1994

Cesarean Delivery And Socioeconomic Status

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CESAREAN DELIVERY AND SOCIOECONOMIC STATUS

by

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Submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Ontario
June, 1994

ISBN 0-315-93207-4

Canada

ABSTRACT

Women of higher socioeconomic status have been observed to have higher rates of cesarean delivery, said to be evidence that many cesarean sections are unnecessary. Previous investigations have been conducted in settings where access to obstetrical services may be dependent on ability to pay, and investigators have often not adjusted differences for maternal age, parity and previous cesarean delivery, factors known to confound the association. Whether women of upper or lower socioeconomic status are at increased risk of cesarean delivery for biological reasons has not been determined.

The purpose of this investigation was to examine the association between cesarean delivery and socioeconomic indicators in a setting with universal health insurance and all obstetrical services. Eligible residents of London, Ontario, giving birth during the study period were invited to participate. Questionnaires were completed by 2383 (78.5 percent) of those eligible during their postpartum stay in hospital. Questionnaire information allowed participants to be classified according to several indicators of socioeconomic status. Additional information was abstracted from consenting participant's hospital charts.

Women of higher socioeconomic status not only did not have higher rates of cesarean delivery, but appeared to have

lower rates. The estimated odds ratio of cesarean delivery for women with a university degree compared to women who had not completed high school was 0.37 (0.22, 0.64; 95% C.I.) after adjusting for age, parity, and previous cesarean delivery. Among women defined as "low risk," the estimated odds ratio of cesarean delivery for women with a university degree compared to women who had not completed high school was 0.16 (0.06, 0.43; 95% C.I.) after adjustment for maternal age, parity, maternal height and infant birth weight. Further exploration showed that factors hypothesized to be related to poor growth during childhood and adolescence may be associated with increased odds of a cesarean delivery.

It is likely that the results of the current investigation differ from the results of previous investigations because of the greater control over potentially confounding factors that the study design facilitated. It is recommended that investigators of differences in cesarean section rates adjust for population differences as fully as possible and consider that undetected differences in population characteristics may exist.

DEDICATION

For Stephen and Brendan

"And, with small childish hands, we are turning around
The apple of life which another has found;
It is warm with our touch, not with sun of the south,
And we count, as we turn it, the red side for four".

From *A Rhapsody of Life's Progress*,
by Elizabeth Barrett Browning.

ACKNOWLEDGEMENTS

While I wish to acknowledge the support of many people over the course of this project, my first expression of gratitude goes to my sons Stephen and Brendan Turner, whose unflagging encouragement, faith, and sacrifice not only facilitated the completion of this thesis, but mandated it.

I am also grateful to Dr. Karen Campbell, my chief advisor, for her support of my ideas, her thoughtful advice and guidance, and the hours of patiently given time throughout my years as a graduate student in the department of Epidemiology and Biostatistics. I wish also to extend thanks to the other members of my advisory committee, Drs. James Robertson and Ken Milne for their time, guidance, and expertise.

The successful completion of the data collection could not have been accomplished without the assistance and support of the following people: Dr. James Silcox of Victoria Hospital; nursing supervisors Jean Stephenson, Gabe Newell, and Anne Pincombe; medical records supervisors Pauline Spencer and Claire Beadle; the ward clerks and postpartum nursing staffs; and the many women who took the time to complete a questionnaire. It was an enjoyable experience working with many of these people and I am pleased to have had the opportunity to meet many of the women who took part in the study.

I also wish to thank Elaine Halinda, Kim Milne and Anna Kim for their careful and accurate assistance with both the data collection and the data entry; Karen Webster of St. Joseph's Health Centre, Birney Lueske and Rob Alder of the Middlesex-London Health Unit for supplying additional information; John Koval, Neil Klar, and Michael Eliasziw for their statistical advice and wise counsel; Teresa Ainsworth for proof reading and suggestions; and Iris Gutmanis for "technical" assistance and moral support.

Study funding was provided by the Pooled Research Trust Fund of St. Joseph's Health Centre. I was supported in part during the course of my graduate program by a research training fellowship awarded by the Ontario Ministry of Health.

Lastly, I wish to express my gratitude for the friendship, good wishes, prayers, encouragement, and support, during the past three years in particular, to my family and the friends with whom I have been blessed. In addition to those already mentioned above, I wish to add: Stephen Moss, Elana Johnson, Cory and Simon Davies, David Murphy, J. Stephen Downie, David Johnston, Kent Buse, Carol Buck, Jim McLurg, Geoff Richardson, and Kathryn and Scott Rigelman.

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CHAPTER 1.0

REVIEW OF THE LITERATURE

1.1 Introduction

For about 30 years prior to 1970, the cesarean section rate in the United States was stable at about five percent (Douglas et al., 1963; Katz and Cefalo, 1988). The cesarean section rate in other developed countries prior to 1970 was similar, ranging between two and six percent (Notzon et al., 1987; Nair, 1991). However, between 1970 and 1982 the cesarean section rates in Canada, Australia, New Zealand and nearly every country of Northern and Western Europe at least doubled (Notzon et al., 1987). In the United States the rate not only doubled, but quadrupled, reaching 20.3 percent in 1983 and nearly 25 percent by 1988 (Placek et al, 1983; Taffel et al., 1990). This phenomenon was not confined to the more industrialized countries; cesarean section rates reported in Brazil and Puerto Rico exceeded even those in the United States (Notzon, 1990).

Although investigations of why this occurred have been inconclusive, it is commonly believed that many cesarean sections are unnecessary (LoCicero, 1993; Sakala, 1993; Silver and Wolfe, 1989; Stephenson et al., 1993; Tanio et al., 1987). Observed differences in cesarean section rates by country, region, or facility, for example, are said to provide evidence for this contention. Of particular concern have been observations that cesarean section rates vary by indicators of women's socioeconomic status (Barros et al.,

1991; Gould et al., 1989; Stafford, 1990; Zdeb and Logrillo, 1989), by the type of health insurance they possess or whether their obstetrical care is paid "privately" or provided at "public" expense (Blumenthal et al., 1984; Haas et al., 1993; Janowitz et al., 1982, 1985; Renwick, 19? : Stafford et al., 1993; Zahniser, 1992). Previous investigations have been conducted in settings where access to obstetrical services may be dependent on ability to pay, and investigators have often not adjusted differences for maternal age, parity and previous cesarean delivery, factors known to confound the association.

There is no "gold standard" of socioeconomic status; theoretical formulations of social stratification, or the relative position individuals occupy in society, are complex and multidimensional. It is known, however, that several *indicators* of socioeconomic status are related to many disease processes (Libertos et al., 1988).

The general purpose of the investigation to be reported here was to examine the association between cesarean delivery and socioeconomic indicators in a setting with universal health insurance. The review of the literature will provide an historical context of the role of cesarean delivery in obstetrical practice, an overview of investigations conducted in response to the rapid rise in cesarean section rates, and a review of previous investigations of the association between cesarean delivery and socioeconomic indicators. In addition, other factors known to be possible reasons that

cesarean section rates may differ among social groups will be discussed, and evidence that inhibition of growth during childhood may be related to a greater likelihood of cesarean delivery will be presented.

1.2 Historical overview

1.2.1 Gradual rise in cesarean section rates

Delivery of a fetus through an incision in the mother's abdomen was a controversial topic as long ago as the Middle Ages. At that time the debate concerned the justification of a church edict mandating cesarean delivery in the event of maternal death in order to baptize the fetus, although almost all were stillborn. Strong opposition to cesarean delivery of a child of a living woman continued until late in the nineteenth century when the mother's odds of surviving the surgery improved with the development of safe techniques of suturing the uterus (Katz and Cefalo, 1988).

Other developments in the early half of this century were accompanied by increasing acceptance of cesarean delivery. The discovery of antibiotics during the 1930s, the development of blood transfusion services during World War II (Baird, 1975), and concerted efforts by governments to organize obstetrical care, improve facilities, and provide trained personnel (Wilson, 1984), led to a rapid reduction of maternal mortality rates for all births, but also drastically reduced the risks of cesarean delivery. By the mid 1940s, cesarean section was said to be "one of the greatest blessings of womankind (Katz and Cefalo, 1988)."

Decreased stillbirth rates due to birth trauma and other "unexplained" causes were attributed to an increasing tendency for births to occur in hospital as well as the increasing use of cesarean section (Baird et al., 1953; Baird 1955). With the cesarean section rate between two and three percent, it was suggested that more cesarean sections could further reduce the fetal death rate (Baird, 1955).

Safety of cesarean delivery continued to improve throughout the 1950s and 1960s accompanied by a growing preference for cesarean delivery to avoid risks to the fetus during a difficult breech or midforceps delivery (Bottoms et al., 1980; Friedman, 1989; Seeds and Cefalo, 1982).

1.2.2 Growing concern about rising rates of cesarean delivery

By the late 1970s, however, concern about the rising rate of cesarean section was beginning to be expressed, and it was questioned whether a balance was being maintained between the risks to the mother and the benefits to the fetus. A report published by the United States Department of Health, Education and Welfare in 1979 documented a 264 percent increase in the cesarean section rate (Marieskind, 1979). Consensus conferences were held in the United States (National Institutes of Health, 1981) and Canada (Consensus Conference Report, 1986) to ascertain why the rates had risen. Conference participants concluded that more research was needed to better answer the questions posed, but made several recommendations that were hoped would lead to a

reduction in cesarean section rates. Cesarean section rates continued to rise, however.

1.2.3 Balance of risks and benefits

Perinatal mortality rates in North America decreased as dramatically as cesarean section rates increased over the same time period (Bottoms et al., 1980). It was disputed whether the decrease in perinatal mortality rates could be attributed to higher rates of cesarean delivery (Marieskind, 1989). Other factors occurring simultaneously were said to be more likely to have been responsible for this improvement, such as advances in the field of neonatal intensive care (National Institutes of Health, 1981). In addition, societal changes, such as a decline in the number of births at the extremes of reproductive age, were also believed to have been responsible for lowered rates of perinatal mortality (Richards, 1977). Moreover, the assumption that cesarean delivery conferred a greater degree of safety to the fetus in some circumstances (Bottoms et al., 1980; Taffel et al., 1987) was challenged. In particular, there was disagreement about whether cesarean delivery was safer for the infant than midforceps delivery (Boyd et al., 1986; Friedman, 1989; Seiler, 1990), vaginal breech delivery at term (Bodmer et al., 1986; Borten, 1989; Green et al., 1982; Flanagan et al., 1987; Huchcroft et al., 1981; Seeds and Cefalo, 1982), or whether cesarean delivery increased the chances of survival of low birth weight infants (Basket and McMillan, 1981; Fleischman and Rhoden,

1989; Paul, 1988; Westgren, 1988).

Care providers and consumers began to question whether cesarean delivery in possibly equivocal circumstances could be balanced against the increased risks of cesarean delivery for the mother. Higher rates of maternal mortality were reported among women having had cesarean as compared to vaginal deliveries (Evrard and Gold, 1977; Pettiti, et al., 1982). Other investigators argued, however, that assessment of the risk of mortality had to take into account the differences in risk associated with intrapartum cesarean delivery as opposed to elective procedures, as well as risks to the mother associated with the antecedent conditions leading to the decision to perform the cesarean section. This was often very difficult to do (Lilford et al., 1990). Nevertheless, after one cesarean delivery there are indisputably higher risks of both mortality and serious morbidity to both the mother and the fetus in subsequent pregnancies. This is because of increased risks of uterine rupture, placenta previa and placenta accreta; risks that increase with increasing numbers of prior cesarean deliveries (Chazotte and Cohen, 1990; Clark et al., 1985).

In an assessment of the balance between risk and benefit, other adverse maternal outcomes associated with cesarean delivery were said to require consideration as well. Investigators and consumers drew attention to higher rates of spontaneous abortion and difficulty conceiving following a cesarean delivery (Garel et al., 1990; Hall et

al., 1989); a fear of decreased fertility in cultures where large families are desired because of social or religious custom (Vaclavinkova, 1989); the risk of postoperative infection (Baskett and McMillen, 1981; Evrard et al., 1980); and psychological trauma to both the mother and other family members (Garel et al., 1990; Green et al., 1990; Trowell, 1986).

In addition to concerns for the health and well-being of the mother, the child, and the family, concerns were raised about the increased financial cost of high rates of cesarean delivery (Auer, 1987).

1.2.4 Reasons for the rise

Concurrently many investigations were being conducted of possible reasons for the dramatic rise in rates of cesarean delivery. It was believed that the earlier explanation that the rise was due to the increased safety of the surgery was inadequate, and that other factors were operating as well. As discussed in this section, most of the hypothesized reasons for the increase in cesarean section rates placed blame on changes in the practice of obstetrics, such as an increasing reliance on technology, and a greater likelihood that physicians wished to avoid malpractice, inconvenience and to increase their incomes. Some consideration was given to the impact of demographic changes, however.

1.2.4.1 Technology for childbirth

Electronic fetal heart rate monitors were introduced in

1969 to detect fetal distress during labour (Williams and Hawes, 1979). Some institutions reported marked increases in cesarean section with the acquisition of electronic fetal monitors (Haddad and Lundy, 1978). However, reviewers of the evidence were divided as to whether the increased use of electronic fetal monitoring contributed substantially to rising cesarean section rates, and reported that in some settings increased use of monitors was associated with decreased cesarean section rates (Hobbins et al., 1979; Hughey et al., 1977; Marieskind, 1979; Neutra et al., 1980; Taffel et al., 1987). Moreover, in some studies of electronic fetal monitoring, most of the increase in cesarean section rates was found to be due to dystocia or failure to progress, rather than to an increased incidence of fetal distress detected by the monitors (Hughey et al., 1977; Neutra et al., 1980).

Also blamed was an increasing use of epidural analgesia during labour, although a causal role for this use of technology in increased cesarean section rates has been disputed (Adashek et al., 1993; DeMott and Sandmire, 1992; Gribble and Meier, 1991; Thorp et al., 1989, 1990).

1.2.4.2 Physician factors

Investigations of other factors such as an increasing fear of malpractice suits among physicians, and an increasing reliance on cesarean delivery because it may be more convenient or carry a greater financial incentive for the physician, also generated disagreement (Baskett, 1978;

Carpenter et al., 1987; Evans et al., 1984; Fraser et al., 1987; Phillips et al., 1982; Rock, 1988; Tussing and Wojtowycz, 1992; Wadhera and Nair, 1982).

1.2.4.3 Demographic changes

Lastly, although it was known that demographic changes in the population of women giving birth that occurred during the late 1960s and early 1970s had an impact on the rate of cesarean birth, the potential magnitude of this impact was not investigated thoroughly. The rise in the cesarean section rate occurred at about the same time that contraceptives became widely available and attitudes towards childbearing, women's work outside the home, and desired family size changed. This phenomenon was accompanied by an increase in the age at first birth, and decreasing parity with the establishment of a norm of two children per family in North America.

