child were statistically significant.

The socio-economic and health-related determinants of child mortality by region of residence show more interesting results than in the case of infant mortality. There were variables which were statistically significant in determining the level of child mortality in the HMR but which were not statistically significant in the LMR, and vice versa. For example, father's education, cows and buffalo in the house and Indo-Aryan ethnicity were statistically significant in lowering child mortality only in the LMR, while ever use of contraception and *terai* ecological belt were statistically significant in lowering child mortality only in the HMR. In addition, working mothers is a statistically significant factor leading to an increase in the child mortality only for the HMR. The differences in the child mortality due to the differences in the coefficients (structural relationships) corresponding to father's education, Indo-Aryan ethnicity, Nepali language spoken at home and second and third order births are statistically significant, and reveal a strong cultural component to these structural relationships.

The favourable child survival prospects due to father's education in the LMR could be the result of the differences in the level of earnings among the educated fathers between the regions of residence. The significant influence of the Indo-Aryan ethnicity in lowering child mortality only in the LMR is certainly due to the different socio-cultural practices, lifestyles and beliefs which are suggested to be significantly different in structure in relationship between the regions of residence. The effects of Nepali language spoken at home in lowering child mortality only in the HMR seems to be due to the favourable influence of the dissemination by radio broadcast in Nepali language of information regarding prevention and treatment of disease. There is also a possibility that the effect is due partly to the differences in the place of residence and socio-cultural practices reflected according to the mother tongue, but had this effect been due to the differentials in the socio-economic and health-related factors or place of residence captured by the language spoken at home, it perhaps should have shown a significant influence in the LMR too. There are differences in ethnicity and ecological belt between the HMR and LMR. It can therefore be argued that the effects of the knowledge disseminated by radio in the Nepali language on prevention and treatment of the diseases was beneficial only to those sections of the population, especially in the HMR (rural areas), who speak this language at home. A study conducted in two districts of Nepal also noted that 63.9 per cent of the total sample of Kavre district (close to Kathmandu, the capital of the country, where the majority are classified as Nepali speakers) nominated radio as their source of information about rehydration solution as against only 19 per cent in Dhanusha district (where the majority of the people speaks Maithali language) (Japan International Co-operation Agency (JICA), 1987: 64).

Overall, this study suggests that much of the inter-regional variation in infant and child mortality is due to the differences in the variable values rather than to difference in the structure in relationships between the regions of residence, but this is more true for infant than child mortality. Similar results were also found in a study in Malaysia (Peterson et al., 1986). The higher average infant and child mortality in the HMR appears to be due mainly to the lower values of the variables in this region of residence that are associated with reducing the risk of death. For example, the smaller proportion of women with second and third order births and the lower incidence of births 37 months and more after the birth of the preceding child in the HMR compared with the LMR have partly contributed to the higher than average infant mortality rate in the HMR. A similar argument could be made for the effect of higher incidence of previous child loss, except that it is not really valid to use high mortality to explain high mortality, no matter how significant previous child loss may be at the individual level. In addition, the lower level of average education of mothers, the smaller proportion of those who have ever used contraception, and the smaller proportion who speak Nepali language at home are other factors contributing to the higher average infant mortality in the HMR.

It appears here that the proportions of the population according to the ever use of contraception and women who have experienced previous child loss between the regions of residence are the major factors among the variables considered in the model that account for the higher infant mortality rates in the HMR. Ignoring the circularity associated with previous child loss, the impression remains that use and availability of health services is a highly important factor. The differences in the infant mortality rates between the two regions of residence would also have been much higher had the proportions of households with cows and buffalo in the HMR not been as large. The differences in the mean values of all variables, except father's education, working mothers, cows and buffalo in the house and mother's age at childbirth under 24 years of age, were able to capture only 28 per cent of the differences in infant death rates between the HMR and the LMR.

The factors that account for the higher average child mortality in the HMR are the smaller proportions of women with education, who have ever used contraception, who are Nepali speakers at home, had a childbirth 37 months or more after the birth of the preceding child, and those with second and third order births. In the HMR, the incidence of preceding child loss was higher, proportions of births to women aged under 24 years were higher and proportions of working mothers were higher. The differences in the level of child mortality between the regions of residence would have been wider still had it not been for the differences in the structural relationship corresponding to father's education as well as the higher proportions of households with cows and buffalo in the HMR.

Although mother's education did not appear to have significant influence in determining child mortality in either of the regions, its role in explaining the higher child mortality in the HMR appears to be very important. The results in this part of the analysis (Table 6.13) clearly indicate the greater importance of the socio-economic, health-related and cultural factors in determining child mortality than demographic variables, as compared with the relative importance of these variables for infant mortality.

The analysis of child mortality has indicated strongly that the rather large structural differences are associated with the cultural characteristics of the population of the two regions. The analysis also suggested that the implied structural differences determining child mortality are cultural in nature to a much greater extent than was the case in the analysis of infant mortality. However, it can be argued that infant and child mortality levels are not unrelated. Thus, measures that improve infant mortality, which are less related to cultural factors, inevitably carry over to improve the health of surviving infants and hence result in better childhood survival prospects.

CHAPTER SEVEN

FACTORS INFLUENCING INFANT AND CHILD MORTALITY DECLINE

7.1 Introduction

Chapters Three to Five of this thesis examined the demographic, socio-economic, health-related and biological determinants of infant and child mortality in Nepal. The analyses have shown that the levels of both infant and child mortality from the 1976 NFS data, as expected, were considerably higher than those based on the 1986 NFFS data. However, what accounts for the infant and child mortality decline in Nepal during the past two decades (see Chapter One, Table 1.5) is still not very clear. This chapter examines the extent to which the change in the values of variables as against the change in the relationship between the selected independent and dependent variables accounts for the decline in infant and child mortality during the period between the two surveys covered by this study. The following sections discuss mortality decline and its possible causes, based on past studies. This is followed by the description of the changing context, data and variables considered in this study, analytical approach, and the analysis of the survey data.

7.2 Mortality decline and its causes

The mortality decline in the 'modern era' has been classified into three major stages. The decline experienced by Western countries during the late nineteenth and early twentieth century is classified as the first stage. The second stage covers the decline experienced by Eastern and Southern Europe during the present century. The third stage encompasses the mortality decline experienced by developing countries after the Second World War (Stolnitz, 1965: 118-119; Gwatkin, 1980: 615-617). The mortality decline experienced in the developing countries after the Second World War was more rapid than that experienced by the developed countries during the eighteenth and nineteenth centuries (Palloni, 1981: 627). Whenever a country experiences a decline in mortality, the greatest decline usually occurs in infant and child mortality (Preston, 1980: 289). Many developing countries since the Second World War have experienced a considerable decline in infant and child mortality. Hill and Pebley (1989: 683) noted a considerable decline in under-five mortality in 66 developing countries during the period 1960 to 1985. Among these, 14 were in Asia, where the Philippines experienced the smallest decline (35 per cent) and Hong Kong experienced the greatest (74 per cent). A gain of about 20 years in life expectancy at birth in Asian and Latin American countries and about 13 years in African countries between the period 1935-39 and 1965-70 were also noted in a World Health Organization report (WHO, 1974: 23, cited in Preston, 1980: 289, 307) and by the United Nations (1973: 110). The gain in life expectancy at birth during the period 1950-60 in selected Asian, African and Latin American countries was found to be 0.48, 0.43 and 0.67 years per annum, respectively. These annual gains in life expectancy at birth during the period 1960-70 for Asia and Africa increased to 0.62 and 0.60 years respectively while for Latin America, it declined to 0.36 years (United Nations, 1982: 5). In addition, Gwatkin (1980: 623) suggested that the greatest decline in childhood mortality occurred in Asian countries after the Second World War. All these findings clearly indicate a great decline in infant and child mortality levels in the developing countries after the Second World War.

Just as the history of mortality decline since the late eighteenth century is classified into different stages, the explanations provided for the declines also differ. The mortality decline experienced by the Western countries during the late eighteenth and early nineteenth centuries as well as by Eastern and Southern Europe during this century is attributed to innovations in public health and sanitation as well as an increase in income and an improved standard of living (Stolnitz, 1965: 119). McKeown and Record (1962: 119-122) concluded that improved environment, rising level of income, improved nutrition and sanitary reforms are the most acceptable explanations for the decline in mortality that took place during the late eighteenth and early nineteenth centuries in England and Wales. Along the same lines, Palloni (1981: 626-627) argued that socio-economic development can contribute to mortality decline in the absence of medical innovations because the medical innovations are conditioned by socio-economic development. Palloni further argued that a substantial gain in the life expectancy in the Western countries was made before any significant breakthrough in the field of medicine could reach the majority of the population.

In contrast, the explanations for the mortality decline experienced in the developing countries are contradictory. Different hypotheses have been advanced to explain the post-World-War-Two mortality decline in the developing countries. Some scholars argue that the decline is partly due to socio-economic development and partly due to the availability of modern medical technology, while others argue it is a result of the availability of and access to advanced medical technology and health services *per se*. For example, Preston (1980: 290-293) advocates that as mortality rates are sensitive to private living standards, such that a shift or change in private income, although not necessarily proportionate, could lead to a decline in mortality. In contrast, Gwatkin (1980: 617) argued that the introduction of public health and disease control methods in most of the developing countries are likely to be the major reasons for the post-war decline in infant and child mortality rates. Gwatkin further argued that economic and social miseries in such a situation need no longer pose a significant barrier to a sharp rise in survival probabilities. Similarly, Johansson and Mosk (1987: 235) concluded that in Japan 'above a certain fairly minimum standard of living threshold, the "right" to live to old age, can be secured for the average citizen, even in low income developing countries, if the government is dedicated to the efficient exploration of existing public health technology'. In addition, other studies also suggested that the decline in mortality experienced in the developing countries after the Second World War was the result of the medical technology being developed in the Western countries being made readily available in the developing countries (Ueda, 1983: 121; Davis, 1973: 264; Arriaga and Davis, 1969: 234).

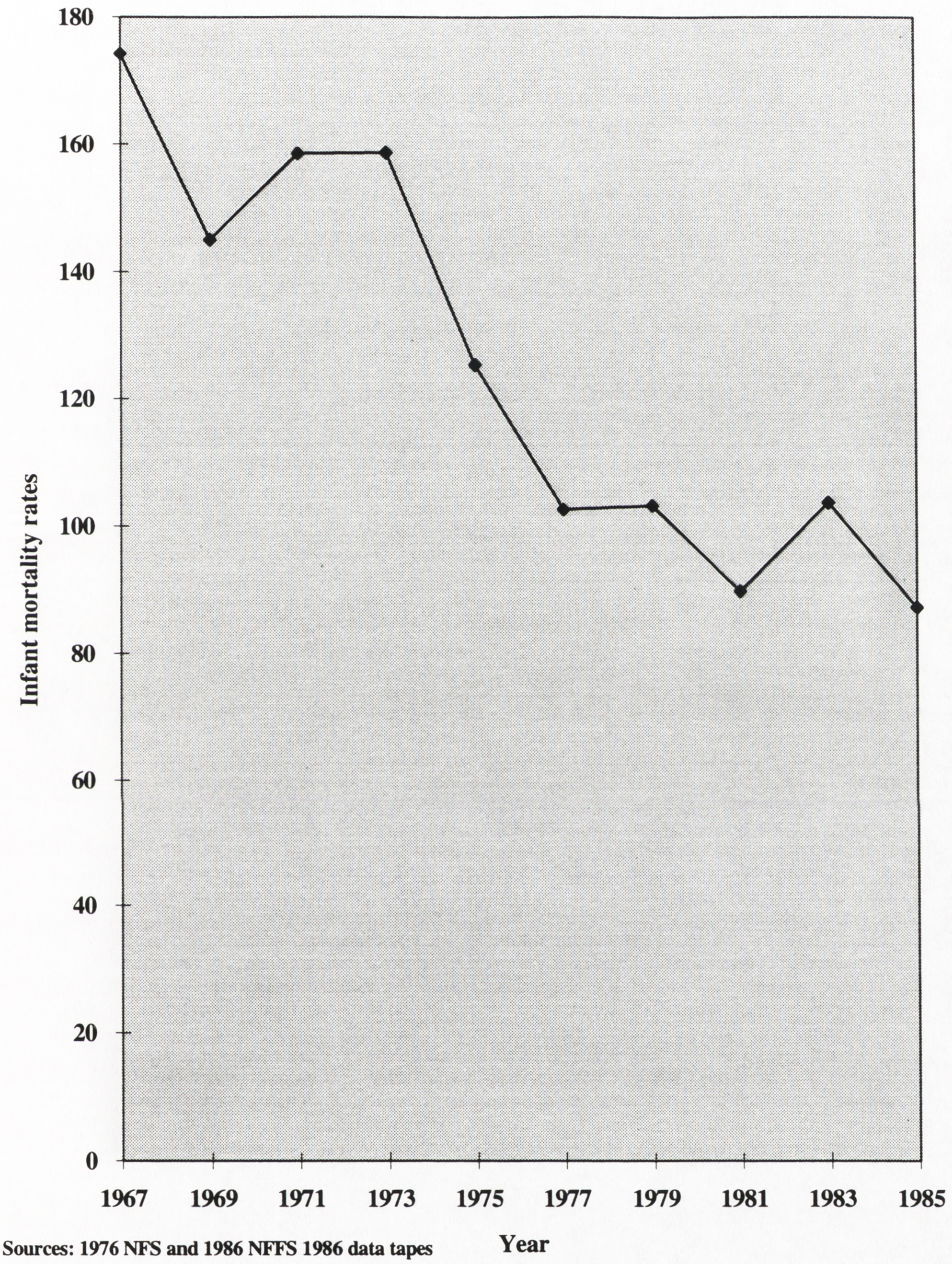
However, Meegama (1967: 237, 1969: 294-301) disputed the view that the decline in the mortality levels experienced in Sri Lanka after 1940 was due to the anti-malaria campaign alone and argued that the decline was assisted by other health and nutrition factors. Similarly Frederiksen (1970: 111-112) and Gray (1974: 205, 226) also agreed that the decline in mortality in Sri Lanka was due to a change in key factors such as levels of living, nutrition and health services rather than the anti-malaria campaign *per se*. Gray (1974: 205) estimated that 23 per cent of the decline in the crude death rate in Sri Lanka was due to the malaria control campaign. For Brazil, Oya (1981: 269) argued that, as mortality levels are sensitive to advances in medical technology, the availability of medicine and provision of health as well as medical services may contribute significantly to mortality decline, but the effect will be limited without profound socio-economic development.

Apart from these arguments, Palloni (1981: 628) observed that the influence of standard of living is particularly important among infant and children because of the precariousness of their resistance capacity. Palloni further argued that the combination of a low standard of living and contacts with new medical technology have ambiguous consequences for children, who have not fully developed natural immunities and are dependent on others to satisfy their basic needs.

7.3 Mortality decline in Nepal

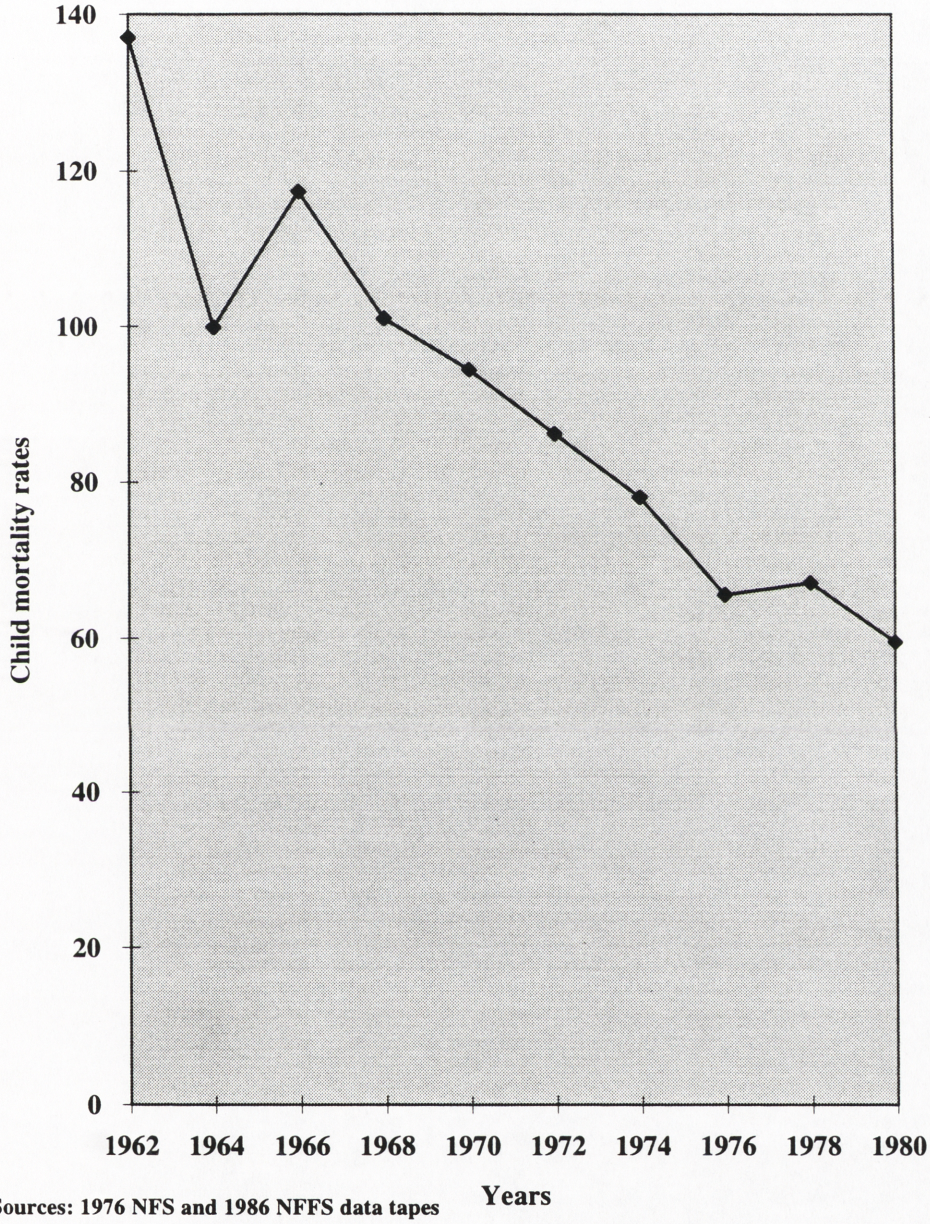
As in other developing nations of the world, a substantial decline in mortality after the Second World War was also experienced in Nepal. Several studies have documented this phenomenon. For example, a gain of about 12 years of life expectancy at birth in Nepal between the periods 1952-54 and 1974-76 was reported (United Nations, 1982: 118), the bulk of which was suggested to have occurred after 1960. A similar gain in life expectancy at birth between the period 1961 and 1981 was also reported (CBS, 1987a: 268). This decline in mortality was basically attributed to the increased health and malaria control programmes (United Nations, 1982: 118, 135). However, one study in Nepal argued that the falling mortality rate before 1950 could be due to the improving economic conditions in the country, although the bulk of the decline after 1950 can be attributed to the modern health and disease control programme which were initiated systematically only after 1950 (Poffenberger, 1980: 40). A considerable improvements in child survival prospects over the past 20-35 years are documented in several other studies. For example, Banister and Thapa (1981: 41)

Figure 7.1 Trends in infant mortality rates (per 1000 live births): 1966-85, Nepal



Sources: 1976 NFS and 1986 NFFS 1986 data tapes

Figure 7.2 Trends in child mortality rates per 1000 children aged one to four years of age: 1962-80, Nepal



Sources: 1976 NFS and 1986 NFFS data tapes show a decline in infant mortality from 182 per 100 live births during the period 1960-64 to 156 per 1000 live births by 1970-74. Other estimates show that the infant mortality rate of about 186 per 1000 live births in the 1960s (UNICEF, 1988: 64) declined to about 113 per 1000 live births in 1984 (CBS, 1987: 74; also see Table 1.5 of Chapter One). Moreover, mortality among under-fives in Nepal dropped from about 297 per 1000 in 1960 to about 202 per 1000 in 1986 (UNICEF, 1988: 64). A gradual decline in both infant and child mortality rates based on the 1976 NFS and 1986 NFFS data sets is also evident in Figures 7.1 and 7.2.

7.4 The changing context

The context of a society is likely to change with development. Nepal is no exception to this. The historical, demographic, cultural, ecological, and socio-economic changes that took place in Nepal have been clearly documented in Poffenberger (1980). Every factor that changes with time, however, cannot be incorporated in one study because of limitations of time, resources and availability of the data itself. Thus, the discussion in this section covers only those factors that have changed between two points of time, and for which information is available and relevant for the purpose of this study.

