DETERMINANTS OF CHILD SURVIVAL, HEALTH CARE SEEKING AND NUTRITIONAL STATUS IN A RURAL DISTRICT OF PAKISTAN

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AKU	Aga Khan University Karachi, Pakistan
aOR	Adjusted Odds Ratio
ARI	Acute Respiratory Infections
BHU	Basic Health Unit
BMI	Body Mass Index
CDC	Centre for Disease Control
CDD	Control of Diarrhoeal Diseases
CHS	Community Health Sciences
CI	Confidence Interval
cOR	Crude Odds Ratio
DHO	District Health Officer
DHS	Demographic Health Surveys
EPI	Expanded Program for Immunization
FATA	Federally Administered Tribal Areas
FHS	Female Health Staff
GDP	Gross Domestic Product
GEE	Generalized Estimating Equations
GHF	Government Health Facility
GNI	Gross National Income
GNP	Gross National Product
GOBI	Growth monitoring, Oral Rehydration, Breastfeeding promotion and Immunization
HDI	Human Development Index

ID	International Dollars
IDRC	International Development Research Centre, Canada
IMCI	Integrated Management of Childhood Illnesses
LHW	Lady Health Worker
MCH	Maternal and Child Health
MDG	Millennium Development Goal
MGR	Multi-centre Growth Reference
MGRS	Multi-centre Growth Reference Study
MTDF	Medium Term Development Framework
NCHS	National Center for Health Statistics
NFHS	National Family Health Survey
NNP	National Nutrition Program
OR	Odds Ratio
PIHS	Pakistan Integrated Household Survey
PPP	Purchasing Power Parity
PHC	Primary Health Care
PHF	Private Health Facility
PR	Pakistani Rupee
PSU	Primary Sampling Unit
RHC	Rural Health Centre
RIS	Research Information System
SES	Socio-Economic Status
THSRP	Thatta Health System Research Project
UC	Union Council
U5MR	Under-Five Mortality Ratio

UNDP	United Nation Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
VHV	Village Health Volunteer
WHO	World Health Organization

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Forewords

It is an honour and privilege for me to make use of the dataset derived from Research Information System (RIS) of Thatta Health System Research Project (THSRP) of the Aga Khan University (AKU), Karachi for my PhD thesis at the National University of Singapore (NUS).

I was given this opportunity to utilise RIS data by the department of Community Health Sciences (CHS) of the Aga Khan University (AKU) because of my intense involvement with the THSRP, familiarity with the local situation of Thatta district (the study site) and my potential for research work. I am thankful to the Department of Community Occupational and Family Medicine (COFM) at the NUS for permitting me to use RIS dataset for my PhD thesis.

I joined THSRP in 1990 during Phase II of the project and served as co-ordinator for three main components of the project; (i) Female health staff (FHS) development (1990-1993), (ii) Village health volunteers (VHVs) training program (1991-1993) and (iii) Primary health care (PHC) prototype development (1993).

FHS development aimed at improving knowledge, skills and practices of the FHS of the district in maternal and child health (MCH). I was responsible for planning, organising and conducting training workshops and preparing training modules. VHV training program was designed to train the health staff as trainers for the VHVs residing in the catchment area of their health facilities for promotion of village-based PHC. My major tasks were to plan, organise and conduct training of trainers for VHVs, develop and monitor village-based management information system and

prepare training modules. PHC prototype development aimed to develop a locally relevant and sustainable PHC prototype in partnership with government staff at a first-level health care facility. I led the team at six different PHC units (4 BHUs and 2 RHCs). I also served as THSRP Director and Co-ordinator during the last year of Phase III and Project phasing out period (1995 –1997) when I was responsible for supervising the implementation of THSRP activities at district, health facility and community levels and for reporting to the International Development Research Centre (IDRC), Canada (the funding source).

My involvement in RIS consisted of being a core member of the survey team who planned, designed and supervised survey implementation. I led preparation of codebook for the survey questionnaires. During 1995, I prepared a report for submission to IDRC describing demography (population distribution, socio-economic and development indicators), health status (rates for mortality and morbidity, nutritional status of under three children and fertility trends), accessibility and utilisation of health services (Noor Ali et al., 1994-95).

My thesis submitted for Master of Science (Epidemiology and Biostatistics) (1995) at the McGill University, Canada was also based on RIS dataset. It was titled as "Does living near a government health facility guarantee its usage by rural children in Pakistan". This study was later published in Journal of Health Policy and Planning (NoorAli et al., 1999). Since funding for the THSRP had ceased, making use of RIS dataset for PhD thesis would prevent loss of effort and resources incurred in data collection and of valuable information obtained through this survey.

I hope that the wealth of information mentioned in this thesis would play an important role in improving child health and survival in under-privileged set-ups such as of Thatta district.

Summary

Thatta district of Pakistan has poor child indicators. It ranks lowest among 16 districts of the Sindh province for infant mortality ratio (91/1000 live births) and prevalence of under-weight children (49%). District-wide improvement of child survival and nutritional status requires identification of local determinants.

This thesis investigates: (i) association between under-five deaths and maternal health; (ii) association between child health care and gender; (iii) assessment of nutritional status of pre-school children by the new World Health Organization (WHO) growth standard; and (iv) association between child's nutritional status and gender.

Results of this thesis are based on a secondary analysis of the information collected between November 1992 and February 1993 from rural Thatta as a part of project activities of the Aga Khan University, Karachi. A three-staged cluster sampling technique was adopted. Randomly 99 villages were selected from 12 union councils and all households (n=2276) within these village were surveyed. Weighted mortality estimates and prevalence ratios for a two-level random intercept model are reported.

In Thatta district, under-five mortality ratio was 108.1 per 1000 live births (95% C.I. = 82.6, 133.5). Poor maternal health was associated with 87% greater mortality risk among under-five children (95% C.I.) = (1.18, 2.95)], after adjustment of child's age and water source.

Beyond infancy, significantly more girls died than boys. In a two-level model, gender was not a significant predictor of illness reporting [P.R. (95% C.I.) = 0.89 (0.80, 1.01)], visit to health facilities [P.R. (95% C.I.) = 0.95 (0.88, 1.02)], provider choice [P.R. (95% C.I.) = 1.11 (0.96, 1.30)], hospitalization [P.R. (95% C.I.) = 0.68 (0.39, 1.18) and health expenditure [P.R. (95% C.I.) = 0.99 (0.87, 1.13)]. Other significant predictors of child health care were child's age, illness characteristics, maternal health status, number of children in the family, household SES and absence of girl's school in the village.

The new WHO growth standard showed significantly higher prevalence of stunting (52.9%) and wasting (22.9%) among pre-school children compared to the NCHS reference (44.8% and 15.7%, respectively). The new standard detected greater severe under-nutrition and among infants. Otherwise, the individual estimates showed a good agreement between two references.

In a two-level model, compared to boys, girls had significantly greater risk of stunting [P.R. (95% C.I.) = 1.18 (1.03, 1.36)] and under-weight [P.R. (95% C.I.) = 1.14 (1.03, 1.26)]. Risk of wasting was greater by 16% among sick children and risk of stunting and under-weight increased significantly by 21% and 20% respectively with maternal illiteracy.

Promotion of maternal health should be made an integral part of child survival. Priority areas for policy makers include promoting utilization of public health facilities and economic development in rural Thatta. Appropriate measures should be taken to introduce the new WHO growth standard for nutritional assessment. Gender

sensitive approach in nutritional programmes is recommended. Future research should examine impact of improved maternal nutrition on child survival, use of anthropometric scores from the new WHO standards in hypothesis testing studies and improvement of conceptual frameworks for studies on care seeking and nutritional determinants.

Chapter 1: Introduction

1.1 Overview

This thesis primarily examines association of maternal health with child survival and gender-differential in utilization of health care and nutritional status in a rural district of Pakistan. Though child survival and its determinants had been a focus of public health community for over last two decades, these issues are still relevant for a developing country like Pakistan. This is reflected in United Nations Millennium Development Goals 4 (MDG 4) and 1 (MDG 1) (United Nations, 2005). MDG 4 sets its targets (from 1990 to 2015) as reduction in under-five mortality by two-thirds and MDG 1 as reduction in proportion of under-weight children by half (United Nations, 2005).

Pakistan has poor child health indicators despite a higher per capita income than the average for low-income countries (State of Human Rights, 2003). World-wide, it ranks fourth by number of under-five child deaths in a year (Black et al., 2003). Among South Asian countries, it has the greatest gender disparity in mortality. Girls have a 50% greater chance of death than boys between their first and fifth birthdays (Filmer et al., 1998). Preventable and treatable conditions like diarrhoea and acute respiratory infections are the top two causes of early death and loss of healthy life-years in Pakistan (Hyder and Morrow, 2000). After India (39%) and Bangladesh (5.7%), Pakistan (5.5%) contributes the third largest share of under-weight children in the world (Global framework for action, 2006).

To attain targets set for MDG 4 and 1, district-wide focus is being encouraged (Bhutta, 2004a). District-wide targeted efforts for improvement in child survival

would include identification of its specific determinants and careful exploration of pathways for gender-differentials in child survival such as differential health care seeking or differential nutritional status.

With regard to the specific determinants of child mortality, possibility of an association between mother's health and under-five deaths has not been examined in Pakistan. This is particularly important for rural areas where women are often in poor health status (Ahmad et al., 2005; National Nutrition Survey, 2001-02).

Gender-differential in household decision making for child health care requires examination within a specific conceptual and analytical framework. Conceptual construct developed by Pokhrel and Sauerborn (2004) provides a useful basis to determine at which stage/s of the pathway model gender influences health care decisions.

Evidence for gender as a predictor of child under-nutrition among Pakistani children is scant and conflicting (Baig-Ansari et al., 2006 ; Hazarika, 2000; Shah et al., 2003). This could be due to (i) assessment of child's nutritional status based on 1977 National Centre for Health Statistics (NCHS) growth reference; and (ii) inappropriate analytical techniques including lack of account for contextual community-level factors.

Through this thesis, I examine the following questions linking conceptual frameworks with a two-level analytical framework and taking account of clustered survey design in analysis. I first examine an important question of association between under-five

deaths and maternal health status. Second, I assess gender differentials at five different stages of household decision making for health care among children aged 1-59 months. Third, I determine nutritional status of children 0-35 months by height for age, weight for height and weight for age using the new World Health Organization (WHO) growth standard and the agreement between new (WHO) and old (NCHS) growth references. Finally, I assess gender-differential in nutritional status as defined by the WHO standard.

This chapter has nine major sections beside overview (Section 1.1). Section 1.2 describes status of Pakistan globally and with reference to South Asia in terms of overall demographic, socio-economic and child health indicators, health seeking behaviour, its health care delivery system and its progress towards MDG4 and 1. Section 1.3 describes how Sindh (the second largest province of the country) where the study district is located relates to the country in terms of demographic, socio-economic and child health indicators. In Section 1.4, after portraying three conceptual frameworks for child survival, I present local determinants of child mortality and the studies that have examined the association of maternal health with child survival. Section 1.5 highlights the documented gender differentials in relation to social values in South Asia and its association with child survival. Further, conceptual frameworks for determinants of health care seeking are presented followed by evidence from South Asia. Section 1.6 describes the importance of child under-nutrition in public health and the common parameters used for its assessment. It signifies the importance of use of an appropriate growth standard by describing major flaws with the use of the NCHS growth reference and the need for its replacement with the new WHO growth standard in a country like Pakistan. In section 1.7, conceptual frameworks for

determinants of nutritional status, relevant evidence from South Asia and other determinants of under-nutrition are presented. Description of study objectives, hypotheses and rationale follows in sections 1.8, 1.9. and 1.10.

1.2 Pakistan and child health

Pakistan is a predominantly an Islamic and an agricultural country located in the north-western part of the South Asian subcontinent. It is the second largest country in South Asia after India. It is administratively divided into five provinces; Punjab, Sindh, Balochistan, North West Frontier and Federally Administered Tribal Areas (FATA) (Figure 1.1). Each province is divided into districts, which are the main administrative units (Ghaffar et al., 2000).

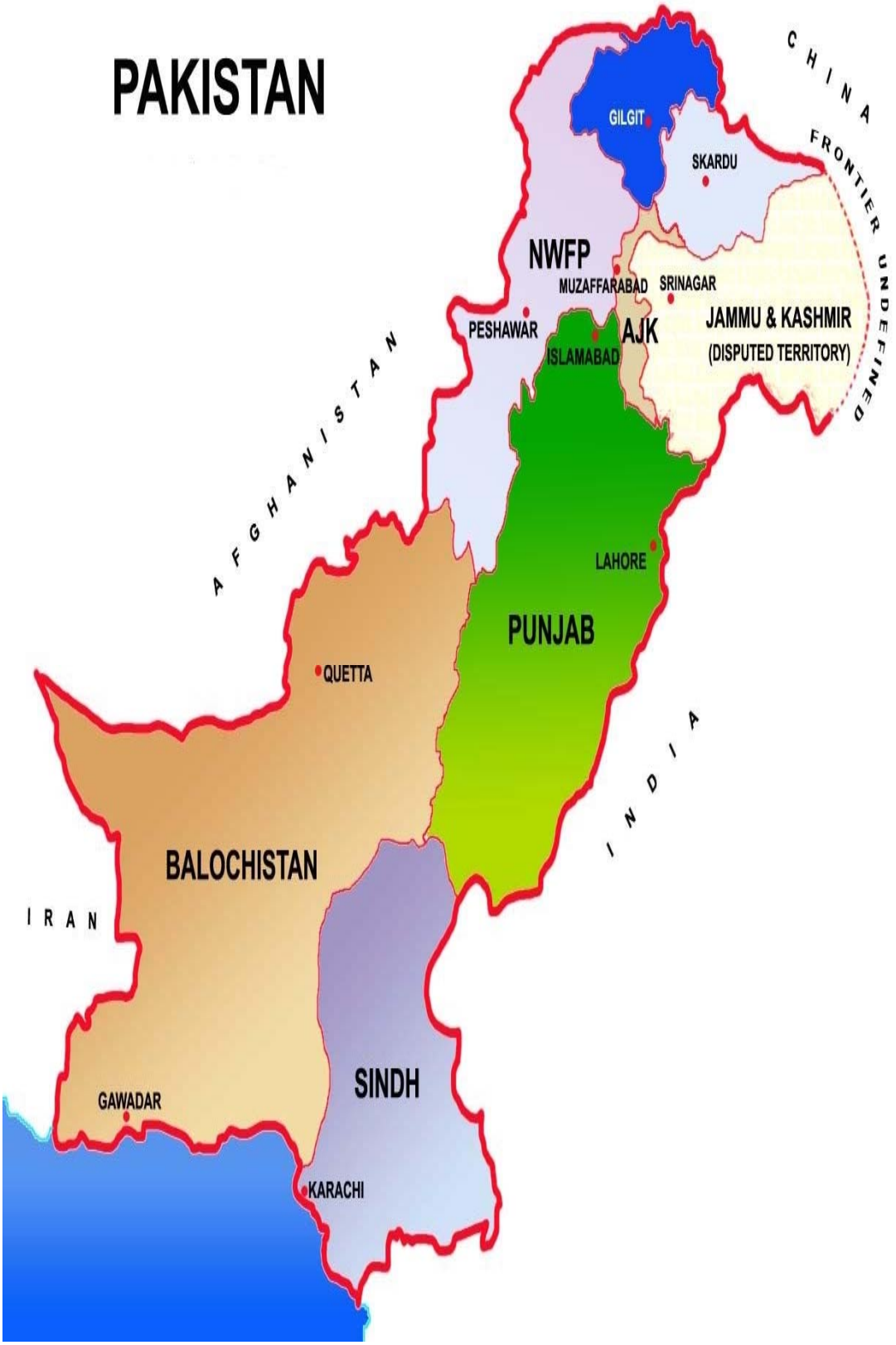
Since its independence in 1947, Pakistan is struggling to emerge from civil and economic crisis and has oscillated between military governments and democratically elected but fragile civilian governments. Persistent political instability has adversely affected all sectors of Pakistani society including health, education and social services (Ghaffar et al., 2000). This is reflected in low ranking (134^{th}) of Pakistan on Human Development Index (HDI) among 177 countries (Human Development Report, 2006).

In this section, I present demographic, socio-economic and child health indicators, behavioural factors influencing child survival in Pakistan, its health care delivery system and its progress towards MDG4 and 1.

1.2.1 Demographic characteristics

Among eight South Asian countries, Pakistan has made late entry into the

Figure 1.1: Map of Pakistan



demographic transition, characterised by the decline in mortality followed by the decline in fertility. It is experiencing *demographic dividend* with a changing age structure as its working-age population bulges and the dependency ratio declines (Durr-e-Nayab, 2006). Globally, it is the sixth most populous country, after China, India, United States of America, Indonesia and Brazil (United Nations Population Division, 2006). About two-thirds of its population is rural. It has a male-biased sex ratio, despite higher life expectancy at birth of females (66 years) than males (64 years) (Population Reference Bureau, 2007). It has a high dependency ratio and a fast growth rate (Pakistan Demographic Survey, 2005) (Table 1.1).

1.2.2 Socio-economic indicators

Pakistan though a low-income country (The World Bank, 2007a) has a gross national income (GNI) per capita of 2,500 International Dollars (ID) (by purchasing power parity (PPP) method) which is third highest in South Asia after Sri Lanka and India (The World Bank, 2007b). Yet, its national health expenditure is only 2% of gross domestic product (GDP) (World Health Organization, 2007). Its literacy level (defined as an ability to read or write a paragraph) is also poor, particularly for females (UNESCO, 2000), an indicator of low social development (Table 1.1). Only about one-third of its population have access to tap water and this proportion drops to 22% for rural population (Pakistan Social and Living Standard Measurement Survey, 2006-07) who rely mainly on unprotected surface sources with inadequate chlorination making them at risk of water-born diseases.

1.2.3 Child health indicators

Pakistan is in a phase of health transition where burden of communicable diseases and

Table 1.1: Demographic and socio-economic indicators of Pakistan and Sindh province

Indicators	Pakistan	Sindh
Total population	165,800,000 (2006) [1]	34,231,000 (2003) [2]
Urban population (%)	34.0 [1]	50.9 [2]
Sex ratio (Male : Female)	102 : 100 [3]	105 : 100 [3]
Dependency ratio (per 100)	81.5 [4]	87.7 [2]
Young population (%)	41.0 (< 15 years) [1]	40.5 (< 14 years) [2]
Population 65 years and over (%)	4.0 [1]	11.9 [2]
Crude birth rate [5]	26.1[4]	26.4 [2]
Crude death rate [5]	7.1[4]	7.4 [2]
Total fertility rate [6]	3.8 [4]	4.7 (1999) [2]
Natural growth rate per annum	1.9 [4]	2.0 [2]
Adult literacy level (%)	42.2 (> 15 years) [7]	45.3 [8]
Male and female literacy levels (%)	53.0 and 29.7 [7]	54.5 and 34.8 [8]
Average household size	6.8 [4]	6.0 [2]
Access to tap water (%)	36 [9]	47 [9]
Concrete housing (%)	32 [9]	40.4 [9]

[1] (Population Reference Bureau, 2007) [2] (Population Welfare Department, 2005b)

[3] (Pakistan Demographic and Health Survey, 2006-07)

[4] (Pakistan Demographic Survey, 2005) [5]Expressed per 1000 population

[6] Expressed per woman of reproductive age [7] (UNESCO, 2000)

[8] (National Plan of Action, 1998)

[9] (Pakistan Social and Living Standard Measurement Survey, 2006-07)

high child mortality has not yet been overcome (Hyder and Morrow, 2000; Pappas et al., 2001). Pakistan has poor child health indicators as shown in table 1.2. Its under-five and infant deaths account for 58% (Mahmood and Kiani, 1994) and 36% (Rukanuddin and Ahmed, 1992) respectively, of all deaths. World-wide, it ranks fourth by number of under-five child deaths in a year (Black et al., 2003) and 47th in descending order by under-five mortality ratio (UNICEF, 2005). Among South Asian countries, its under-five and infant mortality ratios are the second highest after Afghanistan (UNICEF, 2006). For gender difference in child mortality, it ranks fourth globally (Hausmann et al., 2006) and first in South Asia (Filmer et al., 1998). Girls have a 50% greater chance of death than boys between their first and fifth birthdays (Filmer et al., 1998). Preventable and treatable conditions like diarrhoea and acute respiratory infections are the top two causes of early death and loss of healthy life-years in Pakistan (Hyder and Morrow, 2000). Pakistan ranks 88 on the global hunger index out of 119 countries putting Pakistan under extremely alarming situation (Global Hunger Index, 2006). After India (39%) and Bangladesh (5.7%), Pakistan (5.5%) contributes the third largest share of under-weight children in the world (Global framework for action, 2006). Among South Asian countries, Pakistan ranks 3rd, 4th and 6th respectively for prevalence of wasting, underweight and stunting among under-five children (UNICEF, 2006).

These country-wide estimates mask the child health inequalities across urban and rural areas (Ahmed and Ayub, 1992; Ahmed et al., 1992). Infant and under-five mortality ratios are high for rural areas (102 and 132/1000 live births) compared to urban areas (75 and 94/1000 live births), respectively (Ahmed et al., 1992). Similarly, prevalence of under-weight and stunting is greater in rural (44.6% and 54.9%)

compared to urban areas (32.5% and 40.7%), respectively (Ahmed and Ayub, 1992). Hence, rural population not only constitute a majority (66%) (Population Reference Bureau, 2007) but at-risk for greater child mortality and under-nutrition where priority attention needs to be given for identification of specific determinants of child survival and health.

Table 1.2: Maternal and child health indicators of Pakistan and Sindh province

Indicators	Pakistan	Sindh
Maternal mortality ratio [1]	320 (2005) [2]	300 (2005) [3]
Infant mortality ratio [4]	78.0 [5]	81.0 [5]
Neonatal mortality ratio [4]	54.0 [5]	53.0 [5]
Post-neonatal mortality ratio [4]	24.0 [5]	28.0 [5]
Under-five mortality ratio [4]	94.0 [5]	101.0 [5]
Underweight children < 5 years old (%)	38.0 (1996-2005) [6]	48.2 [7]
Stunted children < 5 years old (%)	37.0 (1996-2005) [6]	56.0 [7]
Wasted children < 5 years old (%)	13.0 (1996-2005) [6]	8.7 [7]
A 30 day prevalence of diarrhea (%)	11.0 (2006-07) [8]	12.0 (2006-07) [8]

[1] Expressed per 100,000 live births [2] (UNICEF, 2008) [3] (Government of Sindh, 2005) [4] Expressed per 1000 live births [5] (Pakistan Demographic and Health Survey, 2006-07) [6] (UNICEF, 2006) [7] (Ahmed and Ayub, 1992) [8] (Pakistan Social and Living Standard Measurement Survey, 2006-07)

1.2.4 Health care provision

Pakistan's health care system ranks 122 among 190 countries as assessed by overall

level and distribution of health in the population, responsiveness of health care system to health needs, distribution of financing and fairness of financial contribution (World Health Organization, 2000). It consists of both public and private sectors. The private sector covers a range of health care providers from trained allopathic physicians to faith healers. It is primarily a fee-for-service system that is taking care of 75% of the total curative care services in Pakistan (Health Systems Profile Pakistan, 2005). The public sector comprises more than 10,000 health facilities ranging from Basic Health Units (BHUs) to tertiary referral centres. BHUs cater to around 10,000 to 20,000 population whereas Rural Health Centres (RHCs) cater to around 50,000 to 100,000 population (Health Systems Profile Pakistan, 2005). Both BHUs and RHCs constitute Primary Health Care (PHC) units which provide services at a nominal fee but have limited hours of operation (usually from 8:00 am to 2:00 pm) (NoorAli et al., 1999). In Pakistan, approximately 70% of the population has access to primary health care facilities within one hour of travel time (Health Systems Profile Pakistan, 2005), though large cities are better served by both public and private health facilities than the rural areas (National Health Survey of Pakistan, 1998c).

Under the Pakistani constitution, health is primarily the responsibility of the provincial governments. The federal government is responsible for planning and formulating national health policies and for the implementation of some vertical prevention programmes such as Expanded Program for Immunization (EPI) (Ghaffar et al., 2000). Under the Devolution Plan of the Government of Pakistan, districts have been given comprehensive administrative as well as financial autonomy in almost all sectors, including health (Devolution Plan, 2000). Districts are now

responsible for developing their own strategies, programmes and interventions based on their locally generated data and needs identified (Shaikh and Hatcher, 2004).

1.2.5 Health seeking behaviour for child care

The recent Pakistan Social & Living Standards Measurement Survey (2006-07) shows a two week illness prevalence of 11.6% for children under-five. Of them, 96% had health consultation. This was similar for boys (96.9%) and for girls (96.3%). Among users of health facilities, 69% reported visit to a private facility and only 20% visited public facilities.

1.2.6 Progress with regard to MDG 4 and 1

Pakistan is committed to the United Nations Millennium Development Goals (MDGs) of making its population healthier. To achieve MDG4 (1990-2015), Pakistan is to reduce its under-five mortality ratio (U5MR) from 140/1000 live births to 43/1000 live births (Figure 1.2). Similarly, the target for MDG1 is to reduce under-weight prevalence among children less than 5 years old from 40% to 20% (Pakistan and the MDGs, 2006) (Figure 1.3). However, its progress towards MDG 4 and 1 has not been satisfactory. Pakistan lags behind its neighbouring countries such as Bangladesh and India in reducing its under-five mortality ratios. This is despite the fact that a number of child survival programmes are in place implemented by WHO (EPI, Control of Diarrhoeal Diseases-CDD and acute respiratory infections-ARI), UNICEF (Growth monitoring, Oral rehydration, Breastfeeding promotion and Immunization-GOBI and Integrated Management of Childhood Illnesses-IMCI) and the Government of Pakistan (National Nutrition Program (NNP) and Lady Health Worker (LHW) Program). However, most of theses programmes focus on early detection and

management of the common childhood diseases. There is a lack of enough recognition in these programmes of close association between maternal health and child survival and gender sensitive approach. They also do not address the root causes of child mortality such water source, health behaviour and practices or quality of health care.

Pakistan has been able to reduce its U5MR to 100/1000 live births only, by 2004-05 (Figure 1.2). This is at an average annual rate of 1.8% (1990-2004) and to achieve the target, Pakistan has to accelerate the annual reduction rate to 7.7% (2004-2015) (Bryce et al., 2006). On the other hand, proportion of under-weight children has only dropped to 38% in 2002 (Pakistan and the MDGs, 2006) i.e. only one tenth reduction has occurred over a 12 year period instead of an expected reduction of 50% (Figure 1.3). Hence, focused and accelerated efforts are needed based on locally identified determinants of child survival and health so as to meet the targets for MDG4 and 1.

Figure 1.2: National target and progress towards MDG4

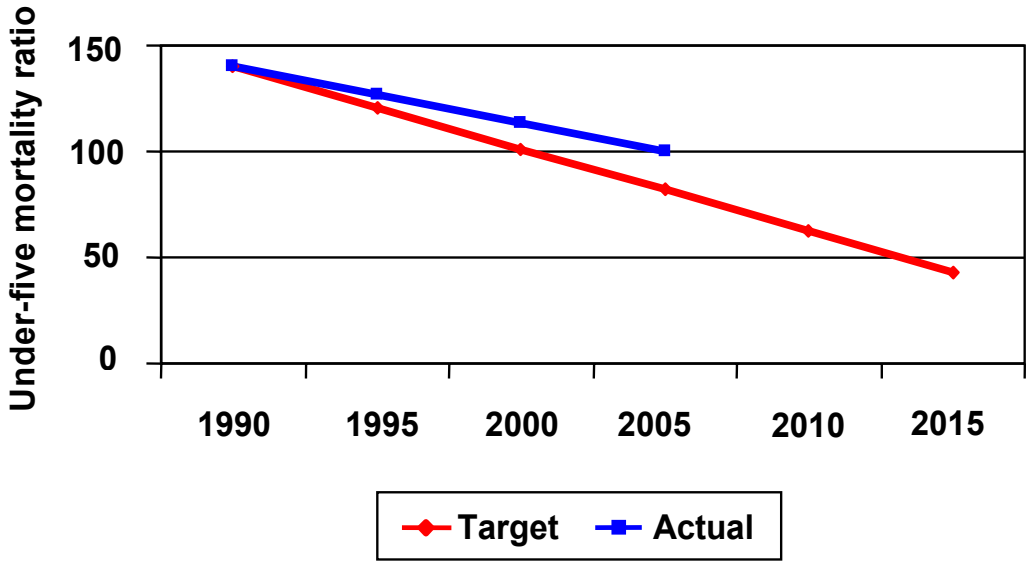
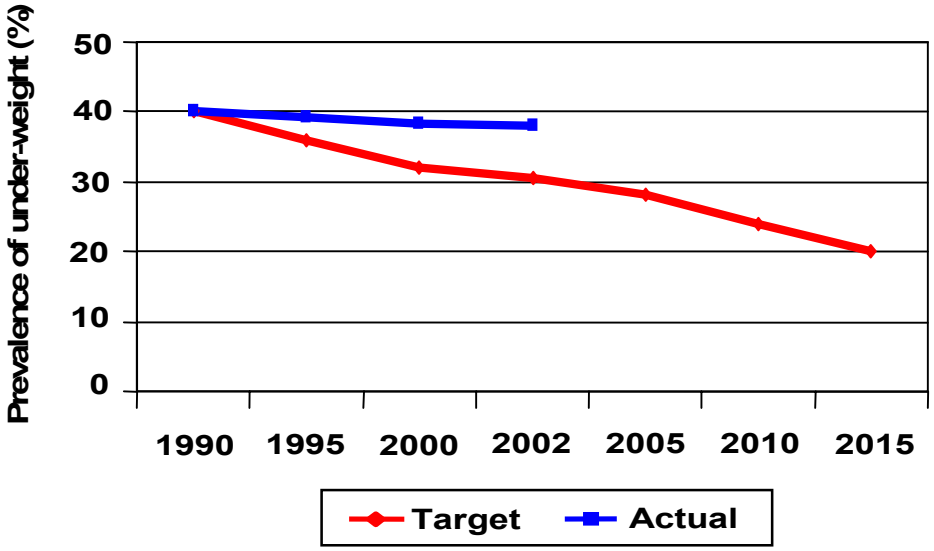


Figure 1.3: National target and progress towards MDG1



1.3 Sindh province and child health

In this section, I describe how Sindh (where the study district is located) relates to the country in terms of demographic, socio-economic and child health indicators.

1.3.1 Background of Sindh province

Sindh is the second largest province of Pakistan that harbours 23% of the total population (Pakistan Demographic Survey, 2000). It is the backbone of country's economy and generates almost 30% of the total national tax revenue. It has a highly diversified economy ranging from heavy industry and finance centred in and around Karachi to a substantial agricultural base along the river Indus. Its population is predominantly Muslim and bilingual with Sindhi and Urdu as its main languages. It has 16 districts which includes Thatta district (the study site) (Figure 1.4).

Figure 1.4: Province of Sindh and its districts

Map of Sindh - Showing Sindh Districts (Produced for Sindhi Association of UK)

1.3.2 Demographic and child health indicators

Due to big cities of Karachi and Hyderabad with the influx of urban migration, its population distribution by urban and rural residence is almost similar. It shows greater disparity in sex ratio and a higher dependency ratio than the national figures (Table 1.1).

Some of its developmental indicators such as literacy level, access to tap water and concrete housing are better than national figures due to predominance of urban population of Karachi in Sindh. Its recent figures of under-five and infant mortality ratio suggest poor child health in the province (Pakistan Demographic and Health Survey, 2006-07) (Table 1.2). Hence, there is a need to investigate the local determinants of child survival at the district level in Sindh province.

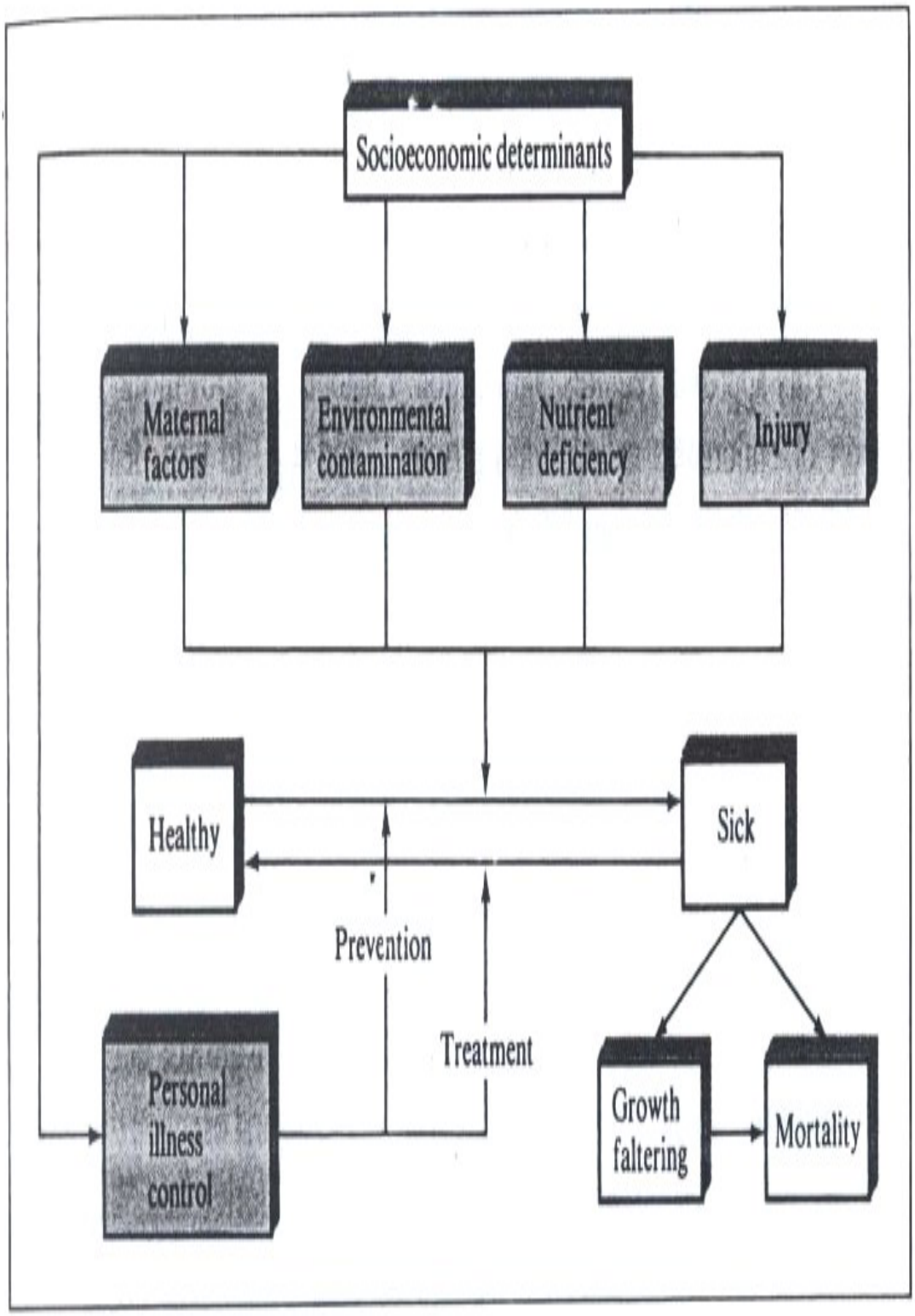
1.4 Child death and poor maternal health

1.4.1 Conceptual frameworks for determinants of child death

Various conceptual frameworks are proposed to study the determinants of child death. The popular framework proposed by Mosley & Chen (1984) identifies a set of socio-economic determinants at the individual, household and community levels that operates through five sets of proximate determinants to influence child mortality. The proximate determinants include maternal factors, environmental contamination, nutrient deficiency, injury and personal illness control. They serve as pathways through which socio-economic factors affect child survival (Figure 1.5).

The model proposed by Becker and Black (1996) takes into account the effect of interventions (preventive and curative) on the frailty distribution of the children

Figure 1.5: Five sets of proximate determinants of child health and mortality (Source: Mosley and Chen, 1984)



(Figure 1.6). It follows a birth cohort with a given birth weight distribution, the latter can be modified in the model by nutritional interventions among mothers. The model inputs for given setting are: (a) the incidence and case fatality by disease and age in the absence of frailty; (b) the coverage and efficacy of interventions against incidence and case fatality by disease and age; (c) the probability of becoming more frail for the survivors of a given disease and less frail for those receiving a nutritional intervention; and (d) relative risks of death associated with different frailty groups. The age interval for the model is a single month so the process is repeated 60 times.

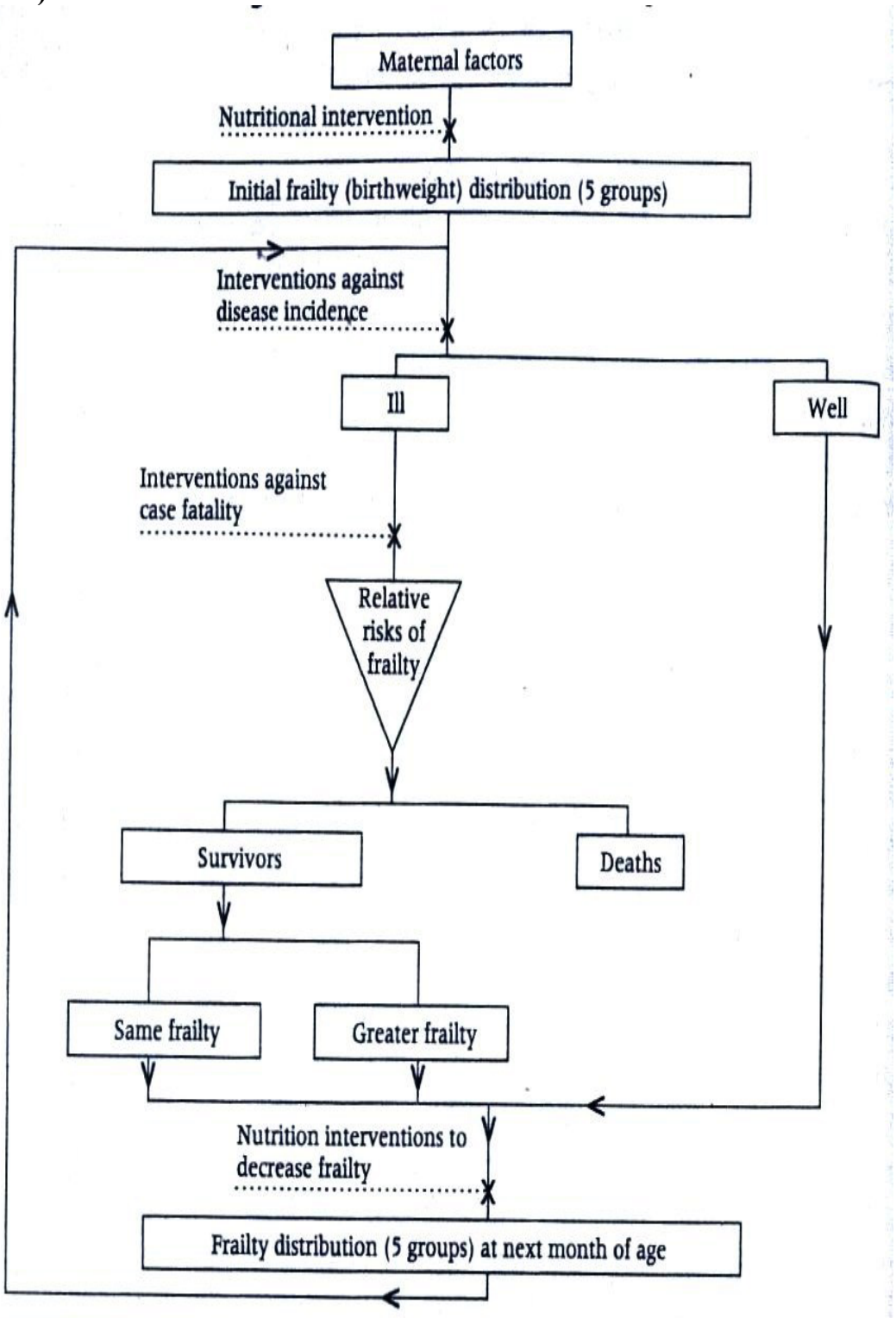
An alternative framework proposed by D'Souza & Bryant (1999) highlights six sets of determinants including maternal, child, socio-demographic, socio-economic, behavioural and environmental factors (Figure 1.7). The progress of illness state to death can be modified by maternal action in the form of illness management and utilization of health services.

In above-mentioned theoretical frameworks, maternal factors such as age, parity, birth interval and previous under-five child death are described as the determinants of child survival. However, maternal health status has not been explicitly described as one of the possible determinants of child survival.

1.4.2 Local determinants of child death

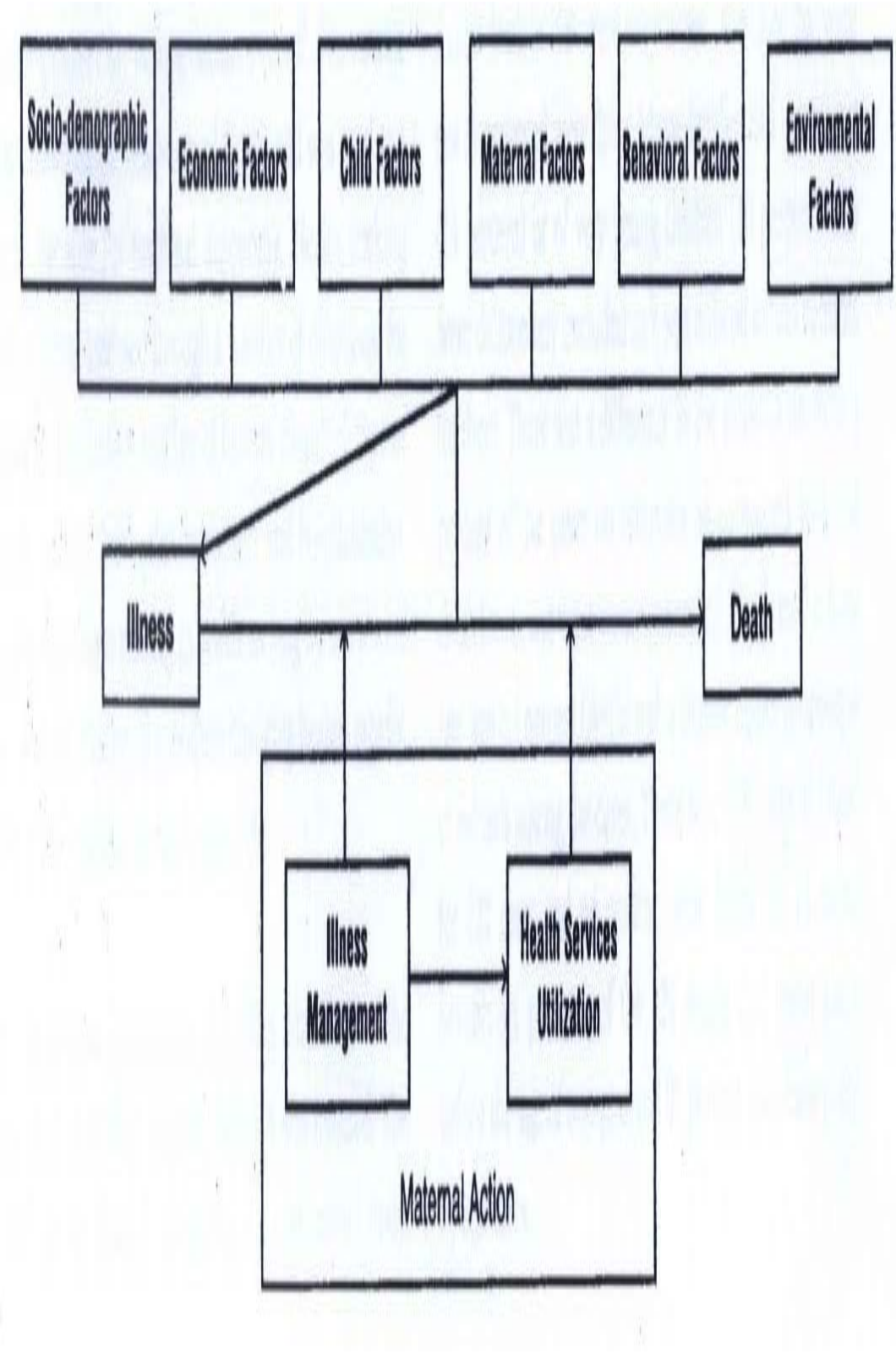
A number of nation-wide (Agha, 2000; Ahmed, 1992; Ali, 2001; Ali et al., 1993; Kiani, 1992; Mahmood and Kiani, 1994; Sathar, 1987; Zahid, 1996) and province-specific studies (Fikree et al., 2002) have been carried out in the past two decades to identify the local determinants of child survival. Small scale studies have also been

Figure 1.6: Model of child mortality (Source: Becker and Black, 1996)



NOTE: Rectangles represent states or outcomes while Xs show where interventions operate in affecting transitions between states. Frailty factors in the triangle affect the risks of death.