Women experiencing a first birth and women of older maternal age are at higher risk of cesarean delivery,[2] and several investigators showed that changes in the age (Anderson and Lomas, 1984; Taffel et al., 1987) and parity (Bottoms et al., 1980) composition of the population of women giving birth had an impact on the cesarean section rate. However, at this time no estimates were apparently

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[1] Parity refers to the number of children a women has had. Primiparity means having a first child; and multiparity refers to a second or higher order birth.

[2] The association between maternal age and parity and the risk of cesarean delivery is discussed in more detail in section 1.4.1.

made that considered the effect of changes in both the age and parity structure of the population, particularly the potential impact of an increasing tendency for first births to occur at later maternal ages.

1.2.5 Summary of historical overview

To summarize the historical context, by the early 1980's, the cesarean section rate had risen rapidly in many countries within a relatively brief period of time. It is likely that the gradual increase observed prior to 1970 and part of the more rapid increase that occurred subsequently were due to the increased safety of cesarean delivery for the mother which, in turn, justified its use in a broadened spectrum of indications to prevent potentially adverse consequences of a difficult vaginal delivery. However, the rise in cesarean section rates subsequent to 1970 was so rapid and widespread that serious investigation began of whether this increase could be justified on the basis of improved fetal outcomes. This rapid increase was of particular concern, because although safety for the mother was certainly improved, cesarean delivery was not without risks to her and was associated with much higher costs than vaginal delivery. Only partial assessment was made of the potential impact of demographic changes that occurred during this time on cesarean section rates.

1.3 Review of investigations of cesarean section rates by socioeconomic indicators and source of payment for obstetrical care

1.3.1 Introduction

Differences in cesarean section rates have been observed and reported since investigation of reasons for the rise in cesarean section rates began. Among these have been differences between: countries (Bergsjo et al., 1983; Lomas and Enkin, 1989; Notzon et al., 1994; Notzon et al., 1987; Notzon, 1990; Stephenson et al., 1993), regions or facilities within countries (Anderson and Lomas, 1985; Kazandjian and Summer, 1989, 1990; Renwick, 1991; Simini et al., 1990; Saunders and Flowerdew, 1991), and physicians practicing in the same region or facility (Goyert et al., 1989; Guillemette and Fraser, 1992). Of particular concern to the current investigation are differences in reported cesarean section rates between types of health insurance, "publicly-funded" versus "private" obstetrical care, and other indicators of socioeconomic status. Investigations of these differences will be reviewed below.

Do differences in cesarean section rates without corresponding differences in neonatal outcomes imply that where rates are higher, many of the cesarean deliveries must be unnecessary? It has been acknowledged that differences in cesarean section rates between regions and facilities, for example, reflect differences in the demographic characteristics of the population as well as differential

availability of services among institutions and regions (Baskett, 1978; National Institutes of Health, 1981a). However, some investigators have not taken these factors into account before arriving at conclusions about the implications of higher rates. The distribution of factors related to risk of cesarean delivery such as maternal age, parity, infant birth weight and previous cesarean delivery could differ among various populations. In the case of the association between cesarean delivery and indicators of socioeconomic status, the potential for these factors to influence an observed association is very great.

1.3.2 Findings of previous studies

Observations have been made in several countries that cesarean section rates differ by indicators of socioeconomic status. Where investigators have not taken into account characteristics of the population that might have an impact on this association the results have been consistent; women who had private health insurance (Blumenthal et al., 1984; Haas et al., 1993; Janowitz et al., 1982, 1985; Renwick, 1991; Stafford et al., 1993; Zahniser, 1992) or who were of higher socioeconomic status (Barros et al., 1991; Zdeb and Logrillo, 1989) had consistently higher rates of cesarean delivery.

When other investigators of this association have adjusted for population differences, the association has often been observed to diminish. McCloskey et al. (1992) reported that without adjustment for potential confounders

primiparous women who were attended by physicians in private practice were 1.5 times more likely to have a cesarean delivery than women who received care in a Health Maintenance Organization or a hospital clinic. However after adjusting for several antepartum risk factors, they found no difference in cesarean section rates by source of care over most age groups. Results of a nation-wide U.S. survey showed that after adjusting for age, primary cesarean section rates did not differ by women's education or income (Placek et al., 1983). Investigators in Washington State showed that adjustment for age, parity and infant birth weight alone accounted for all of the observed difference in primary cesarean section rates between insured and uninsured women (Parrish et al., 1994).

However, other investigators have reported a direct association between socioeconomic indicators and cesarean section rates even after adjustment for population characteristics. Bertollini et al., (1992), using birth registry data from the Lazio region of Italy, showed that after adjusting for maternal age, infant birth weight, gestational age, presentation, day of the week, and parity, the odds of cesarean delivery for women who delivered in private facilities were 1.64 times greater than women whose obstetrical care was publicly-funded. These investigators, however, were unable to control for previous cesarean delivery because of the limitations of the source of their data. Other investigators reported that cesarean section

rates in California varied directly by socioeconomic indicators after adjusting for age and parity (Gould et al., 1989; Stafford, 1990). However, it was not possible to ascertain from their report whether they adjusted for age and parity simultaneously. Moreover, the authors stated that a problem with their aggregate data source was that it under-reported complications of pregnancy. This suggests that multiparous women with previous cesarean delivery may have been misclassified. Their results, therefore, may be misleading. Similarly, Haynes de Regt et al. (1986) found that among low risk women in Brooklyn, New York, private patients had higher rates of cesarean delivery overall than clinic patients after adjusting for age, parity and birth weight in stratified analyses. However, among primiparous women, clinic patients were less likely than private patients to have had a cesarean delivery only among women less than 25. Rates in older age groups were similar.

A few investigators have reported finding an indirect association between cesarean section and socioeconomic indicators after adjusting for population characteristics. Tussing and Wojtowycz (1992) reported that after adjusting for several demographic, obstetrical risk, and organizational factors simultaneously, mother's education was negatively associated with cesarean delivery. Similarly, in some regions of Italy slightly lower cesarean section rates were found in public as compared to private hospitals after standardization for maternal age, education

and birth weight (Parazzini et al., 1992).

Only one report of an investigation of the association of socioeconomic indicators with cesarean delivery under a system of universal health insurance was found. In a letter to the editor Leyland (1993) reported that there was no difference in cesarean section rates by occupation groups in Scotland when the rates were adjusted for age, parity, and breech presentation. However, women in the two lowest social class categories who delivered infants at less than 32 weeks' gestation had lower adjusted odds of cesarean delivery than women in the upper two social class categories.

1.3.3 Interpretations of differences

Overall it appears that adjustment for potential confounders at least reduced any observed association between the likelihood of a cesarean delivery and the indicators or correlates of socioeconomic status in question. However, observed differences, whether adjusted or unadjusted, have been given many different interpretations. Some investigators concluded that observed differences were due to differences in the underlying risk status of the groups, particularly the age and parity composition of the populations being compared (McCloskey et al., 1992; Parrish, 1994). Others considered that the differences might have been due to under-reporting of cesarean deliveries or difficulties in determining whether women had had a previous cesarean delivery with the

available data (Parazzini et al., 1992).

Many others concluded or implied, however, that differences in rates of cesarean delivery observed between insured and uninsured women or over levels of other socioeconomic indicators was evidence that cesarean sections were being performed unnecessarily among affluent women. They argued, for example, that private physicians care for their patients differently (Haynes de Regt, 1986); that these differences signified differences in access to technology or physician work schedules, greater financial incentives for cesarean birth, or medical malpractice concerns (Bertollini et al., 1992; Renwick, 1991; Stafford, 1990; Stafford et al., 1993; Zahniser et al., 1992); that physicians treat women differently depending on their socioeconomic status (Bertollini et al., 1992; Stafford, 1990) or that women's attitudes towards obstetrical intervention differ by their social background or educational levels, and that this influences the likelihood that they are delivered by cesarean section (Bertollini et al., 1992; Haas et al., 1993; Renwick, 1991; Stafford, 1990).

1.4 Potential confounders of the association between cesarean section rates and socioeconomic status

1.4.1 Parity

Of all maternal characteristics, parity has the strongest relationship with the likelihood of cesarean delivery, primiparas more likely to have had a cesarean

delivery in all age groups (Bottoms et al., 1980; Placek et al., 1983). Risks of cesarean delivery are also increased in fifth or higher order births (Bottoms et al., 1980; Placek 1978; Sokol et al., 1982), although most studies which have reported parity as a risk factor for cesarean section have included only two categories; primiparous and multiparous.

1.4.2 Maternal age

Maternal age is also related to the likelihood of cesarean section, although the association has not been reported as consistently. In some populations cesarean section rates increase with maternal age (Placek 1978; Placek et al., 1983; Zdeb and Logrillo 1989), although some investigators have reported a bimodal distribution with higher rates in both younger and older age groups (Marieskind 1979).

The reasons for the association of age with higher rates of cesarean section are not well understood. Older women are more likely to have experienced previous obstetric problems, have higher rates of toxaemia, uterine fibroids, previous uterine surgery, low birth weight infants, prematurity, breech presentation, abruption, pre-eclampsia, and genital herpes, all of which are associated with higher rates of cesarean delivery (Blickstein et al., 1987; Gordon et al., 1991; Kajanoja and Widholm 1978; Kessler et al., 1980). However, older maternal age has been found to be a risk factor for cesarean delivery independent

of many other obstetric risk factors (Delgado et al., 1991; Gordon et al., 1991; Peipert et al., 1993; Tsu, 1992). These investigators concluded that knowledge of age and parity are likely to influence decision-making by the care provider who is more likely to opt for a cesarean delivery for older primiparas, even in the absence of higher risk. Others have disagreed with this conclusion, however. Adashek et al. (1993) reported that they were unable to identify this "physician bias" and concluded that the greater likelihood of cesarean delivery among older women was due to less effective uterine contractions.

It has also been observed that the increased risk of cesarean delivery among older women was independent of education and income levels (Gordon et al., 1991; Peipert et al., 1993).

1.4.3 Previous cesarean delivery

The most common indication in Canada and the United States for cesarean delivery is previous cesarean delivery (Anderson and Lomas, 1984; Marieskind, 1989; Taffel et al., 1987). Repeat cesarean sections account for approximately 30 percent of the total number of cesarean sections in most settings. A trial of labour leading to a possibility of vaginal birth (VBAC) is recommended in most cases where the woman has had a previous cesarean delivery (American College of Obstetrics and Gynaecologists, 1988) but many women and/or their care providers opt for an elective repeat cesarean delivery (Kirk et al., 1990; Placek et al., 1988).

Investigators have found that private patients (Haynes de Regt et al,. 1988; Blumenthal et al., 1984), women with private hospital insurance (Stafford, 1990), and women giving birth in proprietary or nonteaching hospitals (Stafford, 1991) were more likely to undergo a repeat cesarean delivery than a VBAC, and that the likelihood of VBAC decreased with age.

1.4.4 Maternal height, weight and infant birth weight

Maternal height and weight and infant birth weight are known to be associated with both the likelihood of a cesarean delivery (Placek, 1983) as well as with socioeconomic indicators (Institute of Medicine, 1985). Infants of low birth weight (less than 2500 grams) as well as infants of higher than average birth weight (over 4000 grams, for example) are more likely to be delivered by cesarean (Placek, 1983; Turner et al., 1990).

Women of shorter stature are known to have slower labour progress and higher rates of cesarean delivery independently of factors such as maternal pre-pregnancy weight, weight gain, or birth weight of the baby (Parsons et al., 1989; Scott et al., 1989; Seitchik et al., 1987). This association has been reported in investigations conducted in developing countries as well (Roosmalen and Brand, 1992; Sokal et al., 1991; Tsu, 1992).

Both obesity and excessive weight gain during pregnancy have been found to increase the risks of cesarean delivery (Ekblad and Grenman, 1992; Johnson et al., 1992). It has

been found, however, that the increased risk of cesarean delivery among obese women was due to conditions more common among these women, such as diabetes and severe pregnancy-induced hypertension (Perlow et al., 1992). Increased risks of cesarean delivery with excessive weight gain have been found to be independent of infant birth weight (Parker and Adams, 1992).

The association of maternal height and infant birth weight with socioeconomic indicators is somewhat paradoxical. Women in upper social strata are known to be taller than those in lower social strata (Peck and Vagero, 1987; Walker et al., 1988), which would lead to an expectation of a lower rate of cesarean delivery of these women. However, there are also direct relationships between birth weight and cesarean delivery and between birth weight and social class (Alberman, 1991) which would lead to the opposite expectation, that women of upper social strata would have higher rates of cesarean delivery because of their tendency to have heavier babies.

1.4.5 Exploration of additional potential confounders

While some biological risk factors have been discussed above (maternal height and infant birth weight, for example), there are many distinct indications for cesarean delivery, and several are known to be or could be associated with indicators of socioeconomic status. These include certain maternal disease processes where vaginal delivery may increase risks to the fetus, such as genital herpes

(Catalano et al., 1991), or abnormalities of a particular gestation that preclude vaginal delivery, such as abnormal placentation (Mabie, 1992) or some presentations of the fetus (Seeds and Cefalo, 1982). Most of these indications are rare and investigation of them individually would be quite difficult because of the large number of women who would have to be included in the investigation.

However, the most common indication for a first cesarean delivery is "dystocia," an abnormality related to inefficient uterine contractions, or to a condition known as "fetopelvic" disproportion where the fetus is unable to pass safely through the birth canal because the fetus is either "too big" or the mother's pelvis is "too small."

1.4.5.1 Childhood environment

It has been suggested, but apparently never investigated, that factors that retard skeletal growth during childhood or adolescence may result in a greater likelihood of dystocia (Harrison, 1990). That is, "environmental" factors such as sub-optimal nutrition may prevent the achievement of an individual's "genetic" growth potential, including the achievement of the full growth potential of the bones that form the birth canal.

There is evidence that this may be the case. Childhood environment affects adult height even when parental height and birth weight have been controlled (Kuh and Wadsworth, 1989). Nutrition is known to influence growth (Keller and Fillmore, 1983). The World Health

Organization (1987) estimated that 39 percent of the world's children suffer from chronic malnutrition, a problem that exists in both rich and poor countries. While some investigators have found that chronically malnourished children experience rapid "catch-up" growth under conditions of improved nutrition (Schumacher et al., 1987), others have found that malnourished children never completely recover in height, and the degree to which they do so depends on the extent of the early malnutrition and the age at which it occurred (Keller and Fillmore, 1983).

Children who have likely been exposed to difficult situations appear to be at high risk of nutritionally related growth retardation. Studies from the U.S. West Coast, for example, have reported that a high proportion of refugee and other immigrant children meet the definition of growth "stunted," an indication of chronic malnutrition (Peck et al., 1981; Schumacher et al., 1987). A study of the health profile of applicants for refugee status in Quebec showed that approximately 10 percent of the children under 15 years of age were growth stunted (Thonneau et al., 1990).