Table 7.1 shows the change in the selected socio-economic, health-related and demographic factors that took place during the period 1961-1981 (also see Appendix Table 1.1). Table 7.1 quite clearly suggests that socio-economic, health-related and demographic factors in Nepal between these two periods have changed considerably. For example, the average age at marriage for both males and females in the year 1981 increased by about two years as compared with the corresponding figures in 1961. Similarly, the literacy rate during this period for males has doubled while for females it has increased 6 times. The school-going population for both sexes increased considerably and the labour force structure for both sexes also changed to some extent. The proportion of people living in urban areas increased from 2.9 per cent in 1961 to 6.2 per cent in 1981. In addition to all of these changes, the mean values corresponding to all independent variables used from 1976 NFS and 1986 NFFS data sets, except the length of birth interval equal to or greater than 37 months in both Tables 7.3 and 7.7, and Indo-Aryan ethnicity in Table 7.7, are significantly different between the two points of time. These results reveal the extent of change in socio-economic and health-related factors, and to some extent demographic factors, in Nepal during the last two decades. These changes are likely to have a substantial impact on infant and child mortality.

Table 7.1 Comparison of selected socio-economic, health-related and demographic indicators: 1961-1981, Nepal.

Characteristics	1961	1981
Mean age at marriage (years)		
Male	19.4	21.8
Female	15.1	17.1
Literacy rate (10 years and above, percentage)		
Male	16.3	34.9
Female	1.8	11.5
Education (6 years and above, percentage)		
No schooling*		
Male	12.4	8.1
Female	1.2	2.8
1-5 years		
Male	1.6	15.7
Female	0.3	6.8
6 + years		
Male	2.12	10.2
Female	0.27	2.5
Proportion of urban population**	2.9	6.2
Labour force distribution (%)		
Male		
Agriculture	91.7	87.8
Non-agriculture	7.5	9.0
Other	0.8	3.2
Total	100.0	100.0
Female		
Agriculture	96.9	95.7
Non-agriculture	2.5	3.3
Other	0.6	1.0
Total	100.0	100.0

Notes: * A person who is literate but has had no formal schooling.
** In 1961 an urban area in Nepal was defined as an area having 10,000 people. This was re-defined in 1974 to an area having 9,000 people (CBS, 1987a: 179).
Source: CBS (1987a: 101,128,135,180,209)

Koenig et al. (1990: 251) argued that changes in the reproductive pattern can influence child survival through various mechanisms, such as change in mother's age at childbearing, parity and / or the interval between births. It can also be argued that the effect of a particular socio-economic factor in a certain time sequence can be different from the effect in another time sequence, because of the shift in situations with time. The relationships between variables are also likely to be dynamic when there are changes in socio-economic, health-related and demographic factors. Preston (1975: 234), taking the relationship between mortality and income in a changing context, argued that 'if the relationship is indeed causal, then a certain change in income should be associated with a particular change in mortality, with relative magnitudes of change determined by coefficients of the relationship'.

Although mortality in Nepal has undergone a marked decline during the last two to three decades, it is still not clear what accounts for the decline in infant and child mortality. None of the past studies has attempted to quantify the contribution of factors that have an impact on reducing the mortality in Nepal. In addition, none of the studies in Nepal has tried to examine what effect the changes in the socio-economic, health-related and demographic factors have had on infant and child mortality. This study is thus designed to address these issues as well as to examine the magnitude of the contribution of each of the independent factors to both infant and child mortality.

7.5 Data and variables considered in this chapter

As in Chapters Three, Four and Five, this chapter also uses retrospective information on infant and child mortality and its correlates from the 1976 NFS and 1986 NFFS data sets. A control variable 'survey' which distinguish the two periods, 1960s-1970s and 1970s-1980s, and a total of eleven independent socio-economic, health-related, cultural and demographic factors, were considered in this chapter:

Survey variable:
- 1976 if it is related with earlier survey and 1986
  if it is related with the later survey.
  (this variable is described in subsection 7.6 of this chapter)

Socio-economic factors:
- Mother's education: years of schooling completed
- Father's education: years of schooling completed
- Working mothers: who are involved in paid employment after marriage
- Place of residence: urban

- Development regions: Eastern (EDR) and Central (CDR)

Health-related factor:
- Ever use of contraception

Cultural factor:
- Ethnicity: Indo-Aryan

Demographic factors:
- Mother's age at childbirth: < 24 years
- Preceding child: dead
- Length of preceding birth interval: equal to or greater than 37 months
- Birth order of child: 2-3.

Since the focus of this chapter is to examine the effects of the change in the socio-economic, health-related and demographic factors over time on infant and child mortality, variables such as land-holding, access to health and cows / buffalo which were not available in the 1976 NFS data set are excluded from the analysis. The sex of the child and the sex of the preceding child are also excluded from the analysis because they did not prove to be significant in chapters Three and Five. Another variable excluded from this chapter is the child's year of birth, because this variable is likely to be a proxy for the real changes that have occurred over time. Inclusion of this variable in the model thus could add misleading explanatory power to the independent variables. In addition, urban-rural place of residence, ethnicity and development regions (place of residence) are variables added to the analysis in this chapter. Detailed descriptions of the independent variables have already been given in Chapters Three through Six. As in previous chapters, the dependent variables are infant mortality (whether a child died during its first year of life) and child mortality (whether a child who survived its infancy died before age five).

7.6 Analytical approach

The major objectives of this chapter are to examine changes in the independent variables of interest, and their role in determining the decline in infant and child mortality during the period covered by this study. This study compares two sets of 10-year periods, that is, 1966-75 and 1976-85 for the analysis of infant mortality and 1961-70 and 1971-80 for the analysis of child mortality. The data for the earlier periods were based on the 1976 NFS and the later on the 1986 NFFS. The means of each independent variable for the sub-sample of births that took place in each of these sub-periods are calculated and evaluated to see whether or not they differ significantly.

To examine whether a change over time in a variable of interest has any influence on infant or child mortality, various regression models are fitted by adding independent variables to a model which has an estimated logit coefficient for the 1976[1/] survey. If the change in a variable over time has any influence in determining the decline in mortality then the effect due to the 1976 *dummy* variable will decline after the introduction of that particular variable in the model. The survey variable here is equivalent to the time variable described in the analytical framework in Chapter Two.

The next step is to examine the role of each independent variable in determining the decline in infant and child mortality. The role of each independent variable can be analysed according to two perspectives that are described as 'fixed structure' and 'changing structure' by DaVanzo and Habicht (1986: 147). For example, the fixed structure analysis is based on the assumption that the decline in mortality over time is due to change in the values of explanatory variables per se. Changes in the covariates are not considered in this model. The changing structure analysis, by contrast, is based on the assumption that the change in mortality over time is due to the change in the relationship (structure). For the 'fixed structure' analysis, a logit regression model is fitted by employing the pooled data (1976 NFS, and 1986 NFFS) to quantify the role of change in the explanatory variable in explaining the change in the probability of infant and child mortality, which is implied by the logit coefficients evaluated at the sample mean probabilities.

To assess the role of the structural change in mortality, firstly it is important to know which of the coefficients have changed between the two periods. For this purpose a logit model that allows for the different coefficients for the two time periods is fitted by employing the pooled data set. The logit regression that interacts each independent variable with the 1976 dummy, based on the pooled data, yields the logit coefficients and

---

1/ The *dummy* variable indicates the 10 year period, that is, 1966-75 for infant mortality and 1961-70 for child mortality.

corresponding t-statistics that indicate whether the changes in structure that took place between the two points of time are significantly different from zero. This part of the analysis helps in identifying the influence on mortality of each factor that has changed during the two points of time. In addition, the difference in the intercept term explains whether factors that are not considered in the model have changed significantly.

The average of the predicted probabilities for each individual, calculated as $P_i = 1 / (1 + e^{-logit_i})$ is compared with the actual average probability of death in order to examine the role of change in values of variables versus the change in the structure in explaining the decline in mortality between the periods covered by this study (Preston, 1980; 1975a; DaVanzo and Habicht, 1986; Merrick, 1985). The analytical procedure followed to examine the 'fixed structure', 'changing structure', and the role of changing values of variables as against the change in the structure on relationship between variables in this chapter is similar to that in Chapter Six. The analysis in this chapter will focus mainly on the discussion on the inter-survey variations in mortality rather than the intra-survey variations, which have already been discussed in preceding chapters.

7.7 Factors influencing infant mortality decline

Table 7.2 shows the results of logit regression for infant mortality explaining the effects of controlling for other covariates on coefficients of the 1976 survey indicator (1966-75 is set equal to 1). The first column of Table 7.2 (Model One) shows the logit coefficient for the 1976 indicator, which is a positive value and is highly significant when controls for effects of other covariates are not introduced. This indicates that infants born during the period 1966-75 were exposed to 1.75 higher odds of death as compared with those born during the period 1976-85. The second through fourth columns of Table 7.2 (Models Two through Four) show the impact on the coefficient of the 1976 indicator after controlling for the effects of other explanatory variables considered in the respective models. The size and significance of the difference shown by the 1976 indicator in Model One through Four change as alternative groups of infant mortality correlates are added to the Model One. Had only the variables considered in this study been the reason for the decline in the infant mortality, the logit coefficient corresponding to the 1976 survey indicator would have been reduced to zero. The considerable attenuation in the size and significance of the 1976 survey indicator, shown in Model Four after the introduction of the groups of socio-economic, health-related and demographic variables as compared with the corresponding values in Model 1, suggests that these factors have had some influence in reducing infant mortality during the period between 1966-75 and 1976-85 in Nepal.

Table 7.2 clearly suggests that socio-economic and health-related factors played a greater role in reducing infant mortality than the demographic factors considered in this study. For example, the differential in the relative odds pertaining to the 1976 survey indicator decreases from 1.75 to 1.51 where the socio-economic, health-related and demographic factors that might lead to a lower infant mortality rate are not considered as against where they are considered (between Models One and Two). This figure corresponds to the gap in mortality decline of 38 infant deaths per 1000 live births between 1966-75 and 1976-85 as against 56 deaths observed when controls for other factors are not introduced. By contrast, when only demographic factors are considered, the differential in the relative odds decreases to only 1.67 in Model Three from 1.75 in Model One. This corresponds to the gap in mortality decline of about 51 deaths per 1000 live births as against the actual 56 deaths per 1000 decline observed between the two time periods. This supports the conclusion that the influence of the socio-economic and health-related factors in reducing infant mortality in Nepal during the period is more important than the influence of demographic factors. This perhaps could be due to the greater magnitude of the shift in socio-economic and health-related factors than demographic factors during the same span of time, which is clearly evident in Table 7.3.

The other interesting features in Table 7.2 are the size and significance of the logit coefficients in Model Four as compared with the corresponding figures in other models. The effect of father's education on infant mortality, which was not statistically significant in Model Two, becomes more clear and statistically significant in Model Four after considering the demographic factors. The adverse influence of mother's age below 24 years at childbirth in Model Four increases as compared with Model Three, where only

Table 7.2 Results of logit regression for infant mortality showing the effects of controlling for the effect of the other covariates on coefficients of the 1976 survey[a/] indicator: 1976 NFS and 1986 NFFS, Nepal.

Explanatory variables	Logit regression models n=13424 Model 1	Model 2	Model 3	Model 4
Survey (1976) [D]	0.5571 (10.09)***	0.4127 (6.97)***	0.5146 (9.21))***	0.3739 (6.24))***
Mother's education (years)		-0.0348 (-1.27)		-0.0305 (-1.09)
Father's education (years)		-0.0112 (-1.13)		-0.0190 (-1.88)*
Working mothers [D]		0.2670 (2.93)***		0.2166 (2.35)**
Urban residence [D]		-0.1340 (-1.22)		-0.0995 (-0.91)
EDR & CDR [D]		-0.1270 (-2.30)**		-0.1267 (-2.27)**
Ever use of contraception [D]		-0.5058 (-5.16)***		-0.5102 (-5.17)***
Indo-Aryan [D]		-0.0251 (-0.45)		-0.0294 (-0.52)
Mother's age at child [D] birth (< 24 years)			0.2275 (3.40)***	0.2612 (3.85)***
Birth order (2-3) [D]			-0.1902 (-2.99)***	-0.1876 (-2.93)***
Length of preceding [D] interval (≥ 37 months)			-0.5608 (-8.51)***	-0.5820 (-8.80)***
Survival status of preceding [D] child (dead)			0.6406 (9.62)***	0.5967 (8.92)***
Intercept	-2.3297 (-53.93)***	-2.0885 (-32.18)***	-2.2531 (-40.82)***	-1.9975 (-27.14)***
χ^2	104.65	170.48	323.28	388.92

Notes: a/ indicates the period 1966-75.
Figures in parentheses indicate t-statistics.
[D] denotes dichotomous variables.
The analyses include only second and higher order births.
*, ** and *** denote significant at the 10, 5 and 1 per cent level.
EDR & CDR indicate Eastern and Central development regions.
Sources: 1976 NFS and 1986 NFFS data tapes.

demographic factors were considered. In contrast, the adverse influence of the preceding child dead before age one on the risk of death to index child as shown in Model Three, decreases in Model Four after the socio-economic and health-related factors are added.

The adverse influence of working mothers on risk of death to infants is statistically significant in both Models Two and Four, but its adverse effect is attenuated in Model Four, where all socio-economic, health-related and demographic factors are considered, compared with Model Two, where only socio-economic and health-related factors were considered. These results suggest that part of the effect of a dead preceding child on the survival status of the index infant is operating through the socio-economic and health-related factors considered in Model Four. Similarly, part of the effect on infant mortality of working mothers and urban residence is operating through demographic factors. The effects of ever use of contraception and eastern and central development region remain almost constant in both models (Two and Four), whether the demographic factors are considered in the model or not. This indicates that the effects of these factors are independent of demographic and other socio-economic factors considered in the model.

7.8 Role of change in variable values in explaining infant mortality decline

Table 7.3 shows the role of shifts in the values of variables in explaining the decline in infant mortality level between the 1966-75 and 1976-85 periods. The results in Table 7.3 are based on the assumption that the structure of the relationship between the variables during the period considered in the study is unchanged. The first two columns of Table 7.3 show the means of each independent variable of interest. The third column shows the actual change in each of these factors that took place between the two time periods, and the corresponding t-statistics, indicating whether the change that occurred is significant. The results in the third column indicate clearly that the change in the mean values of all factors, except the length of the preceding birth interval equal to or greater than 37 months, are significant.

The infant mortality rate between the two periods has declined by about 39 per cent, from 145 during the period 1966-75 to 89 deaths per 1000 live births during the period 1976-85. During the same span of time, the average level of parents' education, the proportion who had ever used contraception, and the proportion of urban dwellers increased, while the proportion of women who were working outside the home after their marriage decreased. Regarding the demographic variables, the proportion of infants born to mothers under 24 years of age as well as second and third order births increased while the proportion of those who lost their previous sibling declined. Since mother's involvement in work outside the home (Chapter Four, Table 4.6), and a preceding child who died before age one (Chapter Five, Table 5.13) were associated with an elevated risk of death to infants, the decline in the proportions of these factors (events) over time to some extent could contribute to better child survival prospects. Similarly, as mother's education, father's education, ever use of contraception and second and third order birth were associated with a lower risk of infant death (Chapters Four and Five), the increase in the proportion of these factors (events) over time is also likely to contribute to more favourable child survival prospects. In contrast, because mother's age at childbirth less than 24 years was associated with an elevated risk of death to infants (Chapters Four and Five), the increase in prevalence over time could contribute to an increase in risk of death to infants.

The fourth column of Table 7.3 shows the logit regression coefficients, which explain the relationship between infant mortality and explanatory variables of interest, after controlling for the effects of other factors in the model. All logit coefficients show the expected signs and the effects of all, except mother's education and Indo-Aryan ethnicity, are statistically significant. The fifth column of Table 7.3 quantifies the amount of infant mortality decline due to the change in the values of explanatory variables over time. The value corresponding to the 'sum of entries' at the bottom of the fifth column of Table 7.3 is derived by adding all entries of the column. This figure suggests that 28 of the decline of 56 deaths per 1000 live births during the period 1966-75 to 1976-85 are explained by the change over time in the values of factors considered in this study. Thus change in

Table 7.3 Results of logit regression explaining infant mortality and decomposition of the differences in infant mortality rates for the periods 1966-75 and 1976-85: 1976 NFS and 1986 NFFS, Nepal.

Explanatory variables	1966-75 n=6783 mean (1)	1976-85 n=6641 mean (2)	Mean (1976-85) minus (1966-75) (t-stat) (3)	Pooled logit coefficients (t-stat) (4)	Difference in IMR due to change in variable values [a/] (5)
Mother's education (years)	0.1791	0.4627	0.284 (-10.73)***	-0.0213 (-0.77)	-0.63
Father's education (years)	1.2652	2.4609	1.196 (-20.20)***	-0.0244 (-2.42)**	-3.02
Working mothers [D]	0.1011	0.0583	-0.043 (8.56)***	0.2673 (2.91)***	-1.18
Urban residence [D]	0.0229	0.2207	0.198 (-36.73)***	-0.2609 (-2.46)**	-5.34
EDR & CDR [D]	0.5352	0.6178	0.083 (-9.73)***	-0.1419 (-2.55)**	-1.21
Ever use of contraception [D]	0.0656	0.2516	0.186 (-31.90)***	-0.6049 (-6.23)***	-11.65
Indo-Aryan [D]	0.4668	0.4522	-0.015 (1.72)*	-0.0117 (-0.21)	0.02
Mother's age at child birth (< 24 years) [D]	0.3143	0.3305	0.016 (-1.91)*	0.2610 (3.86)***	0.44
Birth order (2-3) [D]	0.4675	0.4931	0.026 (-3.02)***	-0.1873 (-2.93)***	-0.50
Length of preceding [D] interval (≥ 37 months)	0.3263	0.3325	0.006 (-0.73)	-0.5817 (-8.80)***	-0.37
Survival status of preceding [D] child (dead)	0.1694	0.1066	-0.063 (9.81)***	0.6243 (9.36)***	-4.06
Intercept				-1.7635 (-27.92)***	
χ^2				349.08	
Mean Dependent /1000	145	89		Sum of entries	-28.35
$(\partial p/\partial x)$ =		0.104			

Actual difference /1000=56 Explained difference /1000=28 Per cent explained=50

Notes: Figures in parentheses indicate t-statistics.
[D] indicate dichotomous variables.
Analysis includes second and higher order births.
a/ This column is calculated as $(\partial p/\partial x)$ * (mean difference) * (Logit coefficient) * (1000), that is (0.104*0.284*(-0.0213)*1000).
'*, ** and ***' denote significant at the 10, 5 and 1 per cent level respectively.

Sources: 1976 NFS and 1986 NFFS data tapes.

prevalence of factors considered in this study explain 50 per cent of the total decline in infant mortality that took place between the two periods.

The results in the fifth column of Table 7.3 also indicate that the increase in the proportion of those who had ever used contraception makes the largest contribution to the decline in infant mortality rates between the two periods. This is followed by change in the proportions of urban residence, father's education, preceding child dead, and eastern and central development regions (of Table 7.3). The change in the value of ever use of contraception alone explains a decline of 21 per cent of the total (12 of the 56 deaths per 1000 live births). The increase in the variable values of two other factors, father's education and urban place of residence, and the decrease in the proportion of those who have experienced previous sibling loss, explain another 12 per cent of the total decline. The results in Table 7.3 further suggest that much of the decline in infant mortality in Nepal between the periods is due to changes in the socio-economic and health-related factors rather than demographic factors. For example, socio-economic and health-related factors (mother's education, father's education, mother working outside the home, ever use of contraception, urban dwellers, and eastern and central development region) explain 41 per cent of the total 56 deaths per 1000 births decline between the periods, while demographic factors explain only 9 per cent of the total decline. However, the shift in the socio-economic, health-related and demographic factors considered in this study captured only 49 per cent of the total decline that took place over the period. The rest of the decline could be due to factors not considered in this study. In addition, declines in infant mortality due to the shift in the structural relationship, which are discussed in the subsequent sections, also are not captured in this part of the analysis.

7.9 Role of change in structure in explaining infant mortality decline

Table 7.4 shows the coefficients of the independent variables considered in the model that have changed between the two periods. The first and second columns of Table 7.4 show the logit coefficients and corresponding t-statistics according to the independent variables of interest for the period 1966-75 and 1976-85 respectively, after controlling

Table 7.4 Results of logit regression explaining infant mortality, allowing for different coefficients for the periods 1966-75 and 1976-85: 1976 NFS and 1986 NFFS, Nepal.