Figure 1.7: Theoretical framework of determinants of child mortality (Source: D'Souza and Bryant, 1999)



carried out in specific situations such as squatter settlements of Karachi (D'Souza and Bryant, 1999; Rabbani and Merchant, 1999; Thaver et al., 1990), mountainous areas (Marsh et al., 1993) and certain urban and rural areas of Punjab province (Bennett, 1999; Khan et al., 1993; Pervez et al., 1991). These studies identified significant predictors of child survival as being a neonate (Fikree et al., 2002), a male infant (Agha, 2000) or a girl child (Zahid, 1996), a young (Agha, 2000; Mahmood and Kiani, 1994; Zahid, 1996), or an illiterate mother (Agha, 2000; Ali, 2001; D'Souza and Bryant, 1999; Mahmood and Kiani, 1994; Zahid, 1996), low socio-economic status (Rabbani and Merchant, 1999), and increasing number of siblings (Bennett, 1999). The importance of access to safe drinking water on child health has been well documented as diarrhoea remains the major cause of deaths among children under five (Black et al., 2003; Bryce et al., 2005; Woldemicael, 2000). The effect of safe drinking water along with hand washing practices is shown on the prevention of diarrhoea in a cluster-randomized trial in Karachi squatter settlements (Luby et al., 2006).

None of these studies has examined or included maternal health status as a risk factor for childhood mortality. Most studies have examined only a limited range of variables simultaneously without a clearly defined conceptual framework. They have employed either crude analysis (Fikree et al., 2002; Kiani, 1992; Pervez et al., 1991; Rabbani and Merchant, 1999) or limited multivariate analysis (Ahmed, 1992; Sathar, 1987; Thaver et al., 1990) except for some studies that have used multiple logistic or hazard modelling techniques (Agha, 2000; Ali et al., 1993; Bennett, 1999; D'Souza and Bryant, 1999; Mahmood and Kiani, 1994; Zahid, 1996).

1.4.3 Relationship between child death and poor maternal health

An association between child death and poor maternal health has been examined in a few settings only. In a rural area of Bwamanda, northern Zaire, a cohort of 718 healthy breast-fed infants aged 0-3 months were registered prospectively during 30 months for death reporting at quarterly home visits (Broeck et al., 1996). There were 56 deaths during the follow-up. Chronic maternal disease was assessed by clinical examination and by history and its prevalence was found to be only 3.1%. Mothers with more than one chronic disease sign had 4.8 times greater mortality of infants 0-3 months old compared to mothers without any chronic disease sign (95% C.I.:1.1, 20.7), after adjustment of child's age, > 3 live siblings and parity >5. Though authors reported strong co-relation between number of siblings and parity, they continued to retain both the variables in the final regression model

In rural western India, Hirve and Ganatra (1997) enrolled 4129 newborns. During their follow-up till 5 years of age, there were 286 deaths. Multi-variate analysis identified mother's nutritional status as an important determinant of child mortality, beside birth weight, child's nutritional and immunization status. They found four (95% C.I.: 1.7, 9.6) and three times (95% C.I.: 1.7, 5.6) respectively, greater infant and under-five mortality among mothers with non-pregnant weight less than or equal to 40 kg compared to more than 40 kg.

This association between poor maternal health and deaths among under-five children has not been examined in Pakistan. In rural Pakistan, women are often in poor health status. This is evidenced by a high prevalence (77.2%) of self-rated poor or fair health status among women aged ≥ 15 years (Ahmad et al., 2005), a high prevalence of

anaemia (50% by pallor of conjunctiva and 38.9% by haemoglobin levels less than 12 μgrams/millilitre) among women of reproductive age (15-44 years) and a high prevalence of underweight among lactating (16.1%) and non-pregnant women (12.5%) (National Nutrition Survey, 2001-02). Hence, it is important to estimate the possible association of under-five deaths and poor maternal health in a local rural set-up.

1.5 Gender differential and child health care

1.5.1 Gender differentials in relation to social values in South Asia

The term gender refers to perceptions and expectations of the society and constraints placed upon, based on the social and cultural values and roles of men and women (Vlassoff, 1994). It is a social construction of biological sex which determines inequality in power, privileges and resources between men and women (Ahmed et al., 2000). In patriarchial societies such as in South Asia, men have primary responsibility for activities outside home, such as employment and making investment decisions, while women have primary responsibility for taking care of children and home (Balk, 1994). Due to perceived higher status and greater economic power of men than women in the society, the latter are considered to be sub-ordinate of the former within and outside household (Das Gupta and Li, 1999; Mumtaz and Fatima, 1992; Pande, 2003).

However, women are the prime care givers regarding child health care during the event of illness, family health practices and nutrition (Hossain et al., 2007; Okojie, 1994). Lower social status of women may influence health by reduced access to education and information and by lack of decision making power regarding mobility

and expenditure on health care (Hossain et al., 2007; Vlassoff, 1994). Socially determined value of the girl child is often associated with negative and fatal consequences on her health (Bhan et al., 2005).

1.5.2 Gender differentials in child mortality in South Asia

South Asia has the greatest gender disparity in the world (Filmer et al., 1998; The World Bank, 2005). Among South Asian countries, gender disparity in mortality is greatest in Pakistan (Fikree and Pasha, 2004 ; Filmer et al., 1998). Girls have a 50% greater chance of death than boys between their first and fifth birthdays (Filmer et al., 1998). Despite higher life expectancy at birth for Pakistani females (66 years) compared to males (64 years), gender disparity in Pakistan is reflected in later life by a male biased adult sex-ratio (106:100) (Population Reference Bureau, 2007). Occurrence of excessive female mortality after neonatal period (Mahmood and Mahmood, 1995) is of particular concern, despite biological advantage of females over males (Coale, 1991; Koenig and D'Souza, 1986).

1.5.2.1 Pathways for gender differentials in child mortality

Gender differentials in mortality in South Asia is considered to be a clearest sign of overt or covert discriminatory behavioural practices which favour sons over daughters (Ganatra and Hirve, 1994). Though the reasons for gender differential in child mortality in South Asia are not fully understood, two possible mechanisms frequently proposed are;

1) Gender differential in health care utilization (Bhan et al., 2005; Das Gupta, 1987; Fauveau et al., 1991; Hazarika, 2000; Mahmood and Mahmood, 1995; Mitra et al., 2000; Pandey et al., 2002; Pokhrel et al., 2005);

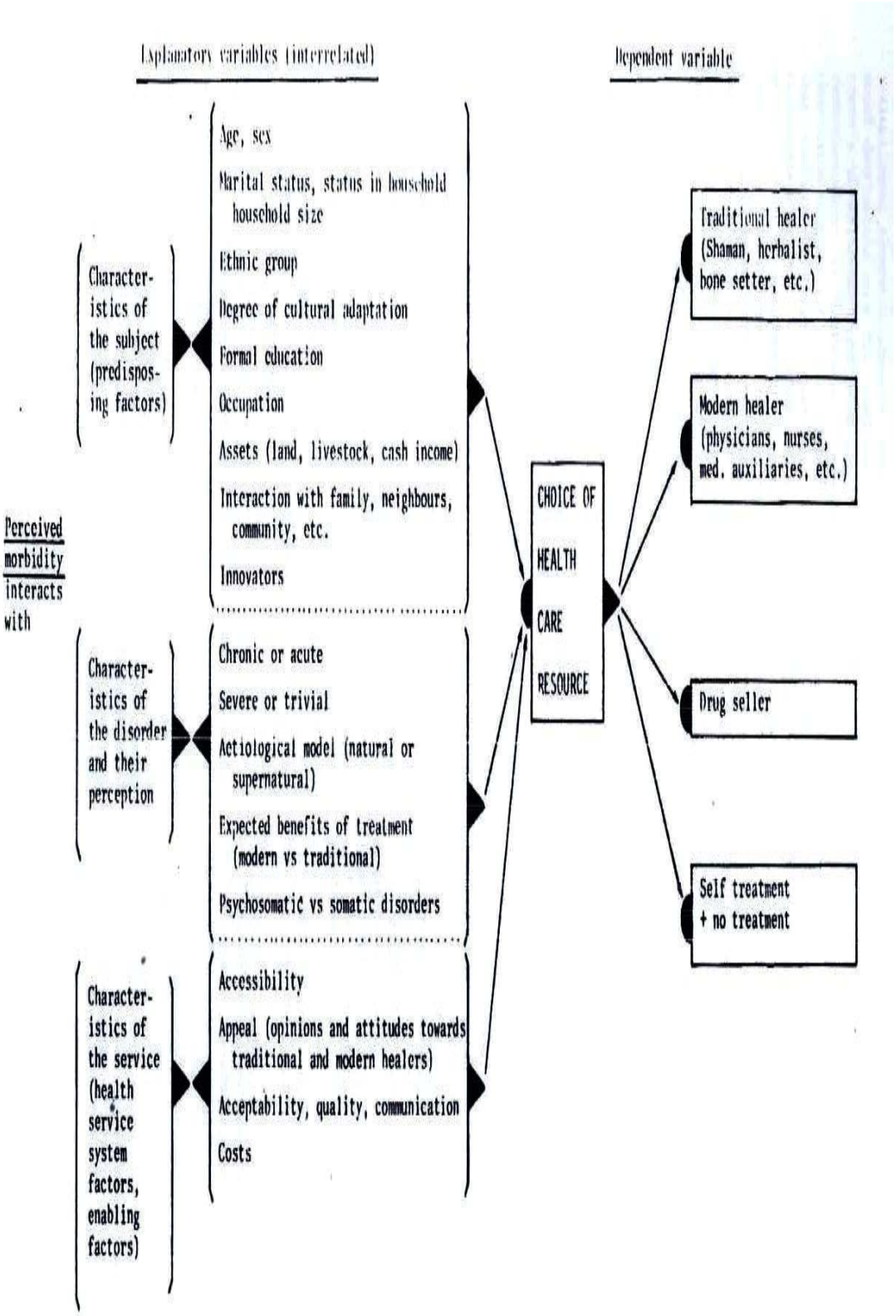
2) Gender disparity in nutritional status (Baig-Ansari et al., 2006 ; Choudhury et al., 2000; Pande, 2003; Rousham, 1996; Shah et al., 2003).

To develop effective child survival policies and to achieve gender equity in health, it is of utmost importance to examine carefully the above-mentioned potential pathways for gender differential in child survival within the appropriate conceptual and analytical frameworks.

1.5.3 Conceptual frameworks for determinants of health care seeking

Widely known conceptual frameworks for determinants of health care seeking in developing countries are those proposed by Kroeger (1983a), Anderson (2001) and Pokhrel and Sauerborn (2004). Kroeger (1983a) categorized health care utilization broadly into two tracks: (i) the pathway model which describes steps in health care decision making, beginning with the perception of symptoms and concluding with the use of different health care facilities and (ii) the determinant model which focuses on a set of explanatory variables associated with the choice of different forms of health services. He combined the two tracks into a simple integrated framework in which the perceived morbidity interacts with the characteristics of subjects, illness and services to influence the choice of health care resource (Figure 1.8). This model is different from the models described by Anderson (2001) and Pokhrel and Sauerborn (2004) in that it includes the illness characteristics among determinants of health care seeking. This model however, has a primary focus on choice among various health care resources as the outcome. It does not consider perceived morbidity as an outcome. Rather, it examines the health care seeking behavioural given the perceived morbidity.

Figure 1.8: Theoretical framework for choice of healer (Source: Kroeger, 1983a)



Anderson behavioural model has evolved since 1968. Originally, it focused on the family as the unit of analysis which later shifted to the individual (Andersen, 1995). There are three major components of this model; (i) predisposing factors, (ii) enabling factors and (iii) health system factors which determine perceived morbidity and choice among health care resources (Figure 1.9). Predisposing factors are mainly characteristics of the individual, enabling factors refer to the ability to spend on health and health system factors relate to availability of and access to the services (Anderson et al., 2001).

The conceptual construct developed by Pokhrel and Sauerborn (2004) takes into account complex nature of household decision-making process regarding child care that involves several steps. This model points to the understanding of the stage of the household decision-making process at which gender bias enters and of the factors that determine this bias. This conceptual construct has four hierarchical steps i.e. (i) perception of illness; (ii) care seeking; (iii) choice of care provider and (iv) health expenditure (Figure 1.10). This model does not however describe illness characteristics among possible determinants of care seeking behaviour. In all three models, gender is included as one of the determining factors, particularly for societies where sex roles are socially constructed.

The model proposed by Pokhrel and Sauerborn (2004) has been applied in Nepal only on children aged 15 years or less using the data from Nepal Living Standard Survey (1996) (Pokhrel, 2007 ; Pokhrel and Sauerborn, 2004; Pokhrel et al., 2005). In these studies, use of a four-step construct was found to be useful in capturing the variation among various choices for health care within the same decision episode and with the

Figure 1.9: Conceptual framework for care seeking behaviour for childhood illness (Source: Anderson, 2001)

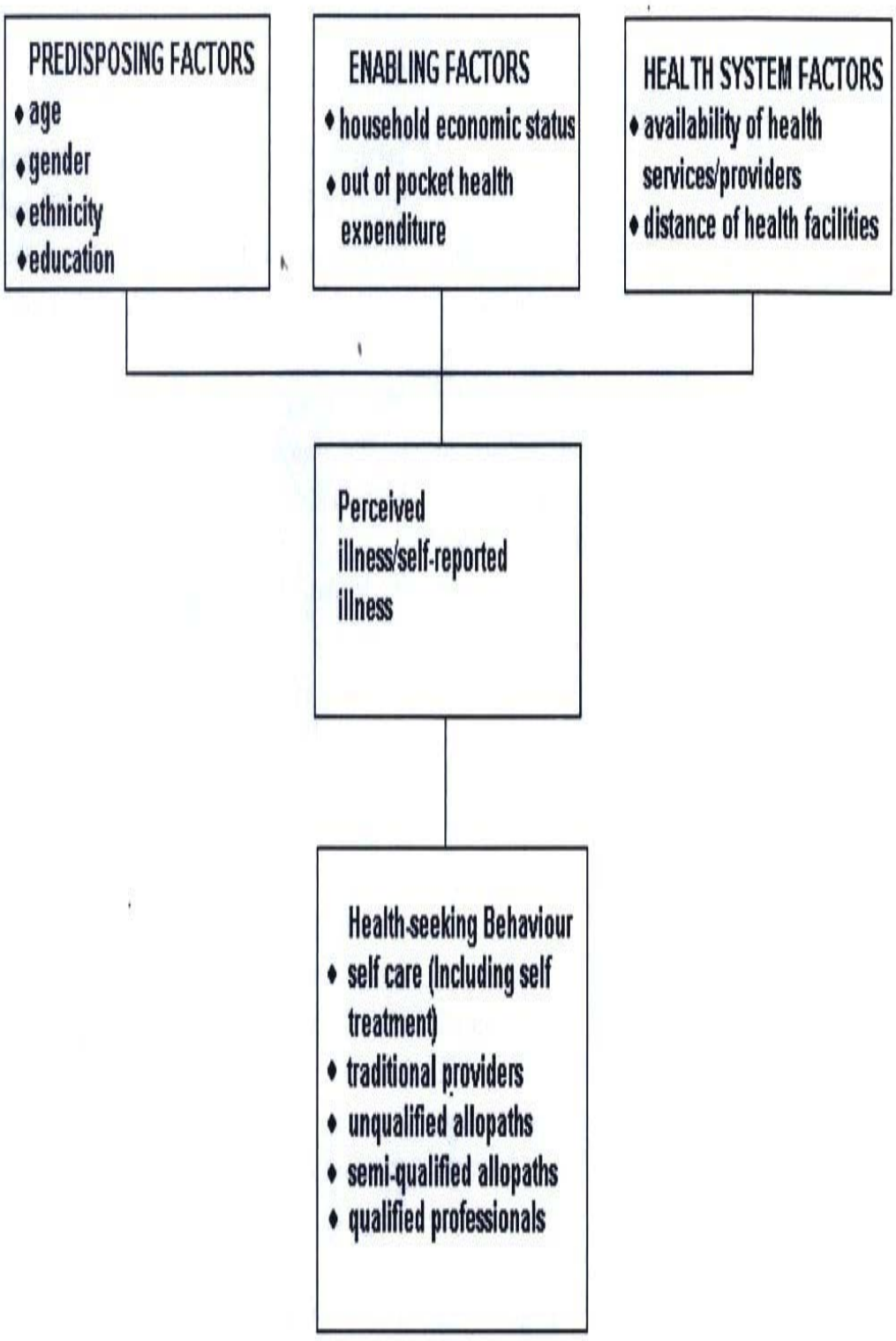
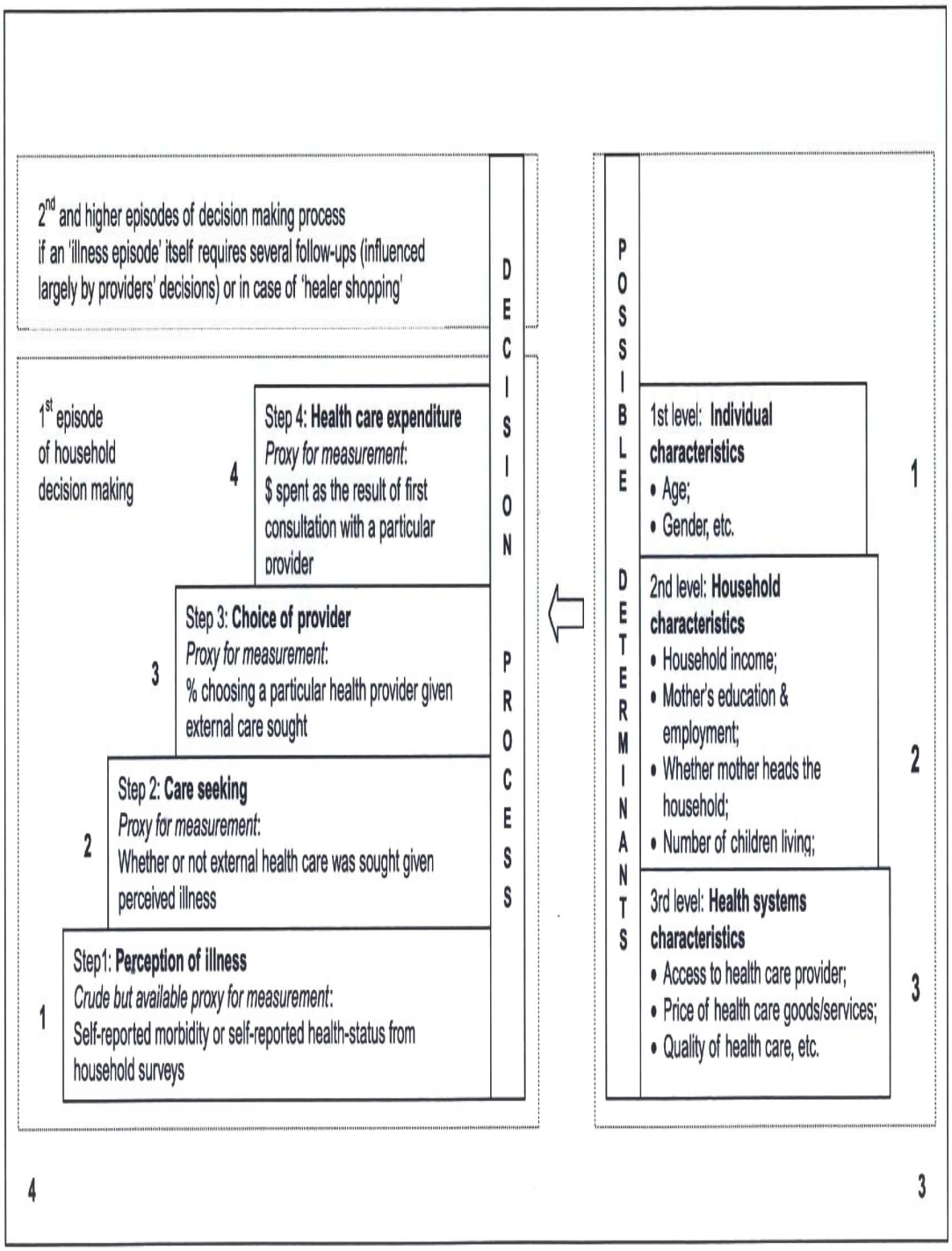


Figure 1.10: Theoretical framework for household decision making on child health care as a process involving four hierarchical steps and determined by factors at three levels (Source: Pokhrel and Sauerborn, 2004)



use of same background characteristics. These studies have highlighted the importance of child's gender in household decision for the health care.

The other popular models that are proposed in the context of developed world are those suggested by David Mechanic (1964) and by Zola (1973). David suggests that illness behaviour for children is influenced by child-rearing practices, family stress, role relationships such as age and sex roles in the society and family definition of health resources. These in turn are determined by the social and psychological characteristics of the mother, child and family, mother's attitude towards her own and children's health, illness and use of medical services, mother's report concerning their children's health and responses of children relevant to health and illness. David's findings are however based on the school-going children from Wisconsin (Mechanic, 1964). Zola describes three assumptions that determine pathway to doctor. These include: (i) importance and frequency of illness episodes in an individual life; (ii) representativeness of those illness episodes that come to the professional attention and (iii) the process by which an individual decides that his symptoms becomes worthy of professional attention. His model was based on the study of English speaking subjects aged 18-50 years who visited Eye, Ear, Nose and Throat and Medical Clinics of Massachusetts General Hospital (Zola, 1973).

1.5.4 Gender and health care seeking in South Asia

Gender and health care seeking has been focus of research over the last two decades in South Asian countries including India, Bangladesh, Nepal and Pakistan. Most of these studies have examined the gender differentials in health care seeking among children less than 5 years old for common childhood illnesses such as fever, diarrhoea

and respiratory infections (Bhan et al., 2005; Filmer et al., 1998; Ganatra and Hirve, 1994; Mahmood and Mahmood, 1995; Pandey et al., 2002; Pillai et al., 2003). Except for study by Pandey et al. (2002) in which illness episode was used as the unit of analysis, the rest considered children as the unit of analysis. Their recall period varied from one week (Ganatra and Hirve, 1994; Pandey et al., 2002) through two weeks (Pillai et al., 2003) or a month (Pokhrel et al., 2005) to two months (Bhan et al., 2005; Das Gupta, 1987).

Seeking timely and effective health care can prevent child mortality (D'Souza, 2003 ; de Silva et al., 2001). This is particularly important for common causes of childhood death (Black et al., 2003; Murray and Lopez, 1997) and illnesses (Filmer et al., 1998) such as diarrhoea and respiratory infections, for which effective low cost treatments are available. Discrimination against girls in health care practices is reported to be one of the factors to account for higher female mortality. With the notable exception of Kerala study on medical care sought and choice of provider (Pillai et al., 2003) and Nepal study on illness reporting (Pokhrel, 2007), most of the studies have consistently shown a favoured bias towards males for use of health services (Hassan and Khanum, 2000; Pillai et al., 2003), choice of care provider (Fauveau et al., 1991; Ganatra and Hirve, 1994; Hazarika, 2000; Pandey et al., 2002; Pillai et al., 2003), referral or hospitalization (Bhan et al., 2005; Fauveau et al., 1991; Ganatra and Hirve, 1994; Mitra et al., 2000) and health expenditure (Das Gupta, 1987; Pandey et al., 2002).

With the particular reference to Pakistan, there is scant evidence of gender differentials in child health care practices. This is in the form of community-based

studies for fatal (Hassan and Khanum, 2000) and non-fatal illnesses (Hazarika, 2000; Mahmood and Mahmood, 1995) or as a hospital-based study (Faisel et al., 1993). In these studies, gender differentials are examined in morbidity reporting or prevalence (Hazarika, 2000; Mahmood and Mahmood, 1995) and outside home care sought (Faisel et al., 1993; Hassan and Khanum, 2000; Hazarika, 2000; Mahmood and Mahmood, 1995). These studies however, did not utilize conceptual frameworks and mainly presented crude estimates. Hence, it is important to carefully examine gender disparity in health care utilization linking the conceptual framework with the analytical framework.

1.5.5 Other determinants of health care seeking

Beside gender, a number of other factors have been identified in the literature as influencing care seeking for childhood illnesses. This includes child's age, illness, maternal, household and community characteristics. Mothers are more likely to seek treatment for infants than for older children (Fosu, 1994; Goldman et al., 2002; Taffa and Chepngeno, 2005). Children with fever and associated gastrointestinal symptoms were more likely to be taken for treatment than for cough or other illnesses (Goldman and Heuveline, 2000; Goldman et al., 2002; Taffa and Chepngeno, 2005). If illness episode is more than 7 days, mothers are more likely to seek care than if illness is of shorter duration (Sutrisna et al., 1993; Terra deSouza et al., 2000). Illness severity is found to influence female disadvantage in care seeking and hospitalization (Bhan et al., 2005)

Young mothers were more likely to take the child to health care provider (Fosu, 1994; Taffa and Chepngeno, 2005). This could be due to less experience and hence, less

confidence among young mothers in their own ability to treat a sick child with home remedies. Older mothers have more young children to look after or they are inclined to use their experience and customs in child rearing and are less likely to use formal health care.

Maternal literacy as a predictor of health service utilization has been widely researched. Literate mothers are more likely to seek care for sick children than illiterate mothers due to their greater decision making power, ability to efficiently utilize financial and other resources, better perception of illnesses severity, improved knowledge of modern health services, greater ability to communicate to modern health care provider or associated improved socio-economic condition (Fosu, 1994; Govindasamy and Ramesh, 1997; Terra deSouza et al., 2000; Thind and Cruz, 2003). However, gender bias in utilization of services is seen greater among literate than among illiterate mothers (Bhan et al., 2005). Greater illness reporting is observed among mothers who report themselves to be in poor health (Minkovitz et al., 2005; Waters et al., 2000).

Other factors that may possibly influence health care seeking include family income (Goldman et al., 2002) or socio-economic status (SES) (Bhan et al., 2005), family size (Bhan et al., 2005; Selwyn, 1987), availability of health care (Goldman et al., 2002) and transportation. Hence, while examining relationship between gender and health care decision, it is important to take into account the effect of other possible determinants.

1.6 Choice of growth standard and nutritional status of pre-school children

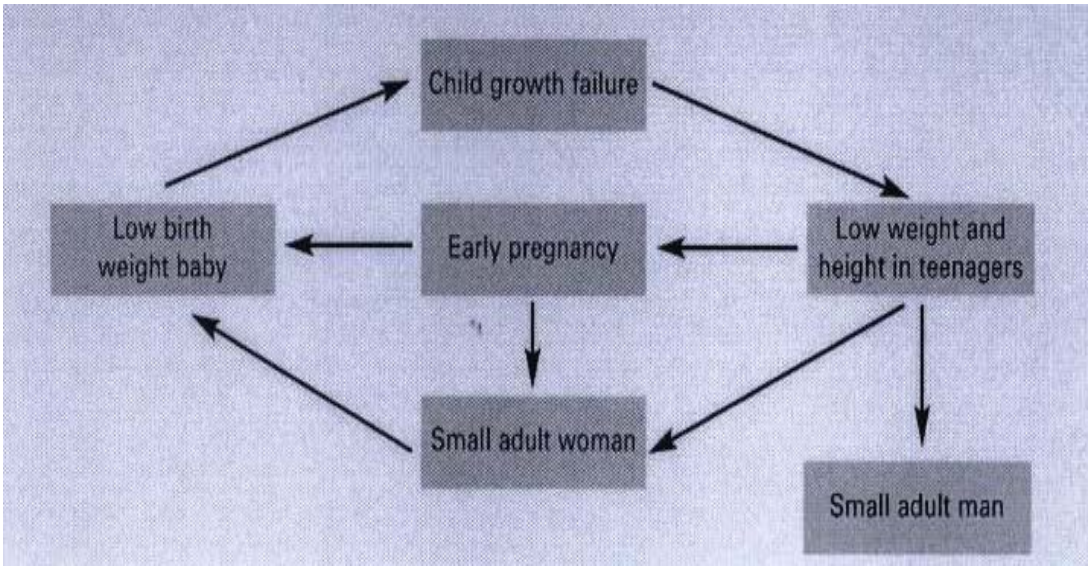
1.6.1 Importance of child under-nutrition in public health

Under-nutrition among children is one of the most important and longstanding public health problems in developing countries (UNICEF, 1990). Reduction of under-weight prevalence among children less than 5 years by half between 1990 and 2015 is among the targets of MDG1 (United Nations, 2005). This is due to increasing recognition of relevance of nutrition as a basic pillar for social and economic development. Under-nutrition is associated with 50% of all child death in developing countries because of its worsening effect on infectious diseases (Pelletier, 1994a; Pelletier, 1994b; Pelletier et al., 1995; Rice et al., 2000; Schroeder and Brown, 1994). Nutritional status is one of the proximate determinants of mortality in the conceptual framework proposed by Mosley and Chen (1984). It also affects physical growth (Golden, 1994; Liu et al., 1998) and cognitive development (Berkman et al., 2002; Mendez and Adair, 1999). Poor health among surviving girls may not only be one of the potential pathways for excessive female mortality but it also has implications for obstetrical risk due to short stature (Martorell et al., 1992) and may be perpetuated across generations (Pande, 2003) (Figure 1.11).

1.6.2 Common parameters for assessment of nutritional status

Nutritional status of children can be assessed using anthropometry, biochemical indicators (e.g. a decrease in serum albumin level) and clinical signs of under-nutrition (e.g. oedema, hair and skin changes). Anthropometry is sensitive over the full spectrum of under-nutrition whereas biochemical and clinical indicators are useful

Figure 1.11: Effect of under-nutrition across life cycle (Source: UNICEF, 1990)



only when a child is at least moderately nourished. It however lacks specificity since changes in body measurements can also be due to several other factors such as altitude, stress and genetic heritage. In children up to five years of age however, the effects of these factors on anthropometric measurements are negligible compared to the effect of under-nutrition (Blossner and de Onis, 2005).

Common anthropometric indicators of child under-nutrition are combinations of body measurements and age. The indicators recommended for international use are stunting, wasting and underweight. Each indicator signals distinct biological processes. Stunting reflects a deficit in height relative to age due to linear growth retardation as a result of long term suboptimal health and/or nutritional conditions. Wasting reflects a deficit in weight relative to height due to deficit in tissues and fat mass, usually as a short term consequence of famine or severe disease. Since, it can be calculated without knowledge of age, it is useful for population where dates of

birth are often not available (Cole, 1993). Underweight or low weight-for-age reflects both wasting and stunting and is thus a synthesis of the current status of body proportion and linear growth (de Onis et al., 1993; World Health Organization, 1995). It reflects both acute and chronic under-nutrition and gives an indication of the overall level of under-nutrition. It is routinely used to monitor a population's nutritional status over time and is one of the Millennium Development Goals indicators (Fenn and Penny, 2008). Two preferred anthropometric indices for nutritional status are height for age and weight for height, since they discriminate different physiological and biological processes (Gorstein et al., 1994).

1.6.3 National Centre for Health Statistics (NCHS) dataset as an international growth reference

Despite its use world-wide, suitability of original 1977 NCHS dataset as an international growth reference for assessment of nutritional status of children has been challenged on serious technical grounds (World Health Organization, 1995). It was derived from two distinct datasets (Fels Research Institute longitudinal and NCHS cross-sectional) compiled over two different time periods (1929-75 and 1960-75) and from two different populations (de Onis et al., 1997). It was based on three-monthly measurements of primarily formula fed, white middle-class children from birth to 3 years of age (de Onis et al., 1997; WHO Working Group on Infant Growth, 1995). Its infancy portion did not adequately reflect the growth of either breast-fed or formula-fed infants (de Onis et al., 1997; de Onis and Habicht, 1996; Garza and de Onis, 1999; Victora et al., 1998; WHO Working Group on Infant Growth, 1995; Zuguo et al., 1998) showing rapid growth up to 3 months of age and then growth faltering after 4 months of age (de Onis and Habicht, 1996; Victora et al., 1998; Zuguo et al., 1998).

Its other drawbacks include curve disjunction at 24 months of age and positive skew in weight distribution (de Onis et al., 1997; de Onis and Habicht, 1996; Ogden et al., 2002), use of varying sample sizes by age (Victora et al., 1998), span of charts between 5^{th} and 95^{th} percentiles (Robert and Dallal, 2001) and possibility of misclassification and misdiagnosis of abnormal growth for some infants due to curve fitting procedures (Piwoz et al., 1992). Also, the statistical techniques available at the time for generating growth curves led to inappropriate modelling of pattern and growth variability (Garza and de Onis, 1999).

Consequently, in early 1990s, World Health Organization (WHO) conducted an in-depth analysis of the growth data from breast-fed infants (de Onis and Habicht, 1996; WHO Working Group on Infant Growth, 1994, 1995). The research showed that the growth pattern of healthy breast-fed infants differs significantly from 1977 international reference. Given the health and nutritional benefits of breast-feeding, the potential misinterpretation of growth pattern of healthy breast-fed infants had great public health significance. Due to possibility of the flawed conclusion, the continued use of 1977 reference to monitor individual growth or derive population-based estimates of under-nutrition was discouraged. It was recommended in 1994 at World Health Assembly by resolution WHA47.5 to develop new international reference (based on an international sample of breast-fed infants from healthy population with unconstrained growth). Hence, WHO organized and sponsored a Multi-centre Growth Reference Study (MGRS) between 1997-2003 to develop new growth standard (Bhandari et al., 2002; Mohamed et al., 2004; Owusu et al., 2004; World Health Organization, 2004.).

1.6.4 WHO Multi-centre Growth Reference (MGR) as the new international growth standard

WHO Multi-centre Growth Reference Study (MGRS) describes the growth of children when disease-free and when reared following healthy practices. The later includes exclusive or pre-dominant breast-feeding for at least 4 months and a non-smoking environment. MGRS is unique because it includes affluent children from widely differing ethnic and cultural settings (Brazil, Ghana, India, Norway, Oman and United States of America) and combines a longitudinal component from birth to 24 months with a cross-sectional component of children aged 18 to 71 months. Rigorous scientific standards, quality control measures during data collection and adoption of state-of-art statistical methods for constructing growth curves are its additional strengths. The new growth standard for infants and young children was released in April 2006 (http://www.who.int/childgrowth/en/) (Garza and de Onis, 2007). Its use was recommended in preference to the NCHS reference to assess nutritional status of children regardless of ethnicity, socio-economic status and type of feeding (WHO Multi-centre Growth Reference Study Group, 2006a, 2006b). The new standard adopts a fundamentally prescriptive approach and serves not only as an international reference useful for comparison but also describes normal growth under ideal circumstances (de Onis et al., 2007; WHO Multi-centre Growth Reference Study Group, 2006a).

1.6.5 Use of NCHS growth reference in Pakistan

Pakistan is among 99 countries where the NCHS reference is currently used in the national program (de Onis et al., 2004). Recently, field testing of the new WHO growth standard for under-five children was carried out at two health centres in

Karachi to examine concordance between clinical assessment and WHO standard (Onyango et al., 2007). Comparison of the estimates of under-nutrition derived from the WHO standard and the NCHS reference in Bangladesh (de Onis et al., 2006) suggest significantly higher prevalence of under-weight, stunting and wasting during infancy using WHO standards. Since Pakistan is the third largest contributor of the undernourished children world-wide, it is highly relevant to examine the impact of this change of growth standard on various parameters of nutritional status at the population and to assess the degree of agreement between individual estimates from the two references. This would have implication for resetting targets for MDG1 and for assessing gender differential in nutritional status.

1.7 Gender differential and nutritional status of pre-school children

1.7.1 Conceptual frameworks for determinants of nutritional status

There are two popular conceptual frameworks for the determinants of under-nutrition; one proposed by Mosley and Chen (1984) and other proposed by UNICEF (1990). Mosley and Chen (1984) identified five sets of proximate determinants of the growth faltering among survivors similar to that identified for child mortality i.e. maternal factors, environmental contamination, nutrient deficiency, injury and personal illness control (Figure 1.5). Among socio-economic determinants that operate through proximate determinants, child's gender may determine food availability (that operates at the household level) based on cultural and societal values.

The conceptual framework proposed by UNICEF (1990) (Figure 1.12) recognises

three levels of determinants;

(i) Basic or distal level determinants that relates to a nation or a society as a whole,

(ii) Underlying or intermediate level determinants that relates to family and/or community and

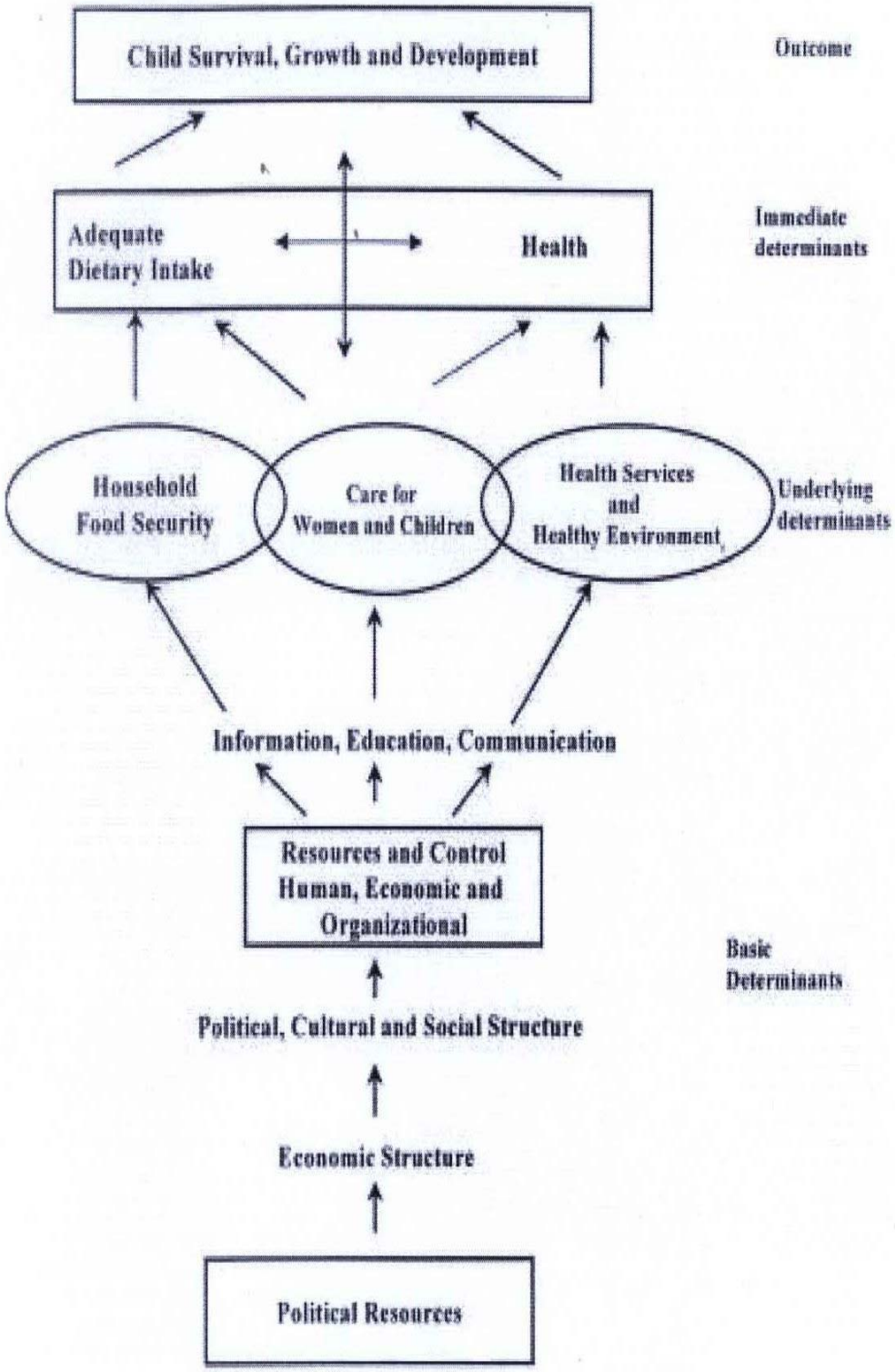
(iii) Immediate or proximal level determinants that relates to the individual.

In this model, gender may determine dietary intake (a proximate determinant) through household food security (an intermediate determinant).

1.7.2 Gender and child's nutritional status in South Asia

Though, gender differential in nutritional status has been suggested to be the alternate explanation for excessive female mortality, there is less extensive work done on this possible association than that on gender differential in health care seeking. In addition, evidence regarding the existence of such a differential in nutritional status is conflicting. A number of studies do not support the existence of female disadvantage in nutritional status. This includes studies from South Asian countries (Filmer et al., 1998) based on Demographic Health Surveys (DHS - 1985 to 1995), 14 Indian States based on National Family Health Survey (NFHS) (Kurz and Johnson-Welch, 1997), North and South Indian residents of a Delhi slum (Basu, 1993), 300 rural and urban communities of Pakistan based on Pakistan Integrated Household Survey (PIHS) (1991) (Hazarika, 2000), 32 enumeration blocks and 48 villages based on National Health Survey of Pakistan (1998a) and four districts of Sindh (Shah et al., 2003). On the other hand, three times greater prevalence of stunting among girls of 6-18 months age was reported for eight squatter settlements of Karachi (Baig-Ansari et al., 2006) and 44% greater occurrence of severe malnutrition among girls (as assessed by mid-

Figure 1.12: UNICEF conceptual framework for determinants of nutrition (Source: UNICEF, 1990)



upper arm circumference) was observed in Chakaria thana of Bangaldesh (Choudhury et al., 2000). In other situations, female disadvantage in nutritional status was observed in the presence of lower socio-economic status (Rousham, 1996) and of the older siblings of similar gender (Pande, 2003).

There is a need to re-assess gender-differential in nutritional status of pre-school children due to two main reasons. First, the nutritional status of the children needs to be defined based on new WHO growth standard since conclusions about the difference in nutritional status of boys and girls would depend upon the growth reference used (Moestue et al., 2004). Second, the net effect of gender on nutritional status should be assessed by using appropriate effect measure (i.e. prevalence ratio instead of odds ratio due to greater frequency of under-nutrition in Pakistani population) and with account of household and contextual community factors.