Childhood poverty is known to be related to other untoward outcomes of pregnancy (Alberman, 1991; Baird, 1977) as well as other diseases in adulthood such as ischemic heart disease (Barker and Osmond, 1986). Childhood poverty may not be detectable when socioeconomic status is measured in adulthood.

1.4.5.2 Oral contraceptive use in adolescence

While not previously explored, another possible determinant of less than adequate growth is oral contraceptive use during adolescence. In 1971, the World Health Organization issued a list of potential contraindications to the use of oral contraceptives, the last of which was, "(t)he effects of such (contraceptive) medication on adolescents whose growth has not ceased are still unknown. This should be borne in mind when prescribing oral contraceptives for adolescent girls (World Health Organization, 1971)." A medline search of the medical literature between 1966 and 1991 revealed no studies of the potential effect of oral contraceptives on skeletal growth during adolescence.

It is known that estrogen affects growth. Since the 1940s, synthetic estrogens have been administered to adolescent girls who were predicted to become excessively tall (Crawford, 1978). Concerns that the amount of synthetic estrogen contained in oral contraceptives could have this effect were dismissed, partly because the usual dose of estrogen used to suppress growth, said to be 500 mcg/day of ethinyl estradiol, is at least ten times higher than the amount of estrogen in most oral contraceptives and partly because growth in stature is nearly completed at the time of menarche (Hofmann, 1984). However, doses as low as 20 mcg/day (lower than the dose in most oral contraceptives) are reported to have achieved height inhibition in tall

girls (Conte and Grumbach, 1978).

Estrogens are known to inhibit skeletal growth through suppressed production of somatomedin, as well as through epiphyseal closure of the long bones (Phillips and Vassilopoulou-Selin, 1980). Affects on skeletal growth may, therefore, be manifested in ways other than reduced stature. Moerman (1982) showed that in adolescent girls, the rate of statural growth decelerates rapidly following menarche and is nearly completed within two years. However, between 12 and 18 percent of growth of the pelvic bones which form the birth canal remained at menarche, with growth of the diameter of the ischial spines being the slowest. Therefore, while the risks of retarded statural growth may be slight for girls beginning oral contraceptive use shortly after menarche, the period of risk of retarded pelvic growth continues for a longer time.

1.5 Gaps in the work to date and purpose of the current investigation

Nearly all of the previous investigations of the association between indicators of socioeconomic status and cesarean delivery have been conducted in settings where access to various components of obstetrical care has been determined by a woman's ability or willingness to pay for care directly or to purchase more comprehensive health insurance. Where previous investigations have shown a greater likelihood of cesarean delivery among women who had private care or were of higher socioeconomic status, a

common conclusion has been that this was due to factors other than a greater necessity of cesarean delivery among these women.

Several risk factors for cesarean delivery are known to confound this association and where some of these have been controlled, the magnitude of the association has been reduced. A problem with some earlier investigations is that only aggregate data sources have been available, such as birth registry data, or hospital discharge abstracts. These sources have not contained sufficient or, in some cases, reliable information about potentially confounding variables. In particular, investigators have often not been able to reliably determine the occurrence of a previous cesarean delivery using aggregate data sources. This is an important consideration in studies of the association between socioeconomic indicators and cesarean delivery because women who have had a previous cesarean delivery are at much higher risk of a cesarean delivery in subsequent pregnancies, or may prefer to have one. These women may be more likely to purchase more expensive health insurance in anticipation of a future pregnancy, or may be more willing to pay for private care for greater assurance that they can have the type of delivery that they prefer.

Another limitation of using large aggregate data bases to study this association is that these have not provided an opportunity for closer examination of the association between directly measured indicators of socioeconomic status

and cesarean delivery as well as consideration of underlying biological risk factors associated with both socioeconomic status and difficulties during labour leading to the necessity of cesarean delivery. Of interest is preliminary exploration of the hypothesis that a lower socioeconomic level during a woman's formative years may have led to an increased likelihood of poor nutrition or other factors that may have inhibited the attainment of her full genetic growth potential. Such factors have not previously been investigated.

This study was designed to examine the association between cesarean delivery and directly measured indicators of socioeconomic status in a well-defined population of manageable size where all obstetrical services were equally available to all without direct cost and where women who were at higher risk of cesarean delivery were not likely to go elsewhere for their care.

CHAPTER 2.0

STUDY OBJECTIVES

2.1 Primary study objectives

Objective 1: To determine whether cesarean delivery is associated with indicators of socioeconomic status among women with no previous cesarean delivery, and adjustment of maternal age and parity.

Objective 2: To determine whether cesarean delivery is associated with socioeconomic status among women who have no previous cesarean deliveries and no absolute indications[3] for cesarean delivery.

Objective 3: To explore whether other factors such as labour management options or "biological" risks affect the association between cesarean delivery and socioeconomic status among a subgroup of women with no previous cesarean delivery, singleton fetuses in a vertex presentation, who are at 37 weeks or more gestation, and who have no absolute indications for a cesarean delivery.

2.2 Secondary objectives

Objective 4: To explore whether the decision to undertake a trial of labour or to elect a repeat cesarean delivery is related to socioeconomic status for women who have had one

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[3] Absolute indications include: triplets or higher order multiple births, transverse lie, placenta previa, obvious skeletal abnormalities, premature breech presentations, prolapsed cord, and severe fetal distress.

or more previous cesarean deliveries and no absolute indications for repeat cesarean delivery.

Objective 5: To explore the association of cesarean delivery and factors that could be related to an inhibition of the achievement of a woman's full growth potential during her childhood or adolescence.

CHAPTER 3.0

METHODS

3.1 Overview of the Methods

The primary objective of this study was to examine the association between indicators of socioeconomic status and cesarean delivery in a setting where the same obstetrical services were available to all women independent of the ability to pay or the type of health insurance they may have possessed. A variation of a retrospective cohort approach was used. To control for access to care, eligibility was restricted to women who resided in London, Ontario, or one of the immediately adjacent communities, who had recently delivered a baby in one of the two London hospitals that provided obstetrical services. In addition, only women 16 years of age and older were invited to participate. Eligible women were asked to complete a questionnaire prior to discharge from hospital. The main purpose of the questionnaire was to solicit information not available on hospital records that would allow classification by socioeconomic strata according to several commonly employed indicators of this concept. Information about consenting participants' labour and delivery was abstracted from their hospital charts. The design, therefore, incorporated elements of a census survey to obtain information on socioeconomic status in addition to the retrospective cohort approach of gathering information retrospectively from hospital records.

Included in this chapter are detailed descriptions of the study methods (section 3.2), the process of data collection (section 3.3), the selection and measurement of study variables (section 3.4), and procedures for the management and analysis of the information collected (section 3.5).

3.2 General Methods

3.2.1 Definition of the study population and description of setting

London, Ontario has a population of approximately 340,000 with approximately 5,000 births per year. Although a few home births occur, and a presumably small number of London residents deliver at facilities outside of London,[4] the majority of births to London residents occur at either Victoria Hospital or St. Joseph's Health Centre. Both facilities have a full range of obstetrical services (eg. obstetrical surgeons, anaesthesia, blood bank) available on a 24-hour basis, are centrally located within the city of London, and can normally be reached in less than 30 minutes from any part of the city. St. Joseph's Health Centre is the obstetrical tertiary care centre for Southwestern Ontario and houses the regional neonatal intensive care unit. The program serves the 34 regional hospitals. Women whose infants are identified antenatally to be at high risk

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[4] In 1987, thirty-one residents of London gave birth in hospitals outside of London and 16 residents of London gave birth outside of hospital (personal communication, Dr. MK Campbell, data obtained from the Provincial Perinatal Information System (Ontario Ministry of Health, 1987)).

of an adverse outcome are transported from these facilities to St. Joseph's Health Centre prior to delivery. Prenatal care in Canada is known to be related to socioeconomic status, with women in lower social strata or of lower levels of education less likely to access prenatal services (Dunkley and Stewart, 1984). Therefore, out-of-town residents who are transferred or referred to London for delivery could be at higher risk of cesarean delivery as well as being of upper socioeconomic status. To avoid this potential source of bias, only women who resided in London or in the immediately adjacent communities were considered eligible to participate.[5]

The Province of Ontario has a system of universal medical insurance. This means that during the study period, choice of physician, hospital facility, and services accessed within the facility during the intrapartum period were not influenced by different types of insurance coverage or the ability to pay.[6] Whether delivery occurred at Victoria Hospital or St. Joseph's Health Centre was determined by the hospital at which the prenatal care provider had privileges. However, a woman could choose the

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[5]Women who resided in the following communities adjacent to London were considered eligible to participate: Birr, Ilderton, Melrose, Lobo, Hyde Park, Komoka, Mount Brydges, Delaware, Lambeth, Scottsville, Glanworth, Nilestown, Dorchester, Thorndale, Bryanston, Ballymote, Crumlin, Arva.

[6] Private or semi-private accommodation after delivery, however, is available at an extra charge to the patient or to those with additional hospital insurance that specifically covers this type of accommodation.

hospital where she delivered by having selected a care provider with privileges at that hospital. The populations served by each hospital may differ according to socioeconomic status because of the proximity to the woman's home of either the facility or the care provider's office. It was important, therefore, to include London and area residents who delivered at both hospitals.

Summary, Inclusion/exclusion criteria

A. Inclusion criteria

1. All residents 16 years of age or older of the city of London and surrounding communities giving birth to infants weighing 500 grams or more, at St. Joseph's Health Centre or Victoria Hospital.

2. Women who delivered precipitously and unintentionally outside of hospital, for example in the emergency receiving department of another hospital or at home, but who were admitted to either of the two London postpartum units following delivery were considered eligible to participate.

B. Exclusion criteria

1. Antenatal transfers from hospitals outside London.

2. Residents of London who delivered outside London.

3.2.2 Sample size required to address study hypotheses

The formula for the sample size calculation can be found in Appendix A. Calculations of the sample sizes needed to address the primary study objectives required an

estimate of the proportion of the population belonging to the "upper" social stratum, the reference group, and an estimate of the cesarean delivery rate in the subgroup of interest. According to a Canadian social stratification system by occupation (Pineo et al., 1977), approximately 30 percent of London's employed population (29.7% of males and 31.2% of females) could be classified as "upper white collar,"[7] using occupational data from the 1986 census. This is consistent with a reported 35.8 percent having post-secondary qualifications, and 32.7 percent of households earning above the mean household income for London (Statistics Canada, 1986). Therefore, it was assumed for the purposes of the sample size estimates that approximately 30 percent of the study population belonged to the upper socioeconomic stratum.

The total cesarean section rate at Victoria Hospital in 1990 was 13.6 percent. The breakdown by primary versus repeat cesarean delivery was unavailable, however (personal communication, Dr. J. Silcox). At St. Joseph's Health Centre the rate of primary cesarean delivery in the year preceding the data collection period was 12.4 percent, while the rate excluding women who were delivered for an absolute indication prior to the initiation of labour was 10.3 percent. The rate of elective cesarean deliveries in women

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[7]Occupational prestige groupings of the census occupational codes included in this categorization are: managerial and administrative; natural science, engineering, and mathematics; teaching and related; medicine and health; technological, social, artistic, and religious.

with one or more previous cesarean deliveries was 37.4 percent. The primary cesarean section rate restricted to residents of London and the immediately adjacent communities was not available so the total primary cesarean rate for St. Joseph's Health Centre was used.

Using these estimates, (12.4 percent cesarean section rate and 30 percent upper socioeconomic status), and the sample size formula of Appendix A, it was determined that in order to detect a relative risk of 1.5 or greater in objective one, approximately 1690 participants would be required to meet objective one. Primary objective two, however, specified that data analyses would be limited to the subset of women without an absolute indication for cesarean delivery. In 1990, approximately 87.5 percent of all deliveries were to women who did not have an absolute indication for a primary cesarean section nor a previous cesarean delivery. Substituting a rate of 10 percent of cesarean delivery in this group into the sample size equation resulted in a requirement of 2164 participants overall to have a sufficient number of women to meet objective two. Inflating this estimate by 10 percent to allow for missing values resulted in a required sample size of 2,380.

3.3 Data Collection

3.3.1 Method of data collection: selection and description

The chiefs of obstetrics and gynaecology and the nursing supervisors at both hospitals were consulted before selecting a method of asking obstetric patients to complete questionnaires. The strategy of surveying women during the hospital postpartum period had been recently employed by a team of Ottawa researchers to study sociodemographic, lifestyle risk factors, and prenatal health service utilization during pregnancy (Stewart et al., 1989). These researchers reported a high level of acceptance of this method; over 80 percent of the women approached completed the questionnaire before being discharged from hospital.

The strategy of asking women to complete a questionnaire before discharge from the postpartum unit was acceptable to the chiefs of obstetrics and gynaecology and the nursing supervisors of these units. The study materials were delivered to patients by a member of the nursing staff or the unit ward clerk when the woman was oriented to the postpartum unit after the delivery of her baby. Study materials included: a letter of information and a consent form (Appendix B), the study questionnaire (Appendix C), and an envelope with the study title and university address of the investigator. The letter instructed patients that the investigator or an assistant would be by in a day or two to pick up the questionnaire, and that if she did not wish to be approached she could inform the nursing station to insure

that no one would visit her room. The nursing supervisors at the two hospitals each requested that a slightly different method be used by patients to inform the nursing station that they did not wish to be approached. Therefore, the instructions to patients contained in the letters distributed at each hospital differ somewhat (Appendix B, letters 1 and 2).

To avoid disturbing patients who had decided to give their babies up for adoption, it was decided that these women would not be approached in person. They would, however, be invited to participate by letter (Appendix B, letter 3) if the nursing staff believed that it would not be too upsetting. This letter directed women to return the questionnaire to the nurse if they wished to participate.

It was also decided that women who had experienced a perinatal loss would be invited to participate using the same approach as that used for mothers who had decided to give their babies up for adoption. Early in the course of the study the investigator learned that several members of the nursing staff did not wish to deliver even a modified version of the study materials to women who had experienced a loss. It was agreed that these women would not be invited to participate.

3.3.2 Approval to conduct the study

Prior to conducting the pilot phase of the study, approval was sought from and granted by the University of Western Ontario (U.W.O.) Review Board for Health Sciences

Research Involving Human Subjects, the Research and Records Committee of the Department of Family Medicine, and the chiefs of obstetrics and gynaecology and the nursing supervisors at both hospitals.

The full study proposal was presented to and approved by an examining committee within the Department of Epidemiology and Biostatistics. Approval to conduct the full study was granted by the U.W.O. Review Board for Health Sciences Research Involving Human Subjects and the Research and Records Committee of the Department of Family Medicine. Approval from the clinical research and nursing research committees at both hospitals to conduct the full study was sought and was granted. In addition, approval of the Medical Records Committees of both hospitals was obtained prior to accessing medical records to abstract the required information.