Explanatory variables	Logit coefficients (1966-75) n=6783 (t-stat)	Logit coefficients (1976-85) n=6641 (t-stat)	Difference in the coefficients of (1966-75) & (1976-85) (t-stat)
Mother's education (years)	-0.0382 (-0.76)	-0.0337 (-1.02)	-0.0045 (-0.07)
Father's education (years)	-0.0421 (-2.73)***	0.0029 (0.21)	-0.0450 (-2.17)**
Working mothers [D]	0.2079 (1.93)*	0.1776 (0.98)	0.0303 (0.14)
Urban residence [D]	-0.0165 (-0.06)	-0.1546 (-1.29)	0.1381 (0.44)
EDR & CDR [D]	-0.1892 (-2.67)***	-0.0011 (-0.01)	-0.1880 (-1.61)
Ever use of contraception [D]	-0.5800 (-3.19)***	-0.4951 (-4.17)***	-0.0849 (-0.39)
Indo-Aryan [D]	-0.0762 (-1.07)	0.0443 (0.49)	-0.1206 (-1.04)
Mother's age at child [D] birth (< 24 years)	0.2844 (3.26)***	0.2486 (2.29)**	0.0357 (0.26)
Birth order (2-3) [D]	-0.1983 (-2.42)**	-0.1820 (-1.76)*	-0.0163 (-0.12)
Length of preceding [D] interval (≥ 37 months)	-0.6517 (-7.64)***	-0.4701 (-4.48)***	-0.1816 (-1.34)
Survival status of preceding child (dead) [D]	0.5334 (6.44)***	0.7079 (6.24)***	-0.1745 (-1.24)
Intercept	-1.5155 (-19.50)***	-2.1859 (-20.82)***	0.6703 (5.13)***
χ^2	401.75		
Mean dependent	0.145	0.089	

Notes: Figures in parentheses indicate t-statistics.
[D] indicate dichotomous variables.
Analysis includes only second and higher order births.
*, ** and *** denote significant at the 10, 5 and 1 per cent level.

Sources: 1976 NFS and 1986 NFFS data tapes.

for the effects of other factors considered in the model. These results are based on logit regression models which allow coefficients to differ between the 1966-75 and 1976-85 periods. Figures in the third column of the Table 7.4, which are calculated by interacting each explanatory variable with the 1976 dummy, show the size and significance of the change in the coefficients that took place between the two periods. Results in this column suggest that although the coefficients (structure) pertaining to all the variables have changed between the two periods, only the change in the coefficient pertaining to father's education is significantly different from zero [two-tailed test $|t| > 1.96$]. This indicates that relationships between factors considered in this study, except father's education and survival status of infants, have not changed significantly, during the two periods of time . However, the large change in the intercept term, shown to be statistically significant, suggests that the relationship between factors not considered in this study with infant mortality during the same span of time has changed considerably .

Among the statistically significant socio-economic and health-related variables in the first and second columns of Table 7.4, except for ever use of contraception, their effect on infant mortality slightly declined during the later period. Father's education and, eastern and central development regions, which were important determinants of infant mortality during the period 1966-75, show no influence during the period 1976-85. The difference in the coefficients between the periods corresponding to the variable eastern and central development regions is just short of significance at the 10 per cent level. In addition, mothers working outside the home is shown to have an influence in increasing the risk of death to infants during the early period, but was no longer statistically significant for the later period. Regarding the demographic variables, the effects of mother's age less than 24 years at childbirth and preceding child dead before age one are shown to be associated with increased infant mortality during both periods of time. The effect of mother's age under 24 years at childbirth during the later period slightly decreased, while the effect of the preceding child dead on index sibling for the later period slightly increased. In addition, the effects of second and third order births and a preceding birth interval equal to or greater than 37 months, although associated with lower infant mortality in both periods, had lower effects during the later period. However, all the demographic factors in Table 7.4 appear to be important determinants of infant mortality for both periods of time.

Table 7.5 shows the relative importance of the role of change in the variable values as against the shift in the structure of the relationship between the period 1966-75 and the period 1976-85 in explaining the decline in infant mortality. The results in Table 7.5 show how far the 1966-75 coefficients and 1976-85 values of explanatory variables predict the 1976-85 infant mortality rate, and vice versa. The calculation is based on the predicted logit for each observation which is converted to a probability using the formula $P_i = 1/(1+e^{-logit_i})$, and then averaged over observations for that period. The difference between the predicted infant mortality rate based on the 1966-75 coefficients and the 1976-85 variable values and the actual 1966-75 rate is the proportion of mortality decline attributed to change in the variable values. By contrast, the difference between the predicted infant mortality rate based on the 1966-75 coefficients and 1976-85 variable values and the actual 1976-85 outcomes is the proportion of decline attributed to the change in the structure (Preston, 1975a; 1980; DaVanzo and Habicht, 1986).

Table 7.5 Predicted infant mortality rates per 1000 using 1966-75 coefficients and 1976-85 variable values and vice versa: 1976 NFS and 1986 NFFS, Nepal.

	Predicted IMR/1000 based on the 1966-75 variable values	Predicted IMR/1000 based on the 1976-85 variable value	Estimated change due to change in values of explanatory variables
Predicted IMR using 1966-75 coeff	145	104	41
Predicted IMR using 1976-85 coeff	121	89	32
Estimated change due to shift in relationship	24	15	56

Notes: Predicted average infant mortality probability for each period is the average of predicted probabilities for each individual, each calculated as $P_i = 1/(1+e^{-logit_i})$.
Analysis includes only second and higher order births.
Sources: 1976 NFS and 1986 NFFS data tapes.

The values in the first and second columns in the last row of Table 7.5 suggest that the decline in infant mortality during the periods 1966-75 and 1976-85 explained by the change in the structure of the relationship is lower than the decline explained by the change in the value of variables. Much of the decline thus is explained by the change in the value of variables. For example, when the coefficients for the period 1966-75 were applied to the 1976-85 values of the explanatory variables, the mortality rate declined from 145 in the period 1966-75 to 104 per 1000 live births in the 1976-85 period. This suggests that the predicted mortality for the period 1976-85 was 15 points higher than the observed infant mortality rate (89 per 1000 live births). Similarly, when the 1976-85 coefficients were applied to the 1966-75 variable values to predict the infant mortality rate for the period 1966-75, the decline in the infant mortality due to the shift in the variable values is 32 points lower. The decline explained by the shift in the values of variables ranges between 57 and 73 per cent of the total 56 per 1000 (IMR) decline that took place between the two periods, as against 27 to 43 per cent explained by the shift in the relationship.

7.10 Factors influencing child mortality decline

Table 7.6 shows the result of an analysis similar to that in Section 7.7, but with child mortality as the dependent variable. Model One measures child mortality for the 1976 dummy indicator when other covariates are not considered in the model. The logit coefficient corresponding to the 1976 dummy in this model is a positive value, and is statistically significant. This result shows that the child mortality level during the period 1966-75 in Nepal was 1.7 times higher than during the period 1976-85.

Models Two and Three introduce socio-economic, health-related and demographic factors respectively into Model One. In addition, Model Four introduces all the socio-economic, health-related and demographic factors into Model One. The results in Models One to Four thus suggest the impact on the coefficient of the 1976 *dummy* variable after controlling for the effects of other explanatory variables. The size and the significance of the difference shown by the 1976 indicator in Models Two to Four vary considerably as the alternative groups of child mortality correlates are added into the model. This indicates that socio-economic, health-related and demographic factors considered in this study have some influence in reducing the level of child mortality during the two periods. For

Table 7.6 Results of logit regression for child mortality showing the effects of controlling other covariates on coefficients of the 1976 survey[a/] indicator: 1976 NFS and 1986 NFFS, Nepal.

Explanatory variables	Logit regression models n=9105			
	Model 1	Model 2	Model 3	Model 4
Survey (1976) [D]	0.5476 (7.22)***	0.3902 (4.81)***	0.5243 (6.84)***	0.3759 (4.60)***
Mother's education (years)		-0.1290 (-2.20)**		-0.1323 (-2.24)**
Father's education (years)		-0.0347 (-2.14)**		-0.0378 (-2.32)**
Working mothers [D]		0.4830 (4.14)***		0.4592 (3.89)***
Urban residence [D]		-0.3541 (-2.24)**		-0.3173 (-2.00)**
EDR & CDR [D]		-0.0307 (-0.40)		-0.0306 (-0.40)
Ever use of contraception [D]		-0.1065 (-0.93)		-0.1482 (-1.29)
Indo-Aryan [D]		-0.2458 (-3.18)***		-0.2434 (-3.13)***
Mother's age at child [D] birth (< 24 years)			-0.0165 (-0.18)	0.0507 (0.54)
Birth order (2-3) [D]			-0.0344 (-0.40)	-0.0269 (-0.31)
Length of preceding [D] interval (≥ 37 months)			-0.7833 (-8.13)***	-0.8038 (-8.30)***
Survival status of preceding [D] child (dead)			0.4084 (4.65)***	0.3422 (3.87)***
Intercept	-2.6390 (-44.96)***	-2.3565 (-26.33)***	-2.4884 (-32.74)***	-2.2088 (-21.57)***
$\chi 2$	53.54	125.75	161.60	233.36

Notes: a/ indicate the period between 1961-70.
Figures in parentheses indicate t-statistics.
[D] indicate dichotomous variables.
The analyses include only second and higher order children.
*, ** and *** denote significant at the 10, 5 and 1 per cent level.

Sources: 1976 NFS and 1986 NFFS data tapes.

example, when the socio-economic and health-related factors which are expected to lead to a lower child mortality rate are considered in the model, the relative odds decline to 1.48 in Model Two from 1.73 in Model One. This figure corresponds to a fall in child mortality between the two periods, from 43 to 28 per 1000 live births. When only demographic factors are considered, the relative odds in Model Three decrease to 1.69 from 1.73 in Model One. This corresponds to a fall in child mortality between the two points of time from 43 to 41 deaths per 1000. The results in Models Two and Three thus indicate that much of the decline in child mortality that took place during the two periods of time, as in the case of infant mortality, was due to the socio-economic and health-related factors. That demographic factors account for only a small proportion of the decline, could be due to the faster change in the socio-economic and health-related factors as compared with changes in demographic factors.

Model Four in Table 7.6 considers both socio-economic and health-related factors and demographic factors. The size and significance of the effects of the socio-economic and health-related factors in this model remain almost the same as they were in Model Two whether the demographic factors were not considered. Similarly, the size and significance of demographic factors in Model Four also do not vary much as compared with Model Three, where socio-economic and health-related factors were not considered. This implies that the effects of socio-economic, health-related factors and demographic factors on child mortality are independent of each other.

7.11 The role of change in variable values in explaining the decline in child mortality

Table 7.7 shows the role of change in the values of explanatory variables in explaining child mortality decline. The first two columns of Table 7.7 show means of each variable for the two periods. The third column shows the actual change in the means of each of these factors that took place between the two periods. In addition, the corresponding t-statistics suggest whether the change in the variable values is significantly different from zero.

Table 7.7 Results of logit regression explaining child mortality and decomposition of the differences in child mortality rates for the periods 1961-70 and 1971-80: 1976 NFS and 1986 NFFS, Nepal.

Explanatory variables	(1961-70) n=4439 mean (1)	(1971-80) n=4666 mean (2)	Mean (1971-80) minus (1961-70) (t-stat) (3)	Pooled logit coefficients (t-stat) (4)	Difference in CMR due to change in variable values a/ (5)
Mother's education (years)	0.1399	0.4676	0.328 (-10.77)***	-0.1222 (-2.08)**	-3.21
Father's education (years)	1.0045	2.2505	1.246 (-17.95)***	-0.0425 (-2.61)***	-4.24
Working mothers [D]	0.0969	0.0615	-0.035 (6.26)***	0.4950 (4.20)***	-1.40
Urban residence [D]	0.0277	0.2362	0.209 (-32.97)***	-0.4595 (-2.98)***	-7.67
EDR & CDR [D]	0.5380	0.6224	0.084 (-8.53)***	-0.0524 (-0.68)	-0.35
Ever use of contraception [D]	0.0849	0.3056	0.221 (-27.37)***	-0.2495 (-2.22)**	-4.41
Indo-Aryan [D]	0.4711	0.4799	0.009 (-0.89)	-0.2273 (-2.93)***	-0.16
Mother's age at child [D] birth (< 24 years)	0.3003	0.3573	0.057 (-5.76)***	0.0290 (0.31)	0.13
Birth order (2-3) [D]	0.5071	0.5300	0.023 (-2.15)**	-0.0188 (-0.22)	-0.03
Length of preceding [D] interval (≥ 37 months)	0.3253	0.3236	-0.002 (0.17)	-0.8062 (-8.34)***	0.11
Preceding child before age two (dead) [D]	0.2073	0.1429	-0.064 (8.25)***	0.3616 (4.10)***	-1.86
Intercept				-1.9672 (-22.79)***	
χ^2				211.82	
Mean Dependent /1000	110	67			
Sum of entries					-23.10
$(\partial p/\partial x)$ =		0.080			
Actual difference=43	Explained difference=23		Explained in percentage=53		

Notes: Figures in parentheses indicate t-statistics. [D] indicate dichotomous variables.
Analysis includes only second and higher order children.
a/ This column is calculated as $(\partial p/\partial x)$ * (mean difference) * (Logit coefficient) * (1000).
*, ** and *** denote significant at the 10, 5 and 1 per cent level.

Sources: 1976 NFS and 1986 NFFS data tapes.

The results in the third column show that the mean values for all, except Indo-Aryan ethnicity and length of the preceding birth interval equal to or greater than 37 months, have significantly changed between the two periods. The child mortality rate (dependent variable) declined from 110 for the period 1961-70 to 67 per 1000 for the period 1971-80 . Over the same period, the mean value of the education of mothers and fathers increased by 3.3 and 2.2 times respectively. Similarly, the mean value of those who had ever used contraception increased by 3.6 times. The urban dwellers and the eastern and central development region dwellers increased by 8.5 and 1.2 times respectively. In contrast, the mean value of women who worked outside the home after marriage declined by 1.5 times. Regarding the demographic factors, mean values of women who had borne a child when they were under 24 years of age and the mean of second and third order births increased by 1.2 and 1.0 times respectively. In contrast, the mean value for those children who had lost their preceding sibling declined by 1.5 times respectively. All these changes can be expected to have some influence on the decline in child mortality that took place during the same periods of time.

The fourth column of Table 7.7 shows the logit coefficients which explain the relationship between child mortality and the explanatory variables of interest, after controlling for the effects of other factors in the model. In addition, the t-statistics corresponding to the logit coefficients suggest whether the net effects due to each of the explanatory variables on child mortality is significantly different from zero. This column clearly shows that the effects of all socio-economic and health-related factors, except eastern and central development regions, are significantly different from zero. However, among the demographic factors considered in the model, only the effects of length of the preceding birth interval equal to or greater than 37 months and the death of the preceding child before age two were statistically significant.

The fifth column in Table 7.7 shows the amount of child mortality decline that took place during the two periods as a consequence of the change in the values of explanatory variables considered in the model. The result in this column indicates that change in the proportion of the urban dwellers has contributed to a decline of about eight child deaths.

Similarly, the increase in the proportion of the educated mothers and fathers and ever users of contraception resulted in a decline of 11 child deaths. In addition, the decline in the proportion of children who had lost their previous sibling contributed to a decline of two child deaths over the two periods. The result at the bottom of Table 7.7 shows that 53 per cent of the decline in child mortality that occurred during the two periods is explained by the socio-economic, health-related and demographic factors considered in the model.

7.12 Role of change in structure in explaining child mortality decline

Table 7.8 shows factors that have changed in their relationship with child mortality during the two periods. The first and second columns of Table 7.8 show the logit coefficients and corresponding t-statistics according to the independent variables of interest for the period 1961-70-and 1971-80 respectively. These estimates are derived by allowing the 1961-70 and 1971-80 dummy variables to differ. The third column of Table 7.8 shows the logit coefficients and the corresponding t-statistics from the estimates drawn by interacting each independent variable with the 1976 dummy.

While the third column of Table 7.8 suggests that all of the variables considered in this study have changed in their relationship with child mortality during the two periods, only the change in relationship of working mothers, eastern and central development region and birth order (second and third order) are statistically significant. The large and statistically significant change shown by the intercept term for the two periods further confirms that the risk of death to children born during the earlier period was considerably higher when all explanatory variables in the model were held constant. In addition, this also explains that the relationship between child mortality and the explanatory variables not considered in the model has changed considerably between the two periods.

The other factors that are to be noted in Table 7.8 are the intra-survey logit coefficients and the corresponding t-statistics according to the explanatory variables considered in the model. For example, the effect of mother's education on child mortality during the later period is more important in reducing the level of child mortality, and is statistically significant. The same is true for second and third order births. In contrast, the

Table 7.8 Results of logit regression explaining child mortality allowing for different coefficients for the periods 1961-70 and 1971-80: 1976 NFS and 1986 NFFS, Nepal.

Explanatory variables	Logit coefficients (1961-70) n=4439 (t-stat)	Logit coefficients (1971-80) n=4666 (t-stat)	Difference between coefficient of (1961-70) & (1971-80) (t-stat)
Mother's education (years)	-0.1085 (-1.02)	-0.1520 (-2.12)**	0.0435 (0.35)
Father's education (years)	-0.0424 (-1.68)*	-0.0275 (-1.26)	-0.0149 (-0.45)
Working mothers [D]	0.2414 (1.59)	0.7922 (4.21)***	-0.5508 (-2.28)**
Urban residence [D]	-0.8653 (-1.64)*	-0.2875 (-1.69)*	-0.5778 (-1.04)
EDR & CDR [D]	-0.1856 (-1.89)*	0.2123 (1.63)	-0.3980 (-2.43)**
Ever use of contraception [D]	-0.2182 (-1.07)	-0.1448 (-1.02)	-0.0734 (-0.30)
Indo-Aryan [D]	-0.2849 (-2.85)***	-0.1544 (-1.24)	-0.1306 (-0.82)
Mother's age at child birth (< 24 years) [D]	-0.0468 (-0.38)	0.1906 (1.32)	-0.2374 (-1.25)
Birth order (2-3) [D]	0.1146 (1.03)	-0.2421 (-1.75)*	0.3567 (2.00)**
Length of preceding interval (≥ 37 months) [D]	-0.8754 (-6.98)***	-0.6844 (-4.49)***	-0.1910 (-0.97)
Survival status of preceding child (dead) [D]	0.3536 (3.20)***	0.2933 (1.96)**	0.0602 (0.32)
Intercept	-1.7257 (-16.14)***	-2.4145 (-16.27)***	0.6887 (3.66)***
χ^2	252.63		
Mean dependent	110	67	

Notes: Figures in parentheses indicate t-statistics.
[D] indicate dichotomous variables.
*, ** and *** denote significant at the 10, 5 and 1 per cent level.
Analysis includes only second and higher order children.
Sources: 1976 NFS and 1986 NFFS data tapes.

effects of father's education and Indo-Aryan ethnicity on child mortality is more important during the early period than during the later period, where the effects of both of these variables are not statistically significant. The effect of mother's involvement in work outside the home on the survival status of children is more unfavourable and highly significant during the later period. In contrast, although the effect of previous sibling loss on the index sibling is adverse for both periods, the statistical significance as well as the effect of this factor has declined for the later period.

Table 7.9 Predicted child mortality rates using 1961-70 coefficients and 1971-80 variable values and vice versa: 1976 NFS and 1986 NFFS, Nepal.

	Predicted CMR/1000 based on the 1961-70 variable values	Predicted CMR/1000 based on the 1971-80 variable value	Estimated change due to change in values of explanatory variables
Predicted CMR using 1961-70 coeff	110	77	33
Predicted CMR using 1971-80 coeff	88	67	21
Estimated change due to shift in relationship	22	10	43

Notes: Predicted average child mortality probability for each period is the average of Predicted probabilities for each individual, each calculated as $P_i = 1/(1+e^{-logit_i})$.
Analysis includes only second and higher order children.
Sources: 1976 NFS and 1986 NFFS data tapes.

Table 7.9 shows the relative importance of the role of change in variable values versus the change in the relationship of the variables between the periods 1961-70 and 1971-80 in explaining the decline in child mortality rate. The left to right diagonal figures (110 versus 67) are the direct estimates of child mortality based on the 1976 NFS and 1986 NFFS data sets respectively. The right to left diagonal figures (77 versus 88) are the predicted values of child mortality based on the variable values of 1971-80 and the coefficients of 1961-80 and vice versa. Figures in the last row show the amount of decline in child mortality due to the change in the relationship (structure) and figures in the last column are the amount of decline in child mortality due to the change in the values of explanatory variables.

Table 7.9 suggests that 49 to 77 per cent of the decline in child mortality during the period 1961-70 and 1971-80 is due to the change in the variable values. The decline in the child mortality accounted for by the change in the relationship (structure) ranges between 21 and 51 per cent. Again, the result confirms that much of the decline in the child mortality that took place during the two periods is explained by the change in the variable values.

7.13 Further discussion of the results

This chapter has examined the role of change in the socio-economic, health-related and demographic factors in explaining the decline in infant and child mortality that took place in Nepal during the 1960s and 1980s. The infant mortality rate, which was 145 per 1000 live births during the period 1966-75, declined to 89 per 1000 by the period 1976-85. Similarly, the child mortality rate, which was 110 per 1000 children aged one to five years during the period 1961-70, declined to 67 per 1000 for the period 1971-80. Both infant and child mortality in the country between the two periods declined by over 38 per cent. During the same span of time the average education of parents improved. The mean proportion of women who had ever used contraception increased while the mean proportion of women working outside the home declined. Moreover, the mean value for children who lost their previous sibling declined, while the mean value for children born to mothers under 24 years of age increased (Tables 7.3 and 7.7). During the shift in the values of socio-economic, health-related and demographic factors that occurred between the two periods, the relationship between the dependent and independent variables also can be expected to have changed.