1.7.3 Other determinants of child's nutritional status

In addition to the child's gender, a number of other factors may influence child's nutritional status. This includes feeding and immunization status, illness, maternal and community characteristics. Increased risk of under-weight is reported with early introduction of food before 6 months (Bloss et al., 2004). Stunting is associated with incomplete or no immunization (Bloss, 2004), morbidity status (Espo et al., 2002; Kossmann et al., 2000), lack of formal maternal education (Baig-Ansari et al., 2006). Community factors such as access to health facilities (Holmes, 2006) and use of piped water supply (Merchant et al., 2003) can also influence child's nutritional status.

1.8 Study objectives

Following are the four specific objectives of this thesis aiming towards improved child survival (Figure 1.13).

1. To quantify the association between self-reported mother's health status and survival of children under-five years of age.

2. To explore existence of gender differential in household-decision for child health care at various stages of the conceptual framework.

3. To compare the estimates of stunting, wasting and under-weight for pre-school children at the population-level based on the WHO Standard and the NCHS reference and to study the degree of agreement between estimates from two references at the individual level.

4. To explore existence of gender differential in stunting, wasting and under-weight among pre-school children based on the new WHO growth standard.

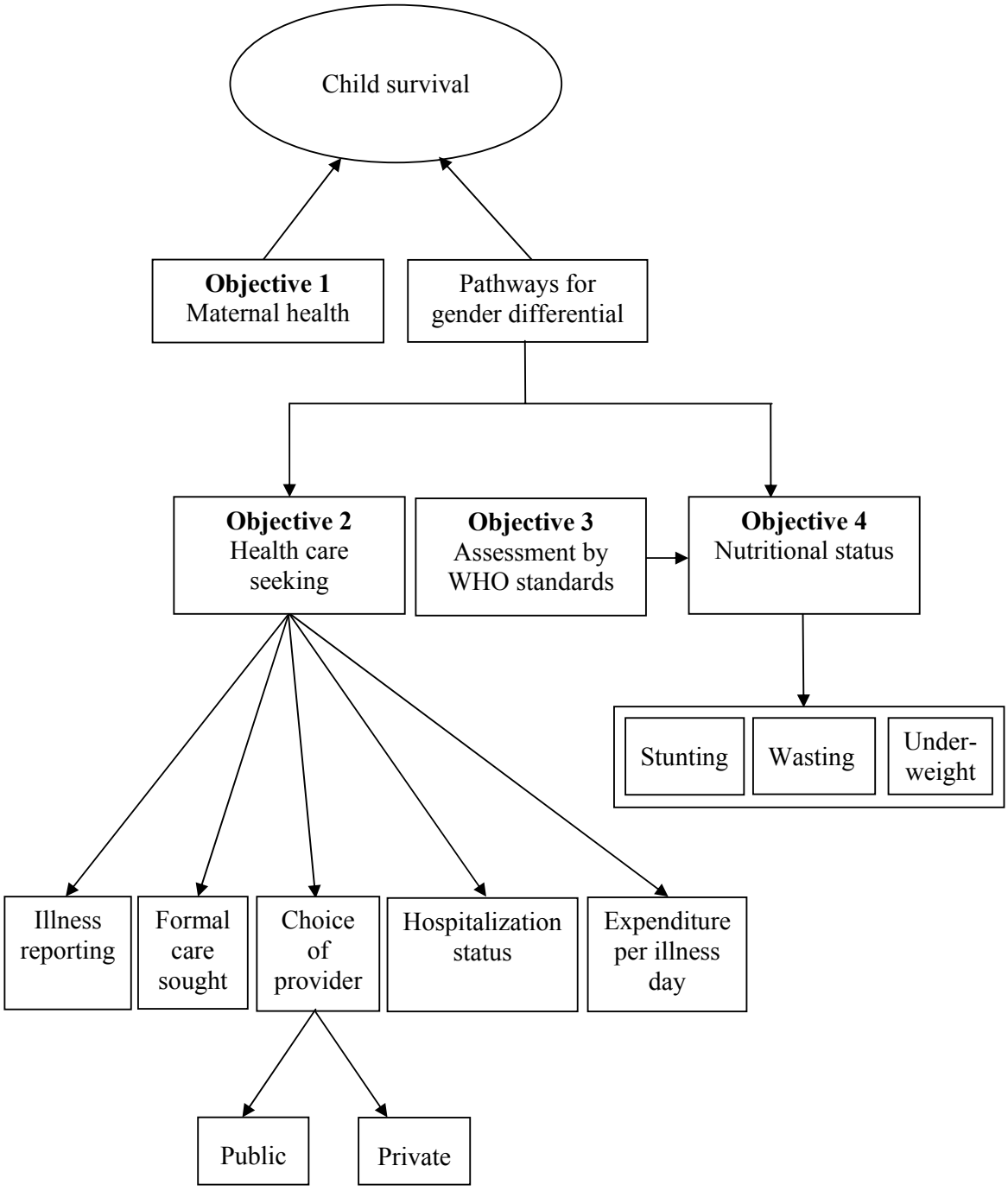
1.9 Study hypotheses

1. Occurrence of under-five (0-59 months) deaths is associated with self-reported poor maternal health (illnesses of more than two weeks duration).

2. Household-decision for health care seeking for children aged 1-59 months is associated with gender.

3. Stunting, wasting or under-weight among children aged 0-35 months is associated with gender.

Figure 1.13: Study objectives for thesis



1.10 Study rationale

The four specific objectives of this thesis target child survival and well-being. These have been a focus of public health community for more than two decades. But they are especially relevant for Pakistan because Pakistan has a poor relative standing on child health indicators and is improving relatively slowly. Pakistan is among 68 priority countries identified for action on maternal, neonatal and child health as a part of United Nations countdown to 2015 initiative (Countdown Coverage Writing Group, 2008). To meet the targets set for Millennium Development Goals 1 and 4, Pakistan needs to identify at the district-level the specific determinants of child survival and to carefully explore the pathways for gender-differentials in child survival such as differential health care seeking or differential nutritional status. Also, the influence of new WHO growth standard needs to be examined at the population and individual levels as it would affect the MDG 1 target. To our knowledge, the extent of agreement between two growth references has not been reported so far.

This thesis for the first time examines the above-mentioned study questions at the district level in Pakistan by using the specific conceptual frameworks and by using appropriate effect measure and analytical frameworks.

Chapter 2: Methods and material

This chapter is organized in ten sections. Section 2.1 provides a brief description of study site followed by description of the data source in section 2.2. Section 2.3 describes the sampling strategy and section 2.4 provides information about sample size estimation. Data collection methods and techniques are described in section 2.5 followed by description of study designs and conceptual frameworks used for each study hypothesis in section 2.6. Definitions and categorization of variables are mentioned in section 2.7. Information about data management is presented in section 2.8. Finally, study power and analytical plan for each study objective are mentioned in sections 2.9 and 2.10, respectively.

2.1 Thatta district (the study site)

Thatta is a predominantly rural district located in the southernmost part of Sindh province between the two major cities of Karachi and Hyderabad (Figure 1.4). Administratively, Thatta is divided into 9 talukas (district sub-divisions) which are further subdivided into 49 Union Councils (UCs) (the administrative units) (Population Welfare Department, 2005a). There are 6,614 village settlements (Situation analysis of Sindh, 1993). It has both irrigated and arid land. The main occupation of the people living in irrigated areas is agriculture (rice, wheat and banana) while people living in arid zones generally work in industries (sugar, textile and flour) and services (Government of Pakistan, 1998). Its climate is largely subtropical with hot summers and mild winters. Its population is predominantly Muslim and people communicate mainly in Sindhi.

A majority of villages are clusters of 30-50 households, belonging to one extended

family. Some large villages have more than 100 households. There are well defined roles and responsibilities among traditional Sindhi families. Women are expected to manage household and rear children. They also play a key role in developing and maintaining relationship within the community. Men are responsible for earning the livelihood and for representing the family to the outside world.

Health coverage for the 1.1 million people in the district is provided through networks of public and private health facilities. The District Health Officer (DHO) is the lead person for management and administration of public health services through a network of primary, secondary and tertiary care facilities. These include 49 BHUs (one for each UC), 12 RHCs, 5 taluka hospitals and 1 district head quarter hospital (Population Welfare Department, 2005a) that are plagued by inadequate staffing and supplies (Shaikh and Hatcher, 2004). The BHUs charge a nominal fee of only 2 Pakistani. Rupees (PR) (US $ 0.06; 1 US$ = 30 PR-1993) (NoorAli et al., 1999) but are closed after 14:00 hours. The services of private practitioners cost 15-50 PR (US $ 0.50-1.6) for routine care and are open in evening hours as well (NoorAli et al., 1999). Most hospital visits are referrals, although direct visits are permissible.

Thatta has poor demographic, developmental and child health indicators (Table 2.1). Some of these indicators have not improved over time. This includes an adult (≥ 15 years) literacy level and proportion of concrete housing. Other indicators such as sex ratio, infant mortality ratio and a two-week prevalence of illness among children less 5 years of age have in fact show deterioration over the last decade. It ranks lowest among other districts of the Sindh province in child health indicators such as infant mortality ratio (91/1000 live births) and prevalence of under-weight children less than five years

of age (49%) (UNICEF, 2003-04) and ranks lowest after Jacobabad district for adult literacy level (Government of Pakistan, 2004-05).

Table 2.1: Indicators of demography, development and health for Thatta District (1992-93 and the recent estimates)

Indicators	1992-93 estimates	The recent estimate
	Demography	
Total population	1,100,000 (90) [1]	1,113,194 (1998) [2]
Sex ratio (Male : Female)	108:100 [3]	112 : 100 [4]
Total fertility rate	7.5 [3]	5.2 [4]
	Development	
Adult (≥ 15 years) literacy level (%)	32 [3]	32 [5]
Average household size	6.3 [3]	5.1[2]
Availability of electricity (%)	21.0 [3]	32 [5]
Piped water supply (%)	11.0 [3]	17.0 [5]
Concrete housing (%)	17.0 [5]	19.0 [5]
	Child health	
Infant mortality ratio	78.0 [6]	91 [7]
Underweight (%)	(< 3 years) 48.0 [8]	(< 5 years) 49.0 [7]
Children < 5 years reported ill over 2 weeks (%)	11 [3]	17 [5]

[1] (Thatta Health System Research Project, 1990) [2] (Government of Pakistan, 1998)

[3] (Noor Ali et al., 1994-95) [4] (Population Welfare Department, 2005a)

[5] (Government of Pakistan, 2004-05) [6] (Nuruddin et al., 2007) [7] (UNICEF, 2003-04)

[8] (Nuruddin et al., 2008)

2.2 Project background

This thesis is based on the dataset derived from Research Information System (RIS) of Thatta Health System Research Project (THSRP) of the Aga Khan University (AKU), Karachi.

2.2.1 Thatta health system research project (THSRP) was a decade long project (1986-1996) of the Aga Khan University (AKU), Karachi, (the project designer and facilitator) in collaboration with the Department of Health, Government of Sindh (the project implementer) and the International Development Research Centre (IDRC), Canada (the funding source). It aimed to explore avenues of input into the district health system to improve population health. Thatta district was selected as the site for this effort. This was because it provided the required exposure of rural health care in an under-privileged set-up, typical of Sindh province and was also accessible to the University (Thatta Health System Research Project, 1990).

Health system research was a complex venture for a district like Thatta with its own socio-political uniqueness while sharing the common indicators of poverty of Pakistan. THSRP had a major focus on building capacity of the government health staff and communities and to promote interaction between government health service providers and communities. The project was a fluid and dynamic process due to complexities created by poorly functioning health services, severe health needs and neglected communities that were uncertain of their own potentials. This social context was of especial concern when health system was to be developed not for the government but with the government through enablement rather than through supplementation or support (Thatta Health System Research Project, 1994-95).

THSRP was implemented in a phased manner.

Phase-I (1986 - 1990): The exploratory Phase-I aimed towards identifying strengths and weakness in the existing system and building working relationship with the government health staff, school teachers and communities. The main findings of Phase-I consisted of: (i) inadequate capacity at the district and health facility-levels in planning and managing health services; (ii) very complex and extensive management information system with inadequate training and supervision of health staff in data handling capacity; (iii) inadequate training, support and supervision of female health staff in maternal and child health services; (iv) curatively oriented health services; (v) extensive under-utilization of health services (0.2 to 0.35 visits/person/year) due to reasons such as in-adequate staffing particularly the shortage of female health personnel, inadequate drug supplies, limited opening hours and poor quality of care (Bryant et al., 1993; NoorAli et al., 1999); and (vi) lack of involvement and interaction between communities and health care providers (Thatta Health System Research Project, 1990).

Phase II (1990 - 1993): Based on findings of situation analysis of Phase-I, various interventions were designed to be applied at three different levels of the district health system. Interventions at district, health facility and village levels were tested out to find what works and what does not work while working with the government health staff and communities. These interventions included: (1) district-wide trainings of (i) medical-officers as health services managers; (ii) female health staff in maternal and child care; and (iii) health staff as trainers for village health volunteers; (2) strengthening of district health management information system by improving

aggregation, analysis and feedback of information and by designing and implementing a simple Maternal and Child Health (MCH) information system; (3) developing primary health care prototypes at the selected health facilities by improving health facility management and community participation and through implementation and strengthening of PHC services; (4) developing village capacity in social development through health as the entry point; and (5) promotion of health through schools by training of teachers as health educators and of students as health promoters (Thatta Health System Research Project, 1991-92).

Phase III (1993-1996): The successful lessons of Phase II were systematically tested out during Phase III. These lessons were assessed by process indicators rather than outcome indicators (e.g. mortality ratios) as there was no health indicator survey at the beginning of Phase II to serve as the baseline. The activities of Phase III consisted of (i) establishment and functioning of district health management team; (ii) implementation of newly designed district-wide management information system; (iii) development of sustainable primary health care prototypes at the selected health facilities; (iv) extension of village capacity development to a new set of villages and (v) extension of health through school to a new set of schools (Thatta Health System Research Project, 1994-95).

2.2.2 Research information system (RIS) was designed to measure health and nutrition status of the population and utilization of government health services, through a village-based survey. This baseline survey was conducted between November 1992 and February 1993 (Thatta Health System Research Project, 1994-95).

The information collected through this survey was organized in six sections that had common identification number and could be linked through link variables (Appendix-1).

Village section provided information about village profiles. This included information about access to health services measured by distance from the nearest government and private health facilities and their approximate travelling time to these health facilities. It also provided information about presence of schools, availability of health manpower and basic amenities such as transport, electricity, gas and water.

Household socio-economic section provided information about socio-economic indicators of the household such as total number of persons, children and married women in the household, average monthly income, type of housing construction material, number of rooms, ownership of house and land.

Section on household profile provided information about basic demographic characteristics of each member of the household. This included age, sex, marital status, literacy level, employment status and occupation. It also included information about reported morbidity status, illness duration and source and cost of treatment.

Section on death included information about deceased subjects who died during the year prior to the survey. The information consisted of age and sex of deceased, reported cause of death, presence or absence of illness prior to death, duration of illness and source and cost of treatment.

Children section presented anthropometric measurements of the children less than 3

years of age, their immunization status and feeding patterns.

Women section presented reproductive history of married women less than 50 years old.

The data can be considered suitable to address the stated study objectives (section 1.8) as they include relevant measures of our conceptual frameworks (mentioned later under section 2.6). The more recent Pakistan Social and Living Standard Measurement Survey (2006-07) and Pakistan Demographic Health Survey (2006-07) lack information about some of the determinants of health care such as illness duration, maternal health status, distance from health facility and availability of transport and about outcome measures for hospitalization and health expenditure. Similarly, National Nutrition Survey (2001-02) lacks information about the contextual factors such as access to a health facility and a girls' school or water source to the village.

2.3 Sample size

Number of villages to be surveyed was based on the target to sample at least 250 households from the catchment area of a PHC unit. With the average household size of 5.5, this would give an average population of 1375 subjects per PHC unit. Assuming an annual crude birth rate of 36/1000 population, there would be a 50 annual births per PHC unit or in other words, 150 children under three years of age per PHC unit (Noorani et al., 1993-94). To estimate a 40% prevalence of under-weight among children less than three years old, sample size estimation was performed assuming an α- error of 5%, a desired precision of 5% and a design effect of 2.5 (Daniel, 1987). This gave us a sample size of 922 children of under-three

years.

2.4 Sampling strategy

A three-staged cluster sampling technique was adopted. First, union councils (UCs) were identified that served as strata. Second, villages were identified that served as clusters or sampling units. Third, all households within selected villages were surveyed to provide information about population elements.

2.4.1 Selection of union councils (strata)

Union Councils (UCs) of the district that had fairly complete enumeration list of their villages were identified. There were 24 such UCs that served as the strata. Three sources of population data namely electoral commission, water and irrigation department and malaria general revision (updated in 1991) were explored. The latter was found to be reasonably complete in recording population settlements (villages) and their resources such as electricity, roads, schools etc and was thus used to define the sampling frame. A detailed wall map of each UC was created by superimposing the administrative boundaries with natural barriers obtained from defence (army) department (Noorani et al., 1993-94).

For the purpose of survey, 18 UCs were identified on the basis of selection of these sites for THSRP activities after negotiation with DHO and his team of AKU project team. A PHC unit (BHU or RHC) was identified as the focal point in these UCs. Since some of these PHC units had an eccentric location within UC, a 5 kilometres radius was drawn surrounding each selected PHC units. Within this radius around a PHC unit, villages were listed and mapped to provide a sampling frame (list frame) for village sampling.

Names of villages and their associated PHC unit were computer fed.

2.4.2 Selection of villages (clusters)

Villages served as the basic population units for data collection. Two different sampling strategies were employed for selection of villages. Of 18 selected PHC units, villages within 5 kilometres radius of 12 PHC units were selected on the basis of computer generated random numbers to give a cluster sample without replacement. The 12 UCs included in the survey belonged to 7 different (out of 9) talukas (sub-divisions) of the district (Figure 2.1). On an average, 8.25 villages were selected per PHC unit. Keeping provision for non-response and incomplete information, 99 villages of unequal sizes were randomly selected without replacement. Average probability of village selection was 0.18 (95% C.I.: 0.12, 2.4).

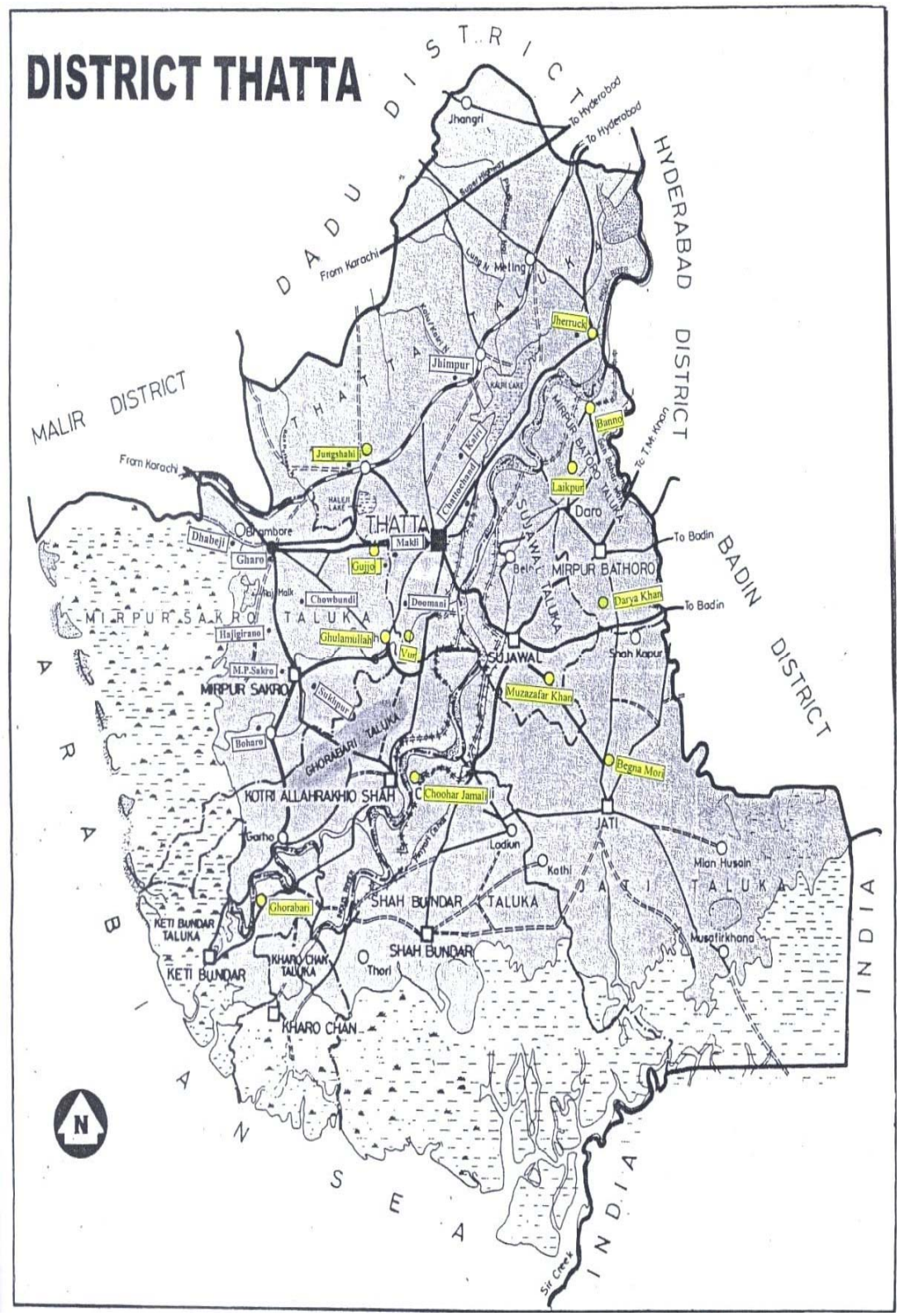
Selection of villages that belonged to the other 6 UCs was non-random as it was based on convenience or intentional inclusion for being sites for community-level interventions of THSRP, based on access and /or willingness of villagers to participate in THSRP activities. They also not necessarily justified the criteria of being located within 5 kilometres radius of the PHC unit.

For this thesis, we limit our analysis to only 99 randomly selected villages so as to permit valid statistical inference.

2.4.3 Selection of households (population elements)

After random selection of 99 villages, a village profile study was carried out to map

Figure 2.1: Distribution of randomly selected union councils (shown in yellow), Thatta district



and enumerate households. We surveyed all households in the selected villages so as to give a sampling fraction of unity for the second stage. Hence, a total of 2276 households were surveyed giving an average of 23 households per village. Within the households, information was obtained about all individuals including children less than 5 years old. With such a sampling strategy, we obtained a sample of 1051 children under-three years of age which was more than the estimated sample size of 922 children (as mentioned in section 2.3).

Selection of first the villages (clusters) and then the household members (elements or units for which the information is sought) lowered the cost of obtaining information per subject. It however, resulted in higher element variance due to their homogeneity within the cluster and violation of assumption of independently sampled subjects (Kish, 1965).

2.5 Data collection

Local Sindhi speaking female interviewers (20), male supervisors (4) and a survey manager were trained in the villages not selected for the actual survey through a three-week field-based program (Noorani et al., 1993-94). Their training mainly focused on interviewing techniques with special reference to determining age with the help of local event calendar, elucidating and coding causes of illness or death through a series of questions about symptoms and measuring height and weight of children under-three years of age.

An elaborate pre-coded survey questionnaire (Appendix-1) was designed for face-to-face interview. After approval from institutional ethical and review committee, the

questionnaire was pre-tested for ease and accuracy of data collection. Interviewers were asked to record interview duration and to follow assigned interview schedule. Completed questionnaires were checked and validated by field supervisors daily. During data collection, spot checks were conducted by field supervisors on a daily basis. Interviewers were unaware of the schedule for the spot checks. On an average, 8-9 villages were surveyed in a week's time (Thatta Health System Research Project, 1991-92). A validation survey of 400 households was conducted within two weeks of the actual survey for determination of data collection errors (Noorani et al., 1993-94).

Written informed consent was obtained from the respective village councils. Village headmen provided information about village profile including water source, presence of girls' school and availability of transport in emergency. Village distance by the shortest possible road route to the nearest health facility was measured (in kilometres) by vehicle odometer.

Trained interviewers visited households with the assistance of village volunteers and conducted survey after securing informed consent. Since a local villager accompanied interview team, there was a very good acceptance and a low non-response rate (9%). A household was defined as a group of people who normally lived and ate their meals together. Household heads (or in their absence, the next elder/responsible member of the household) provided information on socio-demographic and socio-economic characteristics of the households. This included age, sex, marital status and literacy level of household members, total number of persons, children and married women in the household, average monthly income, type of housing construction material, number of rooms and land ownership.

Mothers were the prime source of information for their children under-five years of age (reporting units). Children's ages were estimated with the aid of local event calendars listing important events, festivals and moon cycles in the last five years. Beside child's gender, information was obtained about whether there was a death or illness in the household during the last one year. Further information was obtained about cause of death or illness, duration of illness, whether the child was taken to a government or private health facility for treatment, whether he/she was hospitalized and about total health expenditure including consultation, medicine, investigation and travel cost. For children less than 36 months of age, mothers were inquired about their feeding status, age at weaning and immunization status.

Illness type was recorded based on a series of questions about symptoms. Interviewers were trained to classify reported symptoms into categories or types of illness by means of a coding system. A list of illness conditions was included in the questionnaire based on local disease patterns and peoples' descriptions of common symptoms. Common childhood illnesses were defined as follows: *fever* if child was reported hot by mother without any associated cause/reason; *malaria* as fever with chills/rigors; *poliomyelitis* as fever with muscle weakness; *meningitis* as fever with stiff neck; *pneumonia* as fever and cough with fast breathing or fast moving ribs during breathing; *measles* as fever with rash; *whooping cough* as fever with whooping cough; *upper respiratory illnesses* as fever with cough, cold or sore throat; *ear infection* as fever with ear pain with or without discharging ear; *diarrhoea* as passage of three or more loose or watery stools in the 24 hours and *dysentery* as passage of stools with blood or mucus. Duration of illness was assessed as number of days from recognition of illness till the recovery or the interview date.

Mother's age was determined as the age at the interview date. Her literacy status was defined as the ability to read and/or write a short simple statement such as what is your name. A complete reproductive history was obtained from mothers by asking the number of times they had been pregnant, had live deliveries and still births, the number of live children and when the last delivery was and its outcome. They were inquired whether they were ill during the last one year. Those who reported ill were asked an additional series of questions about symptoms, probable cause and duration of illness and source of care. Interviewers were trained to code common illnesses from reported symptoms.

Trained field workers took anthropometric measurements of each eligible child. Child's weight was recorded to the nearest 0.1 kg using a portable 25 kg spring balance Salter Scale (Salter England, West Bromwich, United Kingdom). Weighing scale was calibrated daily using 20 kg weight. During weighing, children were lightly clad and without shoes/slippers. Recumbent length (for children less than 24 months) or standing height (for children 24 months or older) was measured to the nearest centimetre by portable wooden boards with a sliding foot or head-piece (locally manufactured by Pakistan Medical and Dental Council). Instruments used for anthropometric assessment were checked once a week for accuracy and standardization by a trained technician. Severely malnourished children were referred to a local hospital or a health centre for further assessment and care.

2.6 Study designs and conceptual frameworks used

Data collected in a cross-sectional manner was analyzed as case-control studies to address three study hypotheses (as mentioned in Section 1.9). For study question 3

(as mentioned in Section 1.8), the estimates of under-nutrition at the population and individual levels were compared based on the WHO Standard and the NCHS reference. The details of study designs and conceptual frameworks used for each study objective are described below.

2.6.1 Relationship between child death and poor maternal health

2.6.1.1 Study design: This study is based on children aged 0-59 months old. Index series was defined as children who died during one year prior to the survey. Reference series consisted of children alive at the time of interview. The two groups were compared for the proportion of mothers who self-reported being ill during one year period prior to the survey, after controlling for confounders (Figure 2.2).

2.6.1.2 Conceptual framework used for this study consisted of four sets of determinants of child survival. This included child, maternal, household and village factors (Figure 2.3). These determinants were adopted from the conceptual framework proposed by D'Souza & Bryant (1999) (Figure 1.7). However, variables chosen to reflect these groups differed at some instances from those suggested by D'Souza & Bryant (1999) depending upon their relevance for the rural population and their availability in the dataset.

2.6.2 Relationship between household-decision for child health care and gender

2.6.2.1 Study design: This study is based on children aged 1-59 months. Neonates were excluded from the analyses for two reasons: First, neonatal deaths are

Figure 2.2: Study design to examine association between child death and poor maternal health

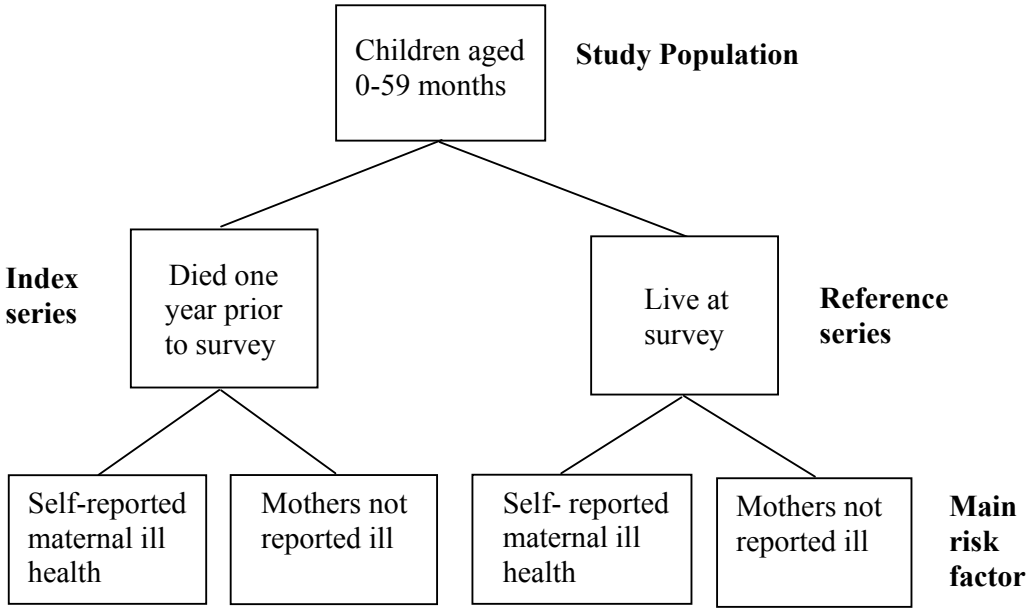
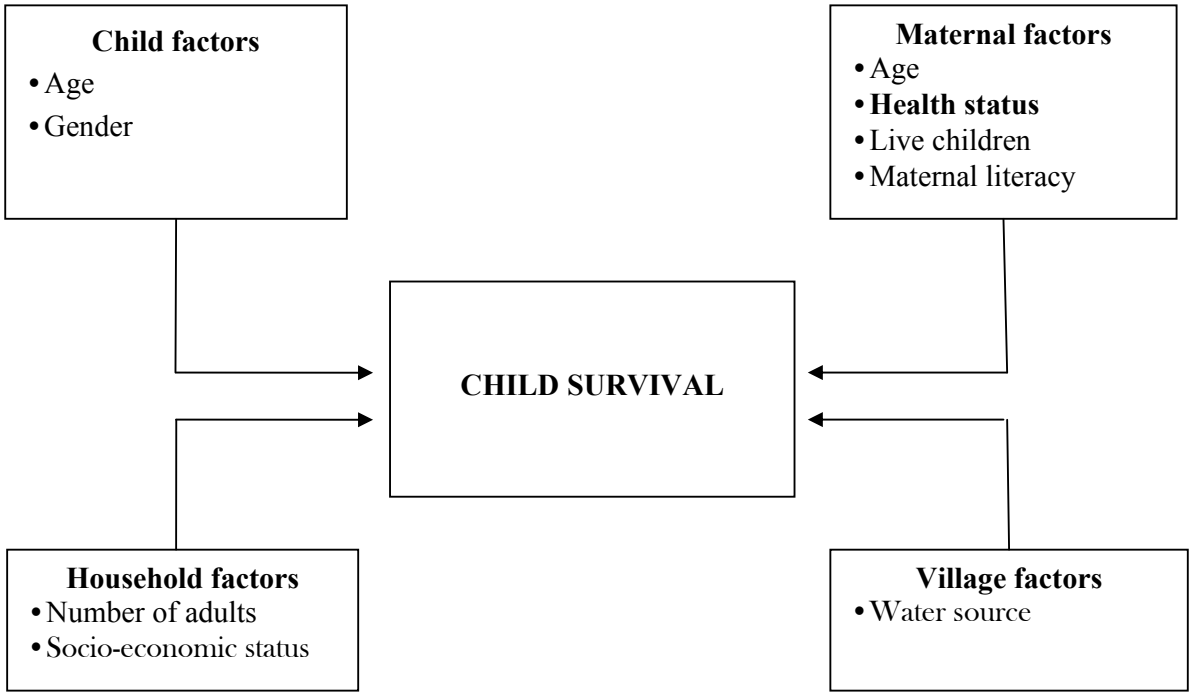


Figure 2.3: Conceptual framework to examine association between child death and poor maternal health



determined partly by genetic factors and partly by prenatal care (a time period, when generally the child's gender is unknown to rural parents). Second, gender disparity in mortality grows with child's age when it is less dependent on genetic factor and more determined by behaviour (Filmer et al., 1998).

Association of child's gender was examined separately with five outcome variables, each describing a stage in health care utilization so as to determine at which stage/s of the pathway model, gender (an explanatory variable) influences health care decisions after controlling for individual, household and village variables. Following five stages in health care utilization are examined in this study:

(i) Reported ill measured as the recent most child illness reported by mother during the past year;

(ii) Seeking outside home care measured by proportion of children who visited a health facility, given the perceived illness;

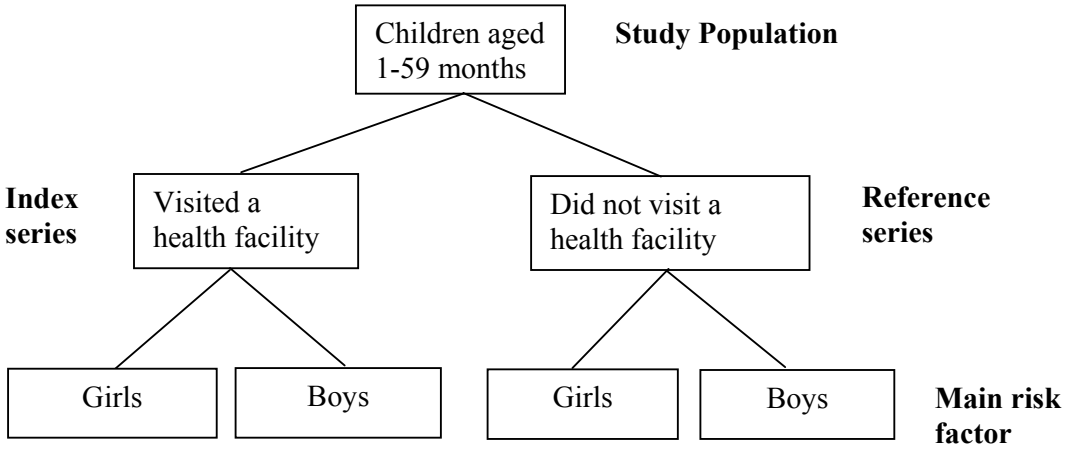
(iii) Choice of provider such as public or private given formal health care sought;

(iv) Hospitalisation for at least a day given formal care sought and;

(v) Health expenditure per illness day including cost of consultation, medicine, investigation and transport, given formal care sought.

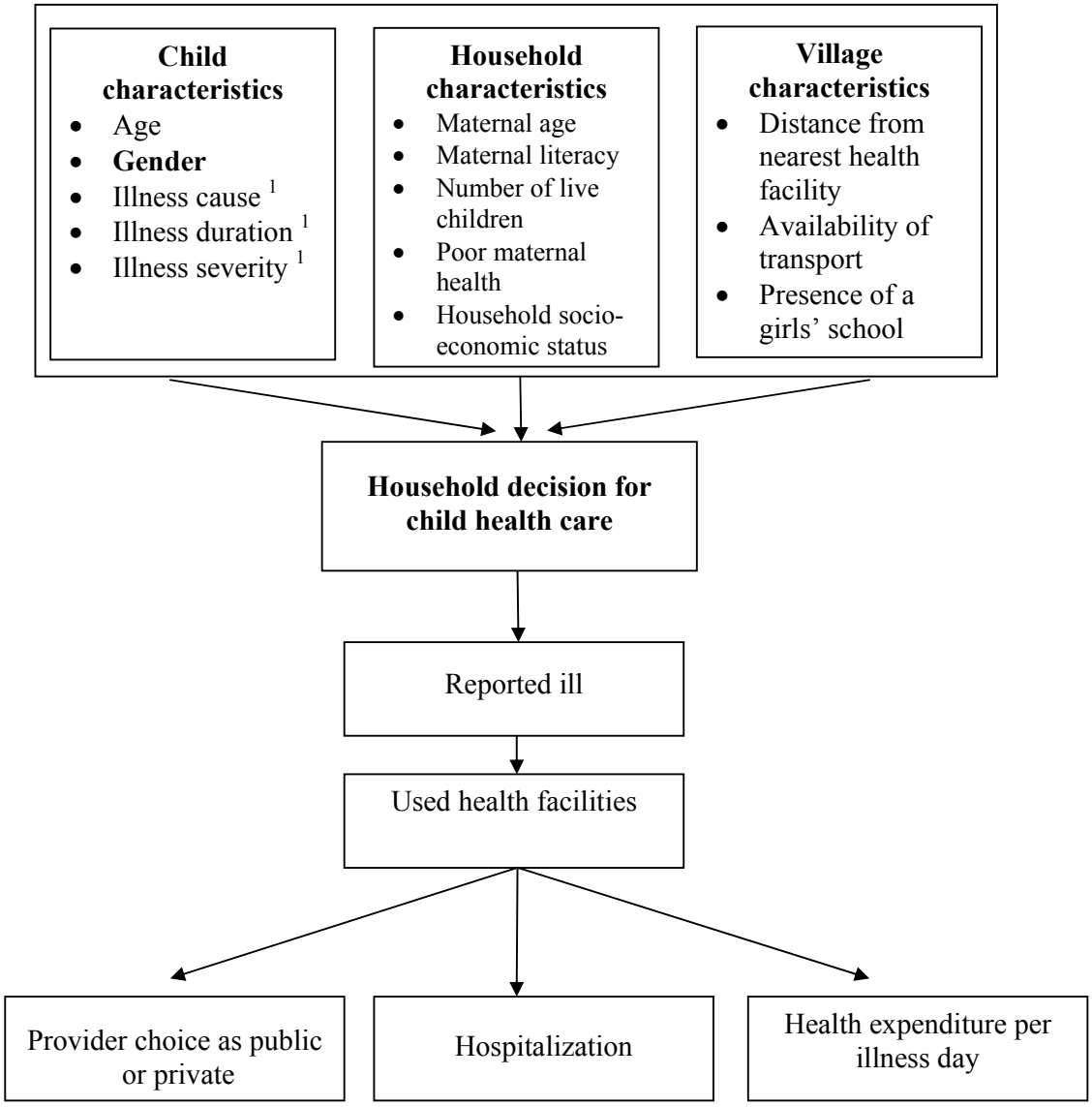
Figure 2.4 shows the study design used for examining association between gender and one of the stage of health care utilization (formal health care sought). Similar, designs were used for other stages of health care utilization.

Figure 2.4: Study design to examine association between formal health care sought and gender



2.6.2.2 Conceptual framework used for this study was adapted from Pokhrel and Sauerborn (2004) (Figure 2.5). It differs from that of Pokhrel and Sauerborn (2004) in four important aspects: First, it examines five stages in health care decisions instead of four by including an additional stage in health care utilization, that is gender differential among hospitalized children. This is important since hospitalization represents the most direct and relevant proxy for death, given that is associated with severe and potentially fatal illnesses (Bhan et al., 2005). Second, it includes illnesses characteristics (as mentioned in the conceptual construct of Kroeger (1983a)) and maternal health status among determinants of health care. Third, it examines health expenditure adjusted by number of illness days. Fourth, it does not include quality of care variables among village level variables due to lack of such information in the data set.

Figure 2.5: Conceptual framework to examine association between household decision for child health care and gender



[1] Variables not included in the modelling for reported ill.

2.6.3. Prevalence of stunting, wasting and under-weight among pre-school children and agreement between estimates based on the WHO Standard and the NCHS Reference

In this study, measured heights and weights were converted to standard normal scores (Z-scores) on the NCHS reference and the WHO standard distributions, taking into account child's age and gender. Prevalence of stunting, wasting and underweight (defined later in section 2.7.3.) among children newborn to 35 months old was estimated. Also, the degree of agreement between the estimates from two growth standards was examined as: (i) proportion of subjects identified as normally nourished or mildly, moderately and severely under-nourished and (ii) agreement in the individual Z-scores.

2.6.4 Relationship between child's nutritional status based on the WHO Standard and gender

2.6.4.1 Study design: This study is based on children aged 0-35 months. Association of child's gender was examined separately for three parameters of under-nutrition (stunting, wasting and under-weight) after controlling for proximate and intermediate determinants. Figure 2.6 shows the study design for examining the association between stunting and gender, one of the parameters of under-nutrition.