3.3.3 Pilot phase

Orientation meetings were conducted with the nursing staffs at each hospital to ensure their familiarity with the study. The purposes of the one week pilot phase were: to determine whether the method selected of distributing the questionnaires and approaching patients would be acceptable to the nursing staff and patients; to determine whether it would be possible for the investigator to travel to both hospitals daily, contact eligible patients, and collect the completed questionnaires; and to determine an approximate response rate that could be expected.

It was found that the time required to conduct the data collection did not exceed four hours per day. The response rate over this one week period among eligible women was 71.1 percent and the method was found to be acceptable to the staff of the postpartum units.

It was also found during the pilot phase the response rate was higher in the hospital where the investigator had explained the study directly to a greater proportion of the nursing staff.

3.3.4 In-service sessions

Before beginning the full study, a sufficient number of in-service sessions to explain the study were conducted by the investigator at different times of the day and evening to insure that over 90 percent of the nurses would be able to attend. At these sessions the investigator explained the rationale for and purpose of the study. The way that questionnaires were to be distributed was explained, as was the letter instructing the patients to inform the nurse or nursing station if they did not wish to be approached by the investigator. The nurses were instructed that if they believed that their patient should not be approached at all or at any specific time, they were to inform the investigator or her assistant. The nursing staffs of each unit determined the specific manner in which this was to be done with due regard to the staffing and routines of the particular unit.

3.3.5 Assistants for data collection and data entry

To ensure an acceptable response rate, it was found that each hospital had to be visited twice each day. While the investigator was able to make two visits to each hospital most days, assistance was required. Two women were hired on a casual part-time basis to assist with the patient contact and the collection of completed questionnaires. They worked on average less than ten hours per week each. This additional help insured that both hospitals could usually be visited early in the day and again in the afternoon or evening, resulting in an improved response rate over that obtained during the pilot phase. One of the assistants was a registered nurse who worked part-time in the delivery room of one of the hospitals and the other was a part-time ward clerk on the postpartum unit of one of the hospitals. The latter person also assisted with the data entry. A third research assistant was hired to assist with the data entry upon completion of data collection.

3.3.6 Distribution and collection of patient questionnaires

Each morning with the exception of Christmas day, the investigator or one of her assistants visited the postpartum units at each hospital. Daily logs were made of the deliveries that had occurred in each hospital the preceding day using information from the ward clerk on each postpartum unit. Permission to access this information was given by the UWO Review Board for Health Sciences Research Involving Human Subjects and the heads of the Obstetrics and

Gynaecology Departments of the two facilities. The daily log was necessary because of the large number of women being surveyed. Patients were identified in the log by room and bed number rather than by name.

In the daily log the investigator and her assistants made note of the room and bed numbers of women who indicated to the nursing staff that they did not wish to be approached and women whom the nursing staff believed should not be approached. The daily log was also used to keep track of women who had already completed questionnaires or who had told the investigator or one of her assistants directly that they did not wish to participate. The log served to communicate this information between the investigators and the assistants.

To identify women who were not eligible to participate because they were from out of town or less than 16 years of age, mother's date of birth and city or town of residence were recorded in this log. Mode of delivery (vaginal or cesarean) was also recorded because women who had had a cesarean delivery were not to be approached until the third or fourth postpartum day. Birth weight, parity and postal code were also recorded using information available from the same source.

Each day after completing the log, a check was made to determine whether any patients had requested that they not be approached or if any of the nurses had requested that any of the patients in their care not be approached. These

patients were identified by room and bed number and noted in the log. Log entries of patients who had left a completed questionnaire at the nursing station were identified by date of birth (question #8 on the questionnaire) and were checked off. If women were breast feeding, sleeping, had a "do not disturb" sign on their door, or were not in their rooms, they were approached at the next visit.

Women being approached for the first time were shown a packet like those delivered by the nurses or ward clerks, and asked if they had completed the questionnaire. If the questionnaire was then returned, the log entry was checked off. If the patient had not yet completed the questionnaire, the investigator or her assistant said that someone would return later or the next day. Log entries of women who indicated to the investigator at this time that they did not wish to participate were marked as refusals, and entries for women who had been discharged but who had not left a questionnaire or refusal slip at the nursing station were also checked off.

Every two or three days, the investigator or her assistant checked with the ward clerks of the gynaecology units where women who had experienced a perinatal loss or had given their infants up for adoption may have been admitted. Daily logs were updated to include these patients and any questionnaires that had been returned by these patients were collected.

Daily logs were kept on separate clip boards for each

hospital until all of that day's entries had been checked off as either: questionnaire completed; discharged without completing a questionnaire; identified by a nurse or ward clerk as someone not to be approached; or refused to complete a questionnaire. When all of the entries had been checked off, that day's log was removed from the clip board and filed by the investigator in a locked drawer with all previous daily logs.

3.3.7 Abstraction of information from patient charts

After a completed questionnaire was returned and if time permitted, information from consenting patients' charts was abstracted by the investigator on the unit (Appendix C, chart abstraction form). Otherwise the patient chart number was recorded and chart information for these patients was abstracted in the medical records departments by the investigator at a later date.

3.3.8 Procedures to protect confidentiality

The patient's room and bed number and the current date were recorded on the envelopes of completed questionnaires as they were collected. If a completed questionnaire was left at the nursing station the date of birth from the questionnaire was used to identify the corresponding daily log entry so that the entry could be checked off. Completed questionnaires and chart abstraction forms were initially kept in a locked drawer in an office assigned to the investigator in one of the hospitals along with the daily logs as they were completed. Study numbers were then

assigned, usually within a day, and the consent forms were separated from the questionnaires and chart abstraction forms and kept in a locked filing cabinet in this location. Questionnaires and chart abstraction forms were taken to another office assigned to the investigator at a different geographic location and filed in a locked cabinet sequentially by study number. If the chart information was abstracted in the medical records department, these were identified by study number and then filed with the corresponding questionnaire.

3.3.9 Ending data collection

A running total of daily births, eligible participants, and participants was kept by the investigator. On the day the sample size of 2380 was reached, the investigator informed the nursing staff and ward clerks to stop distributing questionnaires. The investigator returned each day thereafter until all of the women eligible to participate who had delivered babies on the day the 2380th questionnaire had been returned had either returned a questionnaire, left the hospital, or had refused.

Based on the response rate of 71.1 percent achieved in the pilot phase, it was anticipated that approximately 35 weeks would be required to complete the data collection. The overall response rate achieved during the course of the study, however, was 78.5 percent and only 30 weeks were required to collect the required number of completed questionnaires.

3.3.10 Assessment of completeness of the daily logs

3.3.10.1 Perinatal losses

Women who had experienced a perinatal loss may not have been admitted to hospital or may have been admitted to hospital units other than a postpartum or gynaecology unit. Therefore, following the data collection period, approval was sought and was granted by the chiefs of obstetrics at both hospitals and the U.W.O. Review Board for Health Sciences Research Involving Human Subjects to obtain lists of patients delivering during the study period whose infants were either stillborn or had expired in hospital. These lists were obtained from the medical records departments of both hospitals. The mother's date of birth and the date of the infant's delivery from these lists were checked against the log of deliveries kept by the investigator. Eighteen women eligible to participate had experienced perinatal losses. In nine cases, the fetus was not alive at the time of admission to hospital. None of these nine cases had been included in the log made by the investigator. An additional nine women eligible to participate had experienced perinatal losses, including three participants who had delivered infants that had expired in hospital less than 7 days after birth. Of the remaining six, two were found to have been unknown to the investigator and had not been included in the log made during the course of the data collection. These two deliveries were added to the database at the time of data entry and are included in the total number of eligible

patients.

3.3.10.2 Additional check of log completeness

At one of the two hospitals, ward clerks kept the lists of admissions to the units for the preceding several months, while at the other hospital ward clerks had recorded information only for patients currently on the units. At this hospital, when the daily census was low, one of the three postpartum units might be closed and the patients on this unit transferred to one of the other two units or discharged. If this occurred prior to the arrival of the investigator, patients delivering the previous day might not appear on the ward clerk's daily record in the unit to which they had been transferred. If these patients did not subsequently return questionnaires, they might have remained unknown to the investigator. Therefore, following the data collection period, permission was sought and was granted to compare daily log entries to the delivery room records for the study period at this hospital. It was found that 36 patients (0.87% of the total number of women giving birth) of whom 28 (0.92%) were eligible to participate had not been included in the daily log. One of these patients had been discharged from the delivery room and had not been admitted to a postpartum unit. Birth weight, date of mother's birth, parity, postal code and mode of delivery for these deliveries were recorded from the delivery room records and were included in the database.

3.4 Selection and Measurement of Independent Variables

3.4.1 Measurement of socioeconomic status

The main independent variable in this study is socioeconomic status. Because there is no "best" measure of socioeconomic status, several indicators were collected that have been used to measure this concept in previous epidemiologic studies or studies of obstetric outcomes (Abramson et al., 1982; Libertos et al., 1988). These were: the participant's occupation and level of completed education, her "spouse's" occupation and level of completed education if she was married or cohabitating, household income, and median income of the postal code of the mother's area of residence. The type of accommodation requested at admission to hospital was also collected as an additional potential indicator of socioeconomic status. Determination and measurement of each of these indicators is described below.

3.4.1.1 Occupation

Because a population of child-bearing women would likely include many participants who were not in the workforce, it was decided that a traditional measure of socioeconomic status would be constructed, that is, the occupation of the head of the household (Mueller and Parcell, 1981).

The occupation used as the basis of this measure was the occupation of the woman's partner or husband, her own if she was single, or her father's if she was a dependent living with her parents. The occupation-based scale of

socioeconomic status selected was that developed for Canadian researchers by Blishen et al (1987).

Conversion of occupations to Blishen scores required that the investigator assign a four digit occupational code to each of the occupations using the Canadian Classification Dictionary of Occupations (CCDO). Directions are given in the directory to help locate specific occupations and occupational titles (Ministry of Supply and Services Canada, 1987). This process and further information about the Blishen Index are described in Appendix D.

3.4.1.2 Education

Participants were asked to indicated the highest level of education that they and their partner (if applicable) had completed. Choices were: university degree, diploma or certificate from another post-secondary course or institution, secondary (high) school graduation, some secondary (high) school, elementary school, or no schooling.

3.4.1.3 Income

Participants were also asked to indicate an estimate of their total household income in 1991 before income taxes. They were given eight categories of household income from which to choose that ranged from less than $15,000 to $85,000 and over. However, it had been found in previous studies that requesting information about income for research purposes was often resisted, sometimes so vehemently that potential participants refused to supply further information or chose to withdraw from the study.

Although both the letter of information and the questionnaire included statements saying that participants were free not to respond to any or all of the questions, the first of the choices supplied for the question of household income was "prefer not to answer." It was hoped that this would allow those participants who felt strongly about not revealing their income to indicate this in an acceptable manner and, therefore, not withdraw from further participation because this question had been asked. Results of this strategy are reported in the next chapter.

3.4.1.4 Median income of postal code of residence

Postal code of residence at the time of delivery was available for all participants and non-participants from the patient's hospital chart or from the daily log kept during the data collection period. Participants were classified as living in areas of London where the median household income was "high," "middle," or "low." This was done using information from Statistics Canada that gives median household incomes for areas of London as designated by the first three digits of this code and ranking by median income into these three categories (Statistics Canada, 1991).

3.4.1.5 Type of accommodation requested at admission

All residents of London are covered by the Ontario Health Insurance Plan (OHIP) which paid all hospital and physician services that would be required for both the participant and her child. The plan covers the cost of ward accommodation only, which usually means a room with four

beds. However, additional insurance may be purchased by individuals or their employers to cover the extra cost of either semi-private (a room with two beds) or private accommodation (a room with one bed). Therefore, this type of accommodation would be most likely to be requested by those with additional insurance (possibly as an employment benefit), or by those women who would be able to afford to pay the extra cost personally.

Type of accommodation requested at the time of admission was available on each admitted patient's hospital chart. This did not always correspond to the type of accommodation to which each patient was assigned, which may have depended more on availability or on special circumstances that require that a patient be assigned private accommodation although he/she has no insurance coverage for the extra cost. However, it was the accommodation requested that indicated the type of coverage for which the patient has accepted financial responsibility at the time of admission and which may, therefore, serve as an easily obtained and potentially useful indicator of socioeconomic status.

3.4.2 Reliability of reporting of socioeconomic status

Reliability of reporting of occupation, education and income has been found in previous investigations to be quite high. Test-retest reliability for occupation at a given point in time has been found to be excellent even if reporting times are several years apart (Mueller and Parcel,

1981). Education and income have also been found to have high test-retest reliability, although reliability has been reported to be somewhat higher for education than for income (Libertos et al, 1988). In a feasibility study of women surveyed during their post-partum stay in Ottawa hospitals, the test-retest reliability for all questions including those requesting information about education, income, and occupation was reported to have been over 0.90. (Stewart and Dunkley, 1985).

3.4.3 Selection and measurement of other covariates

3.4.3.1 Indicators of childhood socioeconomic status

The primary measure of childhood socioeconomic status was the educational level of the participant's father. If this was not reported by the participant, but her mother's was, then the mother's educational level was used. In a study in which childhood socioeconomic status was measured for participants from varied cultural backgrounds where many changes in living conditions may have occurred, socioeconomic status as indicated by educational achievement has been preferred as it is generally stable over time (Zurayk et al., 1987).

Another indicator of childhood environment which has been found to be predictive of adult stature, independent of the genetic influence of parental stature, is family size (Kuh and Wadsworth, 1989). Participants were asked to indicate the number of children living in their homes when they were 12 years old as well as to indicate their birth

order (questions 20 and 21 of the questionnaire, Appendix C). These questions were asked in order to explore the association of environmental (as distinct from genetic) determinants of adult stature with cesarean delivery.

While measurement of childhood socioeconomic status is one potential method to assess factors in the childhood environment that could inhibit growth, another selected indicator is the GNP of the mother's country of origin. It is believed that lack of food availability is likely the reason for poor growth in some developing countries (Keller and Fillmore, 1983), and it is possible that a very low GNP of the country may reflect problems with availability of food. Countries of origin have been grouped, therefore, according to GNP rather than region.