In this circumstance, factors considered in this chapter were expected to explain the decline in infant and child mortality from two perspectives: a change in the values of variables and a change in relationship (structure). Accordingly, the first phase of the analysis focused on the role of change in values of explanatory variables while the later phase focused on the role of the changing relationship between variables in explaining the decline in infant and child mortality that took place over the two periods covered in this study.

The earlier part of the analysis of infant mortality based on the logistic models with the addition of socio-economic, health-related and demographic terms into Model One yields interesting results (Table 7.2). The improvement in the χ^2 value after adding the socio-economic, health-related, demographic, as well as all factors in Model One is statistically significant. Moreover, the improvement in the χ^2 value based on Model Three, which considers only demographic factors, is much greater compared with the corresponding figure based on Model Two, that considers only socio-economic and health-related factors. This indicates that demographic factors explain more of the infant mortality differentials. This result is consistent with the findings in the preceding chapters.

The considerable attenuation in the effect of the 1976 survey dummy indicator after considering the socio-economic, health-related and demographic factors in the two models suggests quite a different result, however, and adds an extra dimension to the analysis. For example, the magnitude of the decline in the log of odds from Models One to Two is larger than the corresponding decline from Models One to Three. This suggests that the role of the socio-economic and health-related factors in explaining infant mortality decline over the two periods is much greater than the role of demographic factors. The analysis of child mortality also suggests a similar result (Table 7.6).

What these findings show is that although demographic factors are important in explaining the cross-sectional infant mortality differentials, their role in explaining infant mortality decline over the two periods is less important as compared to the role of socio-economic and health-related factors. Changes in the fertility behaviour and in the timing and spacing of births were also noted to have a negligible effect in explaining the decline in infant mortality in Malaysia (DaVanzo and Habicht, 1986: 155). The increase in the mean value for children born to women under 24 years of age, and no significant difference between the mean values for children born during 37 months or more after the birth of the preceding child over the two periods, also suggest that the efforts of the family planning institutions during the last three decades have not been very successful in raising the childbearing age of mothers and prolonging the length of interval between births. This indicates a need for further strengthening of the programme, which in turn could lead to further declines in infant and child mortality in the future.

The mean values of all explanatory variables considered in this chapter, except birth interval equal to or greater than 37 months, have changed considerably between the two periods, and the changes are statistically significant (Table 7.3). The assessment of the role of the change in the values of variables in explaining the probability of infant mortality that are implied by logit coefficients evaluated at the sample mean probability shows that the amount of infant mortality decline due to the change in the values of explanatory variables explains 28 per cent of the decline of 56 deaths per 1000 that took place between the two periods. Among these explanatory variables, the major portion of the total decline is explained by the increase in ever users of contraception, urban residence, and father's education and a decrease in the mean value for the index child whose preceding sibling died before one year of age. The contribution of ever use of contraception in explaining the decline in infant mortality noted in this chapter further confirms that maternal and child health care services, delivered in conjunction with the family planning programme have had a considerable impact in lowering the infant death rate. Father's education here seems to be reflecting their improving economic power in providing better care, food, health and various services to their infants. In addition, that part of the decline in infant mortality explained by an increase in urban dwellers seems to be due to the increase in the proportion of population with better access to urban facilities and services, the effects of which are not captured by other independent variables in the model.

A similar analysis for child mortality suggests that the change in the values of the explanatory variables considered in this study explains 23 of the 43 child deaths per 1000 over the two periods. Among the independent variables, urban residence, ever use of contraception, father's education and mother's education have been the largest contributors to the child mortality decline. The effect of ever use of contraception on child mortality based on each of the surveys in the analysis in Chapter Four was not statistically significant after controlling for the effects of other factors considered in the model. The same is true in this chapter (Table 7.8). However, the change in the values of this variable over the two periods explains 10 per cent of the total decline in child mortality (Table 7.7). This result suggests that, although use of contraception was employed as an indicator of maternal and child health care services, which are delivered in conjunction with family planning services, and it not able to show cross-sectional differentials in child mortality, it has had some influence in lowering the child mortality in the country. In addition, the results further confirm that the role of socio-economic and health-related factors in explaining the decline in both infant and child mortality in Nepal is much greater than the role of demographic factors (Tables 7.3 and 7.7). The increase in the mean value for children born to mothers aged 24 years of age and under and the small reduction in the mean proportion of children born 37 months or more after the birth of the preceding child has prevented the child mortality rate from falling, but only by a small margin.

Although all the coefficients of variables considered in this study show a change, only the change pertaining to father's education (Table 7.4), working mothers, eastern and central development region and second and third order birth (Table 7.8) are statistically significant. The effect of mother's work outside the home on child mortality is significantly higher for the later period and suggests that the change in the coefficient (structure) in this variable has prevented child mortality from declining as rapidly as it would have otherwise. The same is true for the eastern and central development regions, except that the effect of this variable in the later survey is not statistically significant. In contrast, the change in the structure of the relationship between birth order (second and third order births) and child mortality has contributed to a faster decline in child mortality during the two periods. Despite this change in the structure of the relationship, the contribution of structural change in the decline of child mortality as compared with the contribution of changes in the variable values seems to be smaller (Table 7.9). The same is true for infant mortality (Table 7.5). The explanation for most of the mortality decline due to the structural change lies in the influence of variables not considered in the study, which is shown by the significant difference in the intercept term between the two periods. What these other variables might be is a question to be answered by future studies.

CHAPTER EIGHT

CONCLUSION

Knowledge of the determinants of infant and child mortality in Nepal has been very limited. Many socio-economic and cultural factors affecting child survival prospects in Nepal have not been addressed in past studies. This is partly due to the lack of reliable data, partly due to a failure to explore available data, and partly due to inaccessibility of available data among those who are proficient in technical analysis to shape them into information. The present study has aimed to bridge this gap in knowledge on various aspects of infant and child mortality in Nepal.

Although this is not the first time that infant and child mortality studies have been carried out for Nepal, the present study, is more detailed than any previous study and differs in several ways. First, the present study has employed two sample surveys, the 1976 Nepal Fertility Survey (NFS) and the 1986 Nepal Fertility and Family Planning Survey (NFFS), to compare and assess socio-economic, demographic and health differentials in and determinants of infant and child mortality in Nepal. In addition, it has evaluated the quality of the 1986 Nepal Fertility and Family Planning Survey data set in greater detail than has ever been carried out before[1/]. Second, this study has assessed whether or not maternal education and contraception use are working through the two maternal factors: mother's age at childbirth and birth spacing in influencing infant and child mortality. This has been extended further to examine the extent to which educated mothers as compared with those with no education used contraception to plan the spacing of their children. Third, it assesses the extent to which the effect of the length of the preceding birth interval on infant and child mortality is exaggeration when no controls are introduced for the survival status of the preceding child. Fourth, a wider range of socio-economic and health-related factors are considered in this study than in any previous study for Nepal.

1/ A detailed data quality analysis for the 1976 Nepal Fertility Survey was carried out by Goldman et al. (1979).

Fifth, this study identifies factors that account for the higher infant and child mortality levels in some parts of the country than in others.

This study, as its sixth achievement has assessed whether the observed decline in infant and child mortality between the 1960s and 1980s was due to changes in the value of the socio-economic, health-related, cultural and demographic variables or due to changes in the structure of the relationship between the independent and dependent variables between 1960s and 1980s. Although Nepal has experienced declining infant and child mortality during the last 30 to 40 years the infant mortality rate for the country in 1984 was over 100 per 1000 live births. Despite the persistence of high infant mortality, the most important question, that is, what accounts for the high infant and child mortality, has been left out of past studies. These issues, covered in this study, had previously neither been assessed nor highlighted explicitly in the context of Nepal. The demographic and statistical techniques set out in Chapter Two have served well in achieving the objectives of this study. The major findings of this study and their implications for future research are subsequently considered.

This study has described and assessed the association of the specific characteristics of women's reproductive behaviour, such as age of mother at childbirth, birth order of the child and length of the preceding birth interval, as well as sex of the child and year of child's birth (birth cohorts) with infant and child mortality. The results have shown that, on average, of the six children typically borne by a woman during her reproductive life (estimated TFR for the country during 1976 to 1986 (NFPMCH, 1987: 75), twelve per cent died before attaining one year of age and nine per cent of those who survived their infancy died before they turned five years of age. This result suggest that the Nepalese demographic situation is still marked by high birth and death rates. However, the birth cohort analysis suggested an optimistic scenario in view of the systematic decline in infant and child mortality in the country during the recent past.

It was found in this study that mother's age at childbirth and birth order of the child have a significant influence on both infant and child mortality. The main effects model estimates have shown that the risks of death to infants tend to decrease with the increase in the mother's age at childbirth. Unlike Bangladesh (Majumder, 1989) but like Indonesia (Hull and Gubhaju, 1986) as well as in an earlier study in Nepal (Gubhaju, 1991), this study found that the risk of death to infants increases with the increase in the order of births. This pattern persisted for child mortality. However, the influence of mother's age at childbirth and birth order on infant mortality was considerably attenuated after the length of the preceding birth interval variable was included in the model. For child mortality, the influence of mother's age at childbirth was not statistically significant after controlling for the effects of length of birth interval. As expected, it was also evident in this study that short birth intervals lead to poor child survival prospects and a longer birth interval between siblings provides better child survival prospects. These results confirm the earlier findings for Nepal (Gubhaju, 1991) and Pakistan (Cleland and Sathar, 1984) and provide additional empirical evidence for an association between the length of preceding birth interval and infant and child mortality. In addition, these results, like the study by Hobcraft et al. (1984), lead to the conclusion that most of the influence of the mother's age at child's birth and birth order on infant and child mortality is due to the length of the preceding birth interval between siblings. This identifies length of preceding birth interval as the most important demographic variable influencing both the infant and child mortality in Nepal.

The cross-tabulation analysis showed that women in Nepal typically experience a rapid succession of births during their reproductive life. As a result of births in rapid succession, mothers were likely to be continuously disadvantaged in terms of their depletion in health, nutrition and reproductive efficiency, which in combination could have ultimately resulted in higher rates of child loss for these mothers. In contrast, the favourable child survival associated with long birth intervals observed in this study could be due to mothers having adequate time to recover their strength after the preceding pregnancy and lactation before the conception of the following child. In addition, the probability of disease communication due to having children close in age is also minimised for those who were born after a longer interval. This supports the argument that sibling competition for mother's care, tangible resources and health care is the major cause of child mortality in Nepal.

Unlike the countries neighbouring Nepal, the sex of the child did not have a significant influence on infant and child mortality. This result seems surprising in a country where sons are preferred over daughters. However, the religious importance of daughters among the Hindus of Nepal as well as the equivalent religious significance of grandsons born to daughters and grandsons born to sons could have produced the insignificant influence of sex of the child on infant and child mortality differentials observed in this study. The religious ritual value of a daughter in the Nepalese society was also argued by Karki (1988).

With respect to infant mortality, the socio-economic and health-related factors that had significant influence were mother's work status and ever use of contraception respectively from the 1976 Nepal Fertility Survey; and mother's education, number of cows possessed by a household, ever use of contraception, and place of residence/ access to health services (health posts) from the 1986 Nepal Fertility and Family Planning Survey. With regard to child mortality, only father's education, mother's work status and place of residence from the 1976 Nepal Fertility Survey; and mother's education, mother's work status, size of land-holding, number of cows possessed by households, and place of residence/access to health services from the 1986 Nepal Fertility and Family Planning Survey had significant influence after controlling for the effects of other variables in the model.

Of the significant variables from the 1976 Nepal Fertility Survey, the main effects model estimates have shown that the infants of mothers who worked outside the home were exposed to a higher risk of death than the infants of those mothers who did not work outside the home. Similarly, the infants of women who had ever used contraception were exposed to a lower risk of death than the infants of those who had never used contraception. Favourable survival prospects for the infants of those who had ever used contraception were also found in the main effects model based on the 1986 Nepal Fertility and Family Planning Survey.

Analysis of the 1986 Nepal Fertility and Family Planning Survey data showed that the infants of mothers with some education were exposed to a lower risk of death than those of mothers with no education. The main effects model also showed that the size of land-holding and the number of cows possessed by households had a negative association with infant mortality. The main effects estimates showed that the place of residence/access to health variables did not show any difference in the risk of infant death in the rural areas between those who had access to health services and those who did not have access to health services. However, the risk of death to infants born in urban areas was lower than that of those born in the rural areas, irrespective of whether or not those born in the rural areas had access to health services. This suggested that much of the differential in infant mortality in Nepal was due to place of residence, rather than whether or not an infant had access to health services or not. Despite this finding, the contribution of the health care services in improving child survival prospects in the context of Nepal cannot be discounted, because the 'access to health' variable used in this study only accounts for whether or not a household had any access to the health care services delivered through health posts. It does not account for the level of the utilization of health services delivered through various institutions. A substantial conclusion in this regard could be drawn only after considering the type and level of utilization of health care services, which was not available for this analysis.

Of the significant determinants of child mortality, the main effects model based on both the 1976 Nepal Fertility Survey and 1986 Nepal Fertility and Family Planning Survey showed a higher risk of death to children of women who worked outside the home than to children of those women who did not work outside the home. The urban-rural place of residence variable used in this study showed that the risk of death of children residing in urban areas was lower than that of children living in rural areas. With respect to father's education, based on the 1976 Nepal Fertility Survey, the analysis showed that children whose fathers had no education had the highest risk of death; children whose fathers were literate but had no schooling had a medium risk of death, and children whose fathers were literate and had been to school had the lowest risk of death. The significant influence of father's education based on the 1986 Nepal Fertility and Family Planning Survey disappeared after controlling for the effects of other factors in the model.

The influence of mother's education on child mortality, based on the 1976 Nepal Fertility Survey, disappeared after controlling for the effects of other indicators in the main effects model. However, the influence of mother's education on child mortality based on the 1986 Nepal Fertility and Family Planning Survey continued to be significant, even after controlling for the effects of other variables in the main effects model. The main effects model estimates based on the 1986 Nepal Fertility and Family Planning Survey also showed that children of mothers who had some education were exposed to a lower risk of death. This study also showed that educated women had better access to electricity and toilets, and had better housing. This suggests that women with some education in Nepal are in a better position in terms of resources and socio-economic situation as compared to women with no education. This leads to the argument that the favourable influence of mother's education on child survival prospects shown by the 1986 Nepal Fertility and Family Planning Survey could be working through household resources and better living conditions rather than education *per se*, although it is widely explained in the literature as working through improved child care due to enhanced health knowledge from education. Based on both the 1976 Nepal Fertility Survey and the 1986 Nepal Fertility and Family Planning Survey, the considerable attenuation in the effects of mother's education after controlling for the effects of other factors in the model provides further support for this argument. However, this finding should be viewed with caution because of the smaller number of mothers with some education, as well as the skewed nature of the data regarding education of mothers.

The size of land-holding and the number of cows possessed by a household based on the 1986 Nepal Fertility and Family Planning Survey showed a negative association with child mortality risk. The main effects model estimates have shown that children born in households with larger land-holdings and more cows had a lower risk of death. The influence of this variable on child mortality remained significant, irrespective of whether or not the effects of other factors were controlled. This result confirmed the view that the survival chances of children born in more prosperous households (indicated by the size of land-holding and number of cows owned by the households) are greater.

This study showed that mother's education and mother's work status not only have independent effects but also jointly influence infant mortality. The main effects model estimates of the joint variable, 'mother's education and mother's work status', showed that infants of mothers with no education were exposed to a higher risk of death if their mothers were working outside the home. In contrast, the risk of death among infants of working mothers who had some education was lower than infants of non-working mothers. As different patterns of risk of death emerged for different categories of the joint variables (mother's education and work status), the explanations are also different. First, the higher risk of death among infants of mothers with no education could be due to a different propensity for breastfeeding, as well as to time allocation of care determined by their working or non-working status. Second, the advantage of mothers with some education over mothers with no education could be that mothers with some education are likely to be in economically and environmentally better households. If educated women are working outside the home, they are more likely to be engaged in more highly paid jobs and be more able to afford services their children need. Moreover, such women, as earning members of a household, are likely to have better control over household resource allocation. All of these factors could have worked together to produced the favourable survival prospects for the infants of educated women.

The assessment of the proximate maternal factors along with the mother's education, use of contraception and place of residence showed that the influence of the socio-economic and health-related factors on both infant and child mortality, based on both the surveys, was independent of demographic factors. The influence of mother's education was significantly associated with the risk of dying during infancy, both in the absence and in the presence of controls for the demographic factors, except when first-order births based on the 1986 Nepal Fertility and Family Planning Survey were excluded from the analysis. The influence of contraception use was also significantly associated with the risk of dying during infancy, irrespective of whether or not the effects of demographic factors were controlled for. In the case of child mortality, the influence of maternal education was significantly associated with the risk of death, after controlling for the influence of other factors in the population of all births as well as second and higher order births. The analysis suggested that the influence of use of contraception and mother's education on infant and child mortality in Nepal, unlike the case of infant mortality in Thailand (Frenzen and Hogan, 1982: 401), was mediated neither through mother's age at childbirth nor through length of birth interval. The effects of mother's education were also observed to be independent of demographic factors in Bangladesh (Majumder, 1989).

Further analysis was carried out to assess whether or not educated mothers delayed their first births and whether or not educated mothers maintained a longer interval between their offspring by using modern contraception. The analysis suggested that there was no difference in the average age at first birth and length of spacing between the births of their offspring according to their educational status. The analysis did show that educated women in Nepal were more likely to use modern methods of contraception. In addition, it was also evident that younger women were more likely than older women to use modern methods of contraception. However, the shorter length of birth interval between the offspring of mothers who ever used contraception as against those who never used contraception suggested that use of contraception did not influence child survival in Nepal through maintaining the spacing between births. This result demonstrated that contraception acceptors in Nepal were more likely to be birth limiters than birth spacers. In addition, this result also indicated that the association between use of contraception and lower infant mortality is likely to be due to the maternal and child health care services delivered in conjunction with family planning services. However, the mechanisms through which the health-related factors influence child survival in this study are largely unexplored due to the limitations in the data.

The influence of the survival status of the preceding child on the mortality risk of both infants and children was statistically significant in the multivariate analysis. It was evident in this study that the probability of death to an index child was greater where its preceding sibling had died. This observation holds true for both infant mortality and child mortality, without respect to mother's age at childbirth, birth order and length of birth interval. The effect of the survival status of the preceding child on the infant mortality risk was much greater than on the risk of child mortality. A similar result was observed in an earlier study in Nepal (Gubhaju, 1991) as well as in Indonesia (Hull and Gubhaju, 1986). This, however, does not mean that the survival status of the preceding child did not capture the variation in child mortality.

The estimates from the main effects model showed that the risk of death to infants preceded by a dead sibling was considerably higher than to infants preceded by a surviving sibling. This was also true for the risk of death during childhood. The higher risk of death to infants and children preceded by a dead child as against the risk of death to infants and children preceded by a surviving child in this study suggest that deaths of successive children in a family are interrelated. The influence of the survival status of the preceding child on the mortality risk of index infants and children seems to be working through repetitive biological, behavioural, household socio-economic and environmental factors which are most likely to be common to all children born to the same mother.

This study has re-assessed the effect of length of birth interval on infant and child mortality by taking into account the survival status of the preceding child. The supposition that the effect of the preceding birth interval on infant and child mortality is likely to be biased without control for survival status of the preceding child, holds true both for mortality during infancy as well as during childhood. Despite this, the influence of the preceding birth interval on infant and child mortality continued to be significant after controlling for the effect of the survival status of the preceding child.

The estimates corresponding to the joint variable, 'survival status of the preceding child and mother's age at childbirth', in the main effects model showed that the average risk of death to infants preceded by a dead sibling was considerably higher than the average risk of death to infants preceded by surviving sibling. This was true whatever the mother's age at childbirth. Similar patterns of estimates of the joint variable, 'survival status of the preceding child and birth order', emerged in the main effects model. This further confirmed that deaths of successive children in a family were correlated. As a consequence, a woman who had lost a previous child was at higher risk of losing a subsequent child. Clustering of child deaths was also evident in a study in rural Punjab, India, where the probability of a child's dying was significantly increased if the child had a sibling who had died in childhood (Dasgupta, 1990).

The relationship of the joint variable describing 'survival status of the preceding child and length of the preceding birth interval', with the mortality risk of the index child was found to be similar in both the 1976 Nepal Fertility Survey and the 1986 Nepal Fertility and Family Planning Survey. The estimate based on the main effects model showed that the risk of death to children born less than 19 months after the birth of the surviving sibling was considerably higher than to similar children preceded by a dead sibling. This confirmed the view that the competition mechanism was influencing child survival in such a situation. As the length of birth interval increases, the child does not need to compete so hard with the preceding child for the mother's care and resources. The higher risk of death to children born 19 months or more after a preceding child which was no longer surviving suggested a different mechanism as compared to a surviving sibling. In this case the mechanism could be the correlation between the mortality of members of one family as a consequence of the repetitive biological and mother's behavioural factors which are likely to be common to all children born to the same mother. These results clearly indicate that competition between siblings is not the only mechanism which explains child survival operating through the length of birth interval.