2.6.4.2 Conceptual framework was developed by combining elements of UNICEF (1990) and Mosley and Chen (1984) conceptual models (Figure 2.7). We grouped our variables into two instead of three levels as mentioned in UNICEF model (1990);

(i) *Underlying or intermediate level determinants* that relates to the family and/or

Figure 2.6: Study design to examine association between stunting and gender

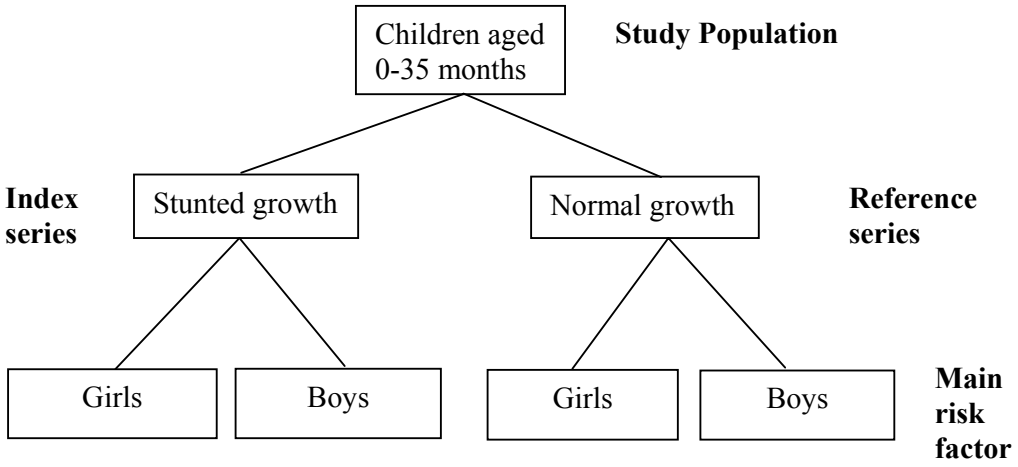
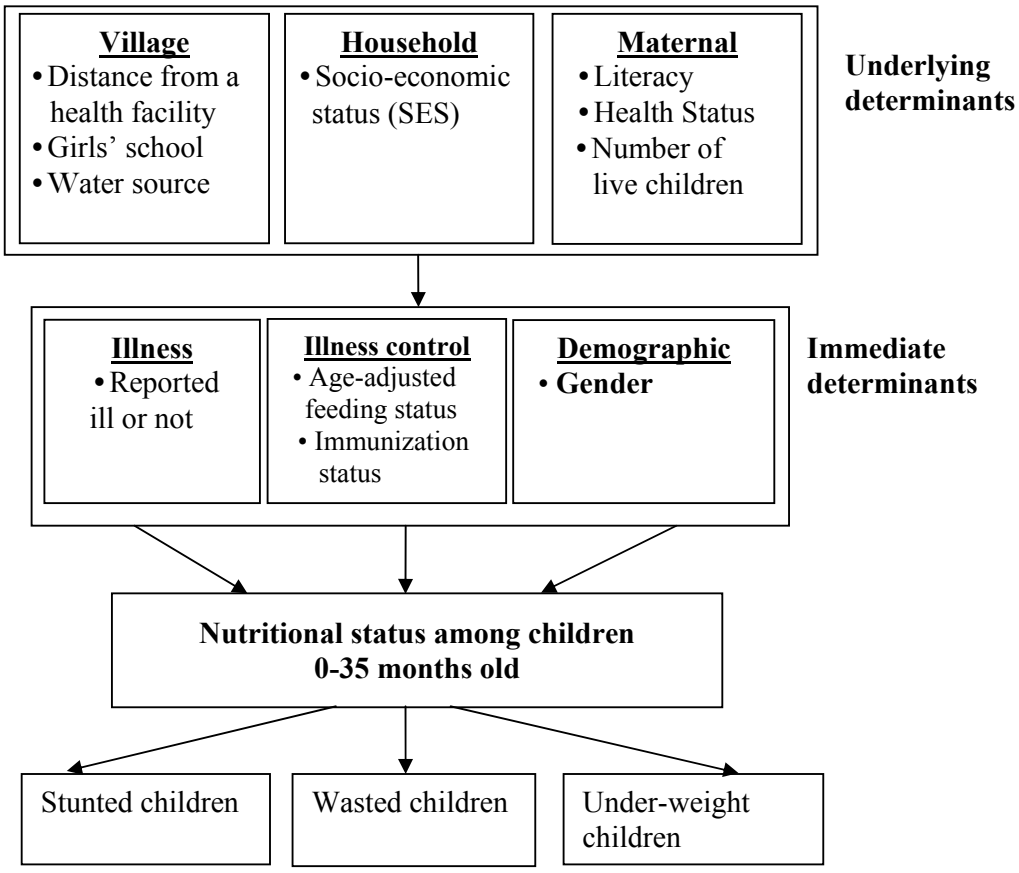


Figure 2.7: Conceptual framework to examine association between child's nutritional status and gender



the community. In this group, maternal, household and village factors were included.

(ii) *Immediate or proximal level determinants* that relates to the individual and consisted of child characteristics.

2.7 Variables definition and categorization

Sub-sections 2.7.1. to 2.7.4. describe definitions and categorization of variable for analysis purpose for each of the four study objectives.

2.7.1 Relationship between child death and poor maternal health

Five mortality ratios were calculated according to WHO standards (Nathan et al., 2002; World Health Organization, 2006). For each ratio, number of live births in a year expressed per 1000 served as a denominator. The numerator varied for each ratio as number of deaths among neonates (new born to 29 days old), post-neonates (completed 1 to completed 11 months old), infants (new born to completed 11 months old), early childhood (completed 12 to 59 months old) or under-five (newborn to completed 59 months old). These ratios are traditionally referred to as neonatal, post-neonatal, infant, early childhood and under-five mortality rates, respectively (Nathan et al., 2002; World Health Organization, 2006).

Dependent variable: Survival status of the children aged 0-59 months categorized as all-cause mortality during one year period prior to the survey or live at the time of survey.

Main independent variable: Maternal health status defined as self-reported presence or absence among mothers of illnesses that lasted for more than two weeks duration and occurred during one year prior to survey. Mothers reporting such illnesses were classified as having poor maternal health and those who did not report any such illnesses constituted the comparison group.

Other independent variables:

a) Child factors

(i) Age grouped as infants (newborn to 11 months) and early childhood (12 to 59 months); and

(ii) Gender (a boy or a girl).

b) Maternal factors

(i) Age grouped as 30 years or less and > 30 years based on data distribution; and

(ii) Number of live children categorized as three or less and four or more.

(iii) Maternal literacy status defined as literate if able to read and/or write a short simple statement; otherwise as illiterate.

c) Household factors

(i) Number of adults (persons older than 18 years of age) in the household as a proxy measure of alternative care providers (categorized as two or less and three or more); and

(ii) Household socio-economic status (SES) was assessed by developing a composite variable from a set of three variables. These variables included

(a) Average monthly income per capita categorized as less than 200 Pakistani Rupees (PR) (6.5 US $) (median) or 200 PR and more;

(b) Housing construction material as concrete or non-concrete such as mud, stone or wood; and

(c) Land ownership.

Based on information about these variables, subjects were grouped into 3 categories as follows:

(1) Low SES if average monthly income less than 200 PR, house made of non-concrete material and no land owned;

(2) Middle SES if any two out of above three variables reflected low SES; and

(3) Upper SES if none or only one out of three variables reflected low SES.

We created two dummy variables: one comparing subjects of low SES with those of upper SES (SES1) and the other comparing subjects of middle SES with those of upper SES (SES 2).

d) Village factors

(i) Water source as a proxy measure of exposure to faecal pathogens. It was grouped as piped or non-piped water sources (which included well, pond, canal, river or sources other than piped water).

2.7.2 Relationship between household-decision for child health care and gender

Gender-specific mortality ratios were calculated according to WHO standards

(Nathan et al., 2002; World Health Organization, 2006). Total number of gender-specific live births in a year expressed per 1000 served as a denominator and total number of deaths among specific gender served as a numerator. These ratios were calculated for (new born to 29 days old), post-neonates (completed 1 to completed 11 months old) and early childhood (12-59 months old).

Dependent variables: Each stage of the pathway model for health care seeking served as an outcome variable. These included;

(i) Reported ill defined as the recent most child illness reported by the mother during the past year. The reference group consisted of children not reported ill during the same period.

(ii) Used a health facility (public or private) given perceived illness. The reference group comprised of sick children for whom outside home formal care was not sought. It included subjects who received home care or alternative care such as homeopathic care.

(iii) Care provider choice as public or private. The latter served as a reference group. Public providers included public hospitals, health units, dispensary and MCH centres. Private providers included private hospitals and clinics.

(iv) Hospitalization for more than 24 hours as an in-patient. The reference group consisted of children not hospitalized.

(v) Health expenditure per illness day including cost of consultation, medicine, investigation and transport. It was dichotomized for the purpose of analysis as less than 20 Pakistani Rupees per illness day (based on

median) and 20 or more Pakistani Rupees per illness day. The latter served as the reference group.

Main independent variable: Child's gender. Boys served as the reference group.

Other independent variables:

a) Characteristics of the child

1. Age comparing post-neonates (one-11 months old) with early childhood (12 to 59 months old).
2. Illness type grouped into four categories; *fever* as the reference category, *diarrhoea*, *respiratory illnesses* (consisted of pneumonia, measles, whooping cough, upper respiratory illnesses and ear infections) and *other causes* (such as tetanus, malnutrition, scabies/skin infections, jaundice or renal conditions grouped together due to small numbers). It was excluded from the model of reported ill.
3. Illness duration grouped into up to 14 days (reference group) and 15 or more days. It was also excluded from the model of reported ill.
4. Illness severity measured as fatal (child died due to illness) or non-fatal illnesses (child was alive at the time of survey). It was also excluded from the model of reported ill.
5. Hospitalization (included in the model for health expenditure per illness day).
6. Choice of care provider as public or private (included in the model of health expenditure per illness day).

b) Characteristics of the household: Variables (i) to (v) defined and categorized in the same way as under section 2.7.1.

(i) Maternal age

(ii) Maternal literacy status

(iii) Number of live children in the family

(iv) Poor maternal health (included only in the model for reported ill and visit to a health facility) and

(v) Household socio-economic status (SES)

c) Characteristics of the village

(i) Distance from the nearest health facility categorized as up to 3 kilometres and >3 kilometres based on data distribution

(ii) Availability of transport during emergency and

(iii) Presence of a girls' school.

2.7.3 Prevalence of stunting, wasting and under-weight among pre-school children and agreement between estimates based on the WHO Standard and the NCHS Reference

Prevalence of under-nutrition (percent of children aged 0-35 months) was calculated following convention (de Onis et al., 2006) as number of children with Z-scores less than -2 standard deviations (S.D.) below the NCHS reference or the WHO standard for the following nutritional parameters: ***wasting*** as weight for height Z-scores (WHZ); ***stunting*** as height for age Z-scores (HAZ) and ***underweight*** as weight for age Z-scores (WAZ). ***Mild, moderate and severe under-nutrition*** were determined

as below -1 and down to -2 S.D., below -2 and down to -3 S.D. and below - 3 S.D., respectively compared to the reference population. ***Mean Z-scores*** (and their S.D) for under-nutrition were calculated to compare the WHO standard and the NCHS reference. Relative difference in prevalence of under-nutrition with the use of the NCHS reference and the WHO standard was calculated by taking the absolute difference of the higher prevalence value from the lower prevalence value and dividing it with the lower prevalence value.

Age-specific prevalence was calculated for seven age groups. During infancy, four age groups were created keeping in view the faster growth velocity in weight and height in this period (Gorstein, 1989). These age groups included 0-3, 4-6, 7-9 and 10-12 months. During the second and third years to account for slower growth velocities and to accommodate small numbers, the age groups were defined as 13-18, 19-24 and 25-35 months.

Gender-specific prevalence was calculated as number of children of a given gender with Z-scores less than -2 standard deviations (S.D.) below the NCHS reference or the WHO standard per 1000 children of a given gender. Gender-specific prevalence was calculated separately for stunting, wasting and under-weight.

The degree of agreement between estimates from two references was examined by comparing proportion of children identified as normally nourished or mildly, moderately and severely under-nourished by the two references. Also, the 'Bland Altman Plot' (Bland and Altman, 1995) was created to examine agreement between the Z-scores from the two references. This provided three main pieces of information:

the bias (the average of the difference); the standard deviation around the bias (SD); and the limits of agreement (the limits within which 95% of all the points fall on either side of the bias that is ±1.96 (2) SD from the bias (Cecconi et al., 2007).

2.7.4 Relationship between child's nutritional status based on the WHO Standard and gender

Dependent variables: Following parameters of under-nutrition for children aged 0-35 months served as dependent variables (as defined under sections 2.7.3):

(i) Stunting

(ii) Wasting and

(iii) Under-weight

Main independent variable: Child's gender. Boys served as the reference group.

Other independent variables:

a) Proximate variables or characteristics of the child

(i) Illness control measures:

1. Age-adjusted feeding status categorized in four groups as follows: (i) nursing infants (newborn to 6 months of age); (ii) infants aged 5-11 months and weaned at 5 or 6 months of age; (iii) infants aged 7-11 months and weaned at or after 7 months of age and (iv) early childhood (aged 12-35 months) who are generally on regular diet. The first category served as the reference group.
2. Immunization status as assessed by immunization card issued by area vaccinator

or by recording immunization history from the mother and grouped as complete/appropriate for age or incomplete/none.

(ii) Illness state:

1. Presence or absence of illness defined as illness reported during one year prior to the survey;

b) Intermediate variables or maternal, household and village characteristics

Variables (i) to (iii) defined and categorized as under sections 2.7.1 and 2.7.2.

(i) Maternal factors:

1. Maternal literacy status
2. Number of live children in the family
3. Poor maternal health

(ii) Household factors

1. Socio-economic status (SES)

(iii) Village factors

1. Distance from the nearest health facility
2. Presence of a girls' school and
3. Water source grouped as piped or non-piped

2.8 Data management

Data were checked for internal consistency before entry. Questionnaires with inconsistencies were re-sent to the field for correction. Data were double entered using dBase III Plus computer software (dBASE III Plus) and checked for obvious errors of data entry and editing. Discrepancies identified between data-entry operators were corrected by checking the original questionnaire. After correcting for

key-punch mistakes, 10% of the questionnaires were randomly selected to check the error rate. An error rate of less than three per thousand strokes was considered as clean data entry.

For weight for height, height for age and weight for age Z-scores, standard deviations were examined to assess quality of measurement. The standard deviations were found close to the expected value of 1 for the reference population, an indication that the measures were of reasonable quality (de Onis and Blossner, 1997). Although WHO recommends taking a Z-score above +6 or below -6 as extreme values potentially indicating measurement problems, we took +4 as the upper threshold of acceptable scores. This is because the probability of a child having a Z-score weight for age (WAZ) or height for age (HAZ) greater than 4 is less than .0001 (Altman, 2000), given that the means of WAZ and HAZ for the study population were -2.0 and -1.9, respectively. Children with incomplete data on age or anthropometric measurement and the flagged cases (10%) are excluded from the analysis.

2.9 Power of the studies

Power of detecting a difference was calculated by taking an α-error of 0.05 and assuming a 20% difference between the groups. This means 20% greater child death among mothers with poor health, 20% greater care seeking for boys than for girls and 20% greater under-nutrition among girls than among boys. For wasting, we assumed a 10% rather than a 20% difference because of its low prevalence. The design effect was obtained by taking a ratio of the squared generalized estimating equations (GEE) standard errors for gender in the final model to its squared initial standard errors.

Following study powers were obtained for each study based on above assumptions:

1) 90% for difference in under-five survival status in the presence or absence of self-reported poor maternal health.

2) 88% for difference in illness reporting between boys and girls.

3) 100% for difference in facility use between boys and girls.

4) 63% for difference in visit to a public provider between boys and girls.

5) 25% for difference in hospitalization between boys and girls.

6) 79% for difference in health expenditure between boys and girls.

7) 74% for difference in stunting between boys and girls.

8) 90% for difference in wasting between boys and girls.

9) 94% for difference in under-weight between boys and girls

2.10 Data Analysis

2.10.1. Weighted mortality estimates

To account for un-equal selection probabilities and cluster-correlated data, we calculated sample weights. Selection probability of villages was first obtained by dividing the number of sampled villages by the number of villages in the list frame of each of the 12 PHC units. Weights were calculated by taking inverse of the probability of selection. Use of weights reduces bias in variance estimation by taking into account unequal sampling in a complex survey design and hence, allows generalizing results from the sample to the target population in an unbiased way. Weighted estimates of age and gender-specific mortality ratios were calculated in SUDAAN (2004) using option of without replacement (WOR) sampling design to take into account clustering by village effects.

2.10.2. Prevalence ratios as measures of effect

Since most of the outcomes measure were common with a prevalence of > 10% (except for child death with a prevalence of 2.7%) and because of better interpretability of prevalence ratio compared to the odds ratio (Lee and Chia, 1993, 1994), we calculated prevalence ratios in SAS proc Genmod (SAS, 2002-2003). Such a modelling assumed a binomial distribution and a log link function (Deddens et al., 2003). When the log-binomial model did not converge, COPY method was used (Deddens and Petersen, 2008). We did not account for clustering at the household level as proportion of households with more than one death, sick or under-nourished child was less than 5%.

2.10.3. A two-level random intercept modelling technique

To account for hierarchically structured (clustered) data, a two-level random intercept modelling technique was adapted. Such a modelling accounts lack of independence of observation due to intra-class correlation whereby the values of dependent variable are more likely to be similar for children belonging to the same village due to unmeasured characteristics (Diez Rouz, 2002; Pickett and Pearl, 2001). This would prevent identification of spurious association owing to under-estimation of standard errors and would also allows for simultaneous examination of the effects of village-level and individual-level predictors (Diez -Roux, 2000). In this model, random intercepts represent villages which are the primary sampling units (PSUs) as mentioned in section 2.4.2. The level-1 (micro-level) variables comprised of child, maternal and household factors with a child as the unit of analysis whereas level-2 (macro-level) variables comprised of village factors and their unit of analysis was a village.

Clustering at village level was accounted for by the use of cluster identity for village level variables in a repeated statement with Proc Genmod. Variance explained by village-level variables was assessed by Max-Rescaled Generalized R-Square (Shtatland et al., 2000). Prevalence ratios of GEE are reported.

2.10.4 Modelling strategy

2.10.4.1. Relationship between child death and poor maternal health

Four models were constructed to examine association between child death and poor maternal health. These models consisted of following variables:

Model 1: Maternal health and water source as shown in the following equation:

$$\frac{\Pr[\text{ChDeath} = 1/\text{MHealth} = 1, \text{Water}]}{\Pr[\text{ChDeath} = 1/\text{MHealth} = 0, \text{Water}]}$$

Here Pr denotes the probability of child death.

Model 2: Maternal health, child and maternal factors and water source.

$$\frac{\Pr[\text{ChDeath} = 1/\text{MHealth} = 1, \text{ChAge}, \text{ChGender}, \text{Mage}, \text{MLiteracy}, \text{LiveCh}, \text{Water}]}{\Pr[\text{ChDeath} = 1/\text{MHealth} = 0, \text{ChAge}, \text{ChGender}, \text{MAge}, \text{MLiteracy}, \text{LiveCh}, \text{Water}]}$$

Model 3: Maternal health, household factors and water source.

$$\frac{\Pr[\text{ChDeath} = 1/\text{MHealth} = 1, \text{Adults}, \text{SES1}, \text{SES2}, \text{Water}]}{\Pr[\text{ChDeath} = 1/\text{MHealth} = 0, \text{Adults}, \text{SES1}, \text{SES2}, \text{Water}]}$$

Model 4: Maternal health, child age and water source.

$$\frac{\Pr[\text{ChDeath} = 1/\text{MHealth} = 1, \text{ChAge}, \text{Water}]}{\Pr[\text{ChDeath} = 1/\text{MHealth} = 0, \text{ChAge}, \text{Water}]}$$

In the final model, maternal health and water source were retained. The rest of the variables were entered in a forward manner. Variable with the smallest p-value (< 0.05) was entered first, followed by addition of one variable at a time, retaining ones with p-value < 0.05 and removing ones with p-value > 0.05.

2.10.4.2 Relationship between household-decision for child health care and gender

Five models were constructed to examine association between each stage of care seeking and gender. These models consisted of following variables:

Model-1: Gender and village variables.

$$\frac{\Pr[\text{CareSought} = 1/\text{Girl}, \text{Distance}, \text{Transport}, \text{Girls'School}]}{\Pr[\text{CareSought} = 1/\text{Boy}, \text{Distance}, \text{Transport}, \text{Girls'School}]}$$

Model-2: Village variables only.

$$\frac{\Pr[\text{CareSought} = 1/\text{Distance} = 1, \text{Transport}, \text{Girls'School}]}{\Pr[\text{CareSought} = 1/\text{Distance} = 0, \text{Transport}, \text{Girls'School}]}$$

$$\frac{\Pr[\text{CareSought} = 1/\text{Distance}, \text{Transport} = 1, \text{Girls'School}]}{\Pr[\text{CareSought} = 1/\text{Distance}, \text{Transport} = 0, \text{Girls'School}]}$$

$$\frac{\Pr[\text{CareSought} = 1/\text{Distance}, \text{Transport}, \text{Girls'School} = 1]}{\Pr[\text{CareSought} = 1/\text{Distance}, \text{Transport}, \text{Girls'School} = 0]}$$

Model-3: Child and village factors.

$$\frac{\Pr[\text{CareSought} = 1/\text{Girl}, \text{ChAge}, \text{Illtype}, \text{IllDur}, \text{IllSev}, \text{Distance}, \text{Transport}, \text{Girls'School}]}{\Pr[\text{CareSought} = 1/\text{Boy}, \text{ChAge}, \text{Illtype}, \text{IllDur}, \text{IllSev}, \text{Distance}, \text{Transport}, \text{Girls'School}]}$$

Model-4: Child and household factors

$$\frac{Pr[CareSought=1/Girl,ChAge,Illtype,IllDur,IllSev,MAge,MLiteracy,LiveKids,MHealth,SES1,SES2]}{Pr[CareSought=1/Boy,ChAge,Illtype,IllDur,IllSev,MAge,MLiteracy,LiveKids,MHealth,SES1,SES2]}$$

Model-5: Child, household and village factors. Only those child and household variables were included in the model that were significant in crude or model-4 analysis.

$$\frac{Pr[CareSought=1/Girl,Illtype,IllDur,IllSev,LiveKids,SES1,SES2,Distance,Transport,Girls'School]}{Pr[CareSought=1/Boy,Illtype,IllDur,IllSev,LiveKids,SES1,SSES2,Distance,Transport,Girls'School]}$$

2.10.4.3 Prevalence of stunting, wasting and under-weight among pre-school children and agreement between estimates based on the WHO Standard and the NCHS Reference

We used a statistical program of World Health Organization (WHO) named ANTHRO (available from the WHO at www.who.int/nutgrowthdb) to obtain reference median and standard deviation scores for weight for age, height for age and weight for height, taking into account child's age and gender. To account for un-equal selection probabilities, weighted estimates of stunting, wasting and under-weight were calculated based on the WHO growth standard and the NCHS reference. 95% C.I. were calculated for each prevalence measure. Kappa statistics was calculated to report agreement for proportion of subjects identified as normal, mildly, moderately and severely under-nourished. Differences between estimates from two references were plotted against the average of the two references to determine the degree of agreement between two estimates.

2.10.4.4 Relationship between child's nutritional status based on the WHO standard and gender

Five models were constructed to examine association between nutritional status and gender. These models consisted of following variables:

Model-1: Gender and village variables.

$$\frac{\Pr[\text{Stunting} = 1/\text{Girl}, \text{Distance}, \text{Girls'School}, \text{Water}]}{\Pr[\text{Stunting} = 1/\text{Boy}, \text{Distance}, \text{Girls'School}, \text{Water}]}$$

Model-2: Village variables only.

$$\frac{\Pr[\text{Stunting} = 1/\text{Distance} = 1, \text{Girls'School}, \text{Water}]}{\Pr[\text{Stunting} = 1/\text{Distance} = 0, \text{Girls'School}, \text{Water}]}$$

$$\frac{\Pr[\text{Stunting} = 1/\text{Distance}, \text{Girls'School} = 1, \text{Water}]}{\Pr[\text{Stunting} = 1/\text{Distance}, \text{Girls'School} = 0, \text{Water}]}$$

$$\frac{\Pr[\text{Stunting} = 1/\text{Distance}, \text{Girls'School}, \text{Water} = 1]}{\Pr[\text{Stunting} = 1/\text{Distance}, \text{Girls'School}, \text{Water} = 0]}$$

Model-3: Child and village factors.

$$\frac{\Pr[\text{Stunting}=1/\text{Girl}, \text{Feeding}, \text{Immunization}, \text{Illreported}, \text{Distance}, \text{GirlsSchool}, \text{Water}]}{\Pr[\text{Stunting}=1/\text{Boy}, \text{Feeding}, \text{Immunization}, \text{Illreported}, \text{Distance}, \text{GirlsSchool}, \text{Water}]}$$

Model-4: Gender, household and village factors

$$\frac{\Pr[\text{Stunting}=1/\text{Girl}, \text{MLiteracy}, \text{LiveKids}, \text{MHealth}, \text{SES1}, \text{SES2}, \text{Distance}, \text{GirlsSchool}, \text{Water}]}{\Pr[\text{Stunting}=1/\text{Boy}, \text{MLiteracy}, \text{LiveKids}, \text{MHealth}, \text{SES1}, \text{SES2}, \text{Distance}, \text{GirlsSchool}, \text{Water}]}$$

Model-5: Gender and village factors along with those child and household factors that were significant either on bi-variate analysis or in Models 3 or 4.

$$\frac{\Pr[\text{Stunting} = 1/\text{Girl}, \text{MLiteracy}, \text{Distance}, \text{Girls'School}, \text{Water}]}{\Pr[\text{Stunting} = 1/\text{Boy}, \text{MLiteracy}, \text{Distance}, \text{Girls'School}, \text{Water}]}$$

Chapter 3: Relationship between child death and poor maternal health

3.1 Overview

In this study, association between child death and poor maternal health is examined. Such an association has been studied so far in a rural area of Bwamanda, northern Zaire (Broeck et al., 1996) and in rural western India (Hirve and Ganatra, 1997). Assessment of such an association in a rural area of Pakistan is important and relevant where women are often in poor health status (Ahmad et al., 2005; National Nutrition Survey, 2001-02).

From the conceptual framework of D'Souza & Bryant (1999), four groups of determinants of child death were adapted (Figure 2.3). Association of child death with self-reported poor maternal health was examined through a two-level random intercept model, adjusting for child, other maternal, household and village factors.

3.2 Study objectives

1. To estimate age-specific mortality ratios for children under-five years of age.
2. To determine association between death among children under-five years of age and self-reported poor maternal health.

3.3 Study hypothesis

Proportion of mothers who self-reported poor health (illnesses of more than two

weeks duration) is greater among under-five children who died during one year period than among those who were alive at the survey.

3.4 Study results

There were 3824 under-five children and 2440 mothers from 2276 households in 99 villages.

3.4.1 Age-specific mortality ratios

During one year prior to the survey, there were 106 deaths among 3824 children aged 0-59 months. Under-five deaths accounted for 43.4% of the total deaths (244). There were 996 live births during the same period, of which 508 were males. Infant deaths constituted 72.6% of under-five deaths and neonatal deaths accounted for 38.9% of infant deaths (Table 3.1).

Table 3.1: Age-specific mortality ratios

Age group	Number of deaths	Mortality ratio (95% C.I.)
Neonates	30	30.6 (21.4, 39.8)
Post-neonates	47	47.1 (32.2, 61.8)
Infants	77	77.7 (57.8, 97.5)
12-59 months	29	30.4 (19.7, 41.1)
0-59 months	106	108.1 (82.6, 133.5)

3.4.2 Characteristics of the study population

Among 3824 children, infants constituted almost a quarter (22.5%) of the study

population. Overall, boys and girls were about equally distributed (50.6% and 49.4%, respectively).

There were 60.2% of the mothers aged less than 30 years. Four-fifths of the mothers (84%) were not able to read or write a short simple sentence. More than half (57%) of the mothers had four or more live children. During one year period prior to the survey, one in five mothers (20.1%) reported being ill for more than 2 weeks duration due to weakness / being pale (40.3%), respiratory illness (19.3%) including tuberculosis and asthma, jaundice/hepatitis (12.6%), urinary problems (8.4%), diabetes (7.7%), skin infections/scabies (5.9%), fever/malaria (1.4%) or illnesses other than classified above (4.4%).

There were 42.2% of the households with three or more adults. A majority of the study population belonged to middle SES (40%), followed by high SES (32%) and low SES (28%) households. Water was supplied through non-piped sources in 80% of the villages.

3.4.3 Co-variates of child death (un-adjusted analysis)

Factors that showed significant association on unadjusted analysis with child death were child's age and maternal health status (Table 3.2). Children at elevated risk of death were infants and whose mothers reported poor self-health.

3.4.4 Co-variates of poor maternal health (un-adjusted analysis)

Poor maternal health was associated with her age, number of children and her literacy status (Table 3.3). Reporting of poor maternal health was significantly greater if

mothers were ≥ 30 years of age, if they had 4 or more live children or if they were literate compared to their respective reference groups.

Table 3.2: Crude prevalence ratios for child death (confidence intervals adjusted for clustered design)

Co-variates	Groups (n)	Deaths (%)	Prevalence ratios (95% C.I.)
Child's age	0-11 months (862)	8.9	8.8 (6.1, 12.8)
	12-59 months (2962)	1.0	1.00
Child's gender	Female (1902)	3.4	1.4 (0.9, 2.1)
	Male (1922)	2.2	1.00
Maternal health status	Reported ill (725)	4.4	1.9 (1.2, 3.0)
	Not reported ill (2874)	2.4	1.00
Mother's age	> 30 years (1304)	3.2	1.2 (0.8, 1.8)
	≤ 30 years (2303)	2.6	1.00
Literacy status	Illiterate (3033)	2.8	0.9 (0.5, 1.7)
	Literate (574)	2.6	1.00
Live children	≥ 4 (2069)	2.9	1.2 (0.8, 1.8)
	≤ 3 (1559)	2.7	1.00
Adults	≤ 2 (2202)	2.8	0.9 (0.6, 1.6)
	≥ 3 (1622)	2.7	1.00
SES	Low (1097)	2.6	0.9 (0.5, 1.8)
	Middle (1507)	3.0	1.0 (0.6, 1.7)
	High (1220)	2.6	1.00
Water source	Non-piped (3111)	3.0	1.3 (0.5, 3.3)
	Piped (713)	2.2	1.00

Table 3.3: Significant co-variates of poor maternal health (n= 3599) (confidence intervals adjusted for clustered design)

Co-variates	Groups (n)	Poor maternal health (%)	Prevalence ratios (95% C.I.)
Mother's age	> 30 years (1298)	26.5	1.6 (1.4, 1.9)
	≤ 30 years (2301)	16.5	1.00
Number of live children	≥ 4 (2058)	23.0	1.2 (1.02, 1.4)
	≤ 3 (1541)	16.2	1.00
Literacy status	Illiterate (3025)	18.6	0.6 (0.5, 0.8)
	Literate (574)	28.1	1.00

3.4.5 Association between child death and poor maternal health

Unadjusted analysis suggested that poor maternal health was associated with 90% greater risk of under-five deaths than mothers who did not report illness (Table 3.2). This association increased to 96% in model-1 and model-3 analyses and decreased to 87% in model-4 analysis (Table 3.4). In model-2, the strength of association between maternal health and child death though dropped to 14% but remained significant when water source, child and other maternal factors were accounted for.

3.4.6 Other significant predictors of child death

As expected, child's age was the most significant predictor of child death in both model 1 and 4 analyses (Tables 3.4). Infants had 8.7 times greater risk of under-five mortality than children aged 12 to 59 months when adjusted for maternal health and water source. No other child, maternal, household or village factor showed significant association with the child survival.

Table 3.4: Child death and poor maternal health: adjusted prevalence ratios (95% C.I.)

Variables	Model-1	Model-2 [2]	Model-3	Model-4
Maternal health	1.96	1.14	1.96	1.87
	(1.23, 3.10)	(1.02,1.27)	(1.23, 3.12)	(1.18, 2.95)
Child's age [1]		1.59		8.71
		(1.44,1.75)		(5.96, 12.73)
Child's gender		1.07		
		(0.99, 1.16)		
Mother's age		1.04		
		(0.94, 1.16)		
Maternal literacy		0.99		
		(0.89, 1.11)		
Live children		1.02		
		(0.92, 1.15)		
Adults			0.96	
			(0.59, 1.56)	
Low SES			0.91	
			(0.52, 1.61)	
Middle SES			0.98	
			(0.59, 1.62)	
Water source	1.37	1.06	1.39	1.34
	(0.54, 3.47)	(0.92 , 1.22)	(0.55, 3.55)	(0.53, 3.36)
Log likelihood	-455.27	-1325.75	-455.18	-398.18

[1] 0-11 months compared to 12-59 months

[2] Results obtained by COPY method (Deddens and Petersen, 2008)

3.5 Interpretation of study findings

Deaths among children under-five years of age were found to be associated with self-reported poor maternal health after adjusting for child's age and water source. This could be due to reduced maternal ability for child rearing activities possibly through reduced duration of breast feeding and/or less utilization of services for curative or preventive care. It may also operate through greater likelihood of low birth weight, under-nutrition or illness susceptibility among children of mothers in poor health. As expected, child's age remained the most powerful determinant of child's death. This could be due to greater susceptibility of young children to communicable childhood illnesses.

Chapter 4: Relationship between household decisions for child health care and gender

4.1 Overview

This study examines the association between household decisions for child health care and gender. Discrimination against girls in health care practices is reported to be one of the factors accounting for higher female mortality in a number of studies from India (Bhan et al., 2005; Das Gupta, 1987; Ganatra and Hirve, 1994; Pandey et al., 2002), Bangladesh (Choudhury et al., 2000; Fauveau et al., 1991; Mitra et al., 2000) and Nepal (Pokhrel, 2007 ; Pokhrel et al., 2005 ; Sreeramareddy et al., 2006). Investigation of gender differential in child health care in Pakistan deserves attention where the greatest gender disparity in child mortality among South Asian countries is seen.

Keeping in view the complex nature of household decision-making processes regarding child care, the conceptual framework of Pokhrel and Sauerborn (2004) was adapted (Figure 2.5). Five stages of health care utilization examined in this study consisted of (i) illness reporting; (ii) outside home formal care sought at a health facility; (iii) choice of provider as public or private; (iv) hospitalisation at least for a day; and (v) health expenditure per illness day.

After examining the gender-specific mortality ratios, the net effect of child's gender was studied for each stage of decision making for child health care, taking account of individual, household and village characteristics in a two-level random intercept model.

4.2 Study objectives

1. To estimate gender-specific mortality ratios for children under-five years of age.
2. To determine level of health care seeking for 1-59 months old rural children.
3. To determine at which stage/s of the pathway model, gender (an explanatory variable) influences health care decisions for 1-59 months old rural children.
4. To examine other predictors of health care decisions for 1-59 months old rural children.

4.3 Study hypothesis

Household-decision for health care seeking for children aged 1-59 months is associated with gender.

4.4 Study results

We analyzed 3740 children aged 1-59 months from 2254 households in 92 villages. The effective sample sizes while performing modelling for the various outcome measures were as follows:

1. Illness reporting = 3740 children;
2. Use of health facilities = 734 children who were reported ill;
3. Choice of provider (public or private) = 432 children who visited health facilities;
4. Hospitalization = 432 children who visited health facilities; and
5. Health expenditure per illness day = 432 children who visited health facilities.

4.4.1 Gender-specific mortality ratios

Of 106 deaths among under-five children during one year period, only 43% were of boys. As expected, male neonates had significantly greater mortality compared to female neonates and there were 20 more boy deaths than girl's per 1000 live births. However, among post-neonates and 12-59 months old children, there were 25 and 38 more girl deaths than boy's per 1000 live births, respectively (Table 4.1). The greatest gender difference in mortality was among children 12-59 months old.

Table 4.1: Mortality ratios and ratio difference by gender

Age group	Number of deaths	Mortality ratio (95% C.I.)			Girls' minus boys' mortality ratio (95% CI)
		Total	Boys	Girls	
Neonates	30	30.6	40.5	20.7	-19.8
		(21.4, 39.8)	(28.3, 52.7)	(6.2, 35.1)	(-39.1,-4.7)
Post-neonates	47	47.0	34.6	59.6	25.0
		(32.2, 61.8)	(20.1, 49.1)	(37.0, 82.2)	(13.9, 48.6)
12-59 months	29	30.4	11.5	49.5	38.0
		(19.7, 41.1)	(1.4, 21.5)	(27.0, 72.0)	(10.5, 65.5)

4.4.2 Characteristics of the study population

Children of age 1-11 months made up a little more than quarter (28.9%) of the study population (Table 4.2). Overall, boys and girls were almost equally distributed (50.4% and 49.6%, respectively). About one fifth (19.4%) of children (n=3740) were reported ill by their mothers (Figure 4.1), of which 10.6% died. The commonest illness reported was fever (40.1%) followed by respiratory illnesses (18.5%) and diarrhoea (15.7%) (Table 4.2). Among sick children (n= 734), illness duration was 14

days or less for two thirds (63.6%) and 3 months or less for 97.3% of subjects.

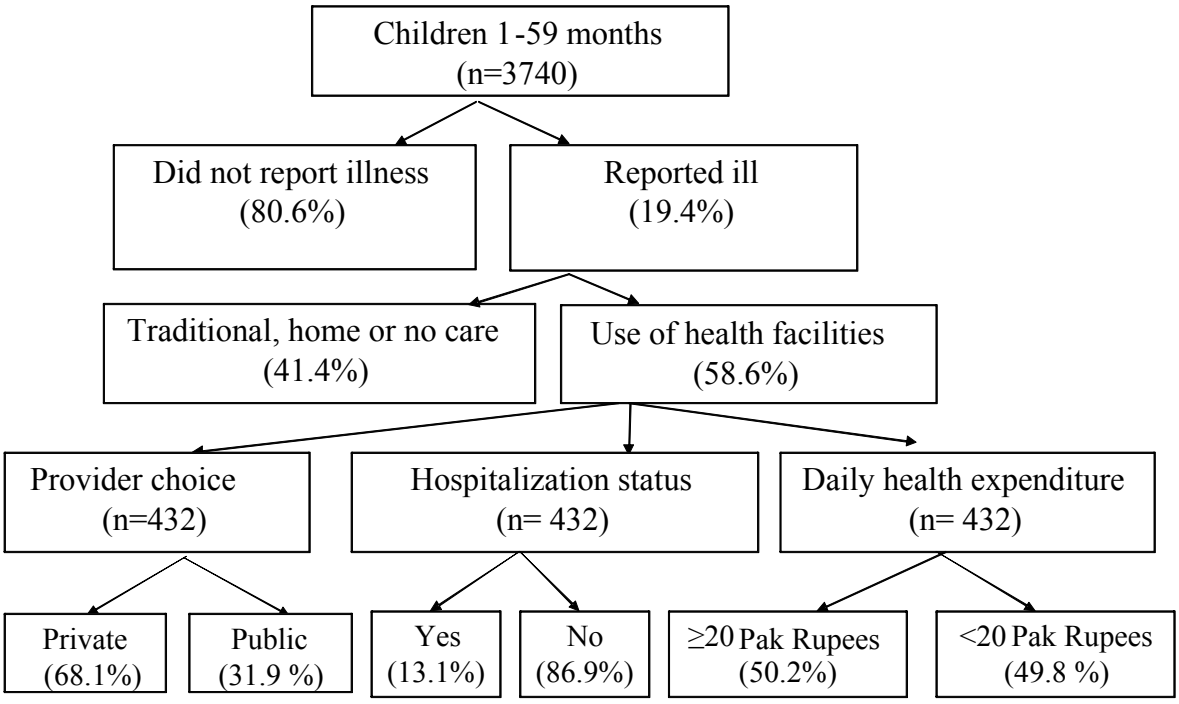
Table 4.2: Child characteristics as a percent of all children, reported ill and users of health facilities

Variables	Percents (weighted)
Female [1]	49.6
Post-neonates [1]	28.9
Reported ill [1]	19.4
Illness type [2]	
Diarrhoea	15.7
Respiratory	18.5
Fever	40.1
Others	25.7
Illness duration 15 or more days [2]	36.4
Fatal illness [2]	10.6
Use of a health facility [2]	58.6
Use of government facilities [3]	31.9
Hospitalized [3]	13.1
Health expenditure less than 20 PR / day [3]	48.2

Denominators consisted of children: [1] aged 0-59 months (n= 3740); [2] reported ill (n= 734); and [3] who visited a health facility (n= 432).

About three-fifths of sick children were taken to a health facility, of whom only about one third visited public facilities and about 13% were hospitalized. Daily expenditure was less than 20 PR for half of the population (Figure 4.1).

Figure 4.1: Health care decisions for child care in Thatta district



Three-fifths of the mothers (62.4%) were younger than 30 years, about four-fifths (84.7%) were illiterate and about half (54.6%) had 4 or more live children. One-fifth of them (20.5%) reported illness. Two-fifths of the children (40.8%) were from households of middle SES. Out of 92 villages, about half (54.8%) were ≥ 3 kilometres away from the nearest health facility, about three-fourths (71.7 %) had no transport during emergency and about four-fifths had no girls' school.

4.4.3 Co-variates of child health care decisions (un-adjusted analysis)

Among children aged 1-59 months, illness reporting was significantly less if the child was a girl (by 15%) or if there were 4 or more live children in the family. On the

other hand, illness reporting was greater if the child was 1-11 months old or if the mother self-reported poor health (Table 4.3).

Among sick children, gender was not a significant predictor of use of health facilities, provider choice, hospitalization or health expenditure. Health facilities were visited less when illness duration was > 14 days and if child had illness due to respiratory or other causes. Use of health facilities was more if the child was 1-11 months old or when there was no girls' school in village (Table 4.3).

Among users of health facilities, public units were visited less compared to private units if the child was 1-11 months old or if he/she was ill due to diarrhoea. Hospitalization was significantly less if there was no girls' school in village. Health expenditure was less for users of public facilities and illiterate mothers (Table 4.3).

4.4.4 Illness reporting and gender (a two-level analysis)

Illness reporting was significantly less for girls in Model-1 and Model-3 analyses but it marginally lost its significance in Model-4 and Model-5 analyses. In Model-5, the net effect of gender on illness reporting was null when the effects of child's age, number of live children in the family, maternal health status and village-level variables were collectively taken into account (Table 4.4). Illness reporting was, however, significantly greater for post-neonates and if the mother self-reported poor health. It was less if there were 4 or more live children in the family. All contextual level factors showed null effect on illness reporting.

Table 4.3: Crude prevalence ratios for child health care seeking (confidence intervals adjusted for clustered design)

Variables	Illness reporting	Facility use	Public provider	Hospitalization	Low expenditure
			Child Characteristics		
Female	0.85	0.97	1.12	0.66	0.88
	(0.76, 0.96)	(0.88, 1.08)	(0.91, 1.37)	(0.39, 1.12)	(0.73, 1.07)
Child's age [1]	1.49	1.17	0.73	1.28	0.87
	(1.29, 1.72)	(1.03, 1.33)	(0.54, 0.98)	(0.73, 2.27)	(0.72, 1.07)
Fatal illness	--	1.09	0.86	0.97	0.05
		(0.83, 1.43)	(0.51, 1.44)	(0.36, 2.62)	(0.007, 0.35)
Ill for ≥ 15 days	--	0.59	0.70	1.63	--
		(0.50, 0.72)	(0.40, 1.23)	(0.94, 2.81)	
Diarrhoea	--	0.90	0.64	1.30	0.84
		(0.79, 1.03)	(0.43, 0.97)	(0.67, 2.53)	(0.58, 1.19)
Respiratory	--	0.58	0.91	0.81	0.95
		(0.48, 0.71)	(0.58, 1.42)	(0.28, 2.33)	(0.67, 1.13)
Others	--	0.59	0.90	1.03	0.85
		(0.47, 0.73)	(0.57, 1.42)	(0.51, 2.08)	(0.65, 1.12)
Hospitalization	--	--	--	--	1.20
					(0.86, 1.68)
Public provider	--	--	--	0.89	1.39
				(0.45, 1.75	(1.13, 1.71)

Table 4.3: continued

Variables	Illness reporting	Facility use	Public provider	Hospitalization	Low expenditure
Household Characteristics					
Mother ≥ 30	1.03	0.96	0.89	1.09	1.12
years old	(0.92, 1.07)	(0.84, 1.09)	(0.66, 1.23)	(0.64, 1.85)	(0.90,1.39)
Illiterate mother	0.87	0.92	1.04	0.87	1.28
	(0.73, 1.05)	(0.80, 1.05)	(0.66, 1.63)	(0.39, 1.91)	(1.01, 1.61)
≥ 4 live children	0.87	1.14	0.87	1.35	0.98
	(0.78, 0.98)	(0.97, 1.34)	(0.68, 1.12)	(0.84, 2.17)	(0.81,1.19)
Poor maternal	1.88	0.97	--	--	--
Health	(1.62, 2.20)	(0.90, 1.05)			
Low SES	0.94	0.88	1.50	1.41	1.19
	(0.74, 1.19)	(0.71, 1.09)	(0.98, 2.29)	(0.67, 2.94)	(0.89, 1.61)
Middle SES	1.09	0.90	1.19	0.84	1.18
	(0.91, 1.31)	(0.76, 1.06)	(0.84, 1.71)	(0.41, 1.75)	(0.90, 1.55)
Village Characteristics					
Health facility at	1.15	0.96	1.35	1.19	1.13
≥ 3 kilometres [1]	(0.89, 1.47)	(0.81, 1.14)	(0.85, 2.16)	(0.66, 2.17)	(0.89, 1.43)
No transport [1]	1.17	0.91	1.09	0.65	0.96
	(0.88, 1.55)	(0.76, 1.09)	(0.67, 1.75)	(0.36, 1.17)	(0.74, 1.24)
No girls' school[1]	0.92	1.24	1.25	0.48	0.89
	(0.72, 1.16)	(1.06, 1.45)	(0.71, 2.12)	(0.27, 0.83)	(0.69, 1.14)

[1] 0-11 months compared to 12-59 months

4.4.5 Use of health facilities and gender (a two-level analysis)

There was no significant difference in use of health facilities between girls and boys, after accounting for illness characteristics, number of live children in the family, socio-economic status and village-level variables (Table 4.5). Use of health facilities was significantly less by 23% for illnesses of long duration and by 29% and 24% respectively, if child had respiratory illness or illness due to causes other than diarrhoea, respiratory illnesses or fever. Children from households of low SES used health facilities less (by 13%) than those from households of high SES. Among contextual variables, if there was no girl school in the village, use of health facilities was decreased by 41%.