3.4.3.2 Other variables collected as candidates for inclusion as covariates in data analyses

Some variables that were collected, such as maternal age and parity, were known to be related to both socioeconomic status and cesarean delivery. These have been discussed in detail in chapter one. Other covariates were collected that were known to be associated with socioeconomic status but whether these had an independent association with cesarean delivery was unknown. These were the amount of prenatal care (Dunkley and Stewart, 1984; Gortmaker, 1979) and previous perinatal loss (Silins et al., 1985). Table 3.1 displays collected covariates grouped according to whether they were known or suspected to be

Table 3.1

List of Covariates

1. Covariates known or suspected to be associated with both SES and cesarean delivery

Maternal Age	Height Difference-between the mother and the baby's father*
Parity	
Birth Weight	Pre-pregnancy Weight
Gestational Age	Weight Gain during Pregnancy
Obstetric History (Previous loss)	Amount of Prenatal Care

2. Components of intrapartum management or factors potentially affecting intrapartum management decisions

Cervical Dilatation at Admission	Epidural Anaesthesia
	Labour Induction
Fetal Distress During Labour	Labour Stimulation
Maternal Distress During Labour	Day of the Week
	Presence of a Labour
Time of Day	Companion
Presentation/Position of the Fetus	Multiple Gestation (Twins or Triplets)
	Electronic Fetal Monitoring

3. Possible proxy indicators of growth inhibition

Oral Contraceptive Use during Adolescence*	Number of Children in Family of Origin*
GNP of the Country of Origin*	Birth Order*
Childhood Socioeconomic Status*	

*Hypothesized association with cesarean delivery

associated with both socioeconomic status and cesarean delivery; whether they were components of intrapartum[8] management or were factors likely to affect intrapartum management decisions; and covariates hypothesized to be associated with cesarean delivery because of their potential association with skeletal growth.

3.5 Management and Analyses of Data

3.5.1 Data management, General

Information from the daily logs for participants, non-participants, and ineligible patients was entered into a database by a research assistant using the ENTER, CHECK, and EPED programs in Epi Info, Version 5 (Dean et al., 1990). Data accuracy was verified by the research assistant and the investigator. A second database was set up also using the Epi Info programs to enter information from the patient questionnaires and the chart abstraction forms. Information from the patient questionnaire was entered and verified by the same person who entered the log information. This was later checked for accuracy again by the investigator. All chart information was entered and verified by the investigator.

3.5.1.1 Entry of Blishen-scaled occupation codes

Occupational codes and their corresponding Blishen scores were entered into the Epi Info Check program so that Blishen codes would be entered automatically for each case into the database at the time of data entry. This facility

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[8] During the course of labour.

of the Epi Info program prevents occupational codes that had not been entered previously into the Check program from being entered into the database thus precluding data entry errors. The original CCDO codes were, therefore, also available in the database along with the assigned Blishen code.

3.5.2 Data analysis, General

Preliminary inspection of the data and categorization of covariates was performed within the Epi Info *Analysis* and Eped programs. The participant's identification number, the dichotomous dependent variable (cesarean versus vaginal delivery), and covariates that were candidates for entry into logistic regression models were written to a file external to the Epi Info program and converted to an SPSS system file using the Epi Info *Convert* program and SPSS/PC+, Version 5.0 (Norusis/SPSS Inc., 1992). Logistic regression modelling procedures of SPSS/PC+ were used to obtain the unadjusted odds of cesarean delivery for individual categories of the socioeconomic measures and the covariates, as well as to obtain the adjusted odds ratios of cesarean delivery controlling for covariates. If continuous independent variables were not expected to have a linear association with the logit, they were stratified into two or more levels and treated as categorical (see section 4.5.6.3). If categorical covariates had more than two levels, they were treated as design variables in the logistic regression models with all other levels of the covariate compared to a

reference category. A special subcommand of the SPSS/PC+ Logistic Regression program allowed the creation of design variables and the designation of any level of the covariate as the reference category.

To test for interactions of covariates with socioeconomic indicators, models were compared with and without the interaction term. The presence of statistically significant interaction was detected by means of the results of likelihood ratio tests of these models (Hosmer and Lemeshow, 1989).

Additional programs used for the data analyses within SPSS/PC+, Version 5.0, were the RANK procedure to calculate the Spearman rank correlation coefficients (Table 4.5), and the CROSSTABS procedure to calculate Pearson's chi square statistic or Fisher's exact test for bivariate analyses of categorical data.

CHAPTER 4.0

RESULTS

4.1 Study Participation

During the period beginning at 00:01 a.m., December 12, 1991, and ending at 24:00 p.m., July 10, 1992, 4144 women gave birth at St. Joseph's Health Centre and Victoria Hospital in London, Ontario. Table 4.1 shows that 1100 of the women who gave birth during this period were not eligible to participate in the study because they were out-of-town residents or were less than 16 years of age. Nine women who were otherwise eligible to participate were excluded because the fetus they were carrying was not alive when the mother was admitted to hospital. In this situation every effort is made to deliver the fetus vaginally and only in extremely rare circumstances would a cesarean delivery be performed. Labour was induced in all nine of these women and they went on to deliver vaginally.

There were 3035 women eligible to participate in the study. Nurses judged that fifteen women should not be approached to participate in the study. An additional thirty-nine women could not be invited to participate because they did not speak English and no one was available to act as a translator. Other non-participants were 274 women who refused participation either by informing the nurse or the ward clerk that they did not wish to be disturbed, or by telling the researcher or her assistant that they did not wish to participate. An additional 324

Table 4.1

Participation Rates

Total Number of Women Giving Birth, London hospitals, > 500 grams (December 12, 1991 - July 10, 1992)	4144*	
Exclusions: not resident of London or adjacent communities (1095), less than 16 years of age (5), fetal heart rate absent on admission (9)	1109	
Eligible to Participate	3035	(100.0%)
Not approached: nurse requested no contact (15), language barrier with no translation available (39)	54	(1.8%)
Refused or did not return questionnaire	598	(19.7%)
Participants	2383	(78.5%)

*2 births excluded from total - induced prior to term for congenital anomalies incompatible with life

women did not return the questionnaire, either prior to leaving the hospital or at a later date by mail. An envelope with a return address was distributed with the questionnaire and 13 participants (0.05%) chose to return the questionnaire by mail or by hand to the investigator's campus address after leaving the hospital.

Fifty-one of the 2383 participants who completed a questionnaire withheld consent for the investigator to access their hospital records. Information that was only available from hospital records is, therefore, missing for these participants.

Four of the participants gave birth out of hospital unintentionally but were admitted to hospital along with their infants following the delivery. They have been included in all analyses. It is unknown if any of the non-participants gave birth before their arrival at the hospital.

4.2 Participants versus Non-participants

The information used in these comparisons was taken from the daily logs made during the data collection period.[9] The information available from the daily logs was less complete than the information subsequently obtained for participants from the hospital charts. However,the

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[9] Incorporated into the daily log following the data collection period was information taken from the delivery room records about the 26 patients who were missed. (see section 3.3.10.1).

comparisons of the participants with the non-participants used information from the daily log only. Therefore, the likelihood that information is missing is assumed to be approximately the same for both participants and non-participants.

Table 4.2 shows that women giving birth at St. Joseph's Health Centre were more likely to have participated than women delivering at Victoria Hospital. Non-participants were more likely than participants to have had two or more previous births, to have given birth to infants with a lower mean birth weight, and to have a different distribution of low birth weight (less than 2500 grams), normal birth weight (2500 to 4000 grams) and macrosomic (birth weight greater than 4000 grams) infants. Participants and non-participants did not differ significantly with respect to age, whether they had a singleton versus a multiple birth, and whether the median income of the postal code area in which they resided was classified as upper, middle or lower. Participants were somewhat more likely to have had a cesarean delivery than non-participants. The mode of delivery was unknown for seven of the participants and six of the non-participants at the time that the log was made.

4.3 Measures of Socioeconomic Status

This section presents: the construction of the head of household occupation measure, the distributions of socioeconomic measures among the participants, the association among the various measures of socioeconomic

Table 4.2
Comparison of Participants and Non-Participants

Variable	Category	Response Rate	Distribution				x^2, df, P-value
			Participants		Non-Participants		
			Percent	No.	Percent	No.	
HOSPITAL	St. Joseph's	80.0	61.1	1457	56.0	365	x^2=5.47, p=.019, 1 df
	Victoria	76.3	38.9	926	44.0	287	
	TOTAL	78.5	100.0%	2383	100.0%	652	
MEDIAN INCOME[a] (of postal code of residence)			Percent	No.	Percent	No.	
	Upper	82.1	23.1	502	18.5	110	x^2=5.93, p=.052, 2 df
	Middle	77.8	46.7	1013	48.7	289	
	Lower	77.1	30.2	655	32.8	195	
	TOTAL	78.5	100.0%	2170	100.0%	594	
DELIVERY			Percent	No.	Percent	No.	
	Cesarean	82.7	11.2	267	8.7	56	x^2=3.27, p=.071, 1 df
	Vaginal	78.1	88.8	2107	91.3	590	
	TOTAL	78.6	100.0%	2374	100.0%	646	
MULTIPLE			Percent	No.	Percent	No.	
	Singleton	78.7	98.9	2343	98.8	634	x^2=.00, p=.987, 1 df
	Multiple[b]	77.1	1.1	27	1.2	8	
	TOTAL	78.7	100.00%	2370	100.00%	642	

[a] Unknown for communities adjacent to, but outside, London
[b] Includes one set of triplets (participant)

Table 4.2, Continued
Comparison of Participants and Non-Participants

Variable	Category	Response Rate	Distribution				x^2, df, P-value
			Participants		Non-Participants		
			Percent	No.	Percent	No.	
MATERNAL AGE	16-19	73.2	4.7	112	6.3	41	x^2=7.93, p=.094, 4 df
	20-24	75.5	17.2	409	20.5	133	
	25-29	80.2	37.1	885	33.7	219	
	30-34	79.5	30.8	735	29.1	189	
	35 & over	78.3	10.2	242	10.3	67	
	TOTAL	78.6	100.0%	2383	100.0%	64[illegible]	
			Percent	No.	Percent	No.	
NUMBER OF PREVIOUS BIRTHS	None	82.1	42.9	941	36.2	205	x^2=30.24 p<.001, 4 df
	One	80.0	39.1	856	37.8	214	
	Two	76.2	13.6	298	16.4	93	
	Three	66.7	3.1	68	6.0	34	
	Four & up	59.2	1.3	29	3.5	20	
	TOTAL	79.5	100.0%	2192	100.0%	566	
			Percent	No.	Percent	No.	
BIRTH WEIGHT* (grams)	< 2500	78.6	4.3	99	4.1	27	x^2=7.25, p=.027, 2 df
	2500-4000	78.1	81.5	1881	85.6	527	
	> 4000	84.1	14.2	328	10.1	62	
	TOTAL	78.7	100.0%	2308	100.0%	616	

*Singleton births only

status, and the rationale for the selection of measures to be used in subsequent analyses. A description of the measures of socioeconomic status that were collected can be found in section 3.4.

4.3.1 Construction of the "head of household" occupation index

To determine head of household, participants were asked with whom they currently resided, and 92.1 percent indicated that they were residing with either a husband or a partner. Of the women living with either a husband or a partner, 93.2 percent indicated that the partner was in the labour force, either currently working (89.7%) or looking for work (3.6%). However, only 70.7 percent indicated that their own main activity in the year prior to becoming pregnant was either working or looking for work.

Table 4.3 gives the numbers of participants for whom the head of household occupation was categorized by their partner's, their own, or their parent's occupations. Of the 83 women with a husband or partner who was neither working nor looking for work, the participant's occupation was used for the 81 of these women whose occupation was codable. Similarly the participant's own occupation was used if she was not living with a husband or partner or was living with her parents and was 18 years of age or older. However, for a small number of women living with their parents who were either less than 18 years of age or not working themselves,

Table 4.3

Designation of Head of Household Occupation

Occupation Code Used[a]	Number in Category	Occupation Missing or Uncodable	Percent of Participants in this category
Husband's or Partner's (Spouse's)	2044	62	85.77
Own[b]	168	8	7.05
Father's (30) or Mothers (1)	34	3	1.43
Unknown[c]	1	1	0.04
Not in Workforce[d]	136	136	5.71
TOTAL	2383	210	100.00%

[a] according to criteria for selection outlined in section 3.4.1.1

[b] living with spouse but spouse not in workforce - 81
not living with a spouse, not dependent on parents - 79

[c] living arrangements unknown and no information given regarding own or spouse's working status

[d] participant and spouse both students - 17
spouse and participant both not working - 15
spouse student, participant not working - 25
no spouse, participant student - 32
no spouse, participant not working - 47

their father's occupation code was used[10]. Living arrangements or occupation codes were either unknown or uncodable for 74 of the participants. For an additional 136 participants, neither the participant nor her husband or partner were in the workforce.

Head of Household Blishen codes were assigned for 2173 or 91.2 percent of the participants. In order to form categories that could be used in the data analyses, cut-points were established that divided the distribution of the participants who could be assigned a Blishen code into thirds. The resulting categories, each comprising as close to one-third of the distribution as possible, were labelled "upper," "middle," and "lower," and refer only to the relative position of the category within which an individual score lies with respect to scores in the other two categories.

4.3.2 Distribution of measures of socioeconomic status

Because the two measures of occupation, the participant's and her partner's, have been used in the creation of the "head of household" occupation, there are six resulting measures of socioeconomic status from the seven collected. The distributions of these among the participants are shown in Table 4.4. Information for each of these measures is missing for some of the respondents.

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[10] In one case where there was no father in the home, the occupation code of the respondent's mother was used.

Table 4.4

Distributions of Measures of Socioeconomic Status

Measure	Category	No.	Percent
HOUSEHOLD BLISHEN	Upper	737	33.9
	Middle	713	32.8
	Lower	723	33.3
	TOTAL	2173	100.0

Missing cases 210 (Not in labourforce, unknown, or uncodable)

ACCOM REQUEST*	Private	716	30.0
	Semi-Private	825	34.8
	Ward	829	35.0
	TOTAL	2370	100.0

Missing cases 13

*Accomodation Requested at Admission

RESIDENCE CODE*	Higher	508	23.2
	Middle	1020	46.6
	Lower	662	30.2
	TOTAL	2190	100.0

Missing cases 193 (Communities adjacent to London)

*Based on Median Income of Postal Code of Residence

Table 4.4, Continued

Distributions of Measures of Socioeconomic Status

Measure	Category	No.	Percent
OWN EDUCATION*	University Degree	537	22.6
	Diploma, Certificate	693	29.2
	Some Post-secondary	285	12.0
	Secondary School Grad	544	22.9
	Some Secondary School	283	11.9
	Elementary School	26	1.1
	No schooling	3	.1
	TOTAL	2371	100.0

Missing cases 12

*Based on highest level completed

HUSBAND'S EDUCATION*	University Degree	589	27.1
	Diploma, Certificate	556	25.6
	Some Post-secondary	306	14.1
	Secondary school Grad	462	21.2
	Some secondary school	240	11.0
	Elementary school	23	1.1
	No schooling	0	-
	TOTAL	2176	100.0

Missing cases 207

*Based on highest level completed

Table 4.4, Continued

Distributions of Measures of Socioeconomic Status

Measure	Category	No.	Percent
HOUSEHOLD INCOME*	$85,000 or over	189	10.8
	75,000 - 84,999	111	6.4
	65,000 - 74,999	182	10.4
	55,000 - 64,999	248	14.2
	45,000 - 54,999	275	15.8
	35,000 - 44,999	248	14.2
	25,000 - 34,999	191	11.0
	15,000 - 24,999	176	10.1
	LESS THAN $15,000	124	7.1
	TOTAL	1744	100.0

Missing cases 639 (Preferred not to answer, did not know, left blank)

*1991 Before Tax Household Income

4.3.3 Association among measures of socioeconomic status

Table 4.5 contains a matrix of the Spearman Rank Correlation Coefficients between the five measures of socioeconomic status. All were significantly associated with each of the others. The coefficients were similar to those found in other studies of the correlations among occupational rankings, income and levels of education (Libertos et al., 1988).