This study has explored why infant and child mortality in certain parts of the country are higher than in other parts. The analysis showed that the socio-economic, health-related and demographic characteristics of the population between the high and low mortality regions were significantly different. Among the socio-economic and health-related variables considered in the multivariate analysis only two variables, 'possessions of cows by the households', and 'ever use of contraception' were statistically associated with lower mortality in both types of region. Among the demographic variables, births 37 months or more after the birth of the preceding child and second and third order births were associated with lower mortality. On the other hand, children born to mothers under 24 years of age and mother's previous experience of child loss were associated with an elevated risk of death in both regions of residence. However, the effect of second and third order births in the low mortality regions was not statistically significant. Among the independent variables considered in the model, the difference in infant mortality between the regions of residence due to the difference in the coefficients (structural relationship) corresponding to working mothers and children born 37 months or more after the birth of the preceding child was statistically significant.

The findings for child mortality to some extent are different than for infant mortality. In the multivariate analysis the socio-economic and health factors that were statistically significant in determining the levels of child mortality in the high mortality region were not statistically significant in the low mortality regions, and vice versa. For example, the effects of father's education, number of cows possessed by the households and Indo-Aryan ethnicity were significantly associated with lower child mortality in the low mortality regions. In contrast, ever use of contraception, Nepali languages spoken at home and *terai* ecological belt were significantly associated with lower child mortality in the high mortality region. Furthermore, working mother as a significant factor leading to an increased risk of death among children was evident only in the high mortality region. Differences in child mortality between the regions of residence due to differences in the coefficients corresponding only to father's education, Indo-Aryan ethnicity, Nepali language spoken at home, and second and third order births were statistically significant.

The favourable child survival prospects due to father's education in the low mortality regions could be the result of a difference in the levels of earning among educated fathers between the regions of residence, as income earning opportunities in the low mortality regions were more likely to be better because the major portion of the sub-sample of this region was from urban areas. The favourable child survival prospects among those born to the Indo-Aryan ethnicity group in the low mortality regions could be due to the differential socio-cultural practices, life styles, perceptions, and beliefs of these groups of people compared with the Tibeto-Mongoloid groups. The favourable effect of the Nepali language use at home in lowering child mortality was observed only in the high mortality region. This could be because messages regarding prevention and treatment of diseases, sanitation, nutrition, and other health information disseminated through the mass media (radio) are in the Nepali language, the benefits of which would not have reached to those who did not understand the language. The effect of this variable in the low mortality regions was observed to be insignificant because the majority of the people in the low mortality regions were able to understand the language and could have benefited from the messages.

The decomposition of the results showed that much of the inter-regional variation in infant and child mortality in this study was explained by the values of explanatory variables rather than by structural relationships between variables. The analysis also suggests that the major reason for the persistence of higher infant and child mortality in the high mortality region was the high proportion of preceding child loss, the small proportion of women with second or third order births, and the low proportion of births with intervals of 37 months or longer. In addition, the low level of average education among mothers, the small proportions of those who had ever used contraception and the small proportions of those who spoke Nepali at home also contributed to the higher level of infant and child mortality in the high mortality region.

The differences in child mortality due to the differences in the coefficients (structural relationships) corresponding to father's education, Indo-Aryan ethnicity, Nepali language spoken at home and second and third order births are statistically significant, and reveal a strong cultural component to these structural relationships. The analysis of child mortality indicates strongly that the rather large structural differences are associated with cultural characteristics of the population of the two regions. The analysis also suggests that the implied structural differences in determination of child mortality are cultural in nature to a much greater extent than was the case in the analysis of infant mortality.

The preliminary analysis showed that the infant mortality rate in Nepal for the periods 1966-75 and 1976-85 declined from 145 to 89 per 1000 live births. Child mortality for the periods 1961-70 and 1971-80 declined from 110 to 67 per 1000 children. During the same span of time the proportion of parents with some education increased. The proportion of those who had ever used contraception increased, while the proportion of women working outside the home declined. In addition, the proportion of children who lost their previous sibling declined, and the proportion of children born to mothers under 24 years of age increased. In this context, this thesis has explored the role of change in the socio-economic, health and demographic factors in explaining the decline in infant and child mortality that took place between the 1960s and the 1980s in Nepal.

The multivariate analysis showed that demographic factors explained more of the infant mortality differentials than did the socio-economic and health factors considered in the study. However, it was also evident that the role of socio-economic and health-related factors was much more important in explaining the decline in infant mortality between 1966-75 and 1976-85 as compared with the role of demographic factors. The results of the child mortality analysis also suggested this. Even so, the assessment of the role of change in the value of the variables in explaining the probability of infant mortality suggested that the change in the value of explanatory variables accounted for no more than 28 per cent of the total decline in infant mortality that took place during the periods 1966-75 and 1976-85. Of the 28 per cent explained, the major portion was captured by the increase in the ever use of contraception, urban residence, father's education and the decline in the proportions of preceding siblings who died at age one.

The similar analysis for child mortality suggested that the change in the values of the explanatory variables considered in this study accounted 23 per cent of the total child mortality decline that took place during the periods 1961-70 and 1971-80. The independent variables that explained much of the decline in child mortality were: urban residence, ever use of contraception, father's education and mother's education. It is important to note here that the effect of ever use of contraception on child mortality from both the 1976 Nepal Fertility Survey and the 1986 Nepal Fertility and Family Planning

Survey was not statistically significant in the main effects model after controlling for the influence of other factors considered in the model. However, the change in the value of ever use of contraception for the periods 1961-70 and 1971-80 showed that this variable alone explained 10 per cent of the total decline in child mortality. This suggests that use of contraception, considered to represent use of health services, was not able to show the cross-sectional differences in child mortality, but did form a considerable portion of the explanation for the decline in child mortality experienced in the country. In addition, as in the case of infant mortality, the role of socio-economic and health-related factors in explaining the declining child mortality was found to be much greater than the role of demographic factors. These results clearly establish that those factors which are significantly associated with lower mortality in a cross-sectional analysis do not necessarily contribute to declining mortality, and vice versa.

The average of the predicted probabilities for each individual were compared with the observed probabilities of death used to examine the role of changes in the values of variables versus the role of changes in the structural relationship in explaining the decline in infant and child mortality during the period covered by this study. This also produced interesting findings. The analysis showed that the decline in infant mortality explained by the change in the value of variables (including those not considered in this study) ranged between 57 and 73 per cent as against the 27 and 43 per cent of the total decline in infant mortality explained by the change in the structural relationship. Similar results were found in a study in Malaysia (DaVanzo and Habicht, 1986).

The corresponding figures for child mortality were 49 to 77 per cent as against 23 to 51 per cent respectively. These results provided further support for the contention that much of the decline in infant and child mortality that took place in Nepal between the 1960s and 1980s was due to changes in the values of variables rather than to changes in the structural relationship between them. In addition, the assessment also suggested that the explanation for most of the mortality decline due to changes in the structural relationship lay in the influence of factors not considered in this study, and was captured by the significant difference in the intercept terms between the two periods of time.

In summary, the rapid succession of births to women in Nepal was found to be one of the factors working against better child survival prospects. Of the socio-economic and heath-related factors considered in this study, ever use of contraception emerged as an important factor in influencing infant mortality. In addition, ever use of contraception was found to be important in explaining both the infant and child mortality decline experienced in the country over the two periods considered in this study. The analysis, however, failed to show that mother's education and ever use of contraception were operating through the maternal factors such as mother's age at childbirth and birth spacing, in exerting their influence on infant and child mortality in Nepal. Finally, this study showed that socio-economic and health-related factors were more important than demographic factors in explaining the decline in infant and child mortality.

The findings of this thesis have various policy implications for improving child survival prospects in Nepal. Since pre-marital and ex-nuptial births are almost totally absent in Nepal because of cultural and religious prohibitions, there seems little room to doubt that an increase in age at marriage would automatically ensure a reduction in births among women at younger ages. This in turn could be expected to reduce the rapid succession of births among younger women, thus contributing to improved child survival prospects.

The adverse influence of the short birth interval found in this study clearly calls for intervention to increase the length of interval between births. It was noted in this study that the Government-supported family planning services have been functioning since 1968 with two broad components: family planning and maternal child health care delivery. It was also noted that the maternal and child health component of the programme aimed to provide health services to mothers and children to build relationship for the promotion of family planning among clients. There is clear evidence in this study that the effect of ever use of contraception was significantly associated with a lower risk of infant death. In addition, it was also evident in this study that the decline in infant and child mortality explained by ever use of contraception was not a result of birth spacing. This suggests that there could be considerable benefit from an increase in number of contraception users, especially temporary method acceptors, in the country. This intervention can be aimed at improving mother's health status by achieving wider spacing between births, and the overall child survival situation, so intervention can ultimately contribute considerably to reducing the persistent high fertility and population growth rate. This is in line with future targets set by the government of Nepal in its plan documents. Due emphasis should be accorded in the policies of the government to improving the overall socio-economic situation of the population, particularly health knowledge and awareness among women, a better working environment for women and for increasing urbanization, all of which can be expected to produce a better quality of life and contribute to better child survival prospects.

One observation in this study was that Nepali language spoken at home was significantly associated with lower infant and child mortality in the high mortality region. This was attributed to the various health and educational messages using the Nepali language which are served through mass media such as radio and are beneficial only to those who understood the language. Although Nepali language is considered as the major *lingua franca*, a sizeable proportion of the rural (41 per cent) and urban (48 per cent) populations in the 1981 Census reported languages other than Nepali as their mother tongue (CBS, 1987a). The dissemination of knowledge regarding disease treatment, health education, nutrition and sanitation using other major languages spoken at different parts of the country could be expected to benefit larger sections of the population. This in turn could be expected to improve the knowledge, and contribute to the survival chances of infants and children. The policies regarding dissemination of health knowledge and welfare targeted at rural people in the country, if adopted vigorously, could be expected to improve the health, well-being and survival situation of their children even if different programmes cannot reach them at the door.

The present study has fostered a more complete understanding of the determinants and differentials of infant and child mortality in Nepal. However, there are still a number of unexplained associations and issues generated by this study. For example, determinants of child survival such as urban-rural place of residence and ethnicity have identified population groups that are without doubt at higher risk and should receive prime focus. In contrast, the significant influence of urban-rural place of residence and ethnicity on infant and child mortality, after controlling for the effects of other factors in the multivariate analysis, indicates that some of the important determinants of infant and child mortality have been left out of this study. This is because urban-rural place of residence and ethnicity do not determine infant and child mortality differentials in their own right. Rather, they are proxies for different factors such as access to health services, living conditions, economic opportunities, sanitation, lifestyles, beliefs, norms and culture.

This study has shown that the decline in infant and child mortality that took place in the country is largely due to changes in the values of socio-economic variables as well as to changes in the structural relationship between them. However, the explanation for most of the mortality decline due to changes in the structure lies in the influence of factors that were not considered in this study.

The influence of ever use of contraception on infant and child mortality was not through demographic factors, but the reason that contraception use is influencing infant mortality in Nepal is largely unexplained in this study. The hypothesis was that the favourable influence of use of contraception on infant and child mortality was due to the beneficial maternal and child health care services delivered in conjunction with family planning services. However, how health-related factor operates through health-related factors are also largely unexplained and needs further investigation. If the dominant causal influence flows from health care towards contraception then maternal and child health care services delivered in conjunction with family planning services can be expected to improve child survival prospects and maternal health status (Potter, 1988). This flow of influence, in turn could reduce fertility, thus contributing to a reduction in the persistent high population growth in Nepal, one of the long term targets set by the Government of Nepal in its development plan document (NPC, 1992).

The influence of the length of birth interval was the major demographic determinant of both infant and child mortality. However, the magnitude of the exaggeration in the effects of this variable on infant and child mortality, in the absence of information on birth weight and due to the limitation of the information on the length of breastfeeding, miscarriage and still births to the selected order of birth, are largely unexplored in this study. In addition, many of the proximate determinants described in the Mosley and Chen (1984) framework, except for maternal factors, could not be analysed. This suggests that there is wide scope for further research on infant and child mortality in Nepal in order to further explain the observed differentials. The 1991 Nepal Fertility, Family Planning and Health Survey, which have covered wide range of health-related factor, could partly serve to achieve this objective.

Appendix table 1.1 Selected socio-economic and health indicators: Nepal

Indicators		Ref period 1961	Ref period 1981	Sources
Population	Total	9412996	15022839	
	Male	4636033	7695336	
	Female	4776963	7327503	CBS, (1987a: 42)
Sex ratio at birth		97.1	105.0	CBS, (1987a :42)
Population density / sq km.		64	102	CBS, (1987a: 15)
Population density / hectare		3.8	6.1	
Proportion of population under 5 years		14.2*	15.4	Calculation based on: (CBS, 1987a: 3) *(CBS,1977a: 54)
Dependency ratio	0-14	73.0	78.1	CBS, (1987a: 12)
	65 plus	10.1	10.8	
Proportion never married	Male	28.5	35.1	CBS, (1987a: 98)
	Female	15.1	23.3	
Crude birth rate (CBR)/1000		42	30	CBS, (1987a: 260)
Crude death rate (CDR)/1000		27	14	
Life expectancy at birth (years)	Male	34.9	55.0	CBS, (1987a: 260)
	Female	38.5	51.2	
Total fertility rate		5.1*	6.3	*(CBS, 1977a: 113) (CBS, 1987a: 266)
(%) of urban population		3.6	6.3	CBS, (1987a: 180)
Literacy rate	Total	8.9	23.5	CBS, (1987a: 128)
	Male	16.3	34.9	
	Female	1.8	11.5	
Labour force	Agriculture	93.8	90.4	CBS, (1987a: 209)
Population per hospital bed		11840*	5608	Calculation based on Total population in Table 1.1 and: *(CBS 1977a: 168) (CBS, 1987: 113)
Population per doctor		75303*	26731	
Health expenditure in total budget (%)		4.7	4.0	(HMG, 1982a; 1982)

Appendix Table 3.1 Birth distribution by mother's age at childbirth: 1976 NFFS and 1986 NFFS

Mother's age at childbirth (years)	Number of children born 1	2	3	4	5	6 +	Total
			1976 NFFS[a/]				
Under 19	219	65	23	1			308
	(71.1)	(21.1)	(7.5)	(0.3)			(100)
19-23	(291	296	203	33	20	6	882
	(33.0)	33.6)	23.0)	(7.5)	(2.3)	(0.7)	(100)
24-33	89	189	287	311	252	369	1497
	(5.9)	(12.6)	(19.2)	(20.8)	(16.8)	(24.6)	(100)
34 plus	9	24	47	102	104	574	860
	(1.0)	(2.8)	(5.5)	(11.9)	(12.1)	(66.7)	(100)
			1986 NFFS[b/]				
Under 19	231	109	28	2			370
	(62.4)	(29.5)	(7.6)	(0.5)			(100)
19-23	186	276	211	87	26	14	800
	(23.3)	(34.5)	(26.4)	(10.9)	(3.3)	(1.8)	(100)
24-33	77	173	338	332	252	304	1476
	(5.2)	(11.7)	(22.9)	(22.5)	(17.1)	(20.6)	(100)
34 plus	3	17	31	59	95	325	561
	(0.5)	(3.0)	(5.5)	(10.5)	(16.9)	(63.5)	(100)

Notes: Figures in parentheses indicate percentage.
Numbers indicate mothers who have had at least one child during the period 1966-75 from the 1976 NFFS and 1976-85 from the 1986 NFFS.

Sources [a/]1976 NFFS and [b/]1986 NFFS data tapes.

Appendix Table 3.2 Average length of preceding birth interval by mother's age at childbirth: 1976 NFFS and 1986 NFFS, Nepal

Mother's age at childbirth (years)	Average length of preceding birth interval	
	1976 NFFS[a/]	1986 NFFS[b/]
< 19	22.3	25.6
	(303)	(450)
20-23	28.5	30.7
	(1904)	(1936)
24-33	34.3	36.1
	(3742)	(3636)
34 +	42.1	41.1
	(1330)	(1054)
Overall average	33.7	34.7
	(7279)	(7076)

Notes: The analysis is based on the cohorts of children born during the periods [a/]1966-75 and [b/]1976-1985.

Analysis in this table considers only second and higher order births.

Figures in parentheses indicate number of births.

Sources [a/] 1976 NFFS and [b/]1986 NFFS data tape.

Appendix Table 4.1 Mean length of breastfeeding by mother's education and current age: 1976 NFFS and 1986 NFFS, Nepal

Mother's education	Mean	Number of mothers	SE	
	1976 NFFS [a]			
None	25.0	1814	0.385	*
Some	22.6	149	1.128	
Current age of mother				
<24	17.1	99	1.217	A1A2 **
24-33	20.7	698	0.522	A2A3 **
3 plus	28	1166	0.500	A1A3 **
	1986 NFFS [b]			
None	26.7	2795	0.297	**
Some	23.3	451	0.626	
Current age of mother				
< 24 (A1)	18.2	228	0.884	A1A2 **
24-33 (A2)	23.6	1537	0.345	A2A3 **
33 plus (A3)	30.1	1454	0.431	A1A3 **

Notes: NS indicate not significant, * and ** indicate significant at the 5 per cent and 1 per cent level of normal distribution test.
Calculations are based on last child.
Those who were not breast-fed at all are excluded.
SE indicates standard errors.
Analysis is based on the cohorts born between the periods [a]1966-1975 and [b]1976-1985
Sources: [a]1976 NFFS and [b]1986 NFFS data tape.

Appendix Table 4.2 Postpartum amenorrhoea by maternal education and age at childbirths: 1986 NFFS, Nepal

Mother's education		Maternal age at childbirth < 24	24-33	34 Plus	All
None					
	Mean	9.4	11.5	12.4	11.0
	Standard error	0.230	0.246	0.386	0.149
	Number of mothers	826	1166	465	2801
Some					
	Mean	8.5	9.9	--	9.2
	Standard error	0.457	0.667	--	0.382
	Number of mothers	186	138	--	344
	t-value	1.76*	2.25**	--	4.39***

Note: '--' indicates less than 20 cases.
Source: 1986 NFFS data tape.

Appendix Table 4.3 Percentage distribution of ever users of contraceptives by maternal age at survey and maternal education: 1976 NFFS and 1986 NFFS, Nepal

Maternal education	< 24	24-33	34 Plus	All
	Maternal age at survey, 1976 NFFS [a]			
None	1.5 (615)	3.6 (1460)	6.4 (1250	4.3 (3325)
Some	10.8 (74)	25.7 (105)	44.2 (43)	24.3 (222)
	Maternal age at survey,1986 NFFS [b]			
Maternal education	< 24	24-33	34 Plus	All
None	6.0 (468)	22.5 (1256)	22.7 (1121)	19.8 (2845)
Some	26.1 (92)	60.7 (196)	63.8 (80)	52.7 (368)

Notes: The analysis is based on cohorts of children born between the periods [a]1966-1975 and [b]1976-1985.
Figures in parentheses indicate number of mothers.
Sources: [a]1976 NFFS and [b] 1986 NFFS data tape.

Appendix Table 4.4 Percentage distribution of mothers by their level of education and selected socio-economic indicators: 1986 NFFS, Nepal

Mother's years of schooling	Socio-economic indicators (percentage)				Number of mothers
	Access to electricity	Access to toilet	Better material of roof	Better material of wall	
None	11	13	14	8	4367
1-5	35	36	28	29	272
6-9	53	65	44	32	161
9 plus	89	88	71	66	145

Source: 1986 NFFS data tape.

Appendix Table 4.5 Mean length of birth interval (months) by current age of mother, status of temporary methods of contraceptions use and mother's education: 1986 NFFS, Nepal

Status of temporary method of contraception	< 24		24-33		34 plus		All	
	Maternal education							
	N	S	N	S	N	S	N	S
Never used	28.6	29.0	32.9	32.6	39.3	38.9	32.6	
	(316)	(46)	(2324)	(155)	(2371)	(70)	(433)	
Ever used	21.4	24.2	31.9	33.9	34.0	32.4	32.2	
	(14)	(19)	(198)	(93)	(221)	(59)	(171)	

Notes: Figures in parentheses indicate number of children.
Results are based on birth cohorts during 1976-85.
N= no education and S= some education.
Sources: 1986 NFFS Data tape.

Appendix Table 4.6 Logit linear model of the joint effect of mother's education and her work status on infant mortality: 1976 NFFS Nepal

Mother's education and her work status	Gross effect odds ratios	LRX^2	P	Net effect odds ratios	LRX^2	P
No education						
Working	1.884	19.8	0.001	1.874	12.7	0.01
Not working	1.446			1.458		
Some education						
Working	0.333			0.291		
Not working	1.102			1.259		
n=9734	Model LRX^2=34.18	df=31		p=.319	overall odds=0.088	

Notes: The analysis is based on the cohort born during the periods 1966-75.
The effect of the joint variable is net of father's education, contraceptives use, and place of residence.
The joint variable has 3 degrees of freedom.
Source: 1976 NFFS data tape.

Appendix Table 4.7 Logit linear model of the joint effect of mother's work status and number of cows possessed by household on child mortality: 1986 NFFS Nepal.