4.4.6 Choice of care provider and gender (a two-level analysis)

Child's gender did not influence the choice of health care provider after adjustment with child's age, SES and the contextual variables in the final model 5. The two significant predictors of care provider choice were child's age and household SES. Public facilities were visited more often for older children (by 23%) and by low SES households (by 32%) (Table 4.6).

4.4.7 Hospitalization and gender (a two-level analysis)

In model-5, though girls were 32% less likely to be hospitalized than boys, the effect was non-significant when contextual factors were taken into account. Among contextual variables, absence of a girls' school in the village was associated with 49% less hospitalization (Table 4.7).

Table 4.4: Illness reporting: prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)** [2]
Child Characteristics					
Females	0.85	--	0.85	0.90	0.89
	(0.76, 0.96)		(0.76, 0.95)	(0.80, 1.01)	(0.80, 1.01)
Child's age [1]	--	--	1.49	1.49	1.47
			(1.30, 1.69)	(1.08, 1.29)	(1.28, 1.70)
Household Characteristics					
Mother ≥ 30 years old	--	--	--	1.07	--
				(0.91, 1.24)	
Illiterate mother	--	--	--	0.94	--
				(0.78, 1.13)	
≥ 4 live children	--	--	--	1.21	0.83
				(1.05, 1.39)	(0.73, 0.94)
Poor maternal health	--	--	--	1.90	1.92
				(1.64, 2.22)	(1.66, 2.23)
Low SES	--	--	--	0.97	--
				(0.77, 1.23)	
Middle SES	--	--	--	1.10	--
				(0.93, 1.31)	

Table 4.4: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Village Characteristics					
Health facility at ≥ 3 kilometres	1.15 (0.89, 1.50)	1.16 (0.89, 1.50)	1.14 (0.88, 1.49)	--	1.15 (0.91, 1.44)
No transport	1.19 (0.93, 1.53)	1.19 (0.93, 1.53)	1.19 (0.93, 1.53)	--	1.15 (0.92, 1.45)
No girls' school	0.91 (0.71, 1.16)	0.90 (0.70, 1.16)	0.89 (0.70, 1.15)	--	0.87 (0.69, 1.09)
Log Likelihood	-1843.08	-1845.93	-1826.54	-1697.36	-1694.18

[1] 0-11 months compared to 12-59 months

[2] Max-Rescaled Generalized R-Square = 0.004

4.4.8 Health expenditure per illness day and gender (a two-level analysis)

Gender did not determine the health expenditure per illness day. The latter was influenced by illness severity and choice of provider. Fatal illnesses were associated with four times greater expenditure than non-fatal illnesses. Use of public facilities was associated with 28% lesser expenditure than use of private facilities (Table 4.8).

4.5 Interpretation of study findings

Significantly greater neonatal mortality was observed among boys than among girls. Girls had significantly greater mortality than boys beyond neonatal age, suggesting

Table 4.5: Use of health facilities: prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)** [2]
Child Characteristics					
Females	0.97	--	0.95	0.96	0.95
	(0.87, 1.08)		(0.89, 1.02)	(0.89, 1.03)	(0.88, 1.02)
Child's age [1]	--	--	1.04	1.03	--
			(0.97, 1.12)	(0.96, 1.11)	
Fatal illness	--	--	1.11	1.14	--
			(0.93, 1.33)	(0.95, 1.36)	
> 14 days Illness	--	--	0.76	0.76	0.77
			(0.67, 0.87)	(0.67, 0.87)	(0.67, 0.88)
Diarrhoea	--	--	0.91	0.91	0.92
			(0.81, 1.03)	(0.82, 1.01)	(0.83, 1.02)
Respiratory	--	--	0.71	0.69	0.71
			(0.61, 0.83)	(0.59, 0.81)	(0.61, 0.83)
Others	--	--	0.75	0.71	0.76
			(0.64, 0.88)	(0.60, 0.84)	(0.64 , 0.89)
Household Characteristics					
Mother ≥ 30 years	--	--	--	1.03	--
old				(0.94, 1.13)	
Illiterate mother	--	--	--	0.95	--
				(0.84, 1.08)	

Table 4.5: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Household Characteristics					
≥ 4 live children	--	--	--	1.10 (0.99, 1.23)	--
Poor maternal health	--	--	--	1.05 (0.96, 1.15)	--
Low SES	--	--	--	0.87 (0.75, 1.01)	0.87 (0.76, 0.93)
Middle SES	--	--	--	0.92 (0.81, 1.04)	0.68 (0.46, 1.03)
Village Characteristics					
Health facility at ≥ 3 kilometres	0.95 (0.82, 1.09)	0.95 (0.82, 1.09)	0.95 (0.86, 1.06)	--	0.79 (0.53, 1.17)
No transport	0.81 (0.71, 0.92)	0.81 (0.71, 0.92)	0.92 (0.83, 1.03)	--	0.66 (0.42, 1.05)
No girls' school	0.76 (0.67, 0.88)	0.76 (0.67, 0.88)	1.12 (0.99, 1.26)	--	0.59 (0.37, 0.92)
Log Likelihood	-488.43	-488.55	-472.42	-449.26	-451.83

[1] 0-11 months compared to 12-59 months

[2] Max-Rescaled Generalized R-Square = 0.007

that behavioural factors may account for greater girl mortality. Prevalence ratios adjusted for significant confounders and cluster identity, however, did not show association of gender with illness reporting, care seeking, provider choice,

Table 4.6: Choice of care provider (public versus private): prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)** [2]
Child Characteristics					
Females	1.13	--	1.11	1.08	1.11
	(0.91, 1.40)		(0.86, 1.44)	(0.92, 1.23)	(0.96, 1.30)
Child's age [1]	--	--	0.75	0.79	0.81
			(0.56, 1.01)	(0.63, 0.99)	(0.66, 0.99)
Fatal illness	--	--	1.02	0.98	--
			(0.61, 1.64)	(0.68, 1.42)	
> 14 days Illness	--	--	0.68	0.76	--
			(0.42, 1.10)	(0.53, 1.07)	
Diarrhoea	--	--	0.69	0.76	--
			(0.48, 1.01)	(0.56, 1.02)	
Respiratory	--	--	0.98	0.98	--
			(0.65, 1.49)	(0.70, 1.36)	
Others	--	--	1. 30	1.08	--
			(0.71, 1.49)	(0.79, 1.47)	
Household Characteristics					
Mother ≥ 30 years	--	--	--	0.86	--
old				(0.69, 1.06)	
Illiterate mother	--	--	--	0.97	--
				(0.76, 1.24)	

Table 4.6: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Household Characteristics					
≥ 4 live children	--	--	--	0.89 (0.74, 1.09)	--
Low SES	--	--	--	1.36 (1.01, 1.85)	1.32 (1.01,1.76)
Middle SES	--	--	--	1.15 (0.91, 1.45)	1.12 (0.89, 1.43)
Village Characteristics					
Health facility at ≥ 3 kilometres	1.39 (0.88, 2.19)	1.37 (0.88, 2.13)	1.35 (0.89, 2.06)	--	1.22 (0.86, 1.73)
No transport	0.98 (0.64, 1.51)	0.98 (0.63, 1.50)	0.98 (0.64, 1.49)	--	0.99 (0.75, 1.33)
No girls' school	1.12 (0.70, 1.77)	1.12 (0.71, 1.77)	1.12 (0.71, 1.77)	--	1.09 (0.78, 1.50)
Log Likelihood	-276.78	-277.22	-269.98	-269.28	-271.44

[1] 0-11 months compared to 12-59 months

[2] Max-Rescaled Generalized R-Square = 0.007

hospitalization or expenditure, contrary to expectation. A number of other significant predictors of health care utilization were identified in this study. These included child's age, illness characteristics, maternal health status, number of children in the family, household SES, and absence of girls' school in the village. Overall, village variables contributed little to explain variability in health care decisions.

Table 4.7: Hospitalization status: prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	Model-2	Model-3	Model-4	Model-5 (Final) [2]
Child Characteristics					
Females	0.68	--	0.82	0.82	0.68
	(0.39, 1.18)		(0.62, 1.11)	(0.62, 1.09)	(0.39, 1.18)
Child's age [1]	--	--	1.01	1.14	--
			(0.84, 1.42)	(0.89, 1.46)	
Fatal illness	--	--	1.03	0.99	--
			(0.63, 1.69)	(0.61, 1.62)	
> 14 days Illness	--	--	1.38	1.29	--
			(0.97, 1.95)	(0.96, 1.75)	
Diarrhoea	--	--	1.07	1.06	--
			(0.72, 1.56)	(0.71, 1.59)	
Respiratory	--	--	0.87	0.91	--
			(0.51, 1.47)	(0.54, 1.52)	
Others	--	--	0.89	0.92	--
			(0.65, 1.25)	(0.64, 1.34)	
Public provider			1.09	0.98	--
			(0.75, 1.36)	(0.69, 1.41)	
Household Characteristics					
Mother ≥ 30 years	--	--	--	1.15	--
old				(0.89, 1.47)	
Illiterate mother	--	--	--	0.96	--
				(0.63, 1.48)	

Table 4.7: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Household Characteristics					
≥ 4 live children	--	--	--	1.32 (0.98, 1.77)	--
Low SES	--	--	--	1.77 (0.82, 2.01)	--
Middle SES	--	--	--	0.92 (0.63, 1.33)	--
Village Characteristics					
Health facility at ≥ 3 kilometres	1.25 (0.74, 2.09)	1.32 (0.78, 2.19)	1.14 (0.85, 1.53)	--	1.25 (0.74, 2.09)
No transport	0.83 (0.46, 1.51)	0.84 (0.46, 1.54)	0.91 (0.67, 1.22)	--	0.83 (0.46, 1.51)
No girls' school	0.51 (0.28, 0.93)	0.51 (0.28, 0.93)	0.71 (0.53, 0.95)	--	0.51 (0.28, 0.93)
Log Likelihood	-162.51	-163.64	-215.35	-209.62	-162.51

[1] 0-11 months compared to 12-59 months

[2] Max-Rescaled Generalized R-Square = 0.014

Table 4.8: Health expenditure per illness day: prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)** [2]
Child Characteristics					
Females	0.89	--	0.99	1.02	0.99
	(0.75, 1.06)		(0.87, 1.14)	(0.89, 1.17)	(0.87, 1.13)
Child's age [1]	--	--	0.98	1.02	--
			(0.83, 1.16)	(0.87, 1.21)	
Fatal illness	--	--	0.26	0.21	0.24
			(0.16, 0.41)	(0.15, 0.32)	(0.17, 0.34)
Diarrhoea	--	--	0.85	0.92	--
			(0.65, 1.01)	(0.69, 1.21)	
Respiratory	--	--	1.04	1.14	--
			(0.81, 1.34)	(0.90, 1.44)	
Others	--	--	1.08	1.09	--
			(0.90,1.28)	(0.91, 1.29)	
Hospitalization	--	--	1.26	1.24	--
			(1.05, 1.52)	(1.03, 1.49)	
Public care	--	--	1.24	1.26	1.28
provider			(1.09, 1.41)	(1.10, 1.43)	(1.11, 1.48)

Table 4.8: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Household Characteristics					
Mother ≥ 30 years old	--	--	--	1.16 (0.95, 1.41)	--
Illiterate mother	--	--	--	1.11 (0.92, 1.34)	--
≥ 4 live children	--	--	--	1.07 (0.89, 1.29)	--
Low SES	--	--	--	1.13 (0.88, 1.44)	--
Middle SES	--	--	--	1.09 (0.87, 1.37)	--
Village Characteristics					
Health facility at ≥ 3 kilometres	1.16 (0.96, 1.41)	1.18 (0.97, 1.43)	1.18 (0.97, 1.43)	--	1.03 (0.89, 1.19)
No transport	0.94 (0.77, 1.14)	0.94 (0.77, 1.14)	0.96 (0.84, 1.09)	--	0.94 (0.81, 1.09)
No girls' school	0.89 (0.73, 1.08)	0.89 (0.73, 1.08)	1.02 (0.88, 1.34)	--	0.94 (0.81, 1.09)
Log Likelihood	-295.34	-296.00	-263.52	-250.55	-253.44

[1] 0-11 months compared to 12-59 months

[2] Max-Rescaled Generalized R-Square = 0.002

Chapter 5: Prevalence of stunting, wasting and under-weight among pre-school children and agreement between estimates based on the WHO Standard and the NCHS Reference

5.1 Overview

This study provides comparison of estimates of nutritional status of children 0-35 months old based on a new growth standard released by the World Health Organization (WHO) in 2006 and the 1977 National Centre for Health Statistics (NCHS) growth reference. In Pakistan, nutritional status of children has been assessed based on the 1977 NCHS dataset (de Onis et al., 2004). Use of the NCHS dataset as an international growth reference has been criticized (World Health Organization, 1995). The new growth standard has been recommended instead for the assessment of nutritional status of children (WHO Multi-centre Growth Reference Study Group, 2006a, 2006b).

This study provides an opportunity to compare the prevalence of under-nutrition among pre-school Pakistani children based on the new WHO growth standard and the NCHS growth reference and to assess the degree of agreement between two measures.

5.2 Study objectives

1. To compare the estimates of stunting, wasting and under-weight for pre-school children based on the WHO standard and the NCHS reference.

2. To assess influence of the WHO standard on age-specific and gender-specific estimates of stunting, wasting and under-weight for pre-school children.
3. To measure the degree of agreement between estimates from the two references.

5.3 Study results

Completed height, weight and age information was available for 1051 children aged 0-35 months. Boys constituted a little more than a half (53%) of the study population. Mean ages of boys and girls were 14.0 months (S.E. = 0.4) and 13.0 months (S.E. = 0.4), respectively.

5.3.1 Z-scores for under-nutrition

Children of Thatta district were shorter and lighter than the reference populations of both the NCHS and the WHO datasets (Table 5.1).

Table 5.1: Mean standard scores (Z-scores) and 95% C.I. for under-nutrition based on the WHO standard and the NCHS reference

Parameter of under-nutrition	Mean Z-scores (95% C.I.)	
	WHO standard	NCHS reference
Height adjusted for age	-2.0 (-2.1.-1.9)	-1.8 (-1.9, -1.7)
Weight adjusted for height	-1.0 (-1.1, -0.9)	-0.8 (-0.9, -0.7)
Weight adjusted for age	-1.9 (-2.0, -1.8)	-1.9 (-2.0, -1.8)

5.3.2 Overall prevalence of under-nutrition

Compared to the NCHS reference, prevalence of stunting was significantly greater by the WHO standard with a relative increase of 18%. For wasting, the relative increase was 46% with the WHO standard. In contrast, prevalence of under-weight was lower but not significantly so, by the WHO standard with a relative decrease of only 4% (Table 5.2).

Table 5.2: Percent prevalence (95% C.I.) of under-nutrition based on the WHO standard and the NCHS reference

Parameter of under-nutrition	WHO standard	NCHS reference
Stunting	**52.9 (48.9, 56.9)**	**44.8 (41.1, 48.5)**
Mild	22.7	27.2
Moderate	24.8	25.8
Severe	28.1	19.1
Wasting	**22.9 (20.3, 25.5)**	**15.7 (13.5, 17.8)**
Mild	24.7	30.7
Moderate	15.3	13.3
Severe	7.5	2.5
Under-weight	**46.5 (42.1, 50.9)**	**48.4 (44.2, 52.6)**
Mild	28.5	29.1
Moderate	25.6	29.9
Severe	21.0	18.6

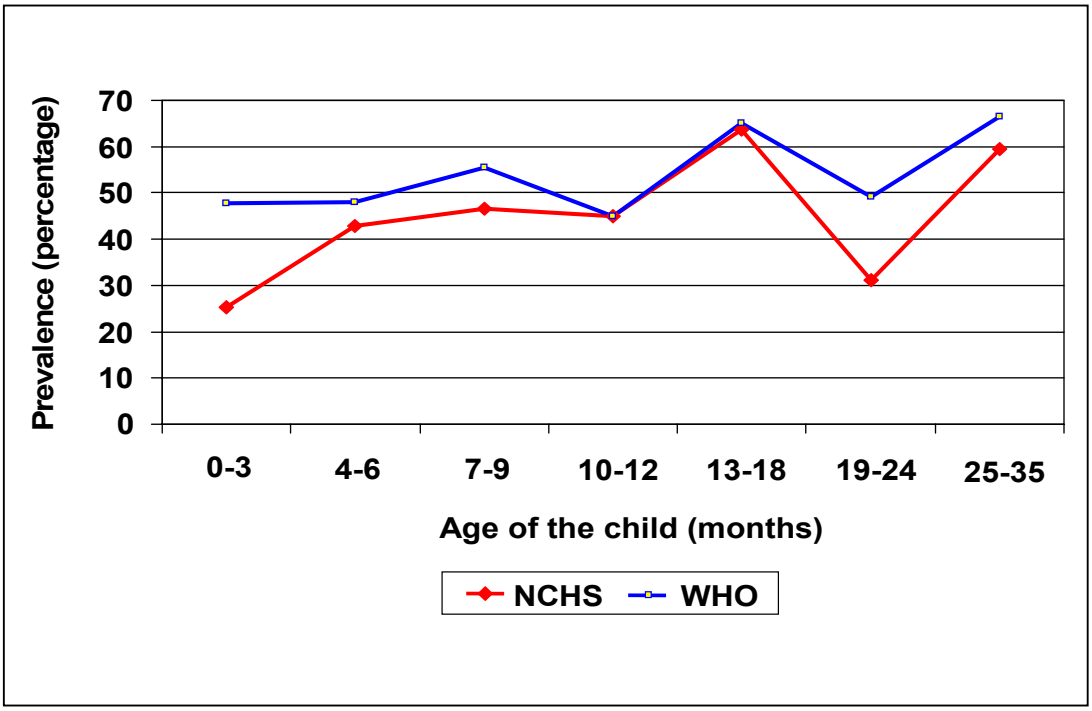
5.3.3 Prevalence of under-nutrition by severity

Prevalence of severely under-nourished children (by all three nutritional parameters) increased with the WHO standard compared to the NCHS reference (Table 5.2). This relative increase was twice for severe wasting, followed by 46.5% for severe stunting and 12% for severe underweight.

5.3.4 Age-specific prevalence of stunting

Age-specific prevalence of stunting was similar across various age groups by both the references except for children 0-3 and 19-24 month old, when the WHO standard gave significantly higher prevalence compared to the NCHS reference (Figure 5.1).

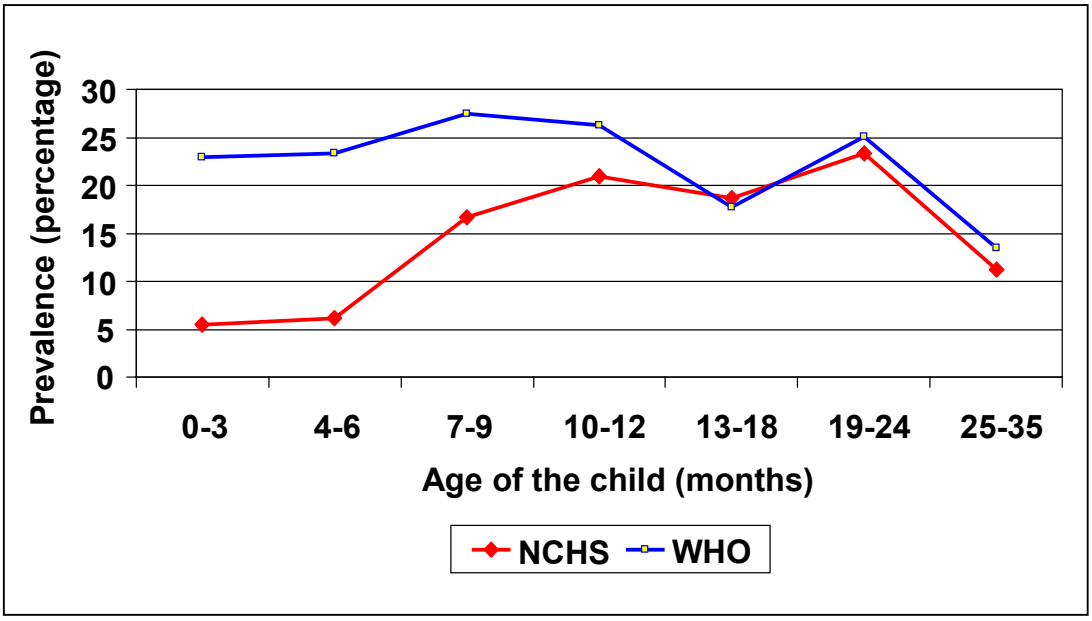
Figure 5.1: Age-specific prevalence (percent) of stunting based on the WHO standard and the NCHS reference



5.3.5 Age-specific prevalence of wasting

Age-specific prevalence of wasting was significantly higher by the WHO standard compared to the NCHS reference up to first 9 months (Figure 5.2). The two curves began to converge after 10-12 month, following which the two references produced similar results.

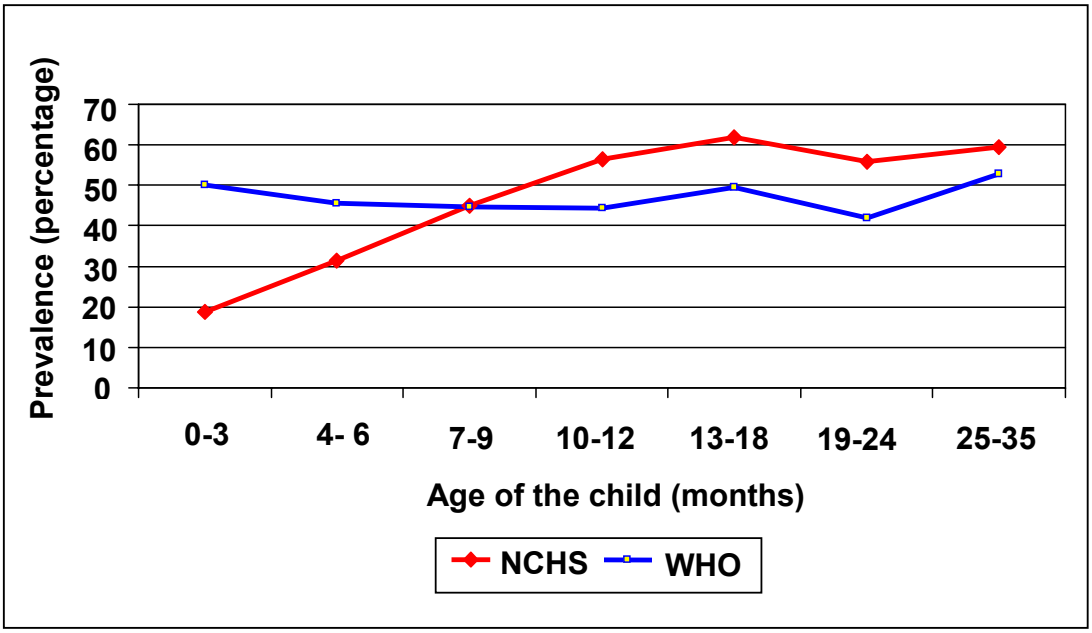
Figure 5.2: Age-specific prevalence (percent) of wasting based on the WHO standard and the NCHS reference



5.3.6 Age-specific prevalence of under-weight

Prevalence of under-weight was significantly higher by the WHO standard up to the first 6 months with a cross-over at 7-9 month, beyond which the WHO standard gave lower prevalence (Figure 5.3). Range of prevalence across various age groups was narrower by the WHO standard (between 42% and 52.8%) than by the NCHS reference (between 18.8% and 62%).

Figure 5.3: Age-specific prevalence (percent) of under-weight based on the WHO standard and the NCHS reference



5.3.7 Prevalence of under-nutrition for boys

Prevalence of stunting among boys was 18.4% greater by the WHO standard compared to the NCHS reference but the difference was not statistically significant. For wasting, prevalence was significantly greater by 41% by the WHO standard. On the other hand, prevalence of under-weight was 7.5% lower by the WHO standard. By all parameters of under-nutrition, proportion of severely under-nourished boys was greater by the WHO standard compared to the NCHS reference. This difference was particularly significant for stunting and wasting (Table 5.3).

5.3.8 Prevalence of under-nutrition for girls

Among girls, prevalence of stunting was 17.6% greater by the WHO standard compared to the NCHS reference but this increase was non-significant like that for the

boys. For wasting, prevalence by the WHO standard was significantly greater by 51.4% compared to the NCHS reference. On the other hand, there was no effect of choice of growth reference on prevalence of under-weight. Similar to boys, the WHO standard identified greater proportion of severe under-nutrition among girls than the NCHS reference, with the greatest impact of choice of reference on stunting and wasting (Table 5.3).

5.3.9 Difference in prevalence of under-nutrition by gender

It is interesting to note that prevalence of under-nutrition was greater among boys than among girls regardless of the growth reference used and for all three parameters of under-nutrition. This gender-difference in prevalence of under-nutrition was however, significantly greater only for under-weight as assessed by NCHS reference. Prevalence of severe under-nutrition was greater among boys than among girls by both the growth references and for all three parameters of under-nutrition. By the WHO standard, the gender difference in prevalence of severe under-nutrition was greatest for stunting, followed by under-weight and wasting. By the NCHS reference, the gender difference in prevalence of severe under-nutrition was greatest for under-weight, followed by wasting and stunting (Table 5.3).

5.3.10 Agreement between under-nutrition estimates from two references

5.3.10.1 Agreement on under-nutrition as a categorical variable

Overall, the grouping of the children as normally, mildly, moderately or severely undernourished showed good agreement between the estimates from two references. This agreement was greatest for height for age parameter (Tables 5.4 to 5.6). Where

Table 5.3: Percent prevalence (95% C.I.) of under-nutrition by its severity based on the WHO standard and the NCHS reference for boys and girls

Parameter of under-nutrition	WHO standard		NCHS reference	
	Boys	Girls	Boys	Girls
Stunting	57.2 (52.8, 61.6)	48.1 (43.3, 59.2)	48.3 (43.3, 53.4)	40.9 (36.2, 45.6)
Mild	22.6	22.9	26.0	28.5
Moderate	26.2	23.4	29.0	22.0
Severe	30.9	24.7	19.3	18.9
Wasting	24.6 (21.4, 27.8)	20.9 (17.3, 24.6)	17.4 (14.6, 20.3)	13.8 (11.1, 16.5)
Mild	27.6	21.8	34.3	29.5
Moderate	15.9	14.8	13.9	12.5
Severe	8.7	6.1	3.5	1.3
Under-weight	49.6 (44.1, 55.1)	43.1 (38.9, 47.3)	53.3 (47.3, 59.2)	43.1 (39.4, 46.7)
Mild	30.1	26.7	27.9	31.2
Moderate	27.3	23.9	32.6	26.7
Severe	22.3	19.2	20.7	16.4

the estimates from two references differed, the WHO Standard was more likely to categorize children as stunted and wasted than the NCHS Reference was (Tables 5.4 to 5.6).

5.3.10.2 Agreement on under-nutrition as a continuous variable

For all the three parameters, regression line is positive suggesting greater differences between the estimates based on WHO and NCHS references for children who are at smaller standard scores (Figures 5.4 to 5.6). Since most of the study population is

Table 5.4: Agreement between WHO growth standard and NCHS growth reference (%) for height for age

NCHS GROWTH REFERENCE	WHO GROWTH STANDARD			
	Normal height for age	Mildly stunted	Moderately stunted	Severely stunted
Normal height for age	24.0	3.9	-	-
Mildly stunted	0.4	18.6	8.2	-
Moderately stunted	-	0.2	16.5	9.1
Severely stunted	-	-	0.1	19.0

Overall weighted Kappa's statistics (95% C.I.) = 0.83 (0.81, 0.84)

Table 5.5: Agreement between WHO growth standard and NCHS growth reference (%) for weight for height

NCHS GROWTH REFERENCE	WHO GROWTH STANDARD			
	Normal weight for height	Mildly wasted	Moderately wasted	Severely wasted
Normal weight for height	46.2	5.7	0.3	-
Mildly wasted	6.3	17.9	6.5	1.3
Moderately wasted	-	1.1	8.5	3.7
Severely wasted	-	-	-	2.5

Overall weighted Kappa's statistics (95% C.I.) = 0.70 (0.69, 0.72)

Table 5.6: Agreement between WHO growth standard and NCHS growth reference (%) for weight for age

NCHS GROWTH REFERENCE	WHO GROWTH STANDARD			
	Normal weight for age	Mildly under-weight	Moderately under-weight	Severely under-weight
Normal weight for age	18.0	4.1	-	-
Mildly under-weight	6.9	16.7	5.5	0.3
Moderately under-weight	-	7.7	17.4	4.8
Severely under-weight	-	-	2.7	15.9

Overall weighted Kappa's statistics (95% C.I.) = 0.72 (0.70, 0.74)

Figure 5.4: Difference in estimates of height for age against average of estimates from WHO and NCHS references, with 95% limits of agreement (broken lines) and regression line

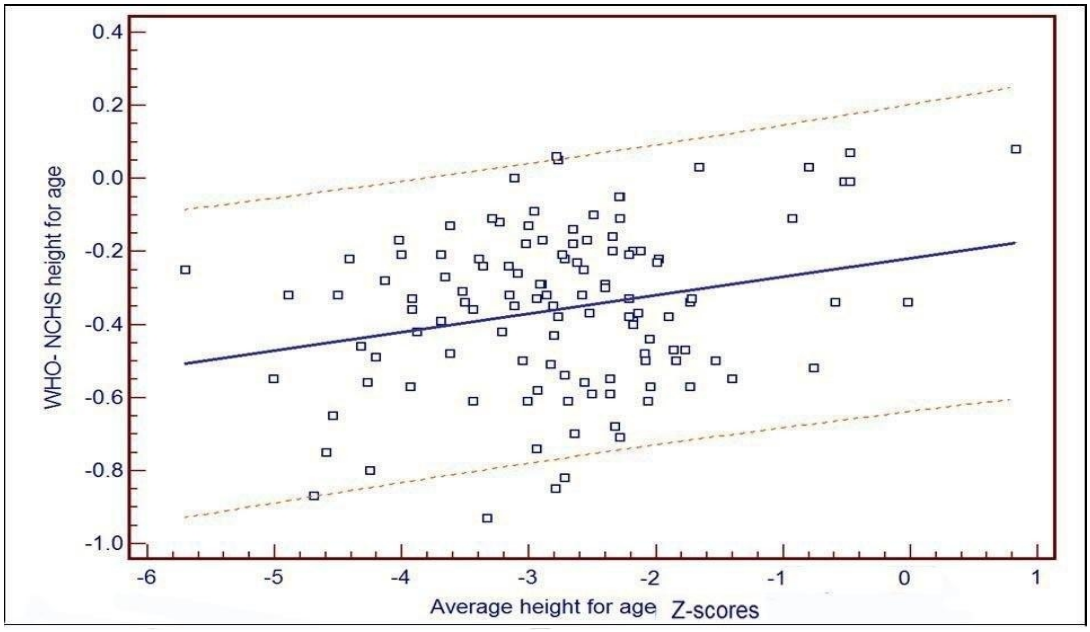
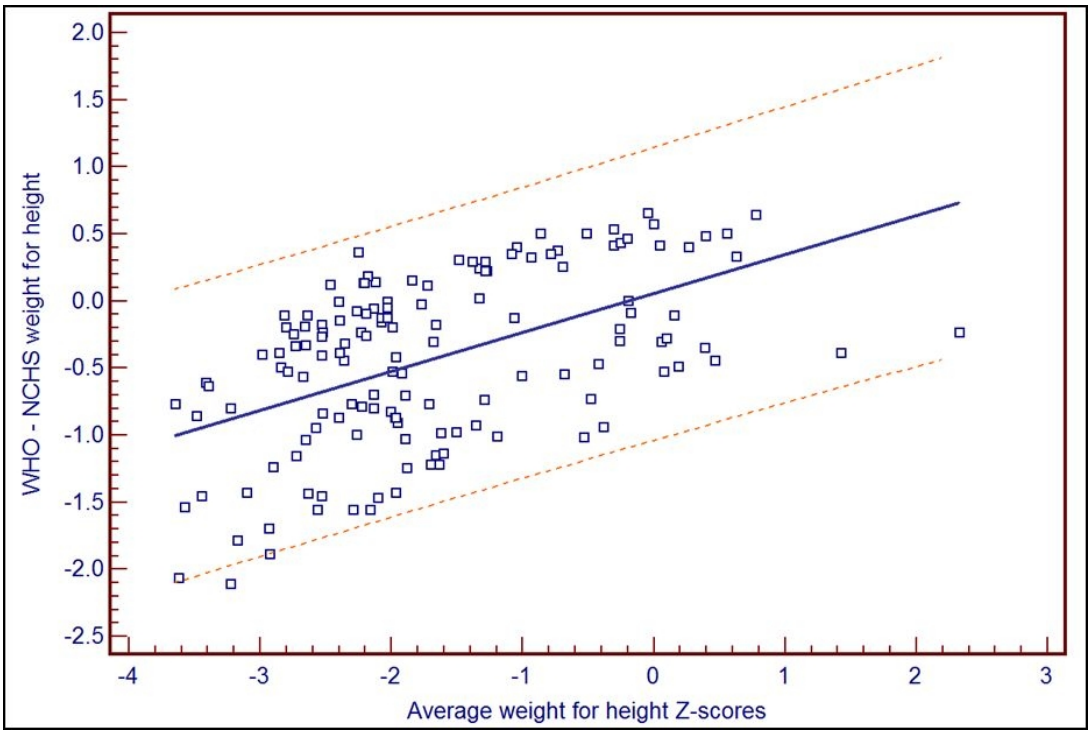
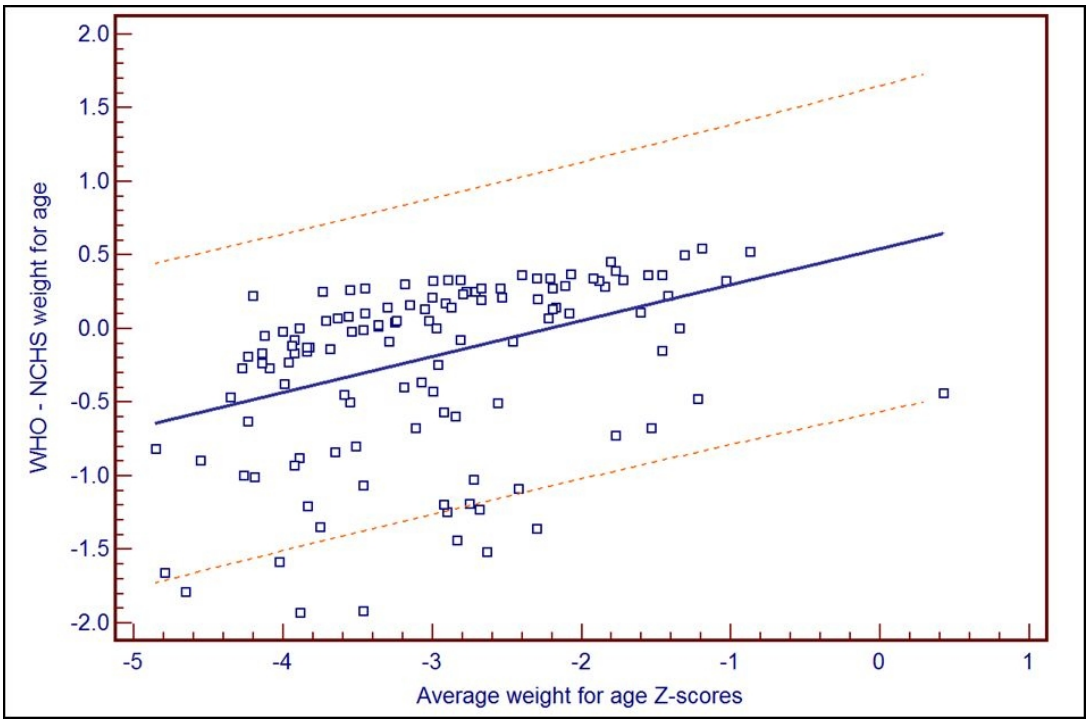


Figure 5.5: Difference in estimates of weight for height against average of estimates from WHO and NCHS references, with 95% limits of agreement (broken lines) and regression line



under-nourished as reflected by mean Z-scores in table 5.1, for a large proportion of the population, compared to WHO standard, on an average NCHS reference over-estimates the height for age by 0.4 SD and weight for height and weight by age by 1.0 SD (Figures 5.4 to 5.6). For values greater than -2.5 SD, no difference between the references is captured in the 95% CI for height for age and weight for height suggesting better agreement between both estimates for better nourished children (Figure 5.4 to 5.5). For weight for age, clustering is observed near the regression line and no difference between the references is captured in the 95% CI even for values at or more than - 4.0 SD suggesting two estimates agree better for weight for age (Figure 5.6).

Figure 5.6: Difference in estimates of weight for age against average of estimates from WHO and NCHS references, with 95% limits of agreement (broken lines) and regression line



5.4 Interpretation of study findings

On an average, children less than three years in Thatta are shorter and lighter than the reference populations. The effect of choice of reference varied depending upon which parameter was used to detect under-nutrition. Compared to the NCHS reference, prevalence of wasting was significantly greater by the WHO standard for all children combined as well as separately for boys and girls. Similarly, prevalence of stunting was significantly greater by the WHO standard for all children. The effect of choice of reference was less on stunting compared to that on wasting. The significant effect of the WHO standard disappeared when prevalence of stunting was examined separately for boys and girls. On the other hand, prevalence of under-weight did not

differ significantly with the choice of reference for all children combined and separately by gender. The proportion of severely under- nourished children increased with the use of WHO standard for all parameters. The impact was most on severe wasting, followed by severe stunting and severe under-weight.

The WHO standard estimated significantly higher prevalence of under-nutrition for young infants compared to the NCHS reference. However, the age group affected by the choice of reference varied depending upon parameter for under-nutrition. Significantly greater prevalence of stunting by the WHO standard was seen for 0-3 month and 19-24 month, of under-weight for up to 6 month and of wasting for up to 9 month. Thereafter, the two references gave similar results. There was no significant gender difference in prevalence of stunting, wasting or underweight with the use of new WHO standard.

Overall, the estimates from two references showed good agreement. This agreement was greatest for height for age when nutritional status was examined as a categorical variable and greatest for weight for height when it was examined as a continuous variable.

Chapter 6: Relationship between nutritional status of pre-school children and gender

6.1 Overview

This study examines the association between nutritional status of pre-school children and gender. Except for a few studies (Baig-Ansari et al., 2006 ; Choudhury et al., 2000; Pande, 2003; Rousham, 1996) that report greater under-nutrition among girls than boys, most of the observations from South Asia (Basu, 1993; Filmer et al., 1998; Hazarika, 2000; Kurz and Johnson-Welch, 1997; National Health Survey of Pakistan, 1998b; Shah et al., 2003) do not support the existence of female disadvantage in nutritional status. In these studies, nutritional status of the children was defined based on the 1977 NCHS growth reference and the contextual effect of community factors was not accounted for. It is important to investigate the existence of any such association in a rural Pakistani community (characterized by high prevalence of under-nutrition and gender differential in child mortality) based on the new WHO growth standard and taking into account the effect of village factors in the analysis.

Using a combination of UNICEF (1990) and Mosley and Chen (1984) conceptual frameworks, determinants of under-nutrition were grouped into proximate (child-related) and underlying factors (maternal, household and village-related) (Figure 2.7). Separate analyses were performed for stunting, wasting and under-weight to study the net effect of child's gender after taking into account other child, maternal, household and village characteristics in a two-level random intercept model.

6.2 Study objectives

1. To identify the existence of gender differential in stunting, wasting and under- weight among rural pre-school Pakistani children based on the new WHO growth standard.
2. To examine other predictors of stunting, wasting and under- weight in the study population.

6.3 Study hypothesis

Stunting, wasting or under-weight among children aged 0-35 months is associated with gender.

6.4 Study results

There were 1051 children 0-35 months old from 952 households in 95 villages.

6.4.1 Characteristics of the study population

Children of age 0-11 months made up a little more than two-fifths of the study population (Table 6.1). Overall, there were fewer girls than boys (47.0% and 53.0%, respectively). There was a very high prevalence of stunting (52.9%), wasting (22.9%) and under-weight (46.5%) based on the new WHO growth standard. Nursing infants (0-6 months) constituted 21.3% of the subjects. Only 11 % of 5-11 months old infants were weaned at 5 or 6 months of age. Among infants of age 7 to 11 months, weaning at or after 7 months of age was reported for 10% of them. Almost three-fifths (57.7%) of the children were older than 12 months at the survey. More than half (53.4%) did not receive any immunization and 26.3% received incomplete

immunization. For only 38.8% of the children, was immunization history obtained from the immunization card. For the rest, it was based on maternal recall. About one fifth (18.0%) of the children were reported ill over a one year period.

Table 6.1: Child characteristics (n=1051)

Variables	Percents (weighted)
Stunted children	52.9
Wasted children	22.9
Under-weight children	46.5
Female	47.0
Age-adjusted feeding status	
Nursing infants (0-6 months of age)	21.3
Infants aged 5- 11 months and weaned at 5-6 months	11.0
Infants aged 7- 11 months and weaned at or after 7 months	10.0
Early childhood (≥ 12months of age)	57.7
None or incomplete immunized children	79.7
Children reported ill	18.0

More than three-quarters of the mothers (83.7%) were illiterate and about half (52.5%) had four or more live children. One-fifth of them (21.9%) reported poor health. About a quarter of the subjects (27.6%) were from households with low socio-economic status (SES) and about two-fifth (40.8%) were from households of middle SES.

Out of 95 villages, more than half (55.4%) were located at three or more kilometres distance from the nearest health facility. Most of the villages obtained water from a non-piped source (90%) and did not have a girls' school (83%).