4.3.4 Selection of measures of socioeconomic status used in the analyses

Three of the six measures of socioeconomic status were dropped from further consideration. The first of these was the income measure because of the large number of participants who did not respond to this questionnaire item. Information was missing for 639 (26.8%) of the participants, including 129 who left the question blank, 119 who selected "do not know," and 391 who chose the "prefer not to answer" option.

The second measure to be dropped from further consideration was "husband's or partner's education." There were 219 (9.2%) missing values that occurred for this measure, mostly for those participants without a husband or partner. However, husband's education was also highly correlated with both the head of household occupation score, which is based to a large extent on education (see Appendix

Table 4.5

Spearman Rank Correlation Coefficents
Between Measures of Socioeconomic Status

Correlations:	HEAD OF HOUSEHOLD OCCUPATION	ACCOM REQUEST	RESIDENCE CODE	OWN EDUCATION	HUSBAND'S EDUCATION
ACCOM REQUEST	.3680a (2163)b p<.001c				
AREA OF RESIDENCE MDN.INCOME	.2032 (1989) p<.001	.1647 (2177) p<.001			
OWN EDUCATION	.4321 (2163) p<.001	.3931 (2358) p<.001	.2057 (2178) p<.001		
HUSBAND'S EDUCATION	.5902 (2056) p<.001	.3517 (2165) p<.001	.2517 (1988) p<.001	.5748 (2167) p<.001	
HOUSEHOLD INCOME	.4524 (1623) p<.001	.5724 (1739) p<.001	.2498 (1602) P<.001	.4552 (1737) p<.001	.3759 (1653) p<.001

a Coefficient
b (N)
c 2-tailed Significance

D), and the mother's own education, making this measure somewhat redundant.

Accommodation requested at admission was the third measure dropped from further analyses. Although it was believed during the design phase of the study that this measure could be a useful proxy measure of socioeconomic status in this population, it was observed during data collection that women who knew that they were at higher risk of a cesarean delivery or a longer hospital stay (women with multiple gestations, for example), and women hospitalized antenatally for problems associated with the pregnancy, were more likely to have requested private or semi-private accommodation.

Retained for consideration in further analyses were head of household occupation, mother's education and median income of mother's area of residence. Although there is some consensus that occupation-based measures are usually the most appropriate single indicator of socioeconomic status (Abramson et al., 1982), in studies where participants may be quite young such as the current one, it is perhaps not appropriate. The large number of participants who could not be classified using the Blishen scale made it less useful than anticipated.

Median income of the mother's area of residence was retained in the preliminary analyses and the analyses to address objective one because it has been used as a measure of socioeconomic status in previous investigations of the

association of cesarean delivery and socioeconomic status (Gould et al., 1989). A problem with this measure in the present study is that although study participation was restricted to residents of London and the immediately adjacent communities, median income by area of residence was not available for women residing outside of the city limits of London.

Mother's education was the most complete measure and is also perhaps the most appropriate measure. It is the indicator most closely associated with the participant, that is, the indicator most likely to be determined by her own resources, health and background and, in turn, most likely to affect her choices, her health-related behaviour, and her relationships with her care provider and her labour attendants. It is also the most objective, known to be the most reliably reported, and provides meaningful cut-points. In addition, while health care is universally available in Canada, higher education is not; the acquisition of post-secondary education requires financial resources in most cases. Thus, mother's level of education is likely the most sensitive to factors of interest in this investigation.

The preliminary investigations of the association between cesarean delivery and socioeconomic status and analyses to address objective one are presented separately for the three retained measures of socioeconomic status in order to assess the consistency of the association when different measures of socioeconomic status are used.

However, for clarity of presentation as well as for the reasons discussed above, only mother's education has been retained as a measure of socioeconomic status in the analyses to address objectives 2 through 5.

All analyses are controlled for age in some manner, either through inclusion in multivariable modelling procedures, stratification, or in some cases, both. The reason for this is that when using any measure of socioeconomic status in investigations where many of the subjects are young, it is important to consider that acquisition of the outward signs associated with social class are dependent on time to a large extent. This applies for example to higher education; many of the participants could not have completed some of the levels of education by virtue of their age. It also applies similarly to the other measures of socioeconomic status, although the dependence of these measures on age is not as obvious as in the case of education. It can be argued, however, that prestigious occupations and the higher incomes that are prerequisites of better housing or more expensive health insurance also depend on having had the time to acquire them.

In cases where analyses have been stratified by age, 24 was chosen as the cut-point because it is the age at which it would be possible to have completed the highest level of education as well as to have carried a pregnancy to term. Levels of education have been collapsed into four categories in most analyses: completion of a university degree

(university), any post-secondary education (post-sec), secondary or high school graduation (HS Grad), and less than secondary or high school graduation (< HS Grad).

4.4 Distribution of Cesarean Delivery by Age, Parity, and Previous Cesarean Delivery

Figure 4.1 presents the differences in cesarean section rates across age groups for women with a previous cesarean delivery, for primiparous women, and for multiparous women who had no previous cesarean delivery. Table 4.6 displays these same data in a tabular format. Marked differences existed in cesarean section rates by age, parity, and whether the participant had had a previous cesarean delivery. For women with a previous cesarean delivery, 42.5 percent were delivered by a repeat cesarean. Multiparous women who had not had a previous cesarean delivery had the lowest rate of cesarean delivery, less than five percent in all age groups except for women 35 and over. Primiparous women under 20 years of age also had a low rate of cesarean delivery. This rate more than doubled, however, for women between the ages of 20 and 34. Primiparous women age 35 and over had a cesarean section rate in excess of 25 percent.

4.5 Analyses to Address the Primary Study Objectives

4.5.1 Overview

In the next section (4.5.2) is a brief description of the statistical procedures used to obtain the adjusted odds ratios reported in tables in sections 4.5.3 through 4.5.5.

Figure 4.1

Cesarean Section Rates by Age, Parity and Previous Cesarean section

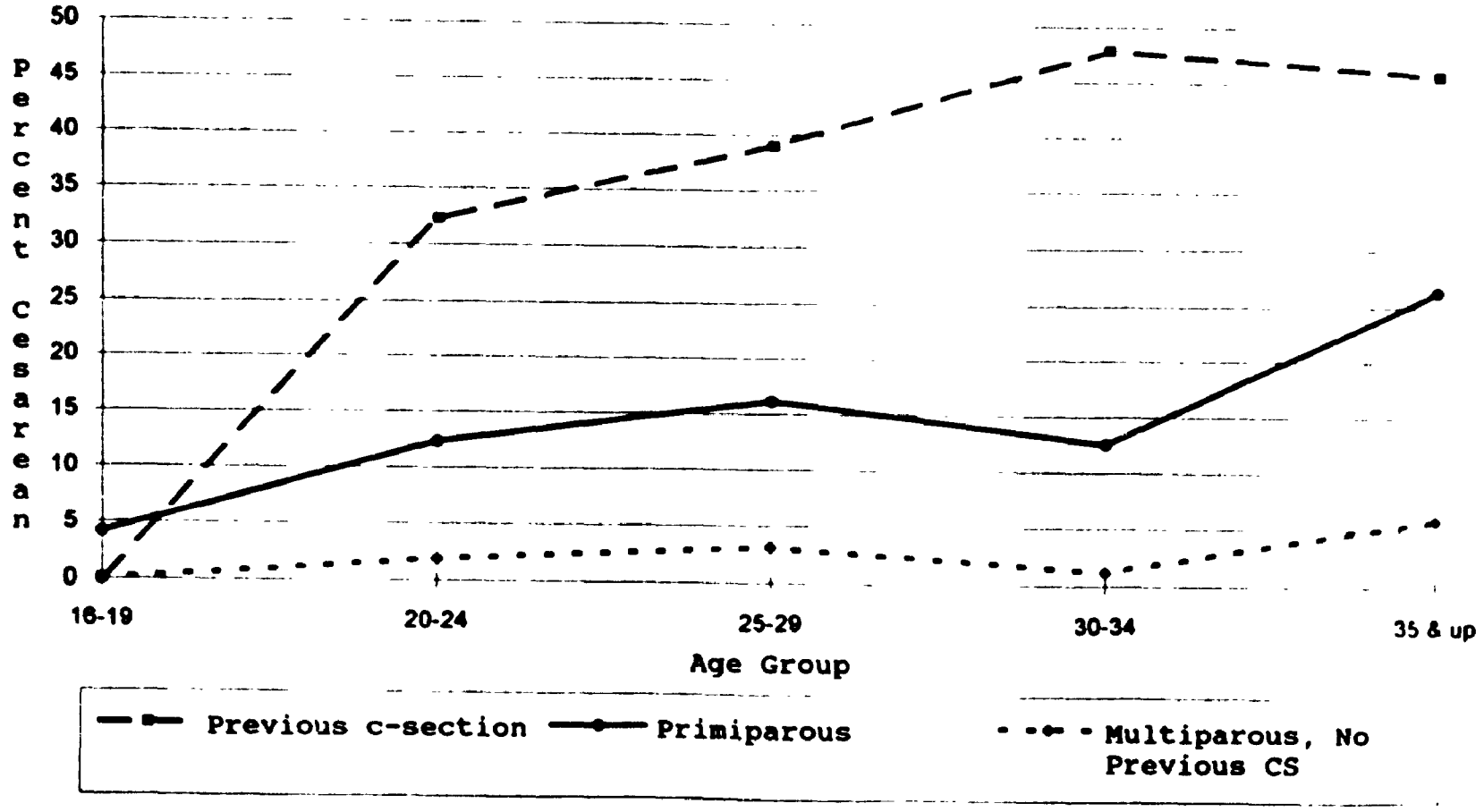

Table 4.6

Percent Cesarean Delivery
by Age Group and Parity

AGE CATEGORY

	16-19		20-24		25-29		30-34		35 & over		TOTAL	
PARITY	(N)	%CS	(N)	%CS	(N)	%CS	(N)	%CS	(N)	%CS	(N)	%CS
Primiparous	98	4.1	227	12.3	410	16.1	216	12.5	57	26.3	1008	13.9
Multiparous[a]	11	0.0	155	1.9	388	3.1	425	1.2	136	5.9	1115	2.5
Previous CS	1	0.0	31	32.3	82	39.0	94	47.9	46	45.7	254	42.5
TOTAL	110	3.6	413	9.9	880	12.5	735	10.5	239	18.4	2377[b]	11.6

[a]No previous cesarean delivery

[b]Parity unknown for 6 respondents

Prior to analyses to address the study objectives, an analysis of the association of cesarean delivery and the three selected measures of socioeconomic status for the total 2383 participants was performed (section 4.5.3). This has been included to provide a basis of comparison with previous investigations that have not controlled for population characteristics, nor restricted their analyses of the association of cesarean delivery and socioeconomic indicators to subgroups of the population.

Analyses to address the primary study objectives (Chapter 2.0) are presented in sections 4.5.4 to 4.5.6. Analyses to address each of these objectives was restricted to a subgroup of the participants. Analyses to address objective one (section 4.5.4) were restricted to the 2129 women with no previous cesarean deliveries.

Analyses to address objective two (section 4.5.5) were to be restricted to women who had no absolute indication for cesarean delivery. However, it was found that determination of "absolute" indication was not straightforward using a chart abstraction process. In addition, only eleven of the cesarean deliveries of women who had not had a previous cesarean delivery were absolutely indicated according to the criteria specified in Chapter 2.0. Separate analyses excluding these women was, therefore, not warranted. However, as will be presented later (Table 4.10, found at the beginning of section 4.5.6) 215 participants had situations which would make them at high risk for cesarean

birth. Excluding these 215 participants resulted in 1869 women who were assumed to be at lower risk.

The analyses to address objective three (section 4.5.6), therefore, were restricted to the 1869 participants with no previous cesarean delivery, who had singleton fetuses in the vertex position, were at a gestational age of 37 weeks or more, and to have had no absolute indications for a cesarean delivery.

4.5.2 Adjustment for age and parity

As discussed in section 4.3, there is reason to expect a strong association between age and all measures of socioeconomic status. In addition, the percent of deliveries by cesarean in this population is also associated with age (Figure 4.1) making it an important potential confounding variable. Parity is associated with both age and cesarean delivery, making it a potential confounder as well.

To assess the importance of statistical adjustment for age and parity (and previous cesarean delivery in analyses reported in section 4.5.3), the following procedure was carried out. In each logistic regression model where a measure of socioeconomic status was the independent variable of interest, models containing the dependent variable (cesarean delivery) and the socioeconomic measure were compared with and without each of the covariates (age, parity or previous cesarean delivery), and each of the covariates and the interaction of each of the covariates

with the socioeconomic indicator. In each case an assessment was made of the resulting likelihood ratio chi-square test statistic. Where these test statistics were significant at a p-value of .05, covariates were retained in the model. In all cases, both age and parity (and previous cesarean delivery in analyses in section 4.5.3) were retained in the models, while interaction terms were not.

4.5.3 Total Sample

To provide a more appropriate basis of comparison with earlier investigations in other populations, summary analyses have been conducted that treat the sample as a whole. Shown in Table 4.7 are the unadjusted and adjusted odds ratios of cesarean delivery across levels of three indicators of socioeconomic status, and the corresponding 95 percent confidence intervals. In each table, the number of participants in the category and the percent delivered by cesarean are also presented. In these models, the reference category is the "lowest" level (participants scoring in the lower third on the Blishen scale, the "lower" level of median income, or women who had not completed high school). With no adjustment for age, parity and previous cesarean delivery, there is little difference in the odds of a cesarean delivery between categories. While adjusting for age, parity and previous cesarean delivery had only a slight effect when socioeconomic status was indicated by the head of household occupation or the median income of the mother's

Table 4.7

Unadjusted and Adjusted[a] Odds Ratios of Cesarean Delivery by Socioeconomic Indicators

(TOTAL 2383 RESPONDENTS)

HEAD OF HOUSEHOLD OCCUPATION

OCCUPATION LEVEL	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted[a] OR*(95% C.I.)
Upper	737	11.5	0.98(0.71,1.35)	0.75(0.52,1.08)
Middle	713	12.2	1.04(0.76,1.38)	0.93(0.65,1.32)
Lower	723	11.8	1.00 -	1.00 -
TOTAL	2173	11.8		

(*n used in logistic regression models = 2170)

MOTHER'S EDUCATION

EDUCATION	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted[a] OR*(95% C.I.)
Univ	537	10.8	0.85(0.55,1.30)	0.37(0.22,0.64)
Post	978	11.2	0.88(0.60,1.31)	0.44(0.27,0.72)
HS Grad	544	12.1	0.97(0.66,1.43)	0.60(0.36.0.99)
< HS	312	12.5	1.00 -	1.00 -
TOTAL	2371	11.5		

(*n used in logistic regression models = 2365)

MEDIAN INCOME OF MOTHER'S AREA OF RESIDENCE

INCOME LEVEL	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted[a] OR*(95% C.I.)
Upper	508	10.6	0.87(0.60,1.26)	0.81(0.54,1.22)
Middle	1020	11.9	0.99(0.73,0.97)	0.94(0.67,1.30)
Lower	662	11.9	1.00 -	1.00 -
TOTAL	2190	11.6		

(*n used in logistic regression models = 2184)

[a]Adjusted for age (5 categories), parity (primip, multip) and previous cesarean delivery (yes,no)

area of residence, the adjustment resulted in decreased odds of cesarean delivery for women with increasingly higher levels of education.