Mother's work status and number of cows possessed by household	Gross effect odds ratios	LRX^2	P	Net effect odds ratios	LRX^2	P
Working mothers						
No cow	2.404	36.5	0.001	2.468	34.3	0.001
One or more cows	0.715			0.614		
Not working mothers						
No cow	0.762			0.922		
One or more cows	0.763			0.715		
n=6480	Model LRX^2=193.53	df=176		p=.174	overall odds=0.053	

Notes: The analysis is based on the cohort born during the periods 1971-85.
The effect of the joint variable is net of mothers' education, father's education, contraceptives use, land-holding and place of residence / health.
The joint variable has 3 degrees of freedom.
Due to the small number of cases the 'households which have 1-3 cows or buffalo' and 'households which have 3 or more than 3 cows and buffalo' are collapsed into one category to assess the two-factor interaction effects on child mortality.
Source: 1986 NFFS data tape.

Appendix Table 4.8 Logit linear model of the joint effect of size of land holding and number of cows possessed by household on child mortality: 1986 NFFS Nepal.

Mother's work status and number of cows possessed by household	Gross effect odds ratios	LRX^2	P	Net effect odds ratios	LRX^2	P
<u>No land</u>		7.0	0.10		14.6	0.01
No	1.250			1.414		
1+ cows	0.916			0.767		
<u>Land holding</u>						
No cow	1.013			1.156		
1+ cows	0.863			0.798		
n=6480	Model LRX^2=148.25	df=123		p=..060	overall odds=.0598	

Notes: The analysis is based on cohort born during the periods 1971-85.
The effect of the joint variable is net of mothers' education, father's education, mother's work status, contraceptives use and place of residence/health care.
The joint variable has 3 degrees of freedom.
Source: 1986 NFFS data tape.

Appendix Table 4.9 Results of logit-model of the joint effects of mother's education and father's education on child mortality: 1986 NFFS, Nepal

	Univariate Model				Multivariate model			
Variables	odds ratios	LRX^2	df	P	odds ratios	LRX^2	df	P
MNE, FNE	1.622	30.4	2	0.001	1.365	14.99	2	0.001
MNE, FED	1.420				1.459			
MED, FED	0.434				0.502			
n=6480	Model LRX^2=195.07		df=180		p=.210			

Notes: MED=Mothers with some education, FED=Fathers with some education, MNE=Mothers with no education, FNE=Fathers with no education.
Reference model is Table 4.8.
MED, FNE effects is not considered in the model because of the small number of cases.
Sources: 1986 NFFS data tapes.

Appendix Table 5.1 Results showing the preference for sons over daughters and vice versa: 1976 NFS and 1986 NFFS , Nepal.

A.Results that do not support parental care in favour of sons over daughters	Child mortality rate /1000	Sources Tables
1. Higher mortality rate to sons preceded by a dead brother than to daughters preceded by a dead brother	119 as against 78	5.9
2. Higher mortality rate to sons preceded by a dead brother as against sons preceded by a dead sister	119 as against 68	5.9
3. Higher mortality rate to sons preceded by a surviving brother than to daughters preceded by a surviving sister	113 as against 96	5.8
B.Results that support parental care in favour of sons over daughters		
1. Lower mortality rate to sons preceded by a dead brother than to daughter preceded by a dead sister	132 as against 171 119 as against 128	5.8 5.9
2. Lower mortality rate to sons preceded by a dead brother than to daughters preceded by a dead brother	132 as against 138	5.8
3. Lower mortality rate to sons preceded by a dead brother than to sons preceded by a dead sister	132 as against 159	5.8
4. Lower mortality rate to sons preceded by a dead sister than to daughters preceded by a dead sister	159 as against 171 68 as against 128	5.8 5.9
5 Lower mortality rate to sons preceded by a surviving sister than to daughters preceded by a surviving sister	89 as against 96 52 as against 73	5.8 5.9
6. Lower mortality rate to sons preceded by a surviving sister than to daughters preceded by a surviving brother	89 as against 103 52 as against 66	5.8 5.9
7. Lower mortality rate to sons preceded by a brother than to daughters preceded by a surviving sister	61 as against 73	5.9
8. Higher mortality rate to sons preceded by a a surviving brothers than to sons preceded by a surviving sister	113 as against 89 61 as against 52	5.8 5.9

Appendix Table 6.1: Infant mortality rates by districts: 1986 NFFS, Nepal

Name of districts	Number died	Exposed births	IMR/1000
	Districts with high infant mortality rates (HMR)		
Bara	16	192	83
Tanahu*	22	262	83
Baitadi*	22	253	86
Panchthar*	22	231	95
Kavre*	19	197	96
Sankhuwasawa**	22	219	100
Jhapa	27	252	107
Kapilbastu	22	201	109
Gulmi*	39	334	116
Dhanusha	36	295	122
Kathmandu*	21	165	127
Mahottari	36	259	139
Rupendehi	26	187	139
Dhading*	35	250	140
Sunsari	32	226	141
Sarlahi	55	384	143
Bajhang**	34	177	192
Sub-total, HMR	486	4084	119
	Districts with low infant mortality rates (LMR)		
Saptari	6	161	37
Dailekh*	8	177	45
Sindhupalchok**	13	259	50
Chitwan	9	165	54
Baglung*	15	220	68
Pyuthan*	16	223	71
Syanja*	21	275	76
Udayapur*	19	248	76
Ramechhap*	20	259	77
Bardia	31	401	77
All Urban	129	1829	70
Sub-total, LMR	287	4217	68
Grand total	773	8301	93

Notes: * and ** indicate hills and mountains districts.
LMR and HMR are respectively defined as areas experiencing below 80 and, 80 and above infant deaths per 1000 live births.
The figures are weighted.
HMR districts are all rural and LMR districts also constitute urban areas.

Source: 1986 NFFS data tape.

REFERENCES

AABY, P.; J. BUKH; I. M. LISSE and A. J. SMITH (1984) 'Overcrowding and intensive exposure as determinants of measles mortality', *American Journal of Epidemiology*, Vol. 120, No. 1, pp. 49-63.

ACHARYA, B. R. (1986) 'Housing and the law: prospects for realistic regulation in Nepal', *The Journal of Development and Administrative Studies*, Kathmandu: Centre for Economic Development and Administration (CEDA), Tribhuvan University, Vol. 6; 7; 8, pp. 65-83.

ACHARYA, M. and L. BENNETT (1981) *The Rural Women of Nepal: an Aggregate Analysis and Summary of 8 Village Studies, The Status of Women in Nepal*, Kathmandu: Centre for Economic Development and Administration (CEDA), Tribhuvan University. Vol. 2, Part 9.

AHMAD, B. O.; I. W. EBERSTEIN and D. F. SLY (1991) 'Proximate determinants of child mortality in Liberia', *Journal of Biosocial Science*, Vol. 23, pp. 313-326.

AMIN, R.; A. G. MARIAM and R. FARUQUEE (1986) 'Infant and child mortality in Bangladesh, 1959-1976', *Demography India*, Vol. 15, No. 1, pp. 34-45.

ANNIS, S. (1981) 'Physical access and utilization of health services in rural Guatemala' *Social Science and Medicine*, Vol. 15D, pp. 515-523.

ANTHONY, C. R. (1979) *Health, Population, and Income: A Theoretical and Empirical Investigation Using Survey Data From Rural Nepal*, Ph.D. dissertation, University of Pennsylvania.

ARRIAGA, E. E. and F. HOBBS (1982) 'Infant mortality differentials in selected East and South Asian countries', pp. 157-176, in *Mortality in South and East Asia: a review of changing trends and, patterns, 1950-75*, Report and selected papers presented at joint WHO/ESCAP meeting held in Manila: 1-5 Dec. 1980, WHO.

ARRIAGA, E. E. and K. DAVIS (1969) 'The pattern of mortality change in Latin America', *Demography*, Vol. 6, pp. 223-242.

BANDA, K. A.; G. H. LESETEDI and G. N. SHASTRI (1990) 'Socio-economic differentials of fertility and infant mortality in Lesotho', *Child Survival Research Note*, No. 28CS, Canberra: The Australian National University.

BANISTER, J. and S. THAPA (1981) *The Population Dynamics of Nepal*, Papers of the East West Population Institution, No. 78, Honolulu: East-West Population Institute.

BEHM, H. (1980) 'Socio-economic determinants of mortality in Latin America' *Population Bulletin of the United Nations*, No. 13, pp. 1-15.

BEHM, H. (1983) 'Final report on the research project on infant and childhood mortality in the Third World', pp. 9-33, in *Infant and Childhood Mortality in the Third World*, Paris: CICRED.

BEHM, H. (1991) *Child Mortality in Developing Countries: Socio-Economic Differentials, Trends and Implications*, New York: United Nations.

BEHM, H. and D. PRIMANTE, (1978) *'Mortalidad en los Primeros Anos de Vida en Paises de la America Latina*, Notas de Poblacion No. 16, ano VI, CELADE.

BEHM, H. and J. VALLIN (1980) 'Mortality differentials among human groups', pp. 11-37, in *Proceedings of a IUSSP seminar at Fiuggi*, Liege: Ordina Editions.

BENJAMIN, B. (1965) *Social and Economic Factors Affecting Mortality*, The Hague: Paris.

BERREBI, Z. M. and JACQUES S. (1981) 'Health and development: socio-economic determinants of mortality structure', *Social Science and Medicine*, Vol. 15C, pp. 31-39.

BHARDWAJ, S. M. and B. K. PAUL (1986) 'Medical pluralism and infant mortality in a rural area of Bangladesh', *Social Science and Medicine*, Vol. 23, No. 10, pp. 1003-1010.

BHUIYA, A. and K. STREATFIELD (1992) 'A hazard model analysis of covariates of childhood mortality in Matlab, Bangladesh', *Journal of Biosocial Science*, Vol. 24, pp. 447-462.

BHUIYA, A. U. (1989) *Factors Affecting Child Survival in Matlab, Bangladesh*, Ph. D. Thesis, Department of Demography, Australian National University, Canberra.

BLUSTAIN, H. S. (1976) 'Levels of medicine in a central Nepali village', *Journal of the Institute of Nepal and Asian Studies, Contribution to Nepalese Studies*, Research Centre for Nepal and Asian Studies, Vol. 3, pp. 83-105.

BOERMA, T. and G. T. BICEGO (1992) 'Preceding birth intervals and child survival: searching for pathways of influence', *Studies in Family Planning*, Vol. 23, No. 4, pp. 243-256.

BONGAARTS, J and R. G. POTTER (1983) *Fertility, Biology and Behaviour; an Analysis of the Proximate Determinants*, New York: Academic Press.

BOURNE, K. L. and G. M. WALKER (1991) 'The differential effect of mother's education on mortality of boys and girls in India', *Population Studies*, Vol. 45, pp. 203-219.

BRASS, W. (1964) 'Use of census and survey data for the estimation of vital rates', *Paper prepared for the African Seminar on Vital Statistics*, Addis Ababa: United Nations Economic Commission for Africa

BRASS, W. (1964a) 'Use of census and survey data for the estimation of vital rates', in *Final Report of the African Seminar on Vital Statistics*, United Nations Economic Commission for Africa, Addis Ababa, Statistical Paper Series M. No. 41, pp. 11-12.

BRASS, W. (1980) 'Screening procedures for detecting errors in maternity history data', pp. 30-49, in *Regional Workshop on Techniques of Analysis of World Fertility Survey data*, WFS Occasional Papers, No. 22, London: WFS, Voorburg: ISI.

BRASS, W. and A. J. COALE (1968) 'Methods of analysis and estimations', pp. 88-167, in *The Demography of Tropical Africa*, Ed., W. Brass, New Jersey: Princeton University Press.

BUCHANAN, R. (1975) 'Breast feeding - aid to infant health and fertility control', *Population Reports*, Series J, No. 4, pp. 49-67.

CALDWELL, J. C. (1976) 'Towards a restatement of demographic transition theory', *Population and development Review*, Vol. 2, No. 1, pp. 321-366

CALDWELL, J. C. (1979) 'Education as a factor in mortality decline, an examination of Nigerian data', *Population Studies*, Vol. 33, No. 3, pp. 395-413.

CALDWELL, J. C. (1981) 'Maternal education as a factor in child mortality', *World Health Forum*, Vol. 2, No. 1, pp. 75-78.

CALDWELL, J. C. and L. T. RUZICKA (1985) 'Determinants of mortality change in South Asia', pp. 333-357, in *Dynamics of Population and Family Welfare*, Ed., K. Srinivasan and S. Mukerji, Bombay: Himalayan Publishing House.

CALDWELL, J. C. and P. McDONALD (1981) 'Influence of maternal education on infant and child mortality: levels and causes', *Proceedings of The International Conference*, IUSSP, Manila, Vol. 2, pp. 79-96.

CALDWELL, J. C.; P. H, REDDY and P. CALDWELL (1983) 'The social component of mortality decline: an investigation in South India employing alternative methodologies', *Population Studies*, Vol. 37, pp. 185-205.

CANTRELLE, P. and H. LERIDON (1971) 'Breast feeding, mortality in childhood and fertility in a rural zone of Senegal', *Population Studies*, Vol. 25, pp. 505-533.

CENTRAL BUREAU OF STATISTICS (CBS) (1974) *Population Projection For Nepal*, 1971-86, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1975) *Population Census 1971*, Vol. I, Kathmandu: Central Bureau of Statistics, His Majesty Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1976) *The Demographic Sample Survey of Nepal, 1974-75, Survey Methods and Findings*, Kathmandu: Central Bureau of Statistics, His Majesty Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1977) *The Demographic Sample Survey of Nepal, Second Year Survey 1976*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1977a) *The Analysis of the Population Statistics of Nepal*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1978) *The Demographic Sample Survey of Nepal, Third Year Survey, 1977-78*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1982) *Statistical Pocket Book*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1984) *Population Census 1981*, Vol. II, Kathmandu: Central Bureau of Statistics, His Majesty Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1984a) 'Social Characteristics Tables', *Population Census, 1981*, Central Bureau of Statistics, His Majesty's Government of Nepal, Vol. I, Part IV.

CENTRAL BUREAU OF STATISTICS (CBS) (1984b) 'Social Characteristics Tables', *Population Census, 1981*, Central Bureau of Statistics, His Majesty's Government of Nepal, Vol. I, Part III.

CENTRAL BUREAU OF STATISTICS (CBS) (1984c) 'Urban Areas Tables', *Population Census, 1981*, Central Bureau of Statistics, His Majesty's Government of Nepal, Vol. III.

CENTRAL BUREAU OF STATISTICS (CBS) (1984d) 'Economic Characteristics Tables', *Population Census, 1981*, Central Bureau of Statistics, His Majesty's Government of Nepal, Vol. I, Part V.

CENTRAL BUREAU OF STATISTICS (CBS) (1984e) *Statistical Pocket Book*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1985) *Inter-Censal Changes of Some Key Census Variables, Nepal 1952/54-1981*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1987) *Statistical Year Book*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1987a) *Population Monograph of Nepal*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1987b) *Demographic Sample Survey, 1986/87, First Report*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1989) *Statistical Year Book*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1990) *Nepal in Figure*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1991) *Statistical Year Book*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CENTRAL BUREAU OF STATISTICS (CBS) (1993) *Population Census-1991*, Kathmandu: Central Bureau of Statistics, His Majesty's Government of Nepal.

CHANDRAN, P. E. (1989) ' Biological influence of infant death on fertility', *Journal of Biosocial Science*, Vol. 21, pp. 217-221.

CHEN, L. C.; M. RAHMAN; S. D'Souza; J. CHAKRABORTY; A. M. SARDAR and M. YUNUS (1983) 'Mortality impact of an MCH-FP programme in Matlab, Bangladesh', *Studies in Family Planning*, Vol. 14, No. 8/9, pp. 199-209.

CHERNICHOVSKY, D. and O. A. MEESOOK (1986) 'Utilization of health services in Indonesia', *Social Science and Medicine*, Vol. 23, No. 6, pp. 611-620.

CHIDAMBARAM, V. C. and A. SATHAR (1984) 'Age and date reporting' *WFS Comparative Studies*, No. 5, London: WFS, Voorburg: ISI.

CHIDAMBARAM, V. C., J. G. CLELAND and V. VERMA (1980) 'Some Aspects of WFS Data Quality, a Preliminary Assessment', *WFS Comparative Studies*, No. 16, London: WFS, Voorburg: ISI.

CHIDAMBARAM, V. C.; John McDONALD and Michael D. BRACHER (1985) 'Infant and child mortality in the developing world: information from the World Fertility Survey', *International Family Planning Perspectives*, Vol. 11, No. 1, pp. 17-25.

CLELAND, J. and I. H. SHAH (1988) 'High Fertility in Bangladesh, Nepal and Pakistan, Motives vs Means', Paper presented at IUSSP seminar on *Fertility Transition in Asia: Diversity and Change*, Chulalongkorn University, Thailand, 28-31 March.

CLELAND, J. G. (1989) *Maternal education and child survival, further evidence and explanations*, Paper presented at Health Transition Workshop, Canberra, 15-19 May.

CLELAND, J. G. and J. K. Van GINNEKEN (1989) 'Maternal education and child survival in developing countries: the search for pathways', pp. 79-99, in *Selected Readings in the Cultural, Social and Behavioural determinants of Health*, Ed., J. C. Caldwell and G. Santow, Health Transition Series, No. 1, Canberra: The Australian National University.

CLELAND, J. G. and Z. A. SATHAR (1984) 'The effect of birth spacing on childhood mortality in Pakistan', *Population Studies*, Vol. 38, pp. 401-418.

COALE, A. J. and P. DEMENY (1966) *Regional Model Life Tables and Stable Population*, New Jersey: Princeton University Press.

COCHRANE, S. H. (1980) The Effect of Education on Health, *World Bank Staff Paper*, No. 405, Washington: World Bank.

COCHRANE, S. H. (1981) 'The Determinants of Fertility and Child Survival in Nepal Terai', *Population and Human Resources Division Discussion Paper*, No. 81-34, Washington, D. C.: The World Bank.

CONDRAN, A. G. and E. CRIMMINS (1980) 'Mortality differentials between rural and urban areas of states in the northeastern United States 1890-1900', *Journal of Historical Geography*', Vol. 6, No. 2, pp. 179-202.

D'SOUZA, S. and A. BHUIYA (1982) 'Socio-economic mortality differentials in a rural area of Bangladesh', *Population and Development Review*, Vol. 8, No. 4, pp. 753-769.

D'SOUZA, S. and L. C. CHEN (1980) 'Sex differentials in mortality in rural Bangladesh', *Population and development Review*, Vol. 6, pp. 257-270.

DAHAL, D. R. (1993) *Rethinking Fertility Transition: Some Observations From Nepal*, Paper Presented at the National Seminar on Population and Sustainable Development in Nepal, Kathmandu: Tribhuvan University, March 22-26.

DAS, N. (1975) 'An indirect approach to study inter-relationship between infant mortality and fertility', *Demography India*, Vol. 4, pp. 449-455.

DASGUPTA, M. (1987) 'Selective discrimination against female children in rural Punjab, India', *Population and development Review*, Vol. 13, pp. 77-100.

DASGUPTA, M. (1989) *Death Clustering Maternal Education and the Determinants of Child Mortality in Rural Punjab, India*. Paper presented at Health Transition Workshop, Canberra, 15-19 May.

DASGUPTA, M. (1990) 'Death clustering, mothers' education and the determinants of child mortality in rural Punjab, India', *Population Studies*, Vol. 44, pp. 489-505.

DASVARMA, G. L. (1984) 'Infant and child deaths in Indonesia: how many can be prevented' *Indonesian Journal of Demography*, Vol 11. pp 1-13.

DASVARMA, G. L. (1990) 'Implications of mortality decline towards development', *Child Survival Research Note*, No. 30CS, Canberra: The Australian National University.

DAVANZO, J. (1984) 'A household survey on child mortality determinants in Malaysia', pp. 307-322, in *Child Survival Strategies for Research*, Ed., W. Henry Mosley and Lincoln C. Chen, New York: The Population Council.

DAVANZO, J. and P. J. HABICHT (1984) *What Accounts for the Decline in Infant Mortality in Peninsular Malaysia, 1946-75?*, N-2166-WB/RF/FF, Santa Monica: The Rand Corporation.

DAVANZO, J. and P. J. HABICHT (1986) 'Infant mortality decline in Malaysia 1946-1975: the roles of change in variables and change in the structure of relationship', *Demography*, Vol. 23, No. 2, pp. 143-160.

DAVANZO, J. W. P. BUTZ and P. J. HABICHT (1983) 'How biological and behavioural influences on mortality in Malaysia vary during the first year of life', *Population Studies*, Vol. 37, pp. 381-402.

DAVIS. K. (1973) 'Cities and Mortality' in *International Population Conference*, Liege. Vol. 3, pp. 259-281.

DeSWEEMER, C. (1984) 'The influence of child spacing on child survival', *Population Studies*, Vol. 38, pp. 47-72.

DURKIN, M (1988) 'Ayurvedic treatment for jaundice in Nepal', *Social Science and Medicine*, Vol. 27, pp. 491-495.