6.4.2 Co-variates of nutritional status (un-adjusted analysis)

Stunting was associated significantly with child's gender and maternal literacy. Its risk was greater for girls (by 19%) and for children of illiterate mothers (by 25%) (Table 6.2). Wasting was not significantly associated with gender. However, sick children were at 17% greater risk than those not reported ill. Significant associations of under-weight were observed with gender, maternal literacy and water source. Risk of under-weight was greater for girls (by 13%), if mother was illiterate (by 25%) and if water source was non-piped (by 20%).

6.4.3 Gender and stunting (a two-level analysis)

In all models, gender showed a significant association with stunting and its estimate remained stable across various models. Girls were at 18% significantly greater risk of stunting than boys, after adjustment of maternal literacy and village variables in model-5. Similarly, illiterate mothers were at 21% greater risk of having stunted children than literate mothers after accounting for child's gender and village level factors. All contextual factors had a null effect on stunting (Table 6.3).

6.4.4 Gender and wasting (a two-level analysis)

Gender was a significant predictor of wasting only in model-4 analysis. It lost its significance in final model when adjustment was made for illness in children and village variables. The only significant predictor of wasting in our population was

Table 6.2: Crude prevalence ratios for under-nutrition (confidence intervals adjusted for clustered design)

Variables	Crude prevalence ratios (95% C.I.)		
	Stunting	Wasting	Under-weight
Child characteristics			
Female	1.19 (1.03, 1.37)	1.05 (0.99, 1.12)	1.13 (1.02, 1.27)
Early childhood [1]	0.89 (0.76, 1.04)	1.04 (0.95, 1.13)	1.07 (0.89, 1.27)
Infants weaned late [1]	0.88 (0.69, 1.11)	0.98 (0.88, 1.09)	0.97 (0.72, 1.31)
Infants weaned early [1]	0.99 (0.82, 1.20)	0.93 (0.81, 1.06)	1.02 (0.79, 1.30)
None/incomplete immunization	1.01 (0.84, 1.22)	0.96 (0.87, 1.07)	0.88 (0.76, 1.02)
Reported ill	0.95 (0.79, 1.15)	1.17 (1.05, 1.31)	0.83 (0.65, 1.06)
Household characteristics			
Illiterate mother	1.25 (103, 1.52)	0.99 (0.91, 1.07)	1.25 (1.06, 1.47)
≥ 4 live children	0.98 (0.85, 1.14)	1.01 (0.94, 1.09)	1.01 (0.88, 1.16)
Poor maternal health	0.98 (0.83, 1.15)	1.05 (0.97, 1.13)	1.04 (0.91, 1.18)
Households of low SES [2]	1.05 (0.89, 1.24)	1.04 (0.93, 1.14)	0.95 (0.78, 1.14)
Households of middle SES [2]	1.03 (0.87, 1.23)	1.07 (0.98, 1.17)	1.10 (0.94, 1.29)
Village characteristics			
Health facility at ≥ 3 kilometres	0.86 (0.71, 1.03)	1.01 (0.94, 1.09)	0.87 (0.74, 1.03)
Non-piped water supply	0.84 (0.67, 1.06)	0.93 (0.86, 1.01)	1.20 (1.01, 1.43)
No girls' school	0.96 (0.75, 1.22)	0.99 (0.90, 1.09)	0.99 (0.79, 1.23)

[1] Reference category is nursing infants

[2] Reference category is households of high SES

Table 6.3: Stunting: prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)** [1]
Child characteristics					
Female	1.18 (1.03, 1.36)	--	1.18 (1.03, 1.36)	1.18 (1.03, 1.36)	1.18 (1.03, 1.36)
Early childhood	--	--	0.88 (0.75 1.04)	--	--
Infants weaned early	--	--	0.88 (0.70,1.10)	--	--
Infants weaned late	--	--	0.99 (0.82, 1.21)	--	--
None/incomplete immunization	--	--	1.03 (0.85, 1.24)	--	--
Reported ill	--	--	1.02 (0.84, 1.22)	--	--
Household characteristics					
Illiterate mother	--	--	--	1.21 (1.01, 1.45)	1.21 (1.01, 1.46)
≥ 4 live children	--	--	--	0.97 (0.82, 1.15)	--
Poor maternal health	--	--	--	0.98 (0.82, 1.17)	--

Table 6.3: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Household characteristics					
Low SES	--	--	--	1.13 (0.96, 1.33)	--
Middle SES	--	--	--	1.07 (0.89, 1.27)	--
Village characteristics					
Health facility at ≥ 3 kilometres	0.89 (0.75, 1.05)	0.88 (0.74, 1.04)	0.89 (0.75, 1.05)	0.90 (0.77, 1.07)	0.91 (0.77, 1.07)
Non-piped water supply	1.15 (0.91, 1.42)	1.14 (0.91, 1.41)	1.17 (0.94, 1.47)	1.15 (0.93, 1.41)	1.14 (0.92, 1.41)
No girls' school	0.99 (0.80, 1.21)	0.99 (0.81, 1.21)	0.99 (0.81, 1.22)	0.97 (0.79, 1.18)	0.97 (0.79, 1.18)
Log Likelihood	-683.81	-687.05	-682.04	-680.58	-680.73

[1] Max-Rescaled Generalized R-Square = 0.009

child illness. Sick children were at 16% greater risk of wasting than those not reported ill. For wasting also, village variables did not show any association except for water source in model-4 analysis. Children from villages with non-piped water source were at 10% greater risk of wasting compared to those who had piped water supply (Table 6.4).

Table 6.4: Wasting: prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)** [1]
Child characteristics					
Female	1.05 (0.99, 1.12)	--	1.05 (0.99, 1.11)	1.06 (1.01, 1.13)	1.04 (0.99, 1.15)
Early childhood	--	--	1.04 (0.96, 1.14)	--	--
Infants weaned early	--	--	0.98 (0.88, 1.09)	--	--
Infants weaned late	--	--	0.93 (0.82, 1.07)	--	--
None/incomplete immunization	--	--	0.96 (0.86, 1.06)	--	--
Reported ill	--	--	1.17 (1.04, 1.30)	--	1.16 (1.04, 1.30)
Household characteristics					
Illiterate mother	--	--	--	0.98 (0.91, 1.05)	--
≥ 4 live children	--	--	--	1.03 (0.95, 1.11)	--
Poor maternal health	--	--	--	1.06 (0.99, 1.14)	--

Table 6.4: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Household characteristics					
Low SES	--	--	--	1.03 (0.93, 1.14)	--
Middle SES	--	--	--	1.08 (0.99, 1.18)	--
Village characteristics					
Health facility at ≥ 3 kilometres	0.89 (0.75, 1.05)	1.03 (0.95, 1.11)	1.05 (0.98, 1.13)	1.05 (0.98, 1.12)	1.04 (0.96, 1.11)
Non-piped water supply	1.15 (0.92, 1.43)	1.09 (0.96, 1.17)	1.04 (0.96, 1.15)	1.10 (1.01, 1.19)	1.07 (0.98, 1.16)
No girls' school	0.99 (0.80, 1.21)	0.99 (0.92, 1.09)	0.97 (0.89, 1.05)	0.99 (0.91, 1.07)	0.98 (0.90, 1.07)
Log Likelihood	-535.02	-536.20	-527.59	-531.88	-530.34

[1] Max-Rescaled Generalized R-Square = 0.004

6.4.5 Gender and under-weight (a two-level analysis)

Girls were at 14% greater risk of being under-weight in all the models including model-5. In addition, risk of being underweight was 21% greater if the mother was illiterate. Risk of under-weight increased for children from middle SES households (by 15%) and from villages with non-piped water supply (by 17%) in model-4 analysis (Table 6.5).

Table 6.5: Under-weight: prevalence ratios from a model with cluster identity adjustment

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)** [1]
Child characteristics					
Female	1.14 (1.03, 1.26)	--	1.14 (1.03, 1.26)	1.14 (1.04, 1.27)	1.14 (1.03, 1.26)
Early childhood	--	--	1.05 (0.88, 1.27)	--	--
Infants weaned early	--	--	1.03 (0.77, 1.36)	--	--
Infants weaned late	--	--	1.04 (0.82, 1.33)	--	--
None/incomplete immunization	--	--	0.90 (0.78, 1.04)	--	--
Reported ill	--	--	1.16 (0.93, 1.46)	--	--
Household characteristics					
Illiterate mother	--	--	--	1.22 (1.04, 1.43)	1.20 (1.02, 1.41)
≥ 4 live children	--	--	--	1.02 (0.89, 1.18)	--
Poor maternal health	--	--	--	1.03 (0.91, 1.17)	--

Table 6.5: continued

Variables	Adjusted prevalence ratios (95% C.I.)				
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5 (Final)**
Household characteristics					
Low SES	--	--	--	0.98 (0.84, 1.15)	--
Middle SES	--	--	--	1.15 (1.01, 1.32)	--
Village characteristics					
Health facility at ≥ 3 kilometres	0.90 (0.77, 1.05)	0.89 (0.76, 1.05)	0.91 (0.78, 1.06)	0.94 (0.78, 1.11)	0.93 (0.79, 1.09)
Non-piped water supply	1.16 (0.98,1. 38)	1.16 (0.98, 1.39)	1.12 (0.94, 1.34)	1.17 (1.01, 1.37)	1.15 (0.98, 1.35)
No girls' school	1.02 (0.85, 1.22)	1.03 (0.85, 1.23)	1.02 (0.85, 1.21)	1.01 (0.86, 1.18)	1.02 (0.86, 1.21)
Log Likelihood	-682.91	-685.35	-679.88	-676.56	-679.70

[1] Max-Rescaled Generalized R-Square = 0.008

6.5 Interpretation of study findings

When the nutritional status of the pre-school children of Thatta district was defined based on the new WHO standard, girls had a greater risk of stunting (by 18%) and under-weight (by 14%) than boys. Gender was not the significant predictor of wasting. The only significant predictor of wasting was illness among children. Sick children had 16% greater risk of wasting. Among maternal factors, illiteracy was

associated with 21% greater risk for stunting and under-weight. Among contextual factors, the association between non-piped water and wasting was found for only one model. Overall, village variables contributed little to explain variability in child's nutritional status.

Chapter 7: General discussion

In this chapter, I critically evaluate the study findings in the light of current literature, describe methodological concerns and implications for public health and policy and propose directions for future research.

7.1 Critical evaluation of study findings

7.1.1 Relationship between child death and poor maternal health

Despite, the time lapse between this survey and the recent Pakistan Demographic and Health Survey (2006-07), the infant mortality ratio I found in Thatta (77.7/1000 live births) was similar to the recent estimates for the nation (78/100 live births) and for Sindh province (81/1000 live births). Under-five mortality ratio in Thatta (108/1000 live births) was higher than recent estimates (2006-07) for the country (94/1000 live births) and for Sindh province (101/1000 live births) suggesting some improvement has occurred. In Thatta district, prevalence of self-reported poor health among mothers (20.2%) was similar to that found in the National Health Survey of Pakistan where 21.2% of women from Sindh province, aged ≥ 15 years self-reported to be in "poor" or "fair" health (Ahmad et al., 2005).

In the Pakistani context, this is the first study that has examined the association between deaths among children of 0-59 month old and self-reported poor maternal health. In addition, this study is unique in assessing this relationship by prevalence ratio estimates and with account for water source. The present study reports an association of 1.87 times between child death and self-reported poor maternal health, after adjustment of child's age and water source.

This study differs from that conducted by Broeck et al. (1996) in northern Zaire in several important ways. First, Broeck et al. limited their work to infants 0-3 months old while this work included children 0-59 months old. Second, mortality assessment was done in a prospective fashion in contrast to the cross-sectional manner in Thatta. Third, chronic maternal disease was assessed by clinical examination and by history in northern Zaire compared to self-reported morbidity status in Thatta. Fourth, prevalence of severe chronic disease among mothers was found to be much less [3.1%] in Zaire than in Thatta [20.1%]. Fifth, Broeck et al. found a strong association of 4.8 times after adjustment for child's age, > 3 live siblings and parity >5. The present study found a weaker association (PR=1.87) between child death and poor maternal health. This could be due to the broadening of age selection to 0-59 months, assessment of maternal health by self-reporting, greater prevalence of poor maternal health in our population and reporting of prevalence ratios rather than odds ratio.

In the Thatta sample, child's age was the strongest predictor of child death after adjustment for maternal health and water source. Infants were 8.7 times at a greater risk of dying than children aged 12-59 months, a little lower that that reported by Yassin (OR=10) (2000). Greater mortality among infants compared to older children could be due to their greater susceptibility to communicable childhood illnesses and their severe consequences (Goldman et al., 2002; Heuveline and Goldman, 2000) and greater prevalence of under-nutrition (de Onis et al., 2006; Nuruddin et al., 2008 ; WHO Multi-centre Growth Reference Study Group, 2006a). Though source of water was accounted for in the analysis, it was not observed to be a predictor for child death. This could be due to less variability in data as 90% of the villages had water from non-piped sources.

Results of this study differ from those published in World Health and Population (Nuruddin et al., 2007) from the same dataset in a number of ways: First, I report here prevalence ratios instead of odds ratios. Second, the prevalence ratio is adjusted for child's age and water source instead of child's age, maternal age and type of house. This was because the maternal age was not found to be a significant predictor with the new modelling strategy. Third, I used here a composite variable for SES instead of using three separate indicators (income per capita, type of house and land ownership).

7.1.2 Relationship between household-decision for child health care and gender

There was a significant gender difference in mortality ratio which varied with child's age. Male neonates had greater mortality due to a biological advantage of female neonates (Coale, 1991). After neonatal period, girls had significantly greater mortality than boys. Gender disparity in post-neonatal mortality observed in Thatta is similar to observations from Nepal (Katz et al., 2003), Bangladesh (Bhuiya and Streatfield, 1992; Fauveau et al., 1991; Howlader and Bhuiyan, 1999; Hussain et al., 1999), India (Griffiths et al., 2001) and Pakistan (Pakistan Demographic and Health Survey, 2006-07; Zahid, 1996). Though there were excess male births (104 males: 100 females), assuming equal in- and out-migration of male and female population (Coale, 1991), gender differential in mortality further increased imbalance in gender ratio (for all ages) in Thatta (108 males: 100 females) (Noor Ali et al., 1994-95).

Our illness reporting (19%) for a one year period was less than the recent report of 17% for a two week period (Government of Pakistan, 2004-05). This could be due to potential inaccuracy in recall owing to prolonged recall period (Rothman and

Greenland, 1998) or low awareness among mothers at the time of survey about common childhood illnesses that might have improved following implementation of a community-based lady health worker program in 1994 (Government of Pakistan, 2004). Similarly, health facility use (58.6%) was less than the recent estimate for Thatta (91%) (Government of Pakistan, 2004-05) suggesting improvement in health care use over time. However, it is greater than that found in rural Indonesia (36%) during the similar time period (Sutrisna et al., 1993). Though health care sources and perceptions may not be similar for rural Indonesia and Thatta, the possibility of over-reporting of health care utilization in the study population can not be ruled out.

Under-utilization of public facilities, despite nominal costs, is similar to observations from a local survey (Government of Pakistan, 2004-05), Nepal (Hotchkiss et al., 1998; Sreeramareddy et al., 2006), India (Basu, 1990 ; Bhan et al., 2005; de Zoysa et al., 1998), Sri Lanka (de Silva et al., 2001) and Vietnam (Hong Ha et al., 2002). This could possibly be due to perceived low quality of care at public facilities (Basu, 1990 ; Hjortsberg, 2003) or to limited opening hours (NoorAli et al., 1999 ; Shaikh and Hatcher, 2004). Proportion of sick children being hospitalized was also very low (only 13%).

The lack of association between gender and illness reporting is similar to reports from Nepal (Pokhrel, 2007), Bangladesh (Fauveau et al., 1991) and Sri Lanka (de Silva et al., 2001). This could be due to similar risk among boys and girls to common childhood illnesses. In another study from Nepal, gender was not associated with care seeking behaviour (Sreeramareddy et al., 2006). However, most observations from areas of high under-five and girl child mortality show that boys are favoured in use of

health facility (Hassan and Khanum, 2000; Pillai et al., 2003), provider choice (Fauveau et al., 1991; Ganatra and Hirve, 1994; Hazarika, 2000; Pandey et al., 2002; Pillai et al., 2003), referral (Bhan et al., 2005; Fauveau et al., 1991; Ganatra and Hirve, 1994; Mitra et al., 2000) and health expenditure (Das Gupta, 1987; Pandey et al., 2002).

This study is important in expanding our knowledge about other determinants of health care utilization. Greater illness reporting among infants suggests their greater illness susceptibility and concern for them among mothers as they are often unable to express their sickness and are also at a greater risk of severe consequences of the illness (Goldman et al., 2002; Heuveline and Goldman, 2000). Greater illness reporting was also observed among mothers who report themselves to be in poor health (Minkovitz et al., 2005; Waters et al., 2000) and among small families (Selwyn, 1987).

Greater care seeking for fever compared to respiratory or other illnesses is similar to observations in rural Guatemala (Goldman et al., 2002; Heuveline and Goldman, 2000) and Nairobi slums (Taffa and Chepngeno, 2005). It could be a reflection of greater anxiety over undefined fever or acceptance of common respiratory illnesses as an inevitable part of life (Basu, 1990). Greater use of health care for illnesses of short duration (< 15 days) suggests that illnesses of long duration were not considered serious or that parents adapted to long-standing childhood illnesses.

Parent's capacity to protect their children, as measured by SES, influenced decisions to seek care and provider choice. Less use of health facilities for children from low SES suggest their inability to spend on health care (Sreeramareddy et al., 2006).

Parents of young and high SES children tended to choose private over public services with consequent increases in cost (Bhan et al., 2005). As expected, fatal illnesses were associated with greater expenditure and use of public provider was associated with less expenditure. Given that public facilities charge only nominal fees for their services whereas private facilities rely on user fees to cover most of their costs, choice of practitioner has a large impact on household health expenditure (Hotchkiss et al., 1998).

Association of a girls' school with greater use of health care and hospitalization suggests villages with a girls' school are likely to give importance to girls' education and possibly also to their health.

These findings need to be understood in the *local* context of Thatta consisting of predominantly poor and largely illiterate agricultural families who lack access to emergency transportation. Though a network of public and private providers is available, quality care cannot be assured.

7.1.3 Prevalence of stunting, wasting and under-weight among pre-school children and agreement between estimates based on the WHO Standard and the NCHS Reference

At the population-level, estimates of under-nutrition obtained with the WHO standard and the NCHS reference varied by nutritional parameter, severity of under-nutrition, child's age and gender. According to the WHO standards (de Onis et al., 1993), levels of stunting, wasting and underweight in Thatta district were high by both the international references. Even with recent estimates, prevalence of under-weight in

Thatta continues to remain high (49% for under-five children based on the NCHS reference) ranking Thatta on top among 16 districts of Sindh province (UNICEF, 2003-04). This suggests that under-nutrition is a very serious problem in this rural subset of the population.

Overall, prevalence of wasting and stunting were relatively higher with the WHO standard and relatively lower for underweight. Similar observations are reported for Bangladesh (de Onis et al., 2006) and for Gabon (Schwarz et al., 2007). Of concern is the relative increase in prevalence of severe under-nutrition, particularly of severe wasting and severe stunting with the new standard. Greater prevalence of severe wasting observed by the WHO standard in our sample is similar to other observations (de Onis et al., 2006; Isanaka et al., 2009).

The age-specific growth pattern was consistent with the prediction of the WHO group of experts (de Onis et al., 2006; WHO Multi-centre Growth Reference Study Group, 2006a) suggesting higher prevalence of wasting during first 9 months, higher prevalence of stunting during childhood and higher prevalence of under-weight during the first half of infancy (0-6 months) based on the WHO standard compared to the NCHS reference. It is interesting to note that compared to the NCHS reference, use of the WHO standard showed higher prevalence of under-nutrition for all the three parameters during early life, including the age group of 0-3 months. This indicates that under-nutrition in Pakistani children begins at a very early stage of infancy, even before weaning age. This could be related to poor maternal nutrition or health and low birth weight (Rikimaru et al., 1998) suggesting that children are born malnourished (United Nations, 1992).

For both boys and girls, prevalence of wasting was significantly greater by the WHO standard compared to the NCHS reference with the relative increase being greater for girls (51.4%) than for boys (41%). For both genders, proportions of severely wasted and stunted children were also more with the WHO standard compared to the NCHS reference. Prevalence of all 3 parameters of under-nutrition was however lower in girls regardless of the standard (Fenn and Penny, 2008).

This thesis reports for the first time the agreement between individual estimates from the two references. Overall, there is a good agreement between both estimates, particularly height for age (for classified nutritional status) and weight for height (for nutritional status as Z-scores).

7.1.3 Relationship between nutritional status of pre-school children based on the WHO standard and gender

This study supports the existence of girl disadvantage in child nutrition in Thatta district. Girls were found to be 18% more stunted and 14% more under-weight than boys suggesting the possible role of under-nutrition of girls as one of the possible pathways for their excessive mortality. This association of gender with stunting and underweight is lower than three times greater prevalence of stunting among girls of 6-18 months age for eight squatter settlements of Karachi. In other situations, female disadvantage in nutritional status was not observed (Basu, 1993; Filmer et al., 1998; Hazarika, 2000; Kurz and Johnson-Welch, 1997; National Health Survey of Pakistan, 1998b; Shah et al., 2003). Instead, girls are found to be better nourished than boys (Hong et al., 2006; Hong and Mishra, 2006). This could be due to use of WHO

standard as the reference for this thesis and use of specific analytical framework and technique particularly the use of prevalence ratio instead of odds ratio. In addition, under-nutrition among girls could have in reality been more since anthropometric assessment was done only for surviving children. Hence, possibly more girls than boys were excluded who died of severe under-nutrition.

This study provides additional evidence about association of child's illness and maternal illiteracy with under-nutrition. Increased risk of wasting with child's illness suggests association of acute under-nutrition with severe infections (Ricci and Becker, 1996). Maternal literacy may influence stunting and under-weight through better management of household resources, better weaning and feeding practices and improved health knowledge and behaviour (Terra de Souza et al., 1999). This has been stressed in the literature in the form of ecological study (Bicego and Boerma, 1991), cross-sectional studies (Arya and Devi, 1991; Gupta, 1991; Wamani et al., 2004) and case control studies (Aminul Islam et al., 1994; Piwoz, 1994).

Water source although showed an association with wasting and under-weight in one of the models, lost its significance later in the final model. Lack of association of under-nutrition with the water source is reported by Hong et al (2006) and by Hong and Mishra (2006). This could in part be due to the fact that access to improved water source does not, on its own, ensure improved health. It is its correct use through hygienic behaviour such as washing hands with soap after defecating and before eating and preparing food and safe handling and storage of water that leads to improved health.

7.2 Methodological concerns

This thesis is unique in that it has examined the important child health issues with the use of appropriate conceptual and analytical framework and techniques. Its conclusions are based on the most appropriate measure of association (prevalence ratio) suitable for common outcome measures and with cluster correlation taken into account. Almost all relevant literature in this area has been based on odds ratios which tend to over estimate common outcomes (Deddens and Petersen, 2008). In fact, this thesis reports for the first time cluster adjusted prevalence ratios for the log-binomial model and for the COPY method.

However, in this cross-sectional community-based study except for anthropological measurements, most of the information was based on retrospective interview data. This method of collecting information is relatively quick, low-cost and one of the most widely used methods to measure morbidity and utilization of health services (Kalter et al., 1991 ; Ross and Vaughan, 1986). However, it does bear potential for biases which should be considered while interpreting the study findings. These can be broadly described as information bias, selection bias, inadequate control of confounders, concerns in establishing causality, external validity of the study and other considerations.

7.2.1 Potential sources of information bias

7.2.1.1 Under-reporting of the events

Though death, being a definitive event is easily measured, the possibility of under-reporting cannot be ruled out. Women are at times reluctant to talk about their dead children or may not count children dying shortly after birth as live births, which

would affect estimates of mortality ratio. Greater mortality ratios among girls could be due to less reporting of girl births and greater reporting of girl deaths due to social reasons.

In this survey, a list of illness conditions was included in the questionnaire based on local disease patterns and peoples' description of common symptoms. Such a list is considered a sensitive instrument for measuring illness perception (Kroeger, 1983b). Use of such a list reminds respondents even of minor complaints, forces the interviewer to use it as a strict regulation, does not depend on the respondent's ability to verbalize his opinion and overcomes the problem of variation in definition of illness and people's willingness to describe their complaints.

Maternal health interviews though considered to be of reasonable accuracy in diagnosing common childhood illnesses (Kalter et al., 1991 ; Rousham et al., 1998) could account for inaccuracies in illness reporting, particularly when a child had more than one illnesses. It is difficult to determine whether maternal reports of illness represent the true prevalence since perceived illness might not correspond with a set of symptoms required for a clinical diagnosis of condition (Rousham et al., 1998).

Under-reporting of childhood illnesses could be for chronic (e.g. malnutrition and cough), highly prevalent (e.g. diarrhoea)) and mild (e.g. runny nose) conditions (Kroeger, 1983b; Sen, 2002) that might be considered as normal. It could be due to associated opportunity costs as a result of declaring their children as ill (Pokhrel, 2007) or lack of adequate awareness among mothers of the danger signs for the common conditions. Since utilization of health services was assessed conditional on perceived

morbidity, it is difficult to know the extent of under-reporting of illnesses and its impact on associated under-utilization of the services.

Similarly, poor maternal health might be under-reported as women are often accustomed to viewing their health problems as a part of normal feminism. Self reporting of illnesses could have been influenced by maternal mental health status which was not assessed in the survey.

7.2.1.2 Misclassification of variables

A certain degree of misclassification could not be excluded particularly for variables based on self-report. This includes reporting of age, income, health status and health seeking behaviour. Precise ages of the children were not always known since ages at death or at survey were obtained without reference to exact dates of birth and death. Preferential age reporting in whole months or age-heaping across the boundaries of one month, one year and five years would be of concern if it resulted in systematic transfer of subjects into adjoining ages and if it was differential depending upon survival or nutritional status of the child. However, misclassification by age is not expected to vary by child's gender.

Inaccurate age assessment could lead to under or over estimation of age-specific mortality ratios and misclassification of children as under-weight or stunted (Gorstein, 1989). Nutritional status of children whose actual ages were less than the nearest month could be under-estimated while the status of children who were older than the nearest month would be over-estimated. For the entire population, although this effect can be balanced if the ages are equally distributed throughout the period

(between the middle of the two months), such a distribution cannot be ensured and hence there remains the possibility of misclassification. There is however, a close relationship between prevalence of stunting and underweight obtained from computed ages and by ages rounded to the nearest month (Gorstein, 1989). In a situation such as ours, where accurate age information is often not available, wasting would serve as a useful parameter since it does not require knowledge of child's age (Cole, 1993).

To address the problem of inaccuracy in income reporting, multiple measures of socio-economic status such as income per capita, type of house and land ownership were used to allow a better understanding of the relationships of SES with child survival and health (Durkin et al., 1994).

Possible misclassification of confounders such as age and income might have resulted in residual confounding, despite accounting for these variables in analysis (Rothman and Greenland, 1998). Similarly, assessment of maternal health status by self-report could account for its non-differential misclassification and under-estimation of its effect (Rothman and Greenland, 1998). Moreover, defining poor maternal health status as diseases of more than two weeks duration could result in grouping together of diseases of varying severity making interpretation difficult. Similarly, grouping of common childhood illnesses as fever, respiratory illnesses, diarrhoea and other conditions could result in inclusion together of a range of conditions from mild to severe.

7.2.1.3 Recall bias

Reliance of health interview surveys on people's memory, their willingness to

communicate with interviewers and for children on proxy reporting by mothers are the potential sources of recall bias (Kroeger, 1983b). Reliability of the respondent's recall would vary with time of event occurrence, illness severity and frequency of visits to care providers (Kroeger, 1983b; Rothman and Greenland, 1998). The longer the recall period, the greater would be the possibility of recall bias. Sever symptoms or fatal outcome are remembered longer than the mild ones and few visits to the health facility are recalled better than the frequent ones (Kroeger, 1983b).

Recall period for illness reporting was one year with reference to the interview date. This was a compromise situation between obtaining sufficient events for analysis and loss of accuracy due to vague memory. There is a possibility that the recent illnesses were over-estimated and earlier events were under-reported. Though, one year recall period was used but there were only 2.7% of the children whose illness was longer than 3 months duration. For 63.6% of children, it was up to 14 days.

7.2.1.4 Respondents bias

It is difficult to rule out the problem of respondent bias when individuals feel compelled to respond in a manner consistent with the socially favoured response. This is particularly relevant for reported care sought so as to please the interviewer or to avoid feeling of child neglect when in fact care was not sought. Similarly, some respondents may report themselves or their child as ill so as to extract a more sympathetic response from the interviewers.

7.2.2 Selection bias

Anthropometric measurements in this study were based on only children surviving to

the survey date and hence, were not representative of a birth cohort of children. Identification of a weak association between gender and child nutritional status could possibly be due to survivor bias. It is possible that greater proportion of severely under-nourished girls might have died leaving better nourished girls to be measured (Choudhury et al., 2000). The potential for survivor bias is considered to be greater beyond infancy and for wasting and under-weight than for stunting (Boerma et al., 1992). Since anthropometric measurements were not available for deceased children, gender-specific prevalence of under-nutrition among them could not be assessed to determine the extent of survivor bias in nutritional status. For the same reason, the effect of under-nourished children identified by new WHO standard on morbidity or mortality prediction could not be examined.

Similarly, the influence of maternal death on survival of under-five children could not be assessed as information about maternal death was not available over a five-year period.

7.2.3 Inadequate control of confounders

Robust testing of confounders that were influenced by recall and reporting bias was not possible. Information on several important confounding variables was not available in the dataset. This included other determinants of (i) child death such as maternal survival, gender of older sibling, birth order (Muhuri and Preston, 1991), birth interval and nutritional status of deceased children, mother's child care and hygiene practices; (ii) of health care seeking such as gender of older siblings, number of illness episodes (Thind and Cruz, 2003), number of visits to care provider, changing care provider, health and cultural beliefs, previous experience with the

health providers, quality of care or support of husband and other family members and (iii) of nutritional status such as mother's anthropometry (Espo et al., 2002; Rahman and Chowdhury, 2007), child's birth weight (Ricci and Becker, 1996), birth interval (Thaver et al., 1990) and sibling gender.

7.2.4 Establishing causality

Significant associations reported in this thesis generally had a small magnitude of effect. However, they are all biologically and epidemiologically plausible and are consistent with the existing literature. Being based on a cross-sectional design, establishment of temporal relationship deserves consideration. Though both the child death and history of maternal illness were recorded for one year period prior to the survey, it is difficult to ensure that maternal illness occurred prior to the death of the child. Moreover, characteristics of mother and households were assessed at the time of survey and not at the time when the children under study were exposed to the risk. However, it is unlikely that factors such as socio-economic status had changed significantly for the majority of the study population over a one-year period.

7.2.5 External validity of the study

The sample provided a reasonably good representation of the district since 7 out of 9 talukas were included in the survey. The two talukas not included in the survey however, belonged to the remote areas of the district. It is possible that they might have poorer health and developmental indicators than the rest of the district. Inclusion of villages located within radius of five kilometres of the selected government health facilities might also influence generalizibility of the findings as child mortality ratios, maternal health status, prevalence of childhood illnesses,

utilization of health services and nutritional status might possibly be worse in far-off villages. However, the findings of this thesis could be generalized to other districts of the Sindh that have similar health and developmental indicators.

7.2.6 Other considerations

This thesis though based on information obtained in 1992-93, its findings could still be considered very relevant. This is because some of the health indicators of Thatta such as infant mortality rate (91/1000 live births), prevalence of under-weight children less than five years (49%) (UNICEF, 2003-04) and a two-week prevalence of illness among children less 5 years (17%) (Government of Pakistan, 2004-05) have worsened over time (Table 2.1). Its recent adult sex ratio (112 males for 100 females) reflects increasing gender differential during the last decade (Population Welfare Department, 2005a). In addition, its developmental indicators such as adult (≥ 15 years) literacy level (32%) and proportion of concrete housing (19%) (Government of Pakistan, 2004-05) have also remained static.

Statistical power to detect some of the associations such as of gender with choice of provider, hospitalization, health expenditure and stunting was insufficient. Paternal factors such as age, literacy and occupation were not included in the model building for two reasons: First, paternal factors did not show significant association with the outcome variables on crude analysis and second, to limit the number of variables in modelling, maternal and household characteristics were considered more important and relevant than paternal factors.

The effect of seasonal variation of the study results could not be accounted for. For

example, there was greater reporting of respiratory illnesses than that of diarrhea as the survey was conducted during winter season when prevalence of respiratory illnesses is expected to be more than diarrhea. Variation in reported prevalence of illness with season would possibly influence utilization of service (Sauerborn et al., 1996). Similarly, since the survey was conducted during a dry winter period before the harvest season, low access to food might account for high levels of under-nutrition.

7.3 Implications for public health and policy

This thesis provides valuable information for public health planning of child survival programmes for under-privileged rural communities. It also draws attention of national policy makers to Thatta and similar rural districts of Sindh as geographically important areas for programme implementation and enhancement.

7.3.1 Integration of maternal and child health services

This thesis provides clear evidence of the important contribution of maternal health to child survival. Currently, the national child survival programs are focused on the control of diarrhoea, acute respiratory infections, malnutrition and vaccine preventable diseases but and by and large, ignore the important contribution of maternal health to child survival (Bhutta, 2004a). Moreover, this thesis points out that child survival programs should be expanded to include activities that promote mother's health beyond pregnancy and post-partum. Although promotion of mother's health, particularly prevention and treatment of anaemia, is presently encouraged during antenatal, natal and postnatal periods, it is not monitored beyond the post-partum period. This is particularly relevant in the under-privileged situation of Thatta

where only a quarter of mothers with poor health reported receiving care at a government or a private health centre. In addition, the early onset of under-nutrition in our population suggests that improvement of child's nutrition is dependent on improving maternal health and nutrition further supporting the integration of maternal health with child survival activities. Whenever a mother comes in contact with the health care system (e.g. for routine vaccination of her child), she should be opportunistically screened and treated for common conditions such as anaemia, under-nutrition or chronic cough. Such activities should also be integrated into the existing community-based lady health worker program of the government of Pakistan (Government of Pakistan, 1993).

7.3.2 Improving utilization of public health facilities

Despite the availability of a good network of public health facilities in rural Thatta and the relatively low cost of care, its health services were highly under-utilized. Though a number of reasons are reported for such under-utilization including under-staffing, lack of female health staff in rural areas, inadequate supply of drugs, low quality of care and limited operational hours (Government of Pakistan, 1993; Islam, 2002), concerted efforts are not yet implemented to improve their utilization. The recent Devolution Plan of Government (Devolution Plan, 2000) provides an opportunity to introduce fundamental changes in health care delivery system so as to make it more effective and efficient.

7.3.3 Addressing social development

In the Thatta district, barriers to appropriate care seeking include low SES and lack of girls' school in the village. Also, risk of stunting and under-weight are associated

with maternal illiteracy. Hence, poverty alleviation in rural areas may improve utilization of health services. Similarly, improving literacy among rural girls would influence nutritional status and health service utilization.

7.3.4 Replacement of the NCHS growth reference with the WHO growth standard

This study supports the recommendation by the WHO for developing countries to switch to the more robustly constructed and up-to-date WHO standard for assessing nutritional status of pre-school children. Since growth monitoring is an integral part of child survival programmes, policy makers must comprehend the implications of adopting these new standards on individual management, population statistics and in the planning and implementation of national health services and interventional programmes.

It would certainly affect the classification of nutritional status i.e. a reduction in the number of under-nourished children if weight-for-age is used and an increase in the number if length for-age and weight-for-length are used. At the individual level, for children who are in the middle of the ongoing growth assessment, any switch to the new standard would lead to inevitable disjunction between the different charts.

Since Millennium Development Goal 1 (1990–2015) aims to halve underweight prevalence among under-five children, Pakistan's national target should be re-set based on the new WHO standard (Nuruddin et al., 2008). Such a switch may affect the international ranking of the country for nutritional status of children. It would also affect the findings from routinely collected data such as used in the tracking of

progress toward the Millennium Development Goal as well as analyses from repeated cross-sectional data such as Demographic and Health Surveys. Change of growth standard would require allocation of additional resources for the introduction of new growth charts and for the training of health workers in their use and interpretation in both public and private sectors and at different levels of care.

Lack of a switch to the new standard would, on the other hand, result in missing out on a significant proportion of wasted and stunted children who are at risk of excessive morbidity and mortality (Pelletier and Frongillo, 2003). Likewise, under-nourished infants who are more likely to be missed under the old method than the older children would be the obvious beneficiaries of the new growth curves. In addition, use of the WHO standards could make important differences to the number of children in need of referral or special care. Its implementation as a screening tool for severe under-nutrition would result in increase in the number of referrals for treatment with a consequent increase in resource demand. Increased identification of severely wasted children would have implications for enrolling children into nutritional or feeding programmes based on the criterion of severe wasting (World Health Organization, 1999).

7.3.5 Identification of high risk children for targeted nutritional interventions

Greater prevalence of stunting and under-weight among girls suggests gender sensitive approach to be adapted in nutritional intervention programmes. This would not only improve girl child survival but would also prevent the long term effects of girl under nutrition on delivery complications such as obstructed labour due to short

pelvis or low birth weight babies. High prevalence of wasting, stunting and under-weight among younger infants suggests that nutritional interventions and programmes should be especially targeted at this more vulnerable group. Similarly, children with reported illnesses and whose mothers are illiterate constitute the high risk groups for nutritional advice.

7.4 Direction for future research

This thesis has provided useful insights into the determinants of child survival, health care seeking behaviour and nutritional status for a rural district of Thatta. However, the study findings need to be tested further by studies with objective assessment methods for childhood and maternal illnesses and etiologically relevant induction period. Interventional studies designed to improve the maternal health status needs to be tested out on a small scale to asses its impact on number of death averted.

Studies that use anthropometric scores either as risk factors or as outcome measures should be based on the new growth standard in order to check whether the nature and strength of the relationships are affected with the change of the standard. There is a potential for different results if the analysis were to use categorical variables classifying subjects above and below the Z-score cut-offs. The effect of change of growth standard should be examined on incidence estimates of under-nutrition in longitudinal studies. For monitoring trends in nutritional status, re-analysis of earlier datasets based on algorithms for converting estimates into new standard estimates (Hong and Mercedes, 2008) is suggested.

The question of the gender differential in health care utilization is open for further

research. To improve our understanding in this area, prospective design with follow-up of a birth cohort is needed that would include (i) factors such as birth interval, sibling gender, illness episodes, delay in care seeking, visit frequency, health beliefs and quality of care in the conceptual framework; (ii) additional evidence from facility records (iii) use of appropriate sample size with sufficient variation in village-level factors and (iv) qualitative research.

Similarly, the studies focusing on exploration of gender difference in nutrition status should consider follow-up of a birth cohort so that the information about birth and maternal weight, previous under-five death and sibling gender can be included in the conceptual framework.

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Appendix 1

THATTA HEALTH SYSTEM RESEARCH PROJECT

RESEARCH INFORMATION SYSTEM (RIS) 1993

SURVEY QUESTIONNAIRE

Prepared by

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Mr. Amin Hirani

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Contribution

Thatta Team

TABLE OF CONTENT

GENERAL INFORMATION

Six Questionnaire Sections:

1. Village Profile
2. Household socio-economic information
3. Household profile - Face Sheet
4. Deaths in last one year
5. Children less than 3 years of age
6. Married woman less than 50 years of age

ID Variables :

SRNO	:	Household Serial Number
SRNO_Q7	:	Household Member Serial Number
CQ7	:	Face sheet Number of Child less than 3 years of age
WQ7	:	Face sheet Number of Married Women less than 50 years of age

Universal Codes:

97 No response

98 Don't Know

99 Not applicable

FIRST THREE QUESTIONS COMMON TO ALL SECTIONS

(to be filled by the village headman)

Q1 : Village Name (Coded as 1 - 139)

VILLAGE #	VILLAGE	HOUSEHOLD	POPULATION
1	Amin Mohd Baloch	9	54
2	Rais Qasim Baloch	8	64
3	Punno/Allana	19	409
4	Qabool Baloch	14	68
5	Darya Khan	46	313
6	Khose Mohalla	24	161
7	Hashim Mandra	77	479
8	Hashim Mirbahar	17	113
9	Hargina Salt	58	385
10	Qureshi Salt	40	232
11	Ismaili Jokhiyo	32	190
12	Haji Dado	24	183
13	Haji Karmi	52	310
14	Jaffar Jokhio	35	215
15	Noor Mohd Thaeem	35	452
16	Arif Palijo	69	422
17	Changal Khan Khaskli	57	529
18	Siddique Jokhyo	39	299
19	Ibrahim Jokhyo	23	181
20	Qasim Dars	8	40
21	Hyder Shah/Arbab Mehal	10	92
22	Rias M. Khan Malkani	28	274
23	Ismail Basar	8	75
24	Achar Malah	24	152
25	Khamiso Khan	11	79
26	Yaqoob Otho	22	103
27	Hussain Abad	38	287

VILLAGE #	VILLAGE	HOUSEHOLD	POPULATION
28	Begna Mori	56	344
29	Mohd Bangal Chowan	77	431
30	Siddiq Channa	59	353
31	Ratho Goth	15	76
32	Sabz Ali Baloch	30	149
33	Banno	201	1179
34	Haji Somro	55	340
35	Haji Izza Mohd Khan	74	420
36	Faiz Mohd Jatt	87	396
37	Achar Salar	169	915
38	Haji Abro	20	99
39	Gulan Chandio	19	76
40	Haji Suliman Shah	9	50
41	Biddo Malah	16	84
42	Saifal Chandio	14	58
43	Miro Chandio	23	101
44	Mattio Malirani	18	111
45	Homan Kolhi	17	104
46	Talib Dal	41	201
47	Ali Mir Bahar	56	293
48	Abdullah Magsi	43	220
49	Haji Hooti Gugo	18	97
50	Dars Shoro	13	61
51	Nooro Lashari	5	18
52	Khan Lashari	7	26
53	Mazar Chandio	71	396
54	Kath Bambhera	9	40
55	Haji Ramazan Lashari	14	78
56	Achar Paryar	13	67
57	Alladino Jatt	6	31
58	Akhan Jatt	6	39
59	Ramoo Jatt	9	44

VILLAGE #	VILLAGE	HOUSEHOLD	POPULATION
60	Chutto Malah	18	94
61	Ramzan Samoo	14	88
62	Alladino Jamali	35	161
63	Mevo Jamali	37	180
64	Achar Magsi	28	132
65	Kando Magsi	9	48
66	M. Rahim Magsi	34	171
67	Aroo Shah	5	24
68	Jamoo Sanjarani	42	182
69	Ali Mandra	17	92
70	Qasim Magsi	5	21
71	Nawab Rind	18	78
72	Lal Mohd Dars	7	39
73	Basrio Jotoi	32	155
74	Bello Maqbool	30	164
75	Tando Chughani	43	205
76	Miro Karar	13	56
77	Khair Bux Lughari	74	392
78	Somar	9	58
79	Karim Bux Chandio	10	53
80	Sheedo Jaro	26	128
81	Dost Mohd	21	107
82	Gul Hasan Shah	10	36
83	Urs Jatt	32	182
84	Ashraf Chandio	23	128
85	Arif Chandio	11	51
86	Khameso Jatt	31	156
87	Brosar Colony	44	286
88	Chatto Khayo	41	225

VILLAGE #	VILLAGE	HOUSEHOLD	POPULATION
89	Molvi Mohd Hashim	8	35
90	Babo Burrio	10	136
91	Haji Saleh Kathyar	8	68
92	Essa Nahyo	49	313
93	Ahmed Nahyo	91	692
94	Lakho Baluch	43	220
95	Haji Mohd Ali Chandio	41	342
96	Ismaili Jatt	18	99
97	Shiekh Ismaili	64	423
98	Malook Jheruck	47	354
99	Qadoo Shoro	8	59
100	Rajoo Nizamani	171	1255
101	Haji Malook Jokhyo	15	133
102	Haji Rodni Jokhyo	24	224
103	Mangar Khan Palijo	163	1287
104	Saffar Jokhyo	57	373
105	Ehsakhoo	67	453
106	Peero Gunjan	27	167
107	Ranpathani	18	120
108	Arab Jokhyo	16	139
109	Dars Ghulam Ali	44	358
110	Saleh Jamari	52	421
111	Saffar Halani	12	61
112	Noor Mohd Gabar	27	170
113	Gulmanda	24	186
114	Ahmed Khan Baloch	101	933
115	Molvi A.Haleem Gorai	109	511
116	Haji Y. Kodan	20	120

VILLAGE #	VILLAGE	HOUSEHOLD	POPULATION
117	Maree Village	4	18
118	Long Khan Baloch	16	80
119	A. Qadir Lashari	29	150
120	Samejo Para	106	677
121	Liano Satiyo	33	168
122	Haji Noor Mohd Jatt	33	187
123	Ahmed Shah	13	94
124	Ghulam Hussain Subhani	29	194
125	Babio/Haji Adam Usman	23	133
126	Yaqoob Baloch	5	27
127	Haji Hamir Memon	54	331
128	Kalhoi/Faizmohd Baloch	114	673
129	Misri Khan Unar	40	200
130	Mir Mohd Unar	14	71
131	Ladho Manghar	11	44
132	Sultanabad	54	376
133	Ahmedabad	74	452
134	Bello	185	1346
135	Bhodo Soomro	201	1182
136	Haji Umar Khati	55	503
137	Chodry Atta Mohammed	36	229
138	Haji Noor Mohammed	65	445
139	Gulsher/Jamu Sanjrani	159	1146

Q2 : Union Council Name (Coded as 1 - 24)

1	DHABEJI	14	KHAN
2	DARSANO CHANA	15	GHULAMULLAH
3	BEGNA MORI	16	KARAMPUR
4	KARMALIK	17	JHERRUCK
5	K.A.R SHAH	18	JUNGSHAHI
6	UDASI	19	KALARKI
7	BANNO	20	GUJJO
8	LAIKPUR	21	BUHARO
9	BACHAL GUGO	22	SAJANWARI
10	DARYA KHAN	23	CHOOBANDI
11	GOUNGANI	24	TAKANI
12	BEJORA		
13	CHHURETANI		

Q3 : Taluka Name (Coded as 1 - 9)

1	MIRPUR SAKRO
2	KARACHI EAST
3	JATTI
4	GHORABARI
5	M.P. BATHORO
6	SHAH BUNDAR
7	SUJAWAL
8	THATTA
9	KHAROCHAN

SECTION I: VILLAGE PROFILE
(to be filled by the village headman)

Q4 : How far is the village (Km) from the nearest Government Health Facility?