4.5.4 Objective 1

> To determine whether cesarean delivery is associated with indicators of socioeconomic status among women with no previous cesarean delivery, and adjustment of maternal age and parity.

Table 4.8 presents the results of analyses restricted to participants with no previous cesarean delivery (n=2129, 83.9% of participants). These analyses show results similar to analyses in the previous section which had used the entire sample. Again, the adjustment for age and parity had a slight effect when socioeconomic status was indicated by the head of household occupation or the median income of the mother's residence, but resulted in decreased odds of cesarean delivery for women with increasingly higher levels of education. Both age and parity are, therefore, confounders of the association between cesarean delivery and mother's level of education.

Tables showing the percent of deliveries by cesarean across levels of mother's education stratified by age and parity can be found in Appendix E[11]. The pattern of association is generally in the direction of a higher

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[11] Rates of cesarean delivery by socioeconomic status stratified by age and parity included in appendix D are shown for levels of mother's education only. Mother's education was judged to be the most appropriate indicator of socioeconomic status in this population.

Table 4.8

Unadjusted and Adjusted' Odds Ratios of Cesarean Delivery by Socioeconomic Indicators

(NO PREVIOUS CESAREAN DELIVERY)
(N=2129)

HEAD OF HOUSEHOLD OCCUPATION

OCCUPATION LEVEL	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted' OR*(95% C.I.)
Upper	651	7.8	0.94(0.63,1.40)	0.78(0.51,1.21)
Middle	636	8.3	1.00(0.68,1.49)	0.93(0.61,1.41)
Lower	652	8.3	1.00 -	1.00 -
TOTAL	1939	8.1		

(*n used in logistic regression models = 1936)

MOTHER'S EDUCATION

EDUCATION	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted' OR*(95% C.I.)
Univ	483	7.2	0.87(0.50,1.51)	0.31(0.16,0.60)
Post	872	7.9	0.96(0.59,1.57)	0.41(0.23,0.74)
HS Grad	483	8.1	0.98(0.57,1.69)	0.55(0.30,1.01)
< HS	280	8.2	1.00 -	1.00 -
TOTAL	2118	7.8		

(*n used in logistic regression models = 2112)

MEDIAN INCOME OF MOTHER'S AREA OF RESIDENCE

INCOME LEVEL	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted' OR*(95% C.I.)
Upper	451	6.7	0.77(0.48,1.23)	0.81(0.50,1.32)
Middle	910	8.0	0.94(0.94,1.37)	0.94(0.63,1.37)
Lower	595	8.4	1.00 -	1.00 -
TOTAL	1956	7.8		

(*n used in logistic regression models = 1950)

'Adjusted for age (5 categories), and parity (primip, multip)

percent of cesarean delivery among women with lower levels of education across each of the age categories. An exception is primiparous women between 20 and 24 where women of higher education have generally higher rates of cesarean delivery. The test for interaction of age with mother's education, as shown in Table E.3 (Appendix E) was not significant, however, perhaps because of the relatively small numbers of events determining these rates. As discussed previously, the meaning of an observed association among these younger women, many of whom had not had an opportunity to have completed the higher levels of education, cannot be ascertained.

To assess the association between cesarean delivery among women who would have had an opportunity to complete the higher levels of education, analyses were conducted that were restricted to women over 24 years of age for all three indicators (Table 4.9). The previously observed relationships between levels of two of the socioeconomic indicators, education and head of household occupation, and cesarean delivery became more pronounced, with lower point estimates and narrower confidence intervals. However, the association within strata of median income of mother's area of residence was unaffected.

4.5.5 Objective 2

> To determine whether cesarean delivery is associated with socioeconomic status among women who have no previous cesarean deliveries and no absolute indications[12] for cesarean delivery.

The intent of this objective was to examine the primary question after exclusion of women for whom a cesarean delivery was absolutely indicated. With cesarean delivery the only option to safely deliver the child, the underlying assumption here was that in such circumstances management decisions could not be subject to patient preferences or a physician's "style of care[13]."

Of the 2084 participants who had not had a previous cesarean delivery and for whom information about the participant's labour and delivery was available[14], only 19 participants were delivered by cesarean at or prior to the initiation of labour. Further determination of "absolutely indicated" cesarean delivery was not straightforward, however. In this population, preterm breech was not considered an absolute indication; five of nine preterm

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[12] Prior to the study period, absolute indications at London hospitals were said to include: triplets or higher order multiple births, transverse lie, placenta previa, obvious skeletal abnormalities, premature breech presentations, prolapsed cord, and severe fetal distress. These are consistent with Oxorn (1986).

[13] Although unlikely, it would be possible, however, for women to refuse to consent to an absolutely indicated cesarean delivery.

[14] Of the 2129 participants who had no previous cesarean delivery, 45 withheld permission to access their hospital records.

Table 4.9

Unadjusted and Adjusted[a] Odds Ratios
of Cesarean Delivery
by Socioeconomic Indicators

(NO PREVIOUS CESAREAN DELIVERY, OVER 24 YEARS OF AGE)

HEAD OF HOUSEHOLD OCCUPATION

OCCUPATION LEVEL	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted[a] OR*(95% C.I.)
Upper	605	7.8	0.75(0.48,1.17)	0.62(0.40,0.99)
Middle	510	7.5	0.72(0.45,1.14)	0.65(0.41,1.05)
Lower	419	10.0	1.00 -	1.00 -
TOTAL	1534	8.3		

(*n used in logistic regression models = 1531)

MOTHER'S EDUCATION

EDUCATION	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted[a] OR*(95% C.I.)
Univ	474	7.0	0.46(0.23,0.90)	0.19(0.09,0.42)
Post	738	7.5	0.49(0.26,0.94)	0.25(0.12,0.51)
HS Grad	323	9.3	0.63(0.51,0.77)	0.41(0.19,0.87)
< HS	93	14.0	1.00 -	1.00 -
TOTAL	1628	8.0		

(*n used in logistic regression models = 1622)

MEDIAN INCOME OF MOTHER'S AREA OF RESIDENCE

INCOME LEVEL	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted[a] OR*(95% C.I.)
Upper	389	7.2	0.78(0.47,1.30)	0.87(0.51,1.47)
Middle	685	7.9	0.86(0.56,1.33)	0.82(0.52,1.30)
Lower	414	8.9	1.00 -	1.00 -
TOTAL	1488	8.0		

(*n used in logistic regression models = 1482)

[a]Adjusted for age (3 categories), and parity (primip, multip)

infants with breech presentations were delivered vaginally. In addition, cesarean deliveries were performed for conditions that arose or were detected during labour considered to be "absolute" indications for cesarean delivery, such as prolapsed cord, flat fetal heart rate tracings, and compound presentation. In all, only eleven cesarean deliveries were found to have been "absolutely" indicated. Separate analyses excluding these women was, therefore, not warranted.

All cesareans performed at or prior to the initiation of labour, or performed during labour for an indication that could be considered "absolute" were either multiple births, malpresentations, preterm deliveries, or placenta previae. Displayed in Table 4.10 are the number of deliveries in each of these categories, the number and percent within each category that were delivered by cesarean, and the number that were "elective," that is cesarean deliveries at or prior to the start of labour. The percent of cesarean deliveries overall within this group was 25.6 percent compared to 5.9 percent for the remaining 1869 participants. Thus, the former could be considered to have been at "high risk" and the latter at "low risk[15]" of a primary cesarean delivery.

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[15] "Low risk" is used here only to designate participants at term with a singleton fetus in the vertex position and for whom no absolute indication for a cesarean delivery occurred prior to or during labour. Other conditions may have been present that could have placed these participants in a "high risk" category for an adverse outcome.

Table 4.10

Percent Cesarean Delivery
Multiple, preterm, non-vertex presentations,
or deliveries complicated by placenta previa,
no previous cesarean deliveries

Indication	No. of deliveries	Total No. by CS	(No. Elec Cesarean)[a]	% CS
MULTIPLES - Total	**25**	**7**		**28.0**
Triplets	1	1	(1)	
Twins - Total	**24**	**6**		**25.0**
Preterm - one or both breech	4	2	(1)	
Preterm - both vertex	7	2	(1)	
Term - one or both breech	6	3	(1)	
Term - both vertex	7	0		
PRETERM (singleton) - Total	**115**	**19**		**16.5**
Vertex	106	13	(2)	
Malpresentation[b]	9	6	(3)	
MALPRESENTATION[c] (singleton term) - Total	**73**	**27**	**(8)**	**37.0**
PLACENTA PREVIA (term)	**2**	**2**	**(2)**	**100.0**
TOTAL	**215**	**55**	**(19)**	**25.6**

[a] At or prior to onset of labour
[b] Includes breech and transverse lie presentations
[c] Includes breech, transverse lie, face, and brow presentations

All of the women in the "low risk" category were delivered either vaginally or by cesarean section following a period of labour. Within this group, indications for cesarean delivery included: cephalopelvic disproportion, failure to progress, failed induction, failed forceps, abruption, fetal distress or a combination of these. Analyses to address objectives 3 and 5 were restricted to this subgroup of participants.

4.5.6 Objective 3

> To explore whether other factors such as labour management options or "biological" risks affect the association between cesarean delivery and socioeconomic status controlled for age and parity among a subset of women with no previous cesarean delivery, a singleton fetus in a vertex presentation, who are at 37 weeks or more gestation, and who have no absolute indications for a cesarean delivery.

The intent of objective 3 was to investigate possible reasons for any observed association between cesarean delivery and socioeconomic status by controlling for various covariates in addition to age and parity that might be related to both a risk of cesarean delivery and measures of socioeconomic status.

Analyses to address this objective were restricted to participants at term with a singleton fetus in a vertex presentation at the beginning of labour, excluding women with placenta previa. This subgroup includes the 1869 women for whom labour was not excluded because of a judgement of high risk and for whom management decisions during the course of their labour would have been unrelated to

prematurity, malpresentation, or multiple gestation, conditions that carry a high risk of a cesarean delivery.

4.5.6.1 Cesarean delivery by type of hospital

Prior to considering the effect of adjustment for additional covariates on the association between cesarean delivery and mother's education, an analysis of cesarean delivery by hospital was conducted. The results of this analysis showed that, when restricted to the "low risk" subgroup, little difference existed in cesarean section rates for women delivering at the tertiary facility versus the level two "community" hospital. Adjusting for maternal age and parity further reduced the slight difference in cesarean section rates between these two institutions for this subgroup of women (Table 4.11, Model 1). However, when the comparison included all participants, both the unadjusted and the adjusted odds of a cesarean delivery were significantly higher at the tertiary facility than at the level two community hospital (Table 4.11, Model 2). This finding is similar to findings of an investigation of hospital-specific rates of cesarean delivery in Australia, in which investigators reported that significant differences in rates diminished considerably when these rates were adjusted for maternal age and parity (Kirsop et al., 1992).

4.5.6.2 Measurement of Covariates

Information relating to covariates for use in further analyses were recorded from patient's charts or requested on

Table 4.11

Unadjusted and Adjusted' Odds Ratios
of Cesarean Delivery
by Hospital

MODEL 1: LOW RISK DELIVERIES ONLY

HOSP	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted' OR (95% C.I.)
Tertiary	1113	6.2	1.15(0.77,1.72)	1.04(0.69,1.57)
Community	756	5.4	1.00 -	1.00 -
TOTAL	1869	5.9		

MODEL 2: ALL RESPONDENTS

HOSP	(N)	%CS	Unadjusted OR*(95% C.I.)	Adjusted' OR (95% C.I.)
Tertiary	1459	13.1	1.49(1.14,1.95)	1.43(1.09,1.88)
Community	924	9.2	1.00 -	1.00 -
TOTAL	2383	11.6		

*The total number of respondents included in the calculation of the unadjusted odds ratio has been reduced to reflect observations missing for variables included in the calculation of the adjusted odds ratio.

'Adjusted for age (5 categories), and parity (primip, multip)

the questionnaire. They are listed in the previous chapter in Table 3.1. Some of these variables have been dropped from further consideration for the following reasons: the information was missing for a large proportion of the participants (prenatal care, 35.2% missing), the distribution over categories of the variable did not provide a sufficient number in each category to allow for meaningful analysis (presence of a labour companion, 99.5% had companionship); the chart information was insufficient to assess the covariate (previous obstetrical loss[16]); or appropriate classification required procedures for accurate determination and/or case-by-case clinical judgement with objective pre-established criteria, none of which were available using a chart abstraction process (labour induction, labour stimulation, maternal and fetal distress, and cervical dilatation at admission).

The remaining set of covariates used in the analyses to address objectives 3 and 5 were recorded in an objective and consistent manner, allowed for meaningful categorization, and were available for 90 percent of more of the participants. These covariates can be divided into three

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[16] Although a four-digit TPAL (Term, Preterm, Abortions, Live children) number was available for nearly all of the participants and the intention was to calculate obstetric loss using this information, it was found that the "T" and the "P" components refer to the number of previous births, while "L" refers to the number of living children. Therefore, if a previous multiple gestation had resulted in the loss of one or more (but not all) of the fetuses, the calculation of losses ((T+P)-L) did not reflect this. Chart information recorded for the current birth often did not include information about outcomes of previous deliveries.

categories. The first category consists of factors that potentially have an impact on a risk of disproportion: infant birth weight, mother's height, weight gain during pregnancy, pre-pregnancy weight, and the difference between the father's height and the mother's height. The second category includes those that are related in some way to labour management: external and internal[15] electronic fetal monitoring, epidural anaesthesia, time of day of the delivery, and day of the week of the delivery. A third category contains variables hypothesized to be associated with cesarean delivery because of their potential association with skeletal growth, and therefore, pelvic capacity. These variables, included in analyses to address objective 4, are: socioeconomic status of the participant's family of origin (as indicated by her father's level of education), the number of children present in the participant's home during her childhood, the participant's birth order, the Gross National Product of the participant's country of origin[16], and oral contraceptive use during

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[15] "Internal" fetal monitoring included either the use of an intrauterine pressure catheter to monitor the uterine contractions or the application of a fetal scalp electrode to monitor the fetal heart rate. Because these were usually applied at the same time, they have been grouped together and called "internal" monitoring for the purposes of the data analyses.