DUTTA, M. and P. N. KAPUR (1982) 'Trends and differentials in infant mortality in India: 1950-1978', pp. 215-232, in *Mortality in South and East Asia: A Review of Changing Trends and Patterns, 1950-1975*, report and selected papers presented at Joint WHO/ESCAP meeting held in Manila: 1-5 Dec. 1980, WHO and UNESCAP.

EBERSTEIN, W. I.; C. B. NAM and R. A. HUMMER (1990) 'Infant mortality by cause of death: main and interaction effects', *Demography*, Vol. 27, No. 3, pp. 413-429.

ESCAP (1987) *Women's Economic Participation in Asia and the Pacific*, Bangkok: ESCAP

FARAH A. A. and S. H. PRESTON (1982) 'Child mortality differentials in Sudan', *Population and Development Review*, Vol. 8, No. 4, pp. 753-769.

FEDERICI, N. and others (1976) 'Urban-rural differences in mortality 1950-1970', *World Health Statistics Report*, Vol. 29, No. 5-6.

FEDRICK, J. and P. ADELSTEIN (1973) 'Influence of pregnancy spacing on outcome of pregnancy', *British Medical Journal*, Vol. 29, pp. 753-756.

FEENEY, G. (1980) 'Estimating infant and child mortality trends from child survivorship data', *Population Studies*, Vol. 34, pp. 109-128.

FIENBERG, S. E. (1977) *The Analysis of Cross-Classified Categorical Data*, Massachusetts: Massachusetts Institute of Technology.

FIGA, I. T. (1984) 'Infant and child mortality in the rural areas of the developing world, a review of recent trends and policy implications', *Genus*, Vol. 40, No, 1-2, pp. 131-153.

FLEGG, A. T. (1982) 'Inequality of income, illiteracy and medical care as determinants of infant mortality in underdeveloped countries', *Population Studies*, Vol. 36, No. 3, pp. 441-458

FOSTER, S. O. (1984) 'Immunizable and respiratory diseases and child mortality, pp. 119-140, in *Child Survival Strategies for Research*, Ed., W. Henry Mosley and Lincoln C. Chen, New York: The Population Council.

FREDERIKSEN, H. (1970) 'Malaria eradication and the fall of mortality', *Population Studies*, Vol. 24, pp. 111-112.

FREEDMAN, R. (1975) *The Sociology of Human Fertility: an Annotated Bibliography*, New York: Irvington Publisher.

FRENZEN, P. D. and D. P. HOGAN (1982) 'The impact of class, education and health care on infant mortality in a developing society, the case study of rural Thailand', *Demography*, Vol. 19, No. 3, pp. 391-408.

GAISIE, S. K. (1980) 'Some aspects of socio-economic determinants of mortality in Tropical Africa', *Population Bulletin of the United Nations*, No. 13, pp. 16-25.

GARDINER, E. M. and J. YERUSHALMY (1939) 'Familial susceptibility to stillbirths and neonatal deaths', *The American Journal of Hygiene*, pp. 11-31.

GLASS, D. V. (1964) 'Some indicators of differences between urban and rural mortality in England and Wales and Scotland', *Population Studies*, Vol. 17, pp. 263-267.

GOLDMAN, N. and J. HOBCRAFT (1982) Birth Histories, *WFS Comparative Studies, Cross-national Summaries*, No. 17, London: WFS, Voorburg: ISI.

GOLDMAN, N.; A. J. COALE and M WEINSTEIN (1979) The Quality of Data in the Nepal Fertility Survey, *WFS Scientific Report*, No. 6, London: WFS, Voorburg: ISI.

GONDOTRA, M. M. and N. DAS (1988) Factors associated with infant mortality in Rajasthan and Orissa', pp. 297-321, in *Infant Mortality In India: Differentials and Determinants*, Ed., A. K. Jain and P. Visaria, Delhi: Sage Publications.

GONZALEZ, G. (1990) 'Towards a comprehensive population strategy for Nepal', *Asia-Pacific Population Journal*, Vol. 5, No. 3, pp. 3-28.

GOODMAN, L. A. (1978) 'A modified multiple regression approach to the analysis of dichotomous variables', pp. 7-25, in *Analysing qualitative/ Categorical Data, Log-Linear Models and Latent Structure Analysis*, Ed., Jay Magidson, Massachusetts: ABT Books.

GORTMAKER, S. L. (1979) 'Poverty and infant mortality in the United States', *American Sociological Review*, Vol. 44, pp. 280-297.

GRAY, A. (1985) 'Environment or intervention ? Improvement in Australian Aboriginal childhood mortality', *Child Survival Research Note*, No. 3CS, Canberra: The Australian National University.

GRAY, H. R. (1974) 'The decline of mortality in Ceylon and the demographic effects of malaria control', *Population Studies*, Vol. 28, pp. 205-229.

GRIBBLE, J. (1993) 'Birth interval, gestational age, and low birth weight: are the relationships confounded', *Population Studies*, Vol. 47, pp. 133-146.

GUBHAJU, B. B. (1974) *'An Abridged Life Table Construction for Nepal for the Period 1961-71*, Kathmandu: Nepal Family Planning/Maternal and Child Health Project.

GUBHAJU, B. B. (1984) *Demographic and Social Correlates of Infant and Child Mortality in Nepal*, A PhD. Thesis Submitted to the Department of Demography, Canberra: The Australian National University.

GUBHAJU, B. B. (1985) 'The effect of Previous child death on infant and child mortality in rural Nepal', *Studies in Family Planning*, Vol. 16, No. 4, pp. 231-236.

GUBHAJU, B. B. (1985a) 'Effects of birth order and maternal age on infant and child mortality in rural Nepal', *Biology and Society*, Vol. 2, No. 1, pp. 15-21.

GUBHAJU, B. B. (1986) 'Effects of birth spacing on infant and child mortality in rural Nepal', *Journal of Biosocial Science*, Vol. 18, No. 4, pp. 435-47.

GUBHAJU, B. B. (1991) *Child Mortality and Child Survival in South Asia - Nepalese Perspectives*, Delhi: Anil Mittal Daya Publishing House.

GUBHAJU, B. B.; Minja Kim CHOE ; Robert D. RETHERFORD and Shyam THAPA (1987) 'Infant mortality and differentials in Nepal', *Studies in Family Planning*, Vol. 18, No. 1, pp. 22-31

GWATKIN, D. R. (1980) 'Indications of change in developing country mortality trends: the end of an era', *Population and Development Review*, Vol. 6, pp. 615-644.

HABERMAN, S. J. (1978) *Analyses of Quantitative Data*, Vol. 1, New York: Academic Press.

HAINES, M. R. (1977) 'Mortality in nineteenth century America: estimates from New York and Pennsylvania census data, 1865 and 1900', *Demography*, Vol. 14, No. 3, pp. 311-331.

HAINES, M. R. and R. C. AVERY (1982) 'Differential infant and child mortality in Costa-Rica: 1968-1973', *Population Studies*, Vol. 36, No. 1, pp. 31-43.

HARRIS, G. L.; J. C. GIDDENS; T. E. LUX; F. M. BUNGE; F. C. RINTZ and H. H. SMITH (1973) *Area Handbook for Nepal, Bhutan and Sikkim*, section edition, Washington, DC: United States Government Printing Office.

HILL, K. and A. R. PEBLEY (1989) 'Child mortality in the developing world', *Population and Development Review*, Vol. 15, pp. 657-687.

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG) (1982) *Budget Speech of the Fiscal Year 1982-1983*, Kathmandu: Ministry of Finance.

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG) (1982a) *Budget in Nepal, 1951/52-1981/82*, Kathmandu: Ministry of Finance.

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG) (1986) *Nepal Ma Swastha Sanstha Haru*, (Health posts in Nepal) Integrated Community Health Services Development Project, Kathmandu: Ministry of Health.

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG) (1987) *Basic Health Service by the year 2000, Programme Document*, (in Nepali), Kathmandu, Ministry of Health.

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG) (1991) *Health Information Bulletin*, Kathmandu: Ministry of Health.

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG) and WORLD HEALTH ORGANIZATION (WHO) (1988) *Country Health Profile Nepal*, Kathmandu: Policy, Planning, Monitoring and Supervision Division.

HOBCRAFT, J. N. (1980) Illustrative Analysis: Evaluating Fertility Levels and Trends in Columbia, *WFS Scientific Report*, No. 15, London: WFS, Voorburg: ISI.

HOBCRAFT, J. N. (1987) *Does Family Planning Save Children's Lives?*, [Unpublished] paper prepared for the International Conference on Better Health for Women and Children Through Family Planning, Nairobi: 5-9 October.

HOBCRAFT, J. N. (1993) 'Women's education, child welfare and child survival, a review of the evidence' *Health Transition Review*, Vol. 3, No. 2, pp. 159-175.

HOBCRAFT, J. N., N. GOLDMAN and V. C. CHIDAMBERAM (1982) 'Advances in the P/F ratio method for the analysis of birth histories', *Population Studies*, Vol. 36, No. 2, pp. 291-316.

HOBCRAFT, J. N.; J. W. McDONALD and S. O. RUTSTEIN (1983) 'Child-spacing effects on infant and early child mortality', *Population Index*, Vol. 49, pp. 585-618.

HOBCRAFT, J. N.; J. W. McDONALD and S. O. RUTSTEIN (1985) 'Demographic determinants of infant and child mortality: a comparative analysis', *Population Studies*, Vol. 39, pp. 363-385.

HOBCRAFT, J. N.; J. W. McDONALD and S. O. RUTSTEIN (1984) 'Socio-economic factors in infant and child mortality, a cross national comparison', *Population Studies*, Vol. 38, No. 2, pp. 193-223.

HULL, T. H. and B. B. GUBHAJU (1986) 'Multivariate analysis of infant and child mortality in Java and Bali', *Journal of Biosocial Science*, Vol. 18, pp. 109-118.

ISAACS, S and N. FINCANCIOGLU (1989) 'Promoting family planning for better health: policy and programme implication', *Population Bulletin of the United Nations*, No. 26, New York: pp. 103-125.

JAIN, A. K. (1969) 'Pregnancy outcome and the time required for next conception', *Population Studies*, Vol. 23, pp. 421-433.

JAIN, A. K. (1985) 'Determinants of regional variations in infant mortality in rural India', *Population Studies*, Vol. 39, No. 3, pp. 407-424.

JAIN, A. K. and P. VISARIA (1988) 'Infant mortality in India: an overview', pp. 23-64, in *Infant Mortality in India: Differentials and Determinants*, Ed., A. K Jain and P. Visaria, Delhi: Sage Publications.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) (1987) *Complementary Basic Survey Report on Population and Family Planning in the Kingdom of Nepal*, Kathmandu: Japan International Cooperation Agency, Medical Cooperation.

JOHANSSON, S. R. and C. MOSK (1987) 'Exposure, resistance and life expectancy: disease and death during economic development of Japan, 1900-1960', *Population Studies*, Vol. 41, pp. 207-235.

JOHN, A. M.; J. A. MENKEN and A. K. M. A.CHOWDHURY (1987) 'The effects of breastfeeding and nutrition on fecundity in rural Bangladesh: a hazard-model analysis', *Population Studies*, Vol. 41, pp. 433-446.

JOSHI, P. L. and A. S. DAVID (1983) *Demographic Targets and Their Attainment: The Case of Nepal*, Kathmandu: National Commission on Population, His Majesty's Government of Nepal.

JUSTICE J. (1986) *Policies Plans and People, Culture and Health Development in Nepal*, Berkeley: University of California.

JUSTICE, J. (1984) 'Can socio-cultural information improve health planning? A case study of Nepal's assistant nurse-midwife', *Social Science and Medicine*, Vol. 19, No. 3, pp. 193-198.

KANITKAR, T. and B. N. MURTHY (1988) 'Factors associated with infant mortality in Rajasthan and Orissa', pp. 297-321, in *Infant Mortality In India: Differentials and Determinants*, Ed., A. K. Jain and P. Visaria, Delhi: Sage Publications.

KANSAKAR, V. B. (1981) *Scenario Analysis of the Basic Minimum Needs for Nepal: 2000 A. D.*, Kathmandu: Centre for Economic Development and Administration (CEDA), Tribhuvan University.

KARKI, Y. B. (1984) *Estimates of Total Fertility Rate for Nepal and its Geographical sub-division and Administrative Zones 1971 and 1981*, Kathmandu: Occasional Monograph, National Commission on Population.

KARKI, Y. B. (1988) 'Sex preference and the value of sons and daughters in Nepal' *Studies in Family Planning*, Vol. 19, pp. 169-178.

KC. B. K. (1994) *'Social Composition of Population in Nepal'*, Mimeograph, Kathmandu: Tribhuvan University.

KHAN, M. E. (1988) 'Infant mortality in Uttar Pradesh, a micro study', pp. 227-246, in *Infant Mortality in India: Differentials and Determinants*, Ed., A. K. Jain and P. Visaria, Delhi: Sage Publications.

KIM, T. (1986) The determinants of infant and child mortality in Korea, 1955-1973', *Child Survival Research Note*, No. 10CS, Canberra: The Australian National University.

KIM, T. (1986a) *'Mortality Transition in Korea: 1960-1980'*, Unpublished Ph. D. Thesis, Canberra: The Australian National University.

KIM, T. H. (1986) 'Changing determinants of infant and child mortality: on the basis of the Korean experience (1955-1973)', *Child Survival Research Note*, 9cs, Canberra: International Population Dynamics Program, The Australian National University.

KNODEL, J. (1968) 'Infant mortality and fertility in three Bavarian villages: an analysis of family histories from the 19th century', *Population Studies*, Vol. 22, pp. 297-318.

KNODEL, J. (1977) 'Town and country in nineteenth-century Germany: a review of urban-rural differentials in demographic behaviour', *Social Science History*, Vol. 1, No. 3, pp. 356-382.

KNOKE, D. and P. J. BURKE (1980) *Log-Linear Models*, Sage University Paper, No. 20, London: Sage Publications.

KOENIG, M. A.; J. F. PHILIPS; O. M. CAMPBELL and S. D'SOUZA (1990) 'Birth intervals and childhood mortality in rural Bangladesh', *Demography*, Vol. 27, No. 2, pp. 251-265.

KOENIG, M. A.; V. FAUVEAU and B. WOJTYNIAK (1989) 'Potential reduction in infant and child mortality through immunization programmes: evidence from Matlab, Bangladesh', pp. 433-448, in *Population: Today and Tomorrow-policies, theories and methodologies, Proceedings of the International Population Conference*, New Delhi: B. R. Publishing Corporation.

LANTZ, L.; M. PARTIN and A. PALLONI (1992) 'Using retrospective surveys for estimating the effects of breastfeeding and child-spacing on infant and child mortality', *Population Studies*, Vol. 46, pp. 121-139.

LASKER, J. N. (1981) 'Choosing among therapies: illness behaviour in the Ivory Coast', *Social Science and Medicine*, Vol. 15a, pp. 157-168.

LERIDON, H. (1977) *Human Fertility: the Basic Components*, Chicago: University of Chicago Press.

LEVINE, N. E. (1987) 'Differential child care in three Tibetan communities: beyond son preferences', *Population and Development Review*, Vol. 13, No. 2, pp. 281-304.

LINDENBAUM, S.; M. CHAKRABORTY and M. ELIAS (1989) 'The influence of maternal education on infant and child mortality in Bangladesh', pp. 112-131, in *Selected Readings in the Cultural, Social and Behavioural determinants of Health*, Ed., J. C. Caldwell and G. Santow, Health Transition Series, No. 1, Canberra: The Australian National University.

LITTLE, R. J. A. (1978) 'Generalized linear models for cross-classified data from the WFS', WFS Technical Bulletins, No. 5/TECH. 834, London: WFS, Voorburg: ISI.

LUHAN, J. M. (1992) *UNICEF in Nepal*, Kathmandu: UNICEF.

MacMOHAN, B.; M. G. KOVAR and J. J. FELDMAN (1972) 'Infant mortality rates: socio-economic factors', *Vital and Health Statistics*, Series 22. No. 14, Washington: U. S. Government Printing Office.

MAGIDSON, J (1978) 'An illustrative comparison of Goodman's approach to logit analysis with dummy variable regression analysis', pp. 27-54, in *Analysing qualitative/ Categorical Data, Log-Linear Models and Latent Structure Analysis*, Ed., Jay Magidson, Massachusetts: ABT Books.

MAJUMDER, A. K. (1989) *Determinants of Infant and Child Mortality in Bangladesh*, Unpublished Ph. D. Thesis, Canberra: The Australian National University.

MARTIN, L. G.; J. TRUSSELL; R. S. FLORENTINA and M. S. NASARA (1983) 'Co-variates of child mortality in the Philippines, Indonesia and Pakistan: an analysis based on hazard models', *Population Studies*, Vol. 37, pp. 417-432.

MCKEOWN, T. and R. G. RECORD (1962) 'Reasons for the decline of mortality in England and Wales during the nineteenth century', *Population Studies*, Vol. 15, pp. 94-122.

MEEGAMA, S. A. (1967) 'Malaria eradication and its effect on mortality levels', *Population Studies*, Vol. 21, pp. 207-237.

MEEGAMA, S. A. (1969) 'The decline in maternal and infant mortality and its relation to malaria eradication', *Population Studies*, Vol. 23, pp. 289-302.

MEEGAMA, S. A. (1980) 'Socio-Economic Determinants of Infant and Child Mortality in Sri Lanka, An Analysis of Post War Experience', *Scientific Report*, London: WFS, Voorburg: ISI.

MERRICK, T. W. (1985) 'The effect of piped water on early childhood mortality in urban Brazil, 1970 to 1976', *Demography*, Vol. 22, No. 1, pp. 1-23.

MILLER, J. E.; J. TRUSSELL; A. R. PEBLEY and B. VAUGHAN (1992) 'Birth spacing and child mortality in Bangladesh and the Philippines', *Demography*, Vol. 29, No. 2, pp. 305-318.

MINISTRY OF HEALTH (MOH) (1989-90) *Annual Report*, Kathmandu: Diarrhoeal Disease and Acute Respiratory Infection Control Programme, Public Health Division.

MOMBA, D. D. (1987) *Infant and Child Mortality in Southern Regions of Malawi*, M.A. Thesis, Canberra: The Australian National University.

MORGAN, S. P. and J. D. TEACHMAN (1988) 'Logistic regression: description examples, and comparison', *Journal of Marriage and the Family*, Vol. 50, pp. 929-936.

MORLEY, D and H. LOVEL (1986) *My Name is Today*, Macmillan, London.

MOSLEY, W. H. (1984) 'Child survival: research and policy', pp. 3-23, in *Child Survival Strategies for Research*, Ed., W. H. Mosley and L. C. Chen, New York: The Population Council.

MOSLEY, W. H. (1985) 'Will primary health care reduce infant and child mortality ? A critique of some current strategies, with special reference to Africa and Asia', pp. 103-138, in *Health Policy, Social Policy and Mortality Prospects*, Ed., L. Vallin and A. D. Lopez, Liege: Ordina Edition.

MOSLEY, W. H. and L. C. CHEN (1984) 'An analytical framework for the study of child survival in developing countries', pp. 25-45, in *Child Survival Strategies for Research*, Ed., W. H. Mosley and L. C. Chen, USA: The Population Council.

NAG, M. (1983) 'Impact of social and economic development on mortality: comparative study of Kerala and West Bengal', *Economic and Political Weekly*, Vol. 18, No. 19-21, pp. 887-900.

NATIONAL COMMISSION ON POPULATION (NCP) (1983) *National Population Strategy*, Kathmandu: National Commission on Population Nepal, His Majesty's Government of Nepal.

NATIONAL COMMISSION ON POPULATION (NCP) (nd) *A Profile*, Kathmandu: National Commission on Population, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1965) *Third Plan, 1965-70*, (in Nepali), Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1970) *Fourth Plan, 1970-75*, Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1975) *Fifth Five Year Plan, 1975-80*, (in Nepali), Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1980) *Sixth Five Year Plan, 1980-85*, (in Nepali), Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1983) *Employment, Income Distribution and Consumption Patterns*, Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1986) *Seventh Five Year Plan*, 1985-90 (in Nepali) Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1991) *Approach to the Eighth Plan 1992-97*, Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NATIONAL PLANNING COMMISSION (NPC) (1992) *Eight Plan, summary*, Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

NEPAL FAMILY PLANNING AND MATERNAL CHILD HEALTH PROJECT (NFPMCH) (1977) *Nepal Fertility Survey, 1976, First Report*, Kathmandu: Ministry of Health, His Majesty's Government of Nepal.

NEPAL FAMILY PLANNING AND MATERNAL CHILD HEALTH PROJECT (NFPMCH) (1987) *Nepal Fertility and Family Planning Survey Report, 1986*, Kathmandu: Ministry of Health, His Majesty's Government of Nepal.

NEPAL RASTRA BANK (NRB) (1988) *Multipurpose Household Budget Survey, A Study on Income Distribution, Employment and Consumption Pattern in Nepal*, Kathmandu: Nepal Rastra Bank.

NEW ERA (1986) *Fertility and Mortality Rates in Nepal*, Kathmandu: New Era.

NEW ERA, IIDS and VaRG (1992) *Nepal Fertility, Family Planning and Health Survey*, Kathmandu: UNFPA.