Q5 : What is the approximate travelling time (Min) to nearest Government Health Facility?

Q6 : How far is the village (Km) from the nearest Private Health Facility?

Q7 : What is the approximate travelling time (Min) to nearest Private Health Facility?

Q8 : Is there a Government school in or near the village?

1 Yes
2 No

***Q9 : What is the type of the nearest Government school*?**

1 Boys School
2 Girls School
3 Mixed School (both girls and boys)

Q10 : Is there a Private school in or near the village?

1 Yes
2 No

Q11 : What is the type of the nearest Private school?

1 Boys School
2 Girls School
3 Mixed School (both girls and boys)

Q12 : Do the village have access to Doctors?

1 Yes
2 No

Q13 : Do the village have access to Nurses?

1 Yes
2 No

Q14 : Do the village have access to Health Visitors?

1 Yes
2 No

Q15 : Do the village have access to Birth Attendants?

1 Yes
2 No

Q16 : Do the village have access to Hakim/Homeopaths/Traditional healers?

1 Yes
2 No

Q17 : How far (Km) is the metal road from the village?

Q18 : Is there any vehicle in the village that may be used as ambulance in emergency?

1 Yes
2 No

Q19 : Is electricity available to the village?

1 Yes
2 No

Q20 : Is gas available to the village?

1 Yes
2 No

Q21 : What is the source of drinking water?

1. Pipe water
2. Well/pond
3. Canal/river
4. Other.....

SECTION II: HOUSEHOLD SOCIO-ECONOMIC INFORMATION
(to be filled by head of the household)

SRNO : **Household Serial Number**

HQ22 : ***How many people live in this household?***

HQ23 : ***How many children less than five years of age live in this household?***

HQ24 : ***How many married women up to age 49 years live in this household?***

HQ25 : ***Whether there has been any death in the household during the last one year?***

1. Yes
2. No

HQ26 : ***What is the type of housing construction (by observation)?***

1. Pucca (concrete)
2. Semi Pucca (semi-concrete)
3. Kutcha (mud, stone or wood)
4. Other _____

HQ27 : ***How many rooms are there in this household (write number)?***

HQ28 : ***Do you own this house?***

1. Yes
2. No

HQ29 : ***What is the average total monthly income (in rupees) of the household?***

HQ30 : ***How many acres of land do you own (Write # of acres, zero for no land owned)?***

SECTION III: HOUSEHOLD PROFILE

(to be filled individually for all household members)

SRNO : Household Serial Number

SRNO_Q7: Household Member Serial Number

HQ31 : What is the relation of the respondent with the household head? (Coded as 1 - 8)

1. Self
2. Wife/Husband
3. Son/Daughter
4. Son/Daughter in law
5. Mother/Father
6. Brother/Sister
7. Other relative
8. Non relative

HQ32 : Sex of the respondent.

1. Male
2. Female

HQ33 : What is the age (in year)?

HQ34 : If the infant is less than 12 months old, what is the age (in months)?

HQ35 : If the infant is less than 30 days old, what is the age (in days)?

AGEM: All ages expressed in months.

HQ36 : What is the marital status? (Coded as 1 - 5)

1. Single
2. Married
3. Divorced
4. Separated
5. Widowed

HQ37 : What is the educational level? (Coded as 1 - 7)

1. Illiterate
2. Can read Holy Quran
3. Can read only a short statement such as what is your name?
4. Can read and write a short statement such as what is your name?
5. Class 1-5
6. Class 6-10
7. Class 10+

HQ38 : ***Is respondent presently going to school?***

1. Yes
2. No

HQ39 : ***What is the employment status?*** (Coded as 1 - 7)

1. Unemployed
2. Daily wages
3. Regular monthly
4. Self employed
5. Periodic employment
6. Housewife
7. Student

HQ40 : ***What is the main occupation?*** (Coded as 1 - 999)

1. Physical Scientists and related Technicians
2/3. Architects, Engineers and related technicians
4. Aircraft and Ship's Officers
5. Life Scientists and related Technicians
6/7. Medical, Dental, Veterinary and related workers
8. Statisticians, Mathematicians, System Analysts and related Technicians
9. Economists
11. Accountants
12. Jurists
13. Teachers
14. Workers in religion
15. Authors, Journalists and related writers
16. Sculptors, painters, photographers and related Creative Artists
17. Composers and performing Artists
18. Athletes, sportsmen and related workers
19. Professional, Technical and related workers not elsewhere classified
20. Legislative officials and Government Administrators
21. Managers (Including Directors working Proprietors)
30. Clerical Supervisors
31. Government Executive officials (non-gazattered)
32. Stenographers, Typists and Card and Tape punching machine operators
33. Bookkeeper, Cashier and related workers
34. Computing machine operator
35. Bookkeeper, Cashier and related workers
36. Transport Conductors
37. Mail distribution clerks and workers
38. Telecommunication Operators
39. Clerical and related workers not elsewhere classified
40. Managers (whole sale and retail trade)
41. Working properties (whole sale and retail trade)
42. Sales supervisors and buyers
43. Technical Salesman, Commercial Travellers and Manufacturer's Agents
44. Insurance, Real, Estates, Securities and Business Service Salesman and auctioneers

45. Salesman, Shop Assistants and related workers
49. Sales workers not elsewhere classified (including money-lenders)
50. Managers (Catering and Lodging Services)
51. Working Proprietors (Catering and Lodging Services)
52. Housekeeping ad related Services Supervisors
53. Cooks, Waiters, Bartenders and related workers
54. Maids and related housekeeping Services workers not elsewhere classified
55. Building Caretakers, Char-workers, Cleaners and related workers
56. Launderers, dry, cleaners and related workers
57. Hairdressers, Barbers Beauticians and related workers
58. Protective Services workers
59. Service workers not elsewhere classified
60. Farm managers and supervisors
61. Farmers, Agricultural and Animal Husbandry workers
63. Forestry workers
64. Fishermen, Hunters and related workers
70. Production Supervisors and general foreman
71. Miners, Quarrymen, well drillers and related workers
72. Metal processors
73. Wood preparation workers and paper makers
74. Chemical Processors and related workers
75. Spinners, Weavers, Knitters, dyers and related workers
76. Tanners, Fell-mongers and pelt dressers
77. Food and beverage processors
78. Tobacco prepares and Tobacco product makers
79. Tailors, dress makers, sewers, upholsters and related workers
80. Shoemaker and other foods makers
81. Cabinet makers and related wood workers
82. Stone Cutters and Carvers
83. Black smith, tool makers and machine tool operators
84. Machinery Fitters, Machine assembler and precision Instrument makers (except electrical)
85. Electrical fitters and related electrical and electronics workers
86. Broadcasting station and sound equipment operators and Cinema projectionists
87. Plumbers, Welders Sheet Metal and Structural metal prepares and erectors
88. Jewellery and precious metal workers
89. Glass formers, potters and related workers
90. Rubber and plastic product makers
91. Paper and paper board products makers
92. Printers and related workers
93. Printers
94. Production and related workers not elsewhere classified
95. Bricklayers, Carpenters and other construction workers
96. Stationary engines and related equipment operators
97. Material handling and related equipment operators, dockers and freight handlers
98. Transport equipment operators
99. Unskilled Labour
992. Beggar
993. Not specify
994. Businessman not elsewhere classified
995. Member of National/Provincial assembly

997. Student
998. Not working/Retired
999. Housewife

HQ41 : Did you or your child suffer from any illness over the last one year?

1. Yes
2. No

HQ42 : If yes, what was the main symptom/diagnosis? (Coded as 1 - 28)

1. Diarrhoea (passage of three or more loose or watery stools in the 24 hours)
2. Dysentery (passage of stools with blood or mucus)
3. Passage of worms in stool
4. Upper respiratory infection (cough/cold/sore throat)
5. Ear infection (fever with ear pain with or without discharging ear)
6. Pneumonia (fever and cough with fast breathing or fast moving ribs during breathing)
7. Asthma (whistling sound while breathing, shortness of breath, tightness in the chest or spasmodic cough)
8. Tuberculosis (fever with cough)
9. Fever (hot body with no other associated cause/reason)
10. Malaria (fever with chills/rigors)
11. Meningitis (fever with stiff neck)
12. Poliomyelitis (fever with muscle weakness)
13. Measles (fever with rash)
14. Tetanus (fever with fits)
15. Whooping Cough (fever with whooping cough)
16. Pale look
17. Under-nutrition /weakness
18. Diabetes (high sugar levels)
19. High blood pressure / chest pain
20. Jaundice / Hepatitis
21. Urinary problems (Pain during or frequency of urination)
22. Epilepsy/fits
23. Stroke / Paralysis
24. Scabies/Skin Infection
25. Cancer of any part of the body
26. Animal Bite (snake/ dog Bite)
27. Injury / Accident
28. Other (Please Specify) _____.

HQ43 : How long the person remained ill (In days) (from illness recognition till recovery or interview date)?

HQ44 : What was the mode of treatment? (Coded as 1 - 4)

1. Visit to a Government Health Facility
2. Visit to a Private Health Facility
3. Hakim/ Homeopath/Unqualified Doctor/Traditional healer
4. Self Treatment

HQ45 : ***Whether the ill person was hospitalized at least for a day?***

1. Yes
2. No

HQ46 : ***If hospitalized, where was hospitalization?*** (Coded as 1 - 2)

1. Government Hospital
2. Private Hospital

HQ47 : ***What was the total cost of treatment (In Rupees)?***
(This includes cost of consultation, medicine, investigations and transport).

HQ48 : ***Do you / your child have any disability?*** (Coded as 1 - 6)

1. Blindness
2. Deafness
3. Physically handicap
4. Mentally handicap
5. Fits
6. Other (specify) _____

SECTION IV: DEATHS IN LAST ONE YEAR

HQ49 : Serial Number

HQ50 : What was the relationship of deceased with the household head?
(Coded similar to HQ31)

HQ51 : Sex of the deceased

1. Male
2. Female

HQ52 : What was the age at death (in years)?

HQ53 : What was the age at death in months (if the child was less than 12 months)?

HQ54 : What was the age at death in days (if the child was less than 30 days)?

HQ55 : What was the most likely cause of death (Coded as 1 - 25)?

1. Tetanus
2. Prematurity / Low Birth Weight
3. Birth Injury/Asphyxia
4. Congenital Malformation
5. Measles
6. Polio
7. Whooping Cough
8. Under-nutrition
9. Diarrhoeal disease
10. Fever / Malaria
11. Respiratory Infection
12. Tuberculosis
13. Jaundice/Hepatitis
14. Heart Disease / Diabetes / Hypertension
15. Stroke / Paralysis
16. Cancer (Please specify)
17. Accident / Injury
18. Snake bite poisoning
19. Pregnancy related - Eclampsia / Fits
20. Pregnancy related - Haemorrhage
21. Pregnancy related - Complicated Childbirth
22. Pregnancy related - Retained Placenta
23. Pregnancy related - Other _____
24. Other (Please specify) _____
25. Unknown

HQ56 : ***Whether the deceased suffered from any illness before death?***

1. Yes
2. No

HQ57 : ***If yes, what was the main symptoms/diagnosis?*** (Coded similar to HQ42)

HQ58 : ***How long (in days) the deceased was ill prior to death?***

HQ59 : ***What was the total cost of treatment (In Rupees)?***
(This includes cost of consultation, medicine, investigations and transport).

HQ60 : ***Whether the ill person was hospitalized at least for a day?***

1. Yes
2. No

HQ61 : ***If hospitalized, where was hospitalization?***

1. Government Hospital
2. Private Hospital

HQ62 : ***What was the basis of diagnosis*** (Coded as 1 - 4)

1. Hospital report
2. Doctor / Allopath
3. Other health care provider
4. Self

SECTION V: CHILDREN LESS THAN 3 YEARS OF AGE

CHNO: ***Child Serial number***

CQ7 : ***Face sheet number of children less than 3 years of age***

CQ63 : ***Age (in years)***

CQ64 : ***Age (in months) (if the child was less than 12 months)?***

CQ65 : ***Age (in days) (if the child was less than 30 days)?***

CQ66 : ***Weight (in grams)***

CQ67 : ***Height (in milli-metres)***

CQ68 : ***Mid Upper Arm Circumference (in milli-meters)***

CQ69 : ***Status of Immunization*** (Coded as 1 - 7)

1. No Immunization
2. Incomplete (Memory)
3. Incomplete (Card)
4. Complete (Memory)
5. Complete (Card)
6. Appropriate (Memory)
7. Appropriate (Card)

CQ70 : ***Source of Immunization*** (Coded as 1 - 6)

1. Not Immunized
2. Government BHU/RHC
3. Government outreach team to village
4. Private clinic
5. NGO team
6. Other _____

CQ71 : ***Present Feeding Pattern*** (Coded as 1 - 5)

1. Exclusively breast fed
2. Exclusively bottle fed
3. Breast fed + Bottle fed
4. Weaned
5. Regular Diet

CQ72 : Age when weaning started (Write in months)

CQ73 : Weight/Status at birth (Write weight in Grams if available, otherwise follow the codes)

1. Normal
2. Very weak
3. Very healthy

SECTION VI: MARRIED WOMEN LESS THAN 50 YEARS OF AGE

WNO : ***Women serial number in household***

WQ7 : ***Face sheet No. of married women less than 50 years of age***

WQ7a: ***What is the relationship of the respondent with the household head***
(Coded similar to HQ31)

WQ74 : ***How old are you (in years)?***

WQ75 : ***How old is your husband (in years)?***

WQ76 : ***How many living children do you have now?***

WQ77 : ***How many times you have been pregnant?***

WQ78 : ***How many times you have delivered?***

WQ79 : ***Do you have any stillbirths?***

WQ80 : ***When was your last delivery (number of months ago)?***

WQ81 : ***What was the outcome last delivery?*** (Coded as 1 - 8)

1. Stillbirth
2. Live birth - presently alive
3. Live birth - death within 7 days
4. Live birth - death within 8 - 28 days
5. Live birth - death within 29 days to 11 months
6. Live birth - death within 12 - 35 months
7. Live birth - death within 36 - 59 months
8. Live birth - death after 5 years of age

WQ82 : ***Date of Interview***

WQ83 : ***Name of Interviewer***

WQ84 : ***Duration of Interview (in minutes)***

Maternal Chronic Ill Health Negatively Affects Child Survival in a Poor Rural Population of Pakistan

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Abstract

Pakistan ranks fourth globally in terms of absolute numbers of under-5 deaths. Although several determinants of child deaths have been identified, the possibility of an association between mother's health and under-5 deaths has not been assessed in Pakistan. We compared data on 106 deceased children 0–59 months old with those on 3718 live children, using a cross-sectional survey of 2276 households among 99 randomly selected villages in Thatta, a rural district of Pakistan. We examined the association between self-reported maternal health status and under-5 deaths, using the SUDAAN statistical package to account for cluster sampling technique. Three models for logistic regression analysis were Model-1: demographic factors, Model-2: household socio-economic factors and Model-3: demographic and household socio-economic factors. Mothers of deceased children were 60% more likely to report chronic illnesses than mothers of live children after controlling for child's age, mother's

age and type of house (final Model-3 analysis) (adjusted odds ratio [aOR; 95% confidence interval]: 1.6 [1.01, 2.5]). The association of self-reported maternal ill health with under-5 deaths in Thatta suggests the role of maternal health in child survival. Child survival strategies should include screening and treating mothers for common chronic illnesses. This is particularly important in a setting where only a quarter of chronically ill mothers seek care outside the home.

Background

A widely used analytical framework for child mortality proposed by Mosley and Chen (1984) identifies five sets of proximate determinants, which include maternal factors, environmental contamination, nutrient deficiency, injury and personal illness control. An alternative framework proposed by D'Souza and Bryant (1999) identifies six sets of determinants, including maternal, child, socio-demographic, socio-economic, behavioral and environmental factors. Even though maternal factors such as age, parity and birth interval are included in these theoretical frameworks, mother's health status has not been explicitly described as associated with childhood mortality.

An association between maternal health and child survival, though long appreciated, has been described in only two settings. In a rural area of Bwamanda, Northern Zaire, Broeck et al. (1996) reported a 4.8-times greater mortality in infants 0–3 months old among mothers with more than one sign of chronic disease, compared with mothers without any sign of chronic disease (95% confidence interval [CI]:1.1, 20.7). In rural Western India, Hirve and Ganatra (1997) found a four-times (95% CI: 1.7, 9.6) greater infant mortality and a three-times (95% CI: 1.7, 5.6) greater under-5 mortality among mothers with a non-pregnant weight of less than or equal to 40 kg, compared with those of more than 40 kg. This association between poor maternal health and deaths among under-5 children has not been examined in Pakistan, despite a high prevalence of anemia (47%) as evidence of poor health status in rural Pakistani women of reproductive age (15–44 years) (Pakistan Medical Research Council [PMRC] et al. 1998).

Worldwide, Pakistan ranks fourth by number of under-5 child deaths in a year (Robert et al. 2003) and 47th in descending order by under-5 mortality rate (United Nations Children's Fund [UNICEF] 2005). Pakistan's under-5 mortality rate is the highest among the South Asian countries (High Commission of Pakistan 2003) and exceeds the average for low-income countries by 60% (World Bank Group 1998). In order to achieve the Millennium Development Goal 4, Pakistan aims to reduce its under-5 mortality rate from around 140/1000 live births in 1990 to around 50 /1000 live births by 2015 (Planning Commission of Pakistan 2004).

Currently, a number of child-survival programs have been implemented by the World Health Organization (WHO; Expanded Programme of Immunization – EPI, Control of Diarrhoeal Diseases – CDD and acute respiratory infections – ARI) and UNICEF (growth monitoring, oral rehydration, breastfeeding promotion and Immunization-GOBI and Integrated Management of Childhood Illnesses – IMCI). In spite of these efforts, however, Pakistan's under-5 mortality rate (100/1000 live births) remains unacceptably high (WHO 2006a). Hence, locally relevant factors associated with child mortality need to be examined and incorporated in child-survival programs.

Data from a large community survey in a rural district of Sindh, Pakistan, provides an opportunity to examine whether mother's health is associated with child survival. We hypothesize that poor maternal health is associated with high under-5 mortality.

Material and Methods

Study Site

Thatta is a predominantly rural district located 60 kilometres east of Karachi, in the southernmost part of Sindh province, the second largest province of Pakistan. There are 49 administrative units (called union councils) and 6614 village settlements in Thatta (Government of Sindh and UNICEF 1993). Children aged 5 years and below make up 16% of Sindh's population of 2 million. Indicators of health status reflect the population's poor health and the inadequacy of the healthcare

system. Indicators include a high maternal mortality ratio (800/100,000 live births), low immunization coverage (46% complete immunization for children under 3 years of age), high total fertility rate (7.5) and low contraceptive prevalence (3.3%) (Department of Community Health Sciences [DCHS] 1994).

Data Source and Survey Design

The data analyzed here were collected in a survey by the Research Information System (RIS) of the Thatta Health System Research Project of The Aga Khan University, Karachi, from November 1992 to February 1993, after obtaining approval from the Institutional Ethical and Review Committee (DCHS 1994). The survey served as a baseline in a research project aimed at evaluating interventions in the government health system implemented at district, primary healthcare unit and community levels. Villages (*Primary Sampling Units*) located within a radius of 5 kilometers of 12 different Government Health Facilities (GHFs) (9 intervention and 3 reference health facilities) were listed and mapped to provide *a sampling frame for the first-stage sampling*. Villages (5 to 12) were randomly selected from each service area, with a target to sample at least 250 households per GHF catchment area. In this way, 99 villages were selected, serving as clusters. Within these selected clusters, all 2276 households (*Secondary Sampling Units*) were surveyed.

Data Collection

Interviewers (20), supervisors (four) and a survey manager were trained through a 3-week field-based program. A pre-coded questionnaire was pre-tested for ease and accuracy of data collection. Trained interviewers visited each household, with the assistance of village volunteers, and conducted the survey after securing informed consent. Completed questionnaires were checked and validated by field supervisors daily.

Household heads (or in their absence, the next elder/responsible member of the household) provided information on socio-demographic characteristics of households and their members. A complete reproductive history was obtained from mothers by asking about the number of times they had been pregnant, had live deliveries and still births, the number of live children, and when the last delivery was and its outcome. Children's ages were estimated with the aid of local event calendars listing important events, festivals and moon cycles in the last 5 years. If there had been a death in the household during the last year, information was collected regarding age and sex of the deceased and probable cause of death. Mothers and fathers were asked whether they had been ill during the last year. Those who reported illness were asked an additional series of questions about symptoms, probable cause and duration of illness, and source of care. Interviewers were trained to code common chronic illness from the reported symptoms.

Study Design

This is a cross-sectional study analyzed as a case-control study. We studied all children aged 0–59 months, including those who had died in the last year. Index series are defined as children under 5 years of age who died during the year prior to the survey. Reference series are subjects of similar age to those in the index series and who were alive at the time of interview.

Variables

Five mortality ratios were calculated according to WHO standards (WHO 2006b; Nathan et al. 2002). For each ratio, the number of live births in a year expressed per 1000 served as the denominator. The numerator varied for each ratio as the number of deaths among neonates (newborn to 29 days old), post-neonates (1–11 months old), infants (newborn to completed 11 months old), early childhood (12–59 months old) or under 5 (newborn to 59 months old). These ratios are traditionally referred to as neonatal, post-neonatal, infant, early childhood and under-5 mortality rates (WHO 2006b; Nathan et al. 2002).

Main Independent Variable

The main independent variable, self-reported by mothers, was the presence or absence of illnesses that lasted for more than 2 weeks and occurred during the year prior to the survey. Mothers reporting such illnesses were classified as chronically ill.

Other Independent Variables

(a) *Demographic variables* included (i) child's age (grouped as newborn to 11 months and 12–59 months), (ii) gender, (iii) mother's age (grouped as 30 years or less and above 30 years), (iv) chronic illnesses in father (as defined for mother), (v) number of siblings in the family (categorized as three or less and four or more) and (vi) number of adults (persons older than 18 years of age) in the household (as a proxy measure of alternative care providers, categorized as two or less and three or more).

(b) *Household socio-economic factors* were assessed by (i) average monthly income per capita (categorized as less than 200 Pak. Rupees [6.5 US dollars] or 200 Pak. Rupees and more), (ii) mother's literacy status (ability to read and/or write a short simple statement), (iii) father's literacy status (as defined for mother), (iv) housing construction material (made of concrete or non-concrete, such as mud, stone or wood) and (v) land ownership.

Data Management and Analysis

Data were checked for internal consistency before entry. Questionnaires with inconsistencies were returned to the field for correction. The data were double entered using Borland dBase III Plus 1.1 for DOS Version XX.X computer software and checked for obvious errors of data entry and editing. An error rate of less than 3/1000 strokes was considered clean data entry. Analysis was performed with SUDAAN Release 9.0. due to its computational efficiency and to account for cluster survey design in point and variance estimation.

The statistical power of detecting a difference in under-5 mortality in the presence or absence of self-reported mother's chronic illness was estimated as 83%, assuming an unadjusted odds ratio of 1.90 and prevalence of mother's illness among live children was 20% (NCSS statistical package: Power Analysis & Sample Size, Version XX.X).

To account for unequal selection probabilities, we calculated sample weights from the number of villages in each service area and the number of villages sampled from each area. The use of weights reduces bias in estimation. Keeping in view without replacement (WOR) sampling design, we present weighted estimates of mortality and odds ratios and their 95% CIs.

Multi-collinearity among various independent variables was also assessed using Cramer's V. Three models constructed for logistic regression to examine association between mother's health and child death consisted of the following covariates:

Model-1: Demographic variables
Model-2: Household socio-economic factors
Model-3: Demographic and household socio-economic factors

In each model, after examining the full set of variables, non-significant variables were dropped from the final. We present the results of final models.

Results

Characteristics of the Study Population

Among 3824 children, infants constituted almost a quarter (22.5%) of the study population. Overall, boys and girls were almost equally distributed (50.6% and 49.4%, respectively). The mean age of mothers was 30.0 years (*SE* = 0.12 years). Mean numbers of siblings in a family and mean

number of adults in a household were 4.3 ($SE = 0.04$) and 3.3 ($SE = 0.04$), respectively. Both average (median) monthly income (only 1415 Pak. Rupees or 47.2 US dollars, 1993) and average (median) monthly per capita income (only 193 Pak. Rupees or 6.4 US dollars, 1993) were low. Considerably more mothers (84%) than fathers (54%) were illiterate. One third of households reported owning some land (35%). A majority lived in non-concrete houses (83%).

Overall, 20.2% and 17.7% of mothers and fathers, respectively, reported being ill for more than 2 weeks during the last year. Among mothers defined as chronically ill (725), 40.3% reported weakness/anemia, 19.3% were classified with respiratory illness including tuberculosis and asthma, 12.6% with jaundice/hepatitis, 8.4% with kidney problems, 7.7% with diabetes, 5.9% with skin infections/scabies, 1.4% with fever/malaria and the remaining 4.4% with illnesses other than those listed above. The proportion of child deaths differed significantly by child's age, gender, maternal health status and type of house (Table 1).

Table 1. Significant factors by survival status, Thatta District, Pakistan, 1992–1993 (n = 3824) (unadjusted analysis)

Variables	Groups (*n*)	Deaths (%)	Odds Ratio (95% CI)
Child's age	Infants (862)	8.9	9.6 (6.7, 13.6)
	1–4 years (2962)	1.0	1.00
Child's gender	Female (1902)	3.4	1.5 (1.05, 2.20)
	Male (1922)	2.2	1.00
Maternal health status	Reported ill (725)	4.4	1.9 (1.2, 2.8)
	Reported not ill (2874)	2.4	1.00
Type of house	Non-concrete (3118)	2.9	1.9 (1.1, 3.5)
	Concrete (632)	1.5	1.00

Age-Specific Death Ratios

During the year prior to the survey, 106 children aged 0–59 months died, accounting for 43.4% of total deaths (244). Of the 996 live births during the same period, 508 were males. Infant deaths constituted 72.6% of child deaths, and neonatal deaths accounted for 39% of infant deaths (Table 2).

Table 2. Age-specific mortality ratios: Thatta District, Pakistan, 1992–1993

Age Group	Number of Deaths	Mortality Ratio (Deaths per 1000 Live Births in a Year) (95% CI)
Neonates	30	30.6 (21.4, 39.8)
Post-neonates	47	47.0 (32.2, 61.8)
Infants	77	77.7 (57.8, 97.5)
12–59 months	29	30.4 (19.7, 41.1)
0–59 months	106	108.1 (82.6, 133.5)

Association between Mother's Health and Child Mortality

Unadjusted analysis suggested that children of mothers with reported chronic illness were 90% more likely to die compared with children whose mothers did not report chronic illness (critical odds ratio [cOR; 95% CI]: 1.9 [1.2, 2.8]) (Table 1). After simultaneous adjustment of demographic and socio-economic factors in the final Model-3, although the association of mother's health with under-5 mortality dropped to 60%, it remained significant (Table 3).

Table 3. Association between maternal health and child mortality: Thatta District, Pakistan, 1992–1993

Variables	Adjusted Odds Ratio (95% CI)		
	Final Model-1	Final Model-2	Final Model-3
Chronically ill mother	1.9 (1.2, 2.9)	1.8 (1.2, 2.7)	1.6 (1.01, 2.5)
Child's age	9.1 (6.5, 12.9)	–	9.9 (6.6, 15.0)
Child's gender	1.6 (1.1, 2.4)	–	–
Mother's age	–	–	1.5 (1.1, 2.2)
Non-concrete house	–	2.0 (1.1, 3.5)	2.0 (1.1, 3.7)

List of non-significant variables dropped from final models
Model-1: (i) Chronic illnesses in father (ii) Number of siblings in the family and (iii) Number of adults in the family.
Model-2: (i) Average monthly income per capita (ii) Mother's literacy status (iii) Father's literacy status and (iv) Land ownership.
Model-3: (i) Child's gender (ii) Chronic illnesses in father (iii) Number of siblings in the family (iv) Number of adults in the family (v) Average monthly income per capita (vi) Mother's literacy status (vii) Father's literacy status and (viii) Land ownership.

Other Associations with Child Mortality

Besides child's age, the final Model-3 analysis showed an association of child mortality with mother's age and type of house. Children whose mothers were 30 years or older were 50% more likely to die compared with children of younger mothers. In addition, children who lived in non-concrete houses were twice as likely to die as children who lived in concrete houses (Table 3).

Discussion

Main Study Findings

The observed association between self-reported maternal ill health and under-5 mortality could be due to reduced maternal ability for child-rearing activities, reduced duration of breastfeeding, low birth weight, increased childhood malnutrition, increased child morbidity and reduced utilization of services for curative or preventive care.

As expected, child's age remained the most powerful determinant of child's survival. We identified two more associations with under-5 mortality in Thatta district, namely mother's age of 30 years or above and living in non-concrete houses. Greater mortality associated with older mothers could possibly be due to the increasing number of children and subsequent demand on the mother's physical strength for child rearing, as shown by a highly significant association between maternal age and number of live children. Mothers 30 years and older were 8.4 times more likely to have four or more children than were younger mothers (OR [95% CI]: 8.4 [6.5, 10.8]) (result of a separate analysis). Living in a non-concrete house was also associated with 90% greater under-5 mortality, which could be either a reflection of low socio-economic or poor environmental conditions.

Earlier Work on the Topic

The relationship between maternal health and deaths among the specific age group of children 0–59 months has not been studied in Pakistan. In a rural area of Bwamanda, Northern Zaire (Broeck et al. 1996), a prospective study revealed an association between maternal health and death among infants 0–3 months old. Compared with Northern Zaire, the magnitude of the association is relatively small in Thatta district. This could be due to difference in age distribution of study populations and instruments used to assess chronic diseases in the two surveys. In Northern Zaire, chronic maternal disease was assessed by clinical examination and by history. Prevalence of chronic maternal disease was much less in Northern Zaire (3.1%) than in Thatta (20.2 %). Due to variations in living and

environmental conditions between the settings, different sets of covariates were examined in the two studies through different analytical approaches. In rural Western India, Hirve and Ganatra (1997) considered maternal health status as poor if the mother's non-pregnant weight was less than or equal to 40 kg. In this prospective study, the survival analysis showed a strong association of maternal nutritional status and under-5 mortality. Although we have defined maternal health status subjectively, based on self-reporting of illness, the findings of our study, though lower in magnitude, are consistent with other studies (Broeck et al. 1996; Hirve and Ganatra 1997). These findings are also important since ours is the first such study from Pakistan, a country with a high under-5 mortality ratio (WHO 2006a) and high prevalence of poor maternal health (PMRC et al. 1998).

The observed magnitude of the association between under-5 mortality and child's age (OR = 9.9) is similar to that reported in rural Upper Egypt (OR = 10) by Yassin (2000). Despite using a different age cut-off (20 years) for mothers than ours (30 years), Ahmed (1992) reported lower child mortality for young rural mothers, using the Pakistan Contraceptive Prevalence Survey (1984–85). Other studies from Pakistan using information from the Pakistan Integrated Household Survey 1991 (Agha 2000), the Pakistan Demographic and Health Survey, 1990–91 (Ali et al. 1993; Zahid 1996), and the Pakistan Labor Force and Migration Survey, 1979 (Sathar 1987), reported higher infant death rates among mothers less than 20 years. We did not choose a cut-off at age 20, as only 8.3% of the mothers reported being 20 years or below. In Karachi slums, no association was reported between maternal age and infant or child death (D'Souza and Bryant 1999; Thaver et al. 1990). This suggests that the relationship between maternal age and child survival for rural populations differs from other areas of the country. In a rural population, older mothers have greater rates of child mortality than younger mothers.

The association between type of house and under-5 mortality was stronger in our population than in that reported for Zimbabwe (Root 1997), where households with clay flooring had 47% (95% CI: 1.06, 2.05) greater mortality for children 1–5 years old compared with households with cement flooring. However, using information from the Pakistan Integrated Household Survey 1991, Agha (2000) did not find any significant relationship between type of house and infant mortality. This suggests that observations from a rural population of Sindh are different from those from a national sample.

Study Limitations

Certain methodological issues need to be highlighted. Though death, being a definitive event, is easily measured, the possibility of under-reporting cannot be ruled out. Women are at times reluctant to talk about their dead children or may not count children dying shortly after birth as live births, which would affect estimates of the mortality ratio. Using reported age at death or at survey without reference to exact dates of birth and death results in misclassification or age heaping across the boundaries of 1 month, 1 year and 5 years.

The method of assessing maternal health deserves special consideration. Timing of measurement in this study does not ensure that maternal illness occurred prior to the death of the child. Since both the child death and maternal illness were assessed during a 1-year period prior to the survey, it is possible that maternal illness might have occurred after the death of the child. This makes causality difficult to establish. Assessment of maternal health by self-report could account for non-differential misclassification of exposure status and under-estimation of the effect (Rothman and Greenland 1998). Moreover, defining chronic diseases as those of more than 2 weeks' duration includes diseases of varying severity, making interpretation difficult.

Characteristics of parents and households were assessed at the time of survey and not when the children under study were exposed to risk of death. However, it is unlikely that factors such as socio-economic status had changed significantly over a 1-year period for the majority of the study population. For factors such as income, inaccuracy in reporting cannot be ruled out. Creation of a wealth variable might have addressed this problem, but it was not possible due to lack of such information. We did not account for nutritional status of mothers and deceased children's birth

weights because the information was not available, although they could possibly be associated with chronic maternal illness and child survival (Hirve and Ganatra 1997).

Inclusion of villages located within a radius of 5 kilometers of the selected GHFs may influence the extent to which the findings can be generalized, as child mortality ratios and maternal health status may be worse in far-off villages.

Conclusion: Policy Implications

Currently, local child-survival programs focus on control of diarrhea, acute respiratory infections, malnutrition and vaccine-preventable diseases and ignore the important contribution of maternal health to child survival (Bhutta 2004). Promotion of mother's health, particularly prevention and treatment of anemia, though encouraged during antenatal, natal and postnatal periods, is not performed beyond the postpartum period. This study points out that child-survival programs should include activities leading to the promotion of mother's health beyond pregnancy and postpartum. This is particularly relevant in the underprivileged area of Thatta, where only a quarter of mothers with chronic illness report receiving treatment at a government or private health centre. Whenever a mother comes in contact with the healthcare system (e.g., for routine vaccination of her child), she should be opportunistically screened and treated for common conditions such as anemia, undernutrition or chronic cough. These study findings need to be tested further by studies in which maternal health is assessed objectively, with an etiologically relevant induction period.

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Competing Interests

The authors declare that they have no competing interests.

Author's contributions

RN participated in the design of survey, conceived and designed the study, performed the literature review and data analysis, interpreted the data and drafted and revised the manuscript.

LMK provided guidance during study design and data interpretation and in revising the paper critically for important intellectual content.

WCH provided guidance during data analysis and data interpretation and in revising the paper critically for important intellectual content

IA participated in the data organization and in revising the paper critically for substantial intellectual content.

All authors read and approved the final manuscript.

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Comparison of estimates of under-nutrition for pre-school rural Pakistani children based on the WHO standard and the National Center for Health Statistics (NCHS) reference

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Abstract

Objective: To compare estimates of under-nutrition among pre-school Pakistani children using the WHO growth standard and the National Center for Health Statistics (NCHS) reference.

Design: Prevalence of stunting, wasting and underweight as defined by WHO and NCHS standards are calculated and compared.

Setting: The data are from two cross-sectional surveys conducted in the early 1990s, the time frame for setting the baseline for the Millennium Development Goals: (i) National Health Survey of Pakistan (NHSP) assessed the health status of a nationally representative sample and (ii) Thatta Health System Research Project (THSRP) was a survey in Thatta, a rural district of Sindh Province.

Subjects: In all, 1533 and 1051 children aged 0–35 months from national and Thatta surveys, respectively.

Results: WHO standard gave a significantly higher prevalence of stunting for both national [36·7 (95% CI 33·2, 40·2)] and Thatta surveys [52·9 (95% CI 48·9, 56·9)] compared to the NCHS reference [national: 29·1 (95% CI 25·9, 32·2) and Thatta: 44·8 (95% CI 41·1, 48·5), respectively]. It also gave significantly higher prevalence of wasting for the Thatta survey [22·9 (95% CI 20·3, 25·5)] compared to the NCHS reference [15·7 (95% CI 13·5, 17·8)]. Differences due to choice of standard were pronounced during infancy and for severely wasted and severely stunted children.

Conclusions: Pakistan should switch to the robustly constructed and up-to-date WHO growth standard for assessing under-nutrition. New growth charts should be introduced along with training of health workers. This has implications for nutritional intervention programmes, for resetting the country's targets for Millennium Development Goal 1 and for monitoring nutritional trends.

Keywords
NCHS growth reference
Pre-school children
Pakistan
Under-nutrition prevalence
WHO growth standard

Interpretation of the growth of a population is largely dependent on the growth reference standard used[1]. Based on the 1977 National Center for Health Statistics (NCHS) growth reference, Pakistan is one of three countries (with India and Bangladesh) frequently cited to have in combination more than half of the world's under-nourished children[2]. Among eight South Asian countries, Pakistan ranks 3rd, 4th and 6th, respectively, for prevalence of wasting (13%), underweight (38%) and stunting (37%) among under-five children[2].

Suitability of the NCHS dataset as an international growth reference has been challenged on serious technical grounds[3–7] and its continued use as a reference to monitor individual growth or to estimate prevalence of under-nutrition is being discouraged[8–10]. To address deficiencies in the NCHS reference, the Centers for Disease Control and Prevention (CDC) produced a revised reference in 2000[1,3] and WHO organised and sponsored a Multicentre Growth Reference Study (MGRS) between 1997 and 2003 to develop new growth standards[11–14]. In this study, growth of 8500 children from affluent families was assessed. These children came from widely differing ethnic backgrounds and cultural settings (Brazil, Ghana, India, Norway, Oman and USA). They were reared following healthy practices, which included exclusive or predominant breast-feeding for at least 4 months and the maintenance of a non-smoking environment. WHO released a new growth standard for infants and young

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children in April 2006 (http://www.who.int/childgrowth/en/)[15] and recommended its use in preference to the NCHS reference to assess children regardless of ethnicity, socio-economic status and type of feeding[16,17]. The new standard adopts a fundamentally prescriptive approach and not only serves as an international reference but also describes what might be considered as normal growth under ideal circumstances[18].

Pakistan is among ninty-nine countries where the NCHS reference is currently used in the national programme[19]. Recently, field testing of the new WHO growth standard for under-five children was carried out at two health centres in Karachi[20]. Comparison of the estimates of under-nutrition derived from the WHO standard and the NCHS reference in Bangladesh[21] suggest significantly higher prevalence of underweight, stunting and wasting during infancy using WHO standards. Since Pakistan is the third largest contributor of under-nourished children worldwide, it is highly relevant to examine the impact of this change of growth standard on various parameters of nutritional status by using information from a local population-based survey. In the present paper, we compare the estimates of wasting, stunting and underweight obtained from the WHO standard and the NCHS reference for the Pakistani population and discuss the implications of changing the growth standard for national child health programmes.

Material and methods

Data sources and survey designs

Data for this study are derived from two different sources, which include the National Health Survey of Pakistan (NHSP) (1990–94) and the Thatta Health System Research Project (THSRP) (1992–93). We chose NHSP and THSRP datasets because of their availability and suitability to address the study question. Both the surveys were conducted during the early 1990s, which is the time period that served as a baseline for setting Millennium Development Goals.

NHSP (hereafter referred to as national data) was a multipurpose cross-sectional survey conducted by Pakistan Medical Research Council (PMRC) under the technical guidance and support of NCHS in 1990–94. The details of sampling, design, survey instruments and quality control have been described elsewhere[22]. The main purpose of the survey was to measure the health status of the people of Pakistan, particularly high-risk groups such as children, mothers and the elderly. An Institutional Review Board at PMRC provided ethical approval for the survey[23]. The survey was modelled on the National Health and Nutrition Examination Survey (NHANES) of the USA and was modified according to the information needs of Pakistan. In brief, eight broad strata were created by dividing each of the four provinces into urban and rural areas. Through a two-stage stratified design, eighty primary sampling units (PSU) were randomly selected, comprising thirty-two urban blocks and fourty-eight rural villages[22]. From each PSU, thirty households were drawn systematically into the sample by taking a random start and a sampling interval. All residents of the households were included in the survey[24,25]. In total, 912 urban and 1408 rural households were surveyed covering a total population of 18 315 subjects. Although anthropometric information was available for children under 5 years of age, this study is limited to 1533 children aged 0–35 months from 387 urban and 723 rural households. Overall 3·1 % of the household did not participate in the survey[22].