NORREN V. B. and H. A. W. VIANEN (1986) *The Malnutrition-Infections Syndrome and its Demographic Outcome in Developing Countries*, The Hague: Programming Committee for Demographic Research, Publication No. 4.

OKADA, F. E. (1976) 'Notes on two shaman-curers in Kathmandu', *Journal of the Institute of Nepal and Asian Studies, Contribution to Nepalese Studies*, Research Centre for Nepal and Asian Studies, Vol. 3, pp. 107-112.

OYA, S. D. (1981) 'Effects of industrialization and urbanization on mortality in the developing countries: the case of Brazil', pp. 255-271, in *International Population Conference*, Vol. 2, Manila: IUSSP.

PALLONI, A. (1981) 'Mortality in Latin America: emerging patterns' *Population and Development Review*, Vol. 7, No. 4, pp. 623-649.

PALLONI, A. and G. PINTO (1989) 'Family planning and infant and child survival', pp. 363-377, in *Population Today and Tomorrow-Policies, Theories and Methodologies*, New Delhi: Proceedings of the International Population Conference. Vol. 1.

PALLONI, A. and L. HELIGMAN (1985) 'Re-estimation of structural parameters to obtain estimates of mortality in developing countries', New York: *Population Bulletin of the United Nations*, No. 18.

PALLONI, A. and S. MILLMAN (1986) 'Effects of inter-birth intervals and breastfeeding on infant and early childhood mortality', *Population Studies*, Vol. 40, pp. 215-236.

PANDEY, C. (1980) 'Population growth and health development', pp. 104-121, in *Population of Nepal, Country Monograph Series No. 6*, Bangkok: ESCAP, United Nations.

PANT R. D. and S. ACHARYA (Eds) (1988) *Population and Development in Nepal*, Kathmandu: National Commission on Population, His Majesty's Government of Nepal.

PANT, P. D. (1987) *Socio-economic Consequences of Land Ownership Polarization in Nepal*, Kathmandu: WINROCK International.

PANT, P. D. (1991) 'Effects of education and household characteristics of infant and child mortality in urban Nepal', *Journal of Biosocial Science*, Vol. 23, pp. 437-443.

PARK, C. B. (1986) 'The place of child spacing as a factor in infant mortality: a recursive model', *The American Journal of Public Health*, Vol. 76, pp. 995-999.

PEBLEY, A. R. and I. T. ELO (1989) 'The relationship of birth spacing and child health', pp. 403-417, in *Population: Today and Tomorrow-policies, theories and methodologies, Proceedings of the International Population Conference*, New Delhi: B. R. Publishing Corporation.

PEBLEY, A. R. and P. W. STUPP (1987) 'Reproductive patterns and child mortality in Guatemala', *Demography*, Vol. 24, No. 1, pp. 43-60.

PEBLEY, A. R. and S. MILLMAN (1986) 'Birth spacing and child survival', *International Family Planning Perspectives*, Vol. 12, No. 3, pp. 71-82.

PETERSON C.; K. YUSOF, J. DAVANZO and J. HABICHT (1986) *Why Were Infant and Child Mortality Rates Highest in the Poorest States of Peninsular Malaysia, 1941-75?*, N-2329-FF/RF/WFHF, Santa Monica: The Rand Corporation.

POFFENBERGER, M. (1980) *Patterns of Change in the Nepal Himalaya*, Delhi: The Macmillan Company of India.

POPULATION POLICIES COORDINATION BOARD, NEPAL; MINISTRY OF HEALTH, NEPAL, UNIVERSITY OF CALIFORNIA, BERKELEY AND FP/MCH PROJECT IN NEPAL (1976) *Conference on the implementation of population policies*, Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

POTTER, J. E. (1977) 'Problems in using birth history analysis to estimate trends in fertility', *Population Studies*, Vol. 31, No. 2, pp. 335-364.

POTTER. J. E. (1988) 'Birth spacing and child survival: a cautionary note regarding the evidence from the WFS', *Population Studies*, Vol. 42, pp. 443-450.

PRESTON, S. H (1975) 'The changing relation between mortality and level of economic development', *Population Studies*, Vol. 29, No. 2, pp. 231-248.

PRESTON, S. H. (1975a) *Mortality Patterns in National Populations: With Special Reference to Recorded Cause of Death*, New York: Academic Press.

PRESTON, S. H. (1980) 'Causes and consequences of mortality decline in less developed countries during the twentieth century', pp. 289-360, in *Population and Economic Change in Developing Countries*, Ed., R. A. Easterlin, Chicago and London: University of Chicago Press.

PRESTON, S. H., M. R. HAINES and E. PAMUK (1981) 'Effects of industrialization and urbanization on mortality in developing countries', pp. 233-253, in *International Population Conference*, Vol. 2, Manila: IUSSP.

RAHMAN, M.; L. C. CHEN; J Chakraborty; M. YUNUS; A. I. CHOWDHURY; A. M. SARDER; S BHATIA and G. T. CURLIN (1982) 'Use of tetanus toxoid for the prevention of neonatal tetanus. 1. Reduction of neonatal mortality by immunization of non-pregnant and pregnant women in rural Bangladesh', *Bulletin of World Health Organization*, Vol. 60, No. 2, pp. 261-267.

RAMANUJAM, C. (1988) 'Correlates of infant mortality in a rural area of Tamil Nadu', pp. 259-273, in *Infant Mortality in India: Differentials and Determinants*, Ed., A. K. Jain and P. Visaria, Delhi: Sage Publications.

REDDY, P. H. (1989) *Dietary Practices During Pregnancy, Lactation and Infancy*, Paper presented at Health Transition Workshop, Canberra, 15-19 May.

REISSLAND, N. and R. BURGHART (1989) 'Active patients: the integration of modern and traditional obstetric practices in Nepal', *Social Science and Medicine*, Vol. 29, pp. 43-52.

RISAL, R. P. and A. SHRESTHA (1989) ' Fertility and its proximate determinants' in *South Asia Study on Population Policies and Programmes, Nepal*, Kathmandu: UNFPA, pp. 22-72.

ROSS, J. L.; J. BLANGERO; M.C. GOLDSTEIN and S. SCHULER (1986) 'Proximate determinants of fertility in Kathmandu valley, Nepal: an anthropological case study' *Journal of Biosocial Science*, Vol. 19, pp. 179-196.

RUTSTEIN, S. O. (1983) 'Infant and Child Mortality: Levels Trends and Demographic Differentials', *Comparative Studies Cross National Summaries*, No. 24, London: WFS, Voorburg: ISI.

RUZICKA, L. T (1985) 'Conceptual frameworks for the study of socio-biological correlates of mortality', pp. 185-187, in *International Population Conference*, Florence: IUSSP, Vol. 2.

RUZICKA, L. T. and H. HANSLUWKA (1982) 'A review of evidence on levels trends and differentials since the 1950', pp. 83-156, in *Mortality in South and East Asia, A review of changing trends and patterns, 1950-75*, report and selected papers presented at joint WHO/ESCAP meeting held in Manila: 1-5 Dec. 1980, WHO and UNESCAP.

RUZICKA, L. T. and P. KANE (1985) 'Nutrition and child survival in South Asia', pp. 333-357, in *Dynamics of Population and Family Welfare*, Ed., K. Srinivasan and S. Mukerji, Bombay: Himalayan Publishing House.

SANDHYA, S. (1986) 'Socio-cultural and economic correlates of infant mortality, a case study of Andhra Pradesh', *Demography India*, Vol. 15, No. 1, pp. 86-106.

SATHAR, Z. A. (1985) 'Infant and child mortality in Pakistan, some trends and differentials', *Journal of Biosocial Science*, Vol. 17, No. 3, pp. 315-359

SCHLESINGER, E. W. and N. ALLAWAY (1955) 'Trends in familial susceptibility to perinatal loss', *The American Journal of Public Health*, pp. 174-183.

SCHROEDER, R. and E. SCHROEDER (1979) 'Women in Nepali agriculture: all work no power', *Journal of Development and Administration Studies*, Vol. 1, No. 2, pp. 178-193.

SCHULER, R. S. and M. C. GOLDSTEIN (1986) 'Family planning in Nepal from the user's and nonuser's perspectives' *Studies in Family Planning*, Vol. 17, No. 2, pp. 66-76.

SCHULER, R. S.; E. N. McINTOSH; M. C. GOLDSTEIN and B. R. PANDE (1985) 'Barriers to effective family planning in Nepal', *Studies in Family Planning*, Vol. 16, No. 8, pp. 260-270.

SCHULTZ, T. P. (1979) 'Interpretation of relations among mortality, economics of the household and the health environment', *Proceedings of the meeting on socio-economic determinants and consequences of mortality*, UN/WHO Seminar, Mexico City, June 1979, Geneva: WHO.

SCHULTZ, T. P. (1984) 'Studying the impact of household economic and community variables', pp. 215-235, in *Child Survival Strategies for Research*, Ed., W Henry Mosley and Lincoln C. Chen, New York: The Population Council.

SELVARATNAM, S. (1987) 'Population and status of women', *Asia Pacific Population Journal*, Vol. 3, No. 2, pp. 3-28.

SHAH, A. J. (1987) *Access of Low Income Families to Social Services, A Study in Selected Areas of Kathmandu,* Kathmandu: Centre for Economic Development and Administration (CEDA), Tribhuvan University.

SHRESTHA, A.; B. B. GUBHAJU and M. C. RONCOLI (1987) *Survival and Development in Nepal, an Analysis of District Level Data on Infant Mortality,* Kathmandu: New Era/UNICEF.

SHRESTHA, G. B. (1986) '*Paribarik Kanun*'[Family Law], *In Nepali*, Kathmandu: Nepal Kanun Kitab Company Pvt. Ltd.

SHRESTHA, R. M. and M. LEDIARD (1990) *Faith Healers: a Force for Change*, Kathmandu: UNFPA/UNICEF.

SHRESTHA, S. H.(1989) *Nepal in Maps*, Kathmandu: Educational Enterprise.

SINGH, K. P. (1989) 'Green revolution and child survival in the state of Punjab', pp. 379-388, in *Population Today and tomorrow-policies theories and methodologies*, New Delhi: Proceedings of the International Population Conference, Vol. 1.

SINGH, S. (1987) 'Evaluation of data quality', pp. 615-643, in *The World Fertility Survey An Assessment*, Ed., J. Cleland and C. Scott, Oxford: Oxford University Press.

SKINNER, C. J.; D. HOLT and T. M. F. SMITH (1989) *Analysis of Complex Surveys*, New York: John Wiley & Sons.

SPSS Inc. (1990) *SPSS X User Guide*, 4th edition, Chicago: SPSS Inc.

STOECKEL, J. and A. K. M. A. CHOWDHURY (1972) 'Neonatal and post-neonatal mortality in a rural area of Bangladesh', *Population Studies*, Vol. 26, pp. 113-120.

STOCKWELL, E. and J. W. WICKS (1984) 'Patterns and variations in the relationship between infant mortality and socio-economic status', *Social Biology*, Vol. 31, No. 1-2, pp. 28-39

STOLNITZ, G. J. (1965) 'Recent mortality trends in Latin America, Asia and Africa review and re-interpretation', *Population Studies*, Vol. 19, pp. 117-138.

STONE, L. (1976) 'Concepts of illness and curing in a central Nepal village', *Journal of the Institute of Nepal and Asian Studies, Contribution to Nepalese Studies*, Research Centre for Nepal and Asian Studies, Vol. 3, pp. 55-80.

STONE, L. (1978) 'Cultural repercussions of cheerlessness and low fertility in Nepal', *Journal of the Institute of Nepal and Asian Studies, Contribution to Nepalese Studies*, Research Centre for Nepal and Asian Studies, Vol. 5, No. 2, pp. 7-38.

STREATFIELD, K.; P. KANE and L. RUZICKA (1991) 'Infant and child mortality in Hunan Province of China', *Child Survival Research Note*, No. 37CS, Canberra: The Australian National University.

SUHAIMI, U. (1991) 'Cohort-period fertility rates in West Java, an analysis based on birth histories data', *Forum Statistik*, pp. 16-21

SWENSON, I. (1981) 'Relationship between pregnancy spacing, sex of infants, maternal age, and birth order, and neonatal and post-neonatal mortality in Bangladesh', *Social Biology*, Vol. 28, pp. 299-307.

SWENSON, I. and P. HARPER (1979) High risk maternal factor related to fetal wastage in rural Bangladesh', *Journal of biosocial science*, Vol. 11, pp. 465-471.

TAKCE, B. and F. C. SHORTER (1984) 'Determinants of child mortality: a study of squatter settlements in Jordan', pp. 257-280, in *Child Survival Strategies of Research*, Ed., W. Henry Mosley and Lincoln C. Chen, New York: The Population Council.

TALWAR, P. P. (1988) 'Infant mortality - some evidence from rural Madhya Pradesh', pp. 297-321, in *Infant Mortality In India: Differentials and Determinants*, Ed., A. K. Jain and P. Visaria, Delhi: Sage Publications.

THAPA, S. (1989) 'A decade of Nepal's family planning programme: achievements and prospects', *Studies in Family Planning*, Vol. 20, No. 1, pp. 38-52.

THAPA, S. and R. D. RETHERFORD (1982) 'Infant mortality estimates based on the 1976 Nepal Fertility Survey', *Population Studies*, Vol. 36, No. 1, pp. 61-80.

TRIBHUVAN UNIVERSITY (TU) and HIS MAJESTY'S GOVERNMENT (HMG), (1985) *Report on Performance of Rural Health Workers in Nepal*, Kathmandu: Institute of Medicine, Tribhuvan University and Department of Health Services, His Majesty's Government of Nepal.

TRUSSELL, J. (1975) 'A re-estimation of the multiplying factors for the Brass technique for determining childhood survivorship rates', *Population Studies*, Vol. 29, pp. 97-107

TRUSSELL, J. and A. PEBLEY (1984) 'The potential impact of changes in fertility on infant, child, and maternal mortality' *Studies in Family Planning*, Vol. 15, No. 6, pp. 267-280.

TRUSSELL, J. and C HAMMERSLOUGH (1983) 'A hazard-model analysis of the covariates of infant and child mortality in Sri-Lanka', *Demography*, Vol. 20, No. 1, pp. 1-26.

TRUSSELL, J.; L. G. MIRTIN; R. FELDMAN; J. PALMORE; M. CONCEPCION and D. N. L. B. D. A. BAKER (1985) 'Determinants of birth-interval length in the Philippines, Malaysia and Indonesia: a hazard model analysis', *Demography*, Vol. 22, No. 2, pp. 145-168.

TSUI, A. O.; J. DeCLERQUE and N. MANGANI (1988) 'Maternal and socio-demographic correlates of child morbidity in Bas Zaire: the effects of maternal reporting', *Social Science and Medicine*, Vol. 26, No. 7, pp. 701-713.

TULADHAR, J. M. (1987) 'Effect of family planning availability and accessibility on contraceptive use in Nepal', *Studies in Family Planning*, Vol. 18, No. 1, pp. 49-53.

TULADHAR, J. M. (1989) 'Overview', pp. 1-20, in *South Asia Study on Population Programmes and Strategies*, Nepal Report, Kathmandu: UNFPA.

TULADHAR, J. M. and J. STOCKEL (1982) 'The relative impacts of vertical and integrated FP/MCH programme in rural Nepal', *Studies in Family Planning*, Vol. 13, No. 10, pp. 275-286.

TULASIDHAR, V. B (1993) 'Maternal education, female labour force participation and child mortality: evidence from the Indian census', *Health Transition Review*, Vol. 3, No. 2, pp. 177-190.

UEDA, K (1983) *Recent Trends of Mortality in Asian Countries*, Tokyo: South-East Asian Medical Information Centre.

UNICEF (1985) *The State of the World's Children*, Oxford: Oxford University Press.

UNICEF (1987) *Children and Women of Nepal: a Situation Analysis, Nepal*, Kathmandu: UNICEF.

UNICEF (1988) *The State of the World's Children*, New York: Oxford University Press.

UNICEF (1990) *The State of the World's Children*, New York: Oxford University.

UNICEF (1992) *Children and Women in Nepal, a Situation Analysis*, Kathmandu: National Planning Commission, His Majesty's Government of Nepal.

UNICEF (1992a) *The State of the World's Children*, New York: Oxford University Press for UNICEF

UNITED NATIONS (1971) 'Errors and biases in demographic data', *Methodology of Demographic Sample Survey*, Report of the Inter-regional Workshop on Methodology of Demographic Sample Survey, Copenhagen: United Nations, Statistical Paper Series M. No. 51.

UNITED NATIONS (1973) *The Determinants and Consequences of Population Trends, New Summaries of Findings on Interaction of Demographic, Economic and Social Factors*, New York: United Nations. Vol. 1.

UNITED NATIONS (1982) *Levels and Trends of Mortality Since 1950: a Joint Study by the United Nations and the World Health Organization*, New York: United Nations Publications.

UNITED NATIONS (1982) *Levels and Trends of Mortality Since 1950*, A Joint study by The United Nations and World Health Organization, New York: United Nations Publication.

UNITED NATIONS (1982a) *Model Life Tables for Developing Countries*, New York: United Nations.

UNITED NATIONS (1983) *Manual X: Indirect Techniques for Demographic Estimation*, New York: United Nations.

UNITED NATIONS (1985) *Socio-Economic Differentials in Child Mortality in Developing Countries*, New York: Department of International Economic and Social Affairs.

VAIDYANATHAN, K. E. and F. H. GAIGE (1973) 'Estimates of abridged life tables, corrected sex-age distribution and birth and death rates for Nepal, 1954, *Demography India*, Vol. 2, No. 2, pp. 278-290.

VALLIN, J (1980) 'Socio-economic determinants of mortality in industrialized countries', *Population Bulletin of the United Nations*, No. 13, pp. 26-41.

VINDING, M (1984) 'Making a living in the Nepal Himalayas: the case of the Thakalis of Mustang District', *Contributions to Nepalese Studies*, Vol. 12, No. 1, pp. 51-106.

VISARIA, L. (1985) 'Infant mortality in India, level, trends and determinants', *Economic and Political Weekly*, Vol. 20, Nos. 32, 33 and 34, Aug. 10, 17, 24, pp. 1352-1359, 1399-1405, 1447-1450.

WAKE, C. J. (1976) 'Health services and some cultural factors in eastern Nepal', *Journal of Journal of the Institute of Nepal and Asian Studies, Contribution to Nepalese Studies*, Research Centre for Nepal and Asian Studies, Vol. 3, pp. 113-126.

WALSH, J. A. and K. S. WARREN (1980) 'Selective primary health care: an interim strategy for disease control in developing countries', *Social Science and Medicine*, Vol. 14c, pp. 145-163.

WARE, H. (1984) 'Effect of maternal education, women's roles and child care on child mortality', pp. 191-214, in *Child Survival Strategies of Research*, Ed., W. Henry Mosley and Lincoln C Chen, New York: The Population Council.

WEISBERG, D. H. (1982) 'Northern Thai health care alternatives, patient control and structure of medical pluralism', *Social Science and Medicine*, Vol. 16, pp. 1507-1517.

WEISS, M. G. (1988) 'Cultural models of diarrhoeal illness: conceptual framework and review', *Social Science and Medicine*, Vol. 27, No. 1, pp. 5-16.

WESTIN, R. B. (1974) 'Predictions from binary choice models', *Journal of Econometrics*, Vol. 2, pp. 1-16.

WINIKOFF, B. (1983) 'The effect of birth spacing on child and maternal health', *Studies in Family Planning*, Vol. 14, No. 10, pp. 231-245.

WOLFERS, D. and S. SCRIMSHAW (1975) 'Child survival and intervals between pregnancies in Guayaquil, Ecuador', *Population Studies*, Vol. 29, pp. 479-496.

WOODBURY, Robert M. (1925) *Causal Factors in Infant Mortality*, U.S. Department of Labor, Children's Bureau publication No. 142, Washington, D. C.: U.S Government Printing Office.

WORLD BANK (1978) *World Development Report*, Washington D. C.: The World Bank.

WORLD BANK (1986) *World Development Report*, Washington D. C.: The World Bank.

WORLD BANK (1989) *Nepal Policies for improving Growth and Alleviating Poverty*, A World Bank Country Study, Washington. D. C. : World Bank.

WORLD FERTILITY SURVEY (1984) *Major Findings and Implications*, London: World Fertility Survey and Netherlands: International Statistical Institute.

WORLD HEALTH ORGANIZATION (WHO) (1974) *Health Trends and Prospects*, 1950-2000, World Health Statistics Report 27 (10), pp. 672-706.

WORTH, R. M. and N. K. SHAH (1969) *Nepal Health Survey, 1965-66*, Honolulu: University of Hawaii Press.

WUNSCH, G and J. DUCHENE (1985) 'From theory to statistical model', in *International Population Conference*, Florence: IUSSP, Vol. 2, pp. 209-224.

YOHANNES, A. G. and K. STREATFIELD (1988) 'Utilization of health facilities for child illness in Ethiopia, 1983', *Child Survival Research Note*, No. 19CS, Canberra: The Australian National University.