THSRP (hereafter referred to as Thatta data) was a survey conducted by the Aga Khan University from November 1992 to February 1993 in Thatta, a rural district of Sindh Province, after approval from an Institutional Ethical and Review Committee[26]. The main purpose of the survey was to measure the health and nutrition status of the population and utilisation of health services. Using a three-stage stratified sampling, twelve Union Councils (UC) with fairly complete enumeration lists were identified. Villages (PSU) located within 5 km of the government health facilities (GHF) within selected UC were listed and mapped. Five to twelve villages were randomly selected from each service area, with a target to sample at least 250 households per GHF catchment area. In this way, a population of 24 121 subjects from 2276 households and ninty-nine villages were surveyed. Overall the non-response rate was 9 %. Anthropometric information was available for 1051 children aged 0–35 months from 952 households and 95 villages.

Data collection

Age information

Mothers were interviewed to provide information about the child's age, which was estimated with the aid of local event calendars listing important events, festivals and moon cycles.

Anthropometric measurements

Trained field workers took anthropometric measurements of children. In the Thatta survey, child's weight was recorded to the nearest 0·1 kg using a portable 25 kg spring balance Salter Scales (Salter England, West Bromwich, UK). Weighing scales were calibrated daily using 20 kg weight. During weighing, children were lightly clad and without shoes/slippers. Recumbent length (for children less than 24 months) was measured to the nearest centimetre by portable flat wooden boards with a sliding foot piece (locally manufactured by Pakistan Medical and Dental Council). For children older than 24 months, standing height was obtained. Severely malnourished children were referred to a local hospital or a health centre for further assessment and care.

Data quality assessment

Completed questionnaires were checked and validated by field supervisors daily in both the surveys. Questionnaires

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with inconsistencies were re-sent to the field for correction. Data quality was maintained by supervision and retraining of the field staff. The national survey also used end-digit preference[22]. Only 10·2% of the children's height and 13·2% of the children's weight were rounded to zero. A validation survey of 400 households was conducted within 2 weeks of the actual Thatta survey, for determination of data collection errors[27].

Anthropometric information was missing for 18% and 30%, respectively, of the national and Thatta subjects. For national data, responders were significantly younger [mean age = 15·5 months (SEM = 0·51)] compared to non-responders [mean age = 17·4 months (SEM = 0·22)]. There were significantly more boys (53%) among responders compared to non-responders (44%). For the Thatta survey however, age, gender, mean household income per capita and maternal education did not differ significantly by response status.

Data management and analysis

Measured heights and weights were converted to standard normal scores (*Z*-scores) on the NCHS reference and the WHO standard distributions adjusting for child's age and gender with a software package named ANTHRO (available at http://www.who.int/nutgrowthdb). *Z*-score standard deviations were close to 1, suggesting reasonable quality of the measures[28].

Although WHO recommends taking a *Z*-score above +6 or below −6 as extreme values indicating measurement problems, we took +4 as the upper threshold of acceptable scores. This is because the probability of a child having a *Z*-score for weight-for-age (WAZ) or height-for-age (HAZ) greater than 4 is less than 0·0001[29], given that the means of WAZ and HAZ for a population like Pakistan are −1·4 (Table 2).

To account for unequal selection probabilities and to reduce bias in variance estimation, weights were calculated as the inverse of the sample selection probabilities. To account for data clustering, analysis was performed with SUDAAN[30] using the option of without replacement sampling design. Weighted prevalence of under-nutrition with 95% confidence intervals is presented.

Prevalence of under-nutrition (percentage of children aged 0–35 months) was calculated following convention[21,31] as the number of children with *Z*-scores less than −2 SD below the NCHS reference or WHO standard for the following nutritional parameters: wasting (weight-for-height), stunting (height-for-age) and underweight (weight-for-age). 95% CI were calculated for each prevalence measure. Mild, moderate and severe malnutrition were determined using the relevant parameters of the reference population as below −1 and down to −2 SD, below −2 and down to −3 SD and below −3 SD, respectively. Mean *Z*-scores (and their SD) for under-nutrition were calculated to compare the WHO standard and the NCHS reference.

Age-specific prevalence was calculated for seven age groups. During infancy, four age groups were created keeping in view the rapid growth velocity[32]. These age groups included 0–3, 4–6, 7–9 and 10–12 months. During the second and third years, to account for slower growth velocities and to accommodate smaller numbers, the age groups were defined as 13–18, 19–24 and 25–35 months. To permit comparison with Thatta data, we limit our analysis to children under 3 years of age from national data.

Results

As expected, average household size was smaller for national (8·3) than for Thatta data (10·6) and the literacy level was better for national (35%) than for Thatta (22·1%) data. Greater proportion of the population belonged to low socio-economic status in the national sample (36%) than in the Thatta sample (27·6%).

Height, weight and age information were available for 1533 and 1051 children aged 0–35 months from the national and Thatta surveys, respectively. The gender distribution was similar in both datasets (53% males). Mean ages (months) were younger for the national [boys: 8·3 (SEM = 0·3) and girls: 8·9 (SEM = 0·3)] compared to the Thatta sample [boys: 14·0 (SEM = 0·4) and girls: 13·0 (SEM = 0·4)].

Z-scores for under-nutrition

Pakistani children are shorter and lighter than the reference populations (Table 1). The mean *Z*-scores for all three parameters did not differ significantly with the choice of reference. However, mean *Z*-scores for height-for-age and weight-for-age were significantly lower for the Thatta than for the national sample.

Prevalence of under-nutrition

Prevalence of wasting was higher with the WHO standard than the NCHS reference in both the national (18%:14%) and the Thatta (23%:16%) surveys (Table 2). The relative increase with the WHO standard was 26% for the national and 46% for the Thatta data. Similarly, stunting prevalence was higher with the WHO standard in both the national (37%:29%) and the Thatta (53%:45%) surveys, respectively, with the relative increase of 26% and 18%. On the other hand, prevalence of underweight was lower with the WHO standard for both the national (32%:36·5%) and the Thatta data (46·5%:48%), with the relative decrease of 15·5% and 4%, respectively, compared to the NCHS reference.

Prevalence of severe under-nutrition

Prevalence of severely under-nourished children increased with the WHO standard compared to the NCHS reference (Table 2). The relative increase was greatest for wasting (national: 1·8 times and Thatta: twice), followed

Table 1 Mean standard scores (*Z*-scores) and 95 % CI for indicators of under-nutrition among Pakistani children under 3 years of age: comparison of the WHO standard and National Center for Health Statistics (NCHS) reference with data from the National (1990–94) and the Thatta (1992–93) surveys

	Mean *Z*-scores for National data (95 % CI) (*n* 1533)		Mean *Z*-scores for Thatta data (95 % CI) (*n* 1051)	
Under-nutrition parameter	WHO	NCHS	WHO	NCHS
Weight adjusted for height	−0·9 (−1·0, −0·8)	−0·9 (−1·0, −0·8)	−1·0 (−1·1, −0·9)	−0·8 (−0·9, −0·7)
Height adjusted for age	−1·4 (−1·5, −1·3)	−1·5 (−1·6, −1·4)	−2·0 (−2·1, −1·9)	−1·8 (−1·9, −1·7)
Weight adjusted for age	−1·4 (−1·5, −1·3)	−1·2 (−1·3, −1·1)	−1·9 (−2·0, −1·8)	−1·9 (−2·0, −1·8)

Table 2 Percentage prevalence (95 % CI) of indicators of under-nutrition among Pakistani children under 3 years of age: comparison of the WHO standard and National Center for Health Statistics (NCHS) reference with data from the National (1990–94) and the Thatta (1992–93) surveys

	National survey		Thatta survey	
Under-nutrition parameter	WHO	NCHS	WHO	NCHS
Wasting	18·0 (14·9, 21·1)	14·3 (11·4, 17·2)	22·9 (20·3, 25·5)	15·7 (13·5, 17·8)
Mild	27·1	33·4	24·9	32·0
Moderate	13·0	12·5	15·4	13·2
Severe	5·0	1·8	7·5	2·5
Stunting	36·7 (33·2, 40·2)	29·1 (25·9, 32·2)	52·9 (48·9, 56·9)	44·8 (41·1, 48·5)
Mild	24·5	27·3	22·7	27·2
Moderate	23·3	20·1	24·9	25·7
Severe	13·6	9·0	28·0	19·1
Underweight	31·6 (27·7, 35·5)	36·5 (32·4, 40·6)	46·5 (42·1, 50·9)	48·4 (44·2, 52·6)
Mild	31·9	32·7	28·5	29·4
Moderate	20·3	26·0	25·7	29·8
Severe	11·3	10·5	20·8	18·6

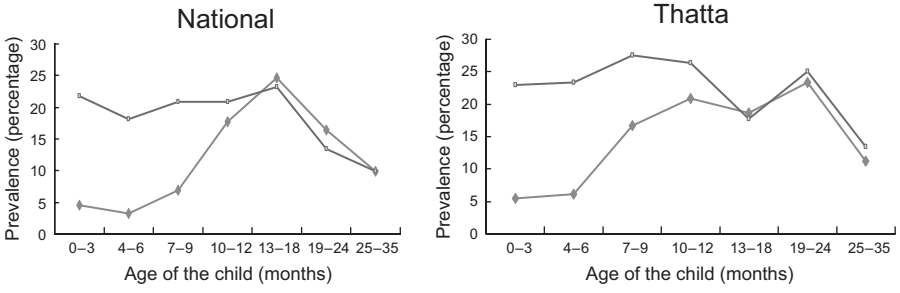

Fig. 1 Percentage prevalence of wasting by age with the WHO (—□—) standard and the National Center for Health Statistics (—◆—) reference for national and Thatta data

by stunting (national: 51 % and Thatta: 46·5 %) and underweight (national: 7·6 % and Thatta: 12 %).

Age-specific prevalence of wasting

For both the surveys, wasting prevalence was significantly higher with the WHO standard compared to the NCHS reference up to the first 9 months (Fig. 1). The two curves began to converge at 10–12 months of age, following which the two references produced similar results.

Age-specific prevalence of stunting

Stunting prevalence was similar across various age groups for both the surveys except for significantly higher prevalence obtained by the WHO standard for 25–35-month-old children in the national survey and 0–3- and 19–24-month-old children in the Thatta survey (Fig. 2).

Age-specific prevalence of underweight

For both surveys, underweight prevalence was significantly higher with the WHO standard up to the first 6 months with a cross-over at 7–9 months (Fig. 3). For the rest of the ages, the WHO standard gave lower prevalence. The range of underweight prevalence across age groups was narrower with the WHO standard (40–50 %) than with the NCHS reference (20–60 %).

Discussion

Impact of the WHO standard on prevalence of under-nutrition

Estimates of under-nutrition obtained with the WHO standard and the NCHS reference varied by growth

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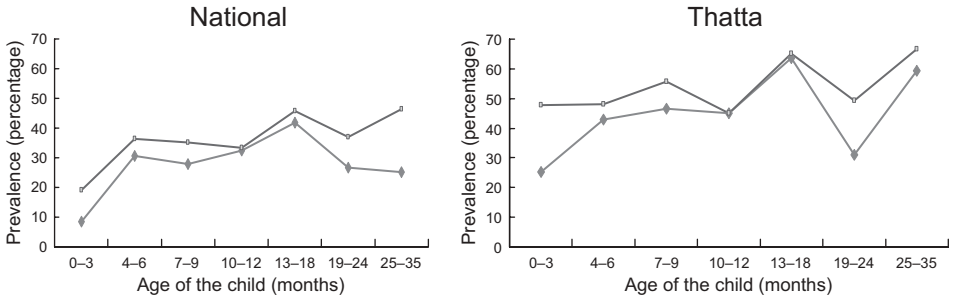

Fig. 2 Percentage prevalence of stunting by age with the WHO (—□—) standard and the National Center for Health Statistics (—◆—) reference for national and Thatta data

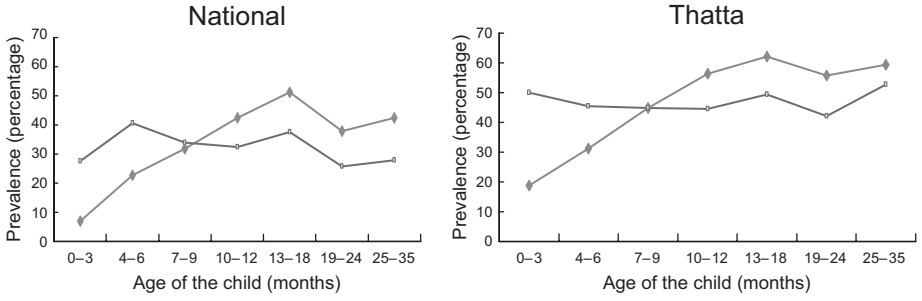

Fig. 3 Percentage prevalence of underweight by age with the WHO (—□—) standard and the National Center for Health Statistics (—◆—) reference for national and Thatta data

indicator, age group and severity of under-nutrition. The high prevalence of under-nutrition in the Thatta compared to the national sample suggests that malnutrition is a very serious problem in this rural subset of the population. The WHO standard resulted in relatively higher overall prevalence of wasting and stunting and a relatively lower overall prevalence of underweight, similar to that observed in Bangladesh National Demographic and Health Survey (1996–97)[21].

Compared to the NCHS reference, the growth pattern based on the WHO standard suggests a higher prevalence of wasting during the first 9 months, of stunting among 0–35-month-olds and of underweight during the first half of infancy (0–6 months). This is consistent with the predictions of a WHO group of experts[21]. It is interesting to note that use of the WHO standard showed higher prevalence of under-nutrition for all the three parameters during early life, including infants 0–3 months old. This indicates that under-nutrition in Pakistani children begins at a very early stage of infancy, even before weaning age. This could be related to poor maternal nutrition or health and low birth weight[33], suggesting that children are born malnourished[34]. Relative increase in the prevalence of severe under-nutrition with the new standard would influence enrolling of children in therapeutic feeding programmes based on the criterion of severe wasting[35].

Study limitations

A number of methodological issues require attention. Misclassification of children as underweight or stunted is possible as age assessment was mainly based on recall of birth event and not on birth certificates. Use of a birth cohort would prevent the problem of age assessment and, hence, possible misclassification. In addition, age reporting in whole months could be another source of misclassification of nutritional status[32]. As a result, the nutritional status of children whose actual ages were less or more than the nearest month could be under- or overestimated, respectively. For the entire population, although this effect can be balanced if the ages are equally distributed throughout the period (between the middle of the two months), such a distribution cannot be ensured and hence the possibility of misclassification remains. Prevalence of stunting and underweight obtained from computed ages and by ages rounded to the nearest month is, however, closely related[32]. In a situation such as ours, where accurate age information is often not available, wasting serves as a useful parameter since it does not require knowledge of the child's age[36].

Conclusion: public health implications

Use of the WHO standard provides new estimates of nutritional status. These should be taken into account while planning and implementing child health services

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and programmes. Under-nourished infants who are more likely to be missed under the old method than the older children are obvious beneficiaries of the new growth standard. We recommend that nutritional interventions and programmes should be especially targeted to infants (the most vulnerable group). Early onset of under-nutrition in our population points that improvement of children's nutrition is dependent on improving maternal health and nutrition. Hence, maternal health promotion should be made an integral component of child survival programmes.

Since Millennium Development Goal 1 (1990–2015) aims to halve underweight prevalence among under-five children based on the WHO standard, the target for Pakistan would now be reduction from 32 % (based on national data) to 16 %. This is lower than reported earlier (20 %) based on the NCHS reference[37]. Hence, accelerated efforts are needed to achieve the new target.

We recommend that Pakistan switch to the more robustly constructed and up-to-date WHO standard for assessing nutritional status of pre-school children. Otherwise, a significant proportion of wasted and stunted children who are at risk of excessive morbidity and mortality would be missed[38]. A change in the growth standard will also influence the country's ranking internationally by nutritional status and redefinition of the target population for nutritional interventions. The introduction of new standard would require re-analysis of earlier datasets based on the WHO standard for trend monitoring. Allocation of additional resources by policy makers would be needed for the introduction of new growth charts and for training of public and private health workers in their use and interpretation.

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Authors' contributions: R.N. participated in the design of survey, conceived and designed the study, performed the literature review and data analysis and drafted the manuscript. M.K.L. participated in the study design and data interpretation and in revising the paper critically for substantial intellectual content. W.C.H. participated in the data interpretation and in revising the paper critically for substantial intellectual content. I.A. participated in the data organisation and interpretation.

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Does child gender determine household decision for health care in rural Thatta, Pakistan?

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ABSTRACT

Background In South Asia, gender disparity in child mortality is highest in Pakistan. We examined the influence of child gender on household decision regarding health care.

Methods Prevalence ratios were calculated for 3740 children aged 1–59 months from 92 randomly selected villages of rural Pakistan using a cluster-adjusted log-binomial model. Level 1 variables included child and household characteristics and level 2 included village characteristics.

Results There were 25 more girl deaths than boys per 1000 live births (95% CI: 13.9, 48.6) among post-neonates and 38 more among children aged 12–59 months (95% CI: 10.5, 65.5). However, in adjusted analysis, gender was not a significant predictor of illness reporting, visit to health facilities, choice of provider, hospitalization and health expenditure. Significant predictors of health care were child's age, illness characteristics, number of children in the family, household socio-economic status and absence of girls' school in the village.

Conclusions Differential care seeking for boys and girls is not seen in Thatta despite clear differences in mortality ratios. This calls for more creative research to identify pathways for gender differential in child mortality. Factors identified as influencing child health care and amenable to modification include poverty alleviation and girls' education.

Keywords children, gender, health services

Background

Gender disparity in child mortality is greatest in Pakistan among eight South Asian countries[1] accounting for 50% more deaths among girls than boys between their first and fifth birthdays.[1] This excessive girl mortality after neonatal period[2] is of concern, despite biological advantage of females over males.[3,4] In Pakistan, life expectancy at birth for females is greater (66 years) compared with males (64 years).[5] However, gender disparity in health leads to a male biased adult sex ratio (106:100).[5]

Seeking timely health care can prevent child mortality,[6] particularly from diarrhoea and respiratory infections[7,8] for which effective low-cost treatments are available. Most studies from South Asia, with a few exceptions[9,10] have consistently shown that boys are favoured in the use of health services,[11–13] choice of care provider,[13–15] referral or hospitalization[15–18] and health expenditure.[13–15,19]

Conceptual frameworks for determinants of health-care seeking in developing countries proposed by Kroeger,[20] Andersen[21] and Pokhrel and Sauerborn[22] include gender as one of its determinants. The framework developed by Pokhrel and Sauerborn[22] provides four decisions for care seeking: (i) illness reporting, (ii) care seeking, (iii) provider choice, and (iv) health expenditure, all determined by characteristics of individuals, households and health systems. In this study, we adapted this framework[22] (Fig. 1) by including: (i) hospitalization (due to its association with severe and potentially fatal illnesses) as one of the outcome measures and (ii) illness characteristics and maternal health status among determinants of health care. Relevant studies from squatter settlements of Karachi,[11] Rawalpindi General Hospital,[23] Pakistan Demographic and Health Survey

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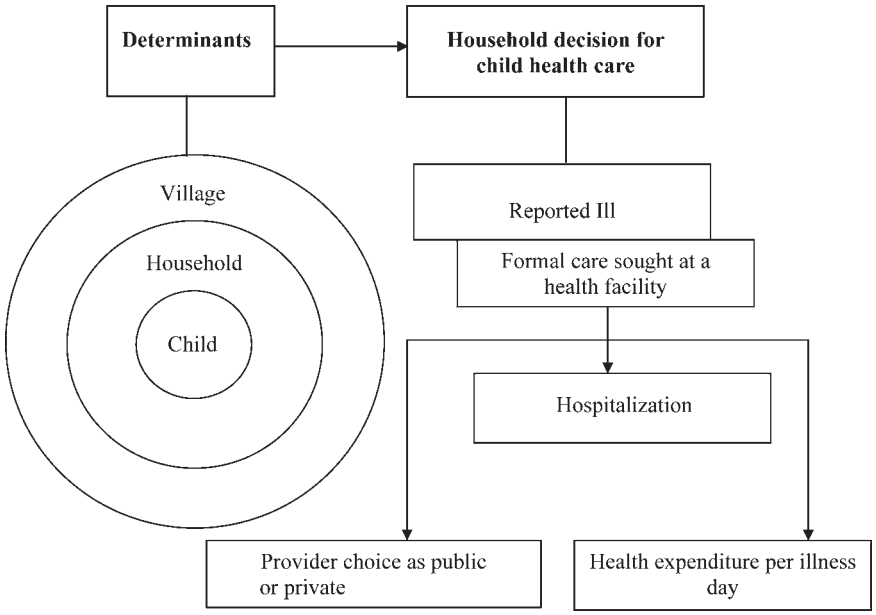

Fig. 1 Conceptual framework to examine association between household decisions for child health care and gender.

(1990/91)[2] and Pakistan Integrated Household Survey (1991)[12] did not utilize any such conceptual frameworks. In this study, we examine gender as a determinant of health-care decisions in specific conceptual and analytical frameworks.

Material and methods

Data source

We used data (collected between November 1992 and February 1993) from a rural district (Thatta) of Sindh province by the Aga Khan University, Karachi. This survey provided baseline information on heath and nutrition status and use of government health services to be used in evaluating a health system improvement project.[24–27] These data include relevant measures of our conceptual framework. The more recent Pakistan Social and Living Standard Measurement Survey (2006–07)[28] and Pakistan Demographic Health Survey (2007)[29] lack information about determinants of health care such as illness duration, maternal health status, distance from health facility and availability of transport and about outcome measures, such as hospitalization and health expenditure. Moreover, these data are still relevant as Thatta has not shown significant improvement in health and developmental indicators over time. This includes infant mortality ratio/1000 live births of 78 in 1992–93[26] and 91 in 2003–04,[30] underweight prevalence of 48% for children under three in 92–93[27] and of 49% for children under five in 2003–04,[30] an adult (≥15 years) literacy level of 32% in both 1992–93[25] and 2004–05[31] and concrete housing for 17% of population in 1992–93[26] and 19% in 2004–05.[31]

Study site

Thatta is a predominantly rural district 60 km east of Karachi. Its 1.1 million people are predominantly Muslim and speak Sindhi. The public health-care system consists of 49 basic health units (BHUs), 12 rural health centres (RHCs), 5 taluka (district subdivision) hospitals and 1 district headquarter hospital.[32] These are plagued by inadequate staffing and supplies.[33] The BHUs charge a nominal fee of only 2 Pakistani Rupees (PR) (US $0.06; 1 US $ = 30 PR-1993)[34] but are closed after 14:00 h. The private sector has an unknown number of clinics and hospitals. Its routine out-patient services cost 15–50 PR (US $0.50–1.6) and usually available during evening hours.[34] Most hospital visits are referrals, although direct visits are permissible.

Survey sampling

From a total of 43 rural administrative units (union councils) of Thatta, 12 were included in the survey because they were accessible and had complete enumeration lists of their villages. Ninety-nine villages within 5 km of a primary health-care (PHC) unit were selected using a simple random sampling from these lists so as to provide 250 households per PHC unit. Only 9% of households refused to participate. From selected villages, all households (2276) were

surveyed and all children aged 1–59 months (3740) were included.

Data collection

Mothers were asked about their age, literacy status (ability to read and/or write a short simple statement) and number of live children. Their health status during the year preceding the interview was assessed through a series of questions about illness symptoms lasting for >2 weeks. Children's age was calculated using a calendar listing important local events, festivals and moon cycles in the last 5 years.

The five stages in health-care seeking were measured as (i) the recent most child illness reported by mother during the past year; (ii) formal care sought at a health facility; (iii) provider choice; (iv) hospitalization for at least a day and (v) health expenditure (total cost of consultation, medicine, investigation and transport) per illness day. Stages (iii)–(v) are conditional on care sought at a health facility. We categorized expenditure per illness day <20 PR as low and ≥20 PR as high based on data distribution (median) and for better interpretability. The cut point of 20 was approximately the median expenditure for subjects who received care at a health facility.

Illness type was assessed by a series of symptom-related questions and coded as 'pneumonia' (fever and cough with fast breathing or fast-moving ribs during breathing), 'measles' (fever with rash), 'whooping cough' (fever with whooping cough), 'upper respiratory illnesses' (fever with cough, cold or sore throat), 'ear infection' (fever with ear pain), 'other fever' including malaria, poliomyelitis or meningitis, 'diarrhoea' (three times or more loose or watery stools in 24 h) or 'other illnesses'. Illness duration was assessed as number of days from illness recognition till reported recovery, death or the interview date.

Three indicators of household socio-economic status (SES) (i.e. type of house, land ownership and per capita average monthly household income divided at its median) were combined to create a single measure. Subjects were grouped as low, middle or upper SES if all three, any two or at most one of three indicators reflected economic disadvantage. Village headmen provided information about presence of girls' school and transport availability during emergency. Village distance by the shortest possible road route to the nearest health facility was measured (in kilometres) using vehicle odometer.

Categorization of the study variables is listed in Table 1.

Mortality ratios were calculated according to World Health Organization standards[35,36] as gender-specific deaths during a year divided by gender-specific live births for neonates (new born to 29 days old), post-neonates (completed 1 to completed 11 months old) and early childhood (12–59 months old). Neonates were excluded from further analyses because neonatal deaths are often determined by genetic factors and prenatal care whereas gender disparity in mortality grows with children's age and is often determined by behaviour.[1]

To account for unequal selection probabilities and to reduce bias in variance estimation, weights were calculated as inverse of sample selection probabilities. Differences in mortality ratios between girls and boys were examined. Because of relatively common outcomes measures (with a prevalence of >10%), we calculated adjusted prevalence ratios[37] using SAS Proc Genmod[38] with the binomial distribution and the log-link function.[39] We adopted COPY method when the log-binomial model did not converge.[40] Clustering at the village level was accounted for by the use

Table 1 Description of study variables and their categorization

Independent variables	*Categories*[a]
Child characteristics	
Age	Post-neonates or early childhood
Gender	Girl or boy
Illness cause[b]	Diarrhoea, respiratory[c], other causes or fever
Illness duration[b]	≥15 days or ≤14 days
Illness severity[a]	Fatal or non-fatal illnesses
Hospitalization[d]	Yes or only visit to a dispensary, a clinic or a PHC
Choice of care provider[e]	Public or private
Household characteristics	
Maternal age	>30 or ≤30 years
Maternal literacy	Illiterate or literate
Number of live children	≥4 or ≤3
Poor maternal health[f]	Yes or no
Household SES	Low, middle or upper
Village characteristics	
Distance from the nearest health facility	>3 or ≤3 km
Transport available	No or yes
A girls' school	Absent or present

[a]The last category of each variable served as the reference group.
[b]Excluded from the model for reported illness.
[c]The category of respiratory illnesses included children with pneumonia, measles, whooping cough, upper respiratory illnesses and ear infections.
[d]Included only in the model for health expenditure.
[e]Included in the models for hospitalization and health expenditure.
[f]Included only in the model for illness reporting and visit to a health facility.

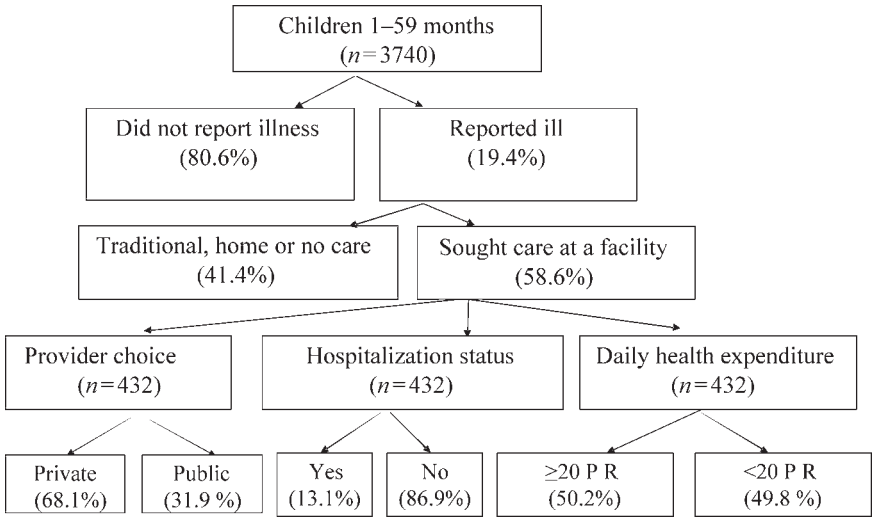

Fig. 2 Household decisions for child health care in Thatta district.

of cluster identity for village level variables in a repeated statement using Proc Genmod. We did not account for clustering at the household level as there was only one sick child per household in 95.5% of the surveyed households.

Five multivariate models were estimated for each of the five outcomes as follows: (i) gender and village variables; (ii) village variables only; (iii) child and village factors; (iv) child and household factors; and (v) gender, village and significant child and household variables identified in crude and model 4 analyses. In the final model, gender and village variables were retained. The remaining variables were entered in a forward manner. Variable with the smallest *P*-value (<0.05) was entered first, followed by addition of one variable at a time, retaining ones with *P*-value <0.05 and removing ones with *P*-value >0.05. We present the results of generalized estimating equations from the final model.

Study results

About one-fifth (19.4%) of 3740 children were reported ill (Fig. 2), of whom 10.6% died. The most commonly reported illness was fever (40.1%) followed by respiratory illnesses (18.5%) and diarrhoea (15.7%) (Table 2). Among sick children, illness duration was 14 days or less for two-thirds (63.6%) and 3 months or less for 97.3% of subjects. About a third of sick children taken to a health facility visited public facilities, about 13% were hospitalized and for half of them daily expenditure was less than 20 PR (Fig. 2).

Most mothers were younger than 30 years (62.4%), illiterate (84.7%) and had four or more live children (54.6%). One-fifth of them (20.5%) reported illness. A majority were from households of middle SES (40.8%). Most villages (54.8%) were $\geq$3 km away from the nearest health facility, had no transport during emergency (71.7 %) and no girls' school (82.6%).

Table 2 Child characteristics as a per cent of all children, reported ill and users of health facilities

Variables	*% (weighted)*
Female[a]	49.6
Post-neonates[a]	28.9
Reported ill[a]	19.4
Illness type[b]	
Diarrhoea	15.7
Respiratory	18.5
Fever	40.1
Others	25.7
Illness duration 15 or more days[b]	36.4
Fatal illness[b]	10.6
Use of a health facility[b]	58.6
Use of government facilities[c]	31.9
Hospitalized[c]	13.1
Health expenditure less than 20 PR/day[c]	48.2

Denominators consisted of children: [a]aged 0–59 months ($n = 3740$); [b]reported ill ($n = 734$); and [c]who visited a health facility ($n = 432$).

Among neonates, there were 20 more boy deaths than girl's per 1000 live births. But, among post-neonates and 12–59 month old children, there were 25 and 38 more girl deaths than boy's per 1000 live births, respectively (Fig. 3).

In unadjusted analyses, girls were less likely than boys (by 15%) to be reported ill (Table 3). In adjusted analysis, gender did not show significant association with any of the five outcomes (Table 4). Illness reporting was, however,

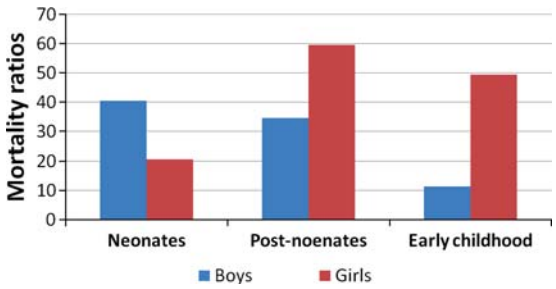

Fig. 3 Age-specific mortality ratios (per 1000 live births) by gender (weighted estimates). This figure appears in colour in the online version of PUBMED.

significantly greater for post-neonates and if mothers reported poor health. It was less if there were four or more live children. The use of health facilities was significantly reduced for illnesses of long duration, respiratory or other causes, low SES households and absence of girls' school. Public facilities were visited more often for older children and low SES households. Hospitalization was significantly less in the absence of a village girls' school. Health expenditure was significantly greater with fatal illnesses and less with public providers. Village distance to health facility and transport availability had no effect on health-care decisions.

Discussion

Main study findings

Girl children had significantly greater mortality than boys beyond their neonatal age, suggesting that behavioural factors may account for greater girl mortality. Prevalence ratios adjusted for significant confounders and cluster identity, however, did not show association of gender with illness reporting, care seeking, provider choice, hospitalization or expenditure, contrary to expectation. Possible reasons for this include (i) bias in reporting of care seeking or (ii) low study power (described later under the section Study limitation).

Greater illness reporting among infants suggests their greater illness susceptibility and concern for them among mothers. Greater use of health care for illnesses of short duration (<15 days) suggests that illnesses of long duration were not considered serious or that parents adapted to long-standing childhood illnesses. Greater care seeking for fever compared with respiratory or other illnesses could reflect greater anxiety over undefined fever or acceptance of common respiratory illnesses as an inevitable part of life.[41] Parent's capacity to protect their children, as measured by SES, influenced decisions to seek care and provider choice.

Table 3 Crude prevalence ratios for child health-care seeking (confidence intervals adjusted for clustered design)

Variables	*Illness reporting*	*Facility use*	*Public provider*	*Hospitalization*	*Low expenditure*
Child characteristics					
Female	0.85 (0.76, 0.96)	0.97 (0.88, 1.08)	1.12 (0.91, 1.37)	0.66 (0.39, 1.12)	0.88 (0.73, 1.07)
Post-neonate	1.49 (1.29, 1.72)	1.17 (1.03, 1.33)	0.73 (0.54, 0.98)	1.28 (0.73, 2.27)	0.87 (0.72, 1.07)
Fatal illness	—	1.09 (0.83, 1.43)	0.86 (0.51, 1.44)	0.97 (0.36, 2.62)	0.05 (0.007, 0.35)
Ill for ≥15 days	—	0.59 (0.50, 0.72)	0.70 (0.40, 1.23)	1.63 (0.94, 2.81)	—
Diarrhoea	—	0.90 (0.79, 1.03)	0.64 (0.43, 0.97)	1.30 (0.67, 2.53)	0.84 (0.58, 1.19)
Respiratory		0.58 (0.48, 0.71)	0.91 (0.58, 1.42)	0.81 (0.28, 2.33)	0.95 (0.67, 1.13)
Others	—	0.59 (0.47, 0.73)	0.90 (0.57, 1.42)	1.03 (0.51, 2.08)	0.85 (0.65, 1.12)
Hospitalization	—	—	—	—	1.20 (0.86, 1.68)
Public provider	—	—	—	0.89 (0.45, 1.75)	1.39 (1.13, 1.71)
Household characteristics					
Mother ≥30 years old	1.03 (0.92, 1.07)	0.96 (0.84, 1.09)	0.89 (0.66, 1.23)	1.09 (0.64, 1.85)	1.12 (0.90, 1.39)
Illiterate mother	0.87 (0.73, 1.05)	0.92 (0.80, 1.05)	1.04 (0.66, 1.63)	0.87 (0.39, 1.91)	1.28 (1.01, 1.61)
≥ 4 live children	0.87 (0.78, 0.98)	1.14 (0.97, 1.34)	0.87 (0.68, 1.12)	1.35 (0.84, 2.17)	0.98 (0.81, 1.19)
Poor maternal health	1.88 (1.62, 2.20)	0.97 (0.90, 1.05)	—	—	—
Low SES	0.94 (0.74, 1.19)	0.88 (0.71, 1.09)	1.50 (0.98, 2.29)	1.41 (0.67, 2.94)	1.19 (0.89, 1.61)
Middle SES	1.09 (0.91, 1.31)	0.90 (0.76, 1.06)	1.19 (0.84, 1.71)	0.84 (0.41, 1.75)	1.18 (0.90, 1.55)
Village characteristics					
Health facility at ≥3 km	1.15 (0.89, 1.47)	0.96 (0.81, 1.14)	1.35 (0.85, 2.16)	1.19 (0.66, 2.17)	1.13 (0.89, 1.43)
No transport	1.17 (0.88, 1.55)	0.91 (0.76, 1.09)	1.09 (0.67, 1.75)	0.65 (0.36, 1.17)	0.96 (0.74, 1.24)
No girls' school	0.92 (0.72, 1.16)	1.24 (1.06, 1.45)	1.25 (0.71, 2.12)	0.48 (0.27, 0.83)	0.89 (0.69, 1.14)

Table 4 Child health-care seeking and gender: adjusted prevalence ratios (95% CI)

Variables	*Illness reporting*	*Facility use*	*Public provider*	*Hospitalization*	*Low expenditure*
Child characteristics					
Females	0.89 (0.80, 1.01)	0.95 (0.88, 1.02)	1.11 (0.96, 1.30)	0.68 (0.39, 1.18)	0.99 (0.87, 1.13)
Post-neonates	1.47 (1.28, 1.70)	—	0.81 (0.66, 0.99)	—	—
Fatal illness		—	—	—	0.24 (0.17, 0.34)
Ill for ≥15 days		0.77 (0.67, 0.88)		—	—
Diarrhoea	—	0.92 (0.83, 1.02)	—	—	—
Respiratory		0.71 (0.61, 0.83)	—	—	—
Others		0.76 (0.64, 0.89)	—	—	—
Hospitalization			—		—
Public provider					1.28 (1.11, 1.48)
Household characteristics					
Mother ≥ 30 yrs	—	—	—	—	—
Illiterate mother	—	—	—	—	—
≥4 live children	0.83 (0.73, 0.94)	—	—	—	—
Poor maternal health	1.92 (1.66, 2.23)	—			
Low SES	—	0.87 (0.76, 0.93)	1.32 (1.01, 1.76)	—	—
Middle SES	—	0.68 (0.46, 1.03)	1.12 (0.89, 1.43)	—	—
Village characteristics					
Facility at ≥3 km	1.15 (0.91, 1.44)	0.79 (0.53, 1.17)	1.22 (0.86, 1.73)	1.25 (0.74, 2.09)	1.03 (0.89, 1.19)
No transport	1.15 (0.92, 1.45)	0.66 (0.42, 1.05)	0.99 (0.75, 1.33)	0.83 (0.46, 1.51)	0.94 (0.81, 1.09)
No girls' school	0.87 (0.69, 1.09)	0.59 (0.37, 0.92)	1.09 (0.78, 1.50)	0.51 (0.28, 0.93)	0.94 (0.81, 1.09)
Log likelihood	−1694.18	−451.91	−271.44	−162.51	−253.44
R-square[a]	0.004	0.007	0.007	0.014	0.002

[a]Max-rescaled generalized R-square.[65]

Parents of young and high SES children tended to choose private over public services with consequent increase in cost. As expected, fatal illnesses were associated with greater expenditure. Association of a girls' school with greater use of health care and hospitalization suggests that villages with a girls' school are likely to give importance to girls' education and possibly also to their health.

These findings need to be understood in the 'local' context of Thatta consisting of predominantly poor and largely illiterate agricultural families who lack access to emergency transportation. Though a network of public and private providers is available, quality care cannot be assured.

What is already known?

Gender disparity in post-neonatal mortality observed in Thatta is similar to observations from Nepal,[42] Bangladesh,[18,43–45] India[46] and Pakistan.[47] Our illness reporting (19%) for a 1 year period was less than the recent report of 17% for a 2 week period.[31] This could be due to recall bias or low awareness among mothers at the time of survey about common childhood illnesses that might have improved following implementation of a community-based lady health worker programme in 1994.[48] Similarly, the use of health facility (58.6%) was less than the recent estimate (91%)[31] suggesting improvement in health-care use over time. Under-utilization of public facilities, despite nominal costs is similar to observations from Nepal,[49,50] India,[17,41,51] Sri Lanka,[6] Vietnam[52] and a local survey.[31] This could possibly be due to perceived low quality of care at public facilities.[41,53] Greater care seeking for fever compared with respiratory or other illnesses is similar to observations in rural Guatemala[54,55] and Nairobi slums.[56]

The lack of association between gender and illness reporting could be due to similar risk among boys and girls to common childhood illnesses. No gender difference in care seeking in Sri Lanka[6] and Kerala, India[9] is consistent with low child and girl mortality in these areas due to improved women status and literacy.[57] The studies from Nepal[10,49] do not provide explanation for no gender difference in illness reporting and care seeking. Our observations is inconsistent with most reports from South Asia that show gender influence on the use of health facility,[11] provider choice,[12,14,15,18] referral[15–18] and health expenditure.[14,19]

What does this study add?

Our study is unique in that its conclusions are based on the most appropriate measure of association (prevalence ratio) suitable for common outcome measures and with cluster correlation taken into account. Studies based on odds ratios tend to overestimate common outcomes.[40] Assessment of household decisions in a fairly comprehensive conceptual framework suggest that age and illness characteristics that make children vulnerable,[54,55] poor maternal health,[58,59] low SES[17,49] and family size[60] predict illness reporting and affect health care. An interesting finding is the influence of a contextual factor, the absence of girls' school on low use of health facility and hospitalization, suggesting villages with poor development indicators may be at risk of low health-care use.

Study limitations

This study is based on retrospective interview data and hence bears potential for biases. Greater mortality ratios among girls could be due to less reporting of girl births and greater reporting of girl deaths. Similarly, inaccurate age assessment could lead to under or overestimation of age-specific mortality ratios. Chronic (e.g. malnutrition and chronic cough) and highly prevalent conditions (e.g. diarrhoea) could possibly be under-reported.[61,62] Reliability of the respondent's recall would vary with time of event occurrence, illness severity and visits frequency.[61,63] The 1-year recall period was a compromise to obtain sufficient events for analysis. Hence, recall errors are possible and the reported health expenditure cannot be verified. Our predictive model did not control for health beliefs and quality of care, which may play a role in determining health-care use. Selected union councils though belonged to seven of nine talukas (subdivisions of the district) their inclusion because of convenience could affect generalizability of the results. Excluded union councils may be worse with regard to prevalence of childhood illnesses and access to health care.

It is also possible that the failure to find a significant gender effect (after adjustment for other variables) could be due to low power. If care seeking was 20% more for boys than for girls then the power for concluding a gender effect was 88% for illness reporting, 100% for facility use, 63% for visit to a public provider, 25% for being hospitalized and 79% for low health expenditure. The power is very low for hospitalization and fairly low for choice of provider and health expenditure. The power was high enough to detect a 20% increase for males in illness reporting and facility use. However, our estimates for Thatta indicate that if there is a gender difference for these two outcome variables, then it is less than 20%. Choice of public provider and low health expenditure appear to also have a smaller effect in addition to low power. Hospitalization was the only variable that had an observed gender difference of more than 20%. Unfortunately, it also had very low power. Thus, even if there is a large gender difference in Thatta for hospitalization, our power was too low to detect it.

Implications for public health policy and research

Concerted efforts are needed to improve utilization of public health facilities by introducing fundamental changes in health-care delivery systems as proposed in the recent Devolution Plan of Government.[64] The significant effect of number of children in the family on illness reporting, suggests continued need for the effective family planning services in rural areas. The significant effects of household SES and girls' school suggest that poverty alleviation and educational development may improve health-care utilization.

The question of the causes of differential survival by gender remains unanswered and open for further research. To improve our understanding of pathways for gender differential in child survival, we suggest inclusion of (i) factors such as birth interval, sibling gender, illness episodes, delay in care seeking, visit frequency, health beliefs and quality of care in the conceptual framework; (ii) additional evidence from facility records; (iii) use of appropriate sample size; and (iv) qualitative research.

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