[16] Gross National Products were assigned to each country of origin on the basis of the per capita GNP of that country in U.S. dollars for 1979, using World Bank estimates (The World Bank, 1981). The cut-point of $3000 U.S. represents the 1979 GNP below which countries (as represented in the distribution of respondents in the current study) were classified by the World Bank as "low or

adolescence. Three of the variables listed in Table 3.1 were used to form the sub-group of singleton, term, vertex deliveries. These were: presentation, multiple gestation and gestational age.

4.5.6.3 Categorization of the covariates

Covariates measured on a continuous scale (heights and weights) were assessed to determine whether to enter them into the logistic regression modelling procedures as continuous variables (Hosmer and Lemeshow, 1989). Because it was unlikely that any of the variables considered were linear in the logit, all continuous covariates were categorized and treated as design variables in the logistic regression models. Categories were formed on the basis of prior knowledge of their association with cesarean delivery as well as sample size considerations.

4.5.6.4 Association of the covariates with cesarean delivery

Shown in Table 4.12 are the associations between the covariates described above and cesarean delivery. Both the unadjusted odds of a cesarean delivery and the odds adjusted

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middle income," as opposed to "industrial" or "capital-surplus oil exporting" economies.

Table 4.12
Odds Ratios of Cesarean Delivery by Covariates

Covariate	(N)	% CS	Unadjusted Odds Ratio (95% C.I.)	Adjusted[a] Odds Ratio (95% C.I.)
MOTHER'S HEIGHT				
54 to 63"	615	8.5	1.90 (1.29,2.79)	1.97 (1.32,2.96)
64" and over	1248	4.6	1.00 -	1.00 -
BIRTH WEIGHT				
< 3000 grams	244	6.6	1.36 (0.77,2.38)	1.17 (0.65,2.11)
3000 to 4000 grams	1341	4.9	1.00 -	1.00 -
> 4000 grams	282	9.9	2.13 (1.34,3.38)	2.86 (1.74,4.70)
PRE-PREG WEIGHT				
< 120 lbs.	448	6.0	1.20 (0.75,1.93)	1.21 (0.74,1.96)
120 to 160 lbs.	1167	5.1	1.00 -	1.00 -
> 160 lbs.	249	9.6	2.00 (1.22,3.29)	2.05 (1.22,3.46)
WEIGHT GAIN				
20 lbs. or less	259	3.5	1.00 -	1.00 -
21 to 40 lbs.	1283	5.8	1.72 (0.85,3.49)	1.33 (0.65,2.75)
over 40 lbs.	260	8.1	2.44 (1.10,5.44)	1.82 (0.79,4.16)
HEIGHT DIFFERENCE[b]				
4" or less	680	4.7	1.00 -	1.00 -
4 to 8"	703	4.8	1.03 (0.63,1.69)	0.91 (0.55,1.52)
9" and over	356	10.1	2.28 (1.39,3.74)	2.17 (1.29,3.63)

[a] Adjusted for age and parity
[b] Baby's father's height - respondent's height

Table 4.12
Odds ratios of cesarean delivery by covariates, continued

Covariate	(N)	% CS	Unadjusted Odds Ratio (95% C.I.)	Adjusted[a] Odds Ratio (95% C.I.)
EPIDURAL				
Yes	1322	7.6	4.39 (2.27,8.46)	2.43 (1.22,4.85)
No	547	1.8	1.00 -	1.00 -
INTERNAL MONITOR				
Yes	322	25.5	18.53 (11.82,29.07)	13.07 (8.18,20.87)
No	1547	1.8	1.00 -	1.00 -
EXTERNAL MONITOR				
Yes	1280	8.3	13.77 (4.84,35.90)	7.43 (2.70,12.47)
No	589	0.7	1.00 -	1.00 -
WEEKEND				
Yes	458	3.7	1.00 -	1.00 -
No	1411	6.6	1.83 (1.08,3.10)	1.86 (1.08,3.19)
TIME OF DAY				
9am - 5pm	631	3.3	1.00 -	1.00 -
5pm - midnight	578	8.7	2.75 (1.63,4.64)	2.47 (1.44,4.23)
midnight to 9am	659	5.9	1.83 (1.06,3.14)	1.64 (1.24,2.18)

[a]Adjusted for age and parity

(The total number of respondents included in the calculation of the unadjusted odds ratio has been reduced to reflect observations missing for variables included in the calculation of the adjusted odds ratio)

for age and parity are reported over levels of each covariate, along with the corresponding 95 percent confidence intervals. In these calculations, the level with the lowest observed percent of cesarean delivery has been chosen as the reference category.

4.5.6.5 Logistic regression modelling procedure

An assessment was made as to whether adjustment for the covariates had an impact on the previously observed association between cesarean delivery and mother's education controlled for age and parity. To do this each covariate was considered individually. Three logistic regression models were fitted for each of these covariates with cesarean delivery as the dependent variable and mother's education, age, and parity entered simultaneously as independent variables. Entered in the first model were the three independent variables, the covariate of interest, and the interaction of the covariate of interest with mother's education. To assess the significance of the interaction term on the association of cesarean delivery with mother's education, a second model controlling for age and parity was fitted with the covariate but without the interaction term. Likelihood ratio tests (Hosmer and Lemeshow, 1989) assessed whether there was an interaction of any of the covariates and education in the association between education and cesarean delivery controlling for age and parity. A third model was then fitted without the covariate but with the number of participants reduced to correspond to missing

observations of the covariate and, therefore, corresponding to the number of participants included in the first two models.

If the interaction was determined to be nonsignificant by the likelihood ratio test statistic as well as by an inspection of the change in coefficients over levels of the covariate, an assessment was made as to whether the addition of this variable had an important effect on the association of cesarean delivery with mother's education controlling for age and parity. This was done by comparing the coefficients in the models with and without the covariate. Where addition of the covariate resulted in a ten percent change in any of the coefficients (Greenland, 1988), the covariate was chosen to be in the full logistic regression model at step 1 of a backwards elimination procedure. In this model, mother's education was forced into the model at the first step with age, parity, and the selected covariates and interaction term(s) eligible for elimination. The likelihood ratio method of elimination was specified in the SPSS/PC+ program with the criteria for removal set at 0.15.

4.5.6.6 Results of the logistic regression modelling procedures

Table 4.13 displays the results of a logistic regression model fitted with both age (five categories) and parity (primiparous versus multiparous) for each level of mother's education compared to the reference category (less

Table 4.13

Adjusted Odds Ratios* of a Cesarean Delivery by Education
Low Risk Deliveries, N = 1869

EDUCATION	(N)	β	SE	Odds Ratio	95% C.I.
University	430	-1.1347	.4244	0.32	(0.14,0.74)
Post-sec	777	-.7579	.3826	0.47	(0.22,0.99)
HS Grad	417	-.7654	.4108	0.47	(0.21,1.04)
< HS Grad	235	reference category		1.00	-
TOTAL	1859				

(10 missing observations)

*Variables in the model: Education, Age (5 categories), Parity (Primip, Multip)

(2-way interactions of covariates with education not significant)

than high school graduation). Reported in this table are the coefficient (β), the standard error of the coefficient (SE), the odds ratio (exp β), and the 95 percent confidence intervals of the odds ratios[19].

The procedure used to evaluate possible interaction of the covariates with mother's education revealed only one such instance. Shown in Table 4.14 are the age and parity adjusted odds of a cesarean delivery by levels of mother's education within each birth weight category. Although the odds ratios decrease over levels of education within both the low birth weight and the high birth weight categories, they increase towards one and become non-significant across levels of education within the "normal" birth weight range. However, as shown in Table 4.15, after controlling for this interaction, the odds of cesarean delivery decrease over levels of mother's education.

The only other covariate of those listed in Table 4.12 to meet the criteria for inclusion into the stepwise procedure was mother's height, although it is evident in Tables 4.13 and 4.16 that the addition of mother's height to the model had only a slight impact.

A final model was fitted using a backward stepwise procedure described in section 4.6.3.3 Covariates that were candidates for elimination were: age, parity, mother's

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[19] The 95 percent confidence intervals were calculated as follows: $\exp(\beta \pm 1.96 \times SE)$.

Table 4.14

Odds Ratios and 95 Percent Confidence Intervals of a Cesarean Delivery by Mother's Education Stratified by Infant's Birth Weight

	Birth Weight Categories								
	< 3000 grams			3000 - 4000 grams			> 4000 grams		
EDUCATION	(N)	OR*	(95% C.I.)	(N)	OR*	(95% C.I.)	(N)	OR*	(95% C.I.)
University	41	0.19	(0.03,1.11)	310	0.67	(0.19,2.29)	77	0.02	(0.002,0.22)
Post-sec	82	0.15	(0.03,0.78)	564	[illegible].74	(0.23,2.3[illegible])	131	0.10	(0.01,0.84)
HS Grad	67	0.45	(0.10,2.13)	297	0.79	(0.23,2.65)	53	0.05	(.0005,0.50)
<HS Grad	52	1.00	-	164	1.00	-	1[illegible]	1.00	-
TOTAL	242			1335			280		

(12 missing observations)

*Adjusted for age (5 categories) and parity (multip, primip)

Table 4.15

Adjusted Odds Ratios* of a Cesarean Delivery by Education Controlling for Birth Weight and the Interaction of Birth Weight with Education

EDUCATION	(N)	β	SE	Odds Ratio	95% C.I.
University	428	-1.8844	.4943	0.15	(0.06,0.40)
Post-sec	777	-1.3401	.4375	0.26	(0.11,0.62)
HS Grad	417	-1.2527	.4631	0.29	(0.12,0.71)
< HS Grad	235	reference category		1.00	-
TOTAL	1857				

(12 missing observations)

*Variables in the model: Education, Age (5 categories), Parity (multip, primip), Birth Weight (3 categories), Birth Weight X Education

Table 4.16

Adjusted Odds Ratios* of a Cesarean Delivery by Education Controlling for Mother's Height

EDUCATION	(N)	β	SE	Odds Ratio	95% C.I.
University	430	-1.0256	.4265	0.36	(0.16,0.83)
Post-sec	777	-.6586	.3849	0.52	(0.24,1.10)
HS Grad	415	-.6655	.4130	0.51	(0.23,1.15)
< HS Grad	231	reference category		1.00	-
TOTAL	1853				

(16 missing observations)

*Variables in the model: Education, Age (5 categories), Parity (multip, primip), Mother's Height (<64", >63")

(2-way interactions of covariates with education not significant)

height, birth weight, and the interaction of education and birth weight. All of the variables were retained in the model (Table 4.17).

Although the sample size was reduced from 2383 to 1869 to address this objective, the addition of meaningful covariates to the models would be expected to reduce response variability and consequently the sample size requirements. The confidence intervals indicate that there was adequate power to address this objective.

In all of the modelling procedures to this point, the odds of a cesarean delivery have been compared to the lowest level, that is, participants who had not completed high school. A consistent finding was that the odds of cesarean delivery were significantly lower within each of the higher levels of education after adjusting for relevant covariates. However, it was of interest to compare participants with lower levels of education to participants who had completed the highest level. When the previously described backwards elimination procedure was run with university education as the reference category, the results shown in Table 4.18 were obtained. While the odds of cesarean delivery increased over levels of education, they were significant only for women with less than high school graduation.

Table 4.19 shows the results of a modelling procedure restricted to participants over the age of 24. The same variables as in the earlier backwards stepwise procedure were entered, but in this case the interaction term (birth weight by education) was removed during the procedure.

Table 4.17

Adjusted Odds Ratios* of a Cesarean Delivery by Education Controlling for Birth Weight, Mother's Height and the Interaction of Birth Weight with Education

EDUCATION	(N)	β	SE	Odds Ratio	95% C.I.
University	428	-1.8183	.4965	0.16	(0.06,0.43)
Post-sec	777	-1.2931	.4398	0.27	(0.12,0.65)
HS Grad	415	-1.1828	.4651	0.31	(0.12,0.76)
< HS Grad	231	reference category		1.00	-
TOTAL	1851				

(18 missing observations)

*Variables in the model: Education, Age (5 categories), Parity (multip, primip), Birth Weight (3 categories), Birth Weight X Education, Mother's Height (<64", >63")

Backward stepwise, likelihood ratio method, criteria for removal = 0.15, no variables removed.

Table 4.18

Adjusted Odds Ratios* of a Cesarean Delivery by Education Controlling for Mother's Height, Birth Weight, and the Interaction of Birth Weight with Education

REFERENCE CATEGORY = UNIVERSITY EDUCATION

EDUCATION	(N)	β	SE	Odds Ratio	95% C.I.
University	428	reference category		1.00	-
Post-sec	777	.5253	.3600	1.69	(0.84,3.42)
HS Grad	415	.6355	.4179	1.89	(0.83,4.28)
< HS Grad	231	1.8183	.4965	6.16	(2.33,16.30)
TOTAL	1851				

(18 missing observations)

*Variables in the model: Education, Age (5 categories), Parity (multip, primip), Mother's Height (<64", >63"), Birth Weight (3 categories), Birth Weight x Education,

Backward stepwise, likelihood ratio method, criteria for removal = 0.15, no variables removed.

Table 4.19

Adjusted Odds Ratios* of a Cesarean Delivery by Education Controlling for Mother's Height and Birth Weight

OVER 24 YEARS OF AGE

EDUCATION	(N)	β	SE	Odds Ratio	95% C.I.
University	423	-1.7399	.5071	0.18	(0.06,0.47)
Post-sec	656	-1.3873	.4820	0.25	(0.10,0.64)
HS Grad	281	-1.1403	.5187	0.32	(0.12,0.88)
< HS Grad	79	reference category		1.00	-
TOTAL	1439				

(12 missing observations)

*Variables in the model: Education, Age (5 categories), Parity (multip, primip), Mother's Height (<64", >63"), Birth Weight (3 categories), Birth Weight x Education,

Backward stepwise, likelihood ratio method, criteria for removal = 0.15, interaction term (birth weight x education) removed.

4.6 Secondary Objectives

4.6.1 Objective 4

> To explore whether the decision to undertake a trial of labour or to elect a repeat cesarean delivery is related to socioeconomic status for women who have had one or more previous cesarean deliveries and no absolute indications for repeat cesarean delivery.

Of the 2383 participants, 254 had had a previous cesarean delivery. Of the 65 participants known to have had an elective repeat cesarean, fourteen would not have been considered eligible to undergo a trial of labour because of one or more of the following factors: having had more than two previous cesarean deliveries, a previous vertical incision or a uterine scar from other previous surgeries, an infant in the transverse lie position, or placenta previa. Table 4.20 presents the breakdown of outcome by education excluding these fourteen women.

Women who had a previous cesarean delivery were asked to recall their attitudes towards having a trial of labour in the week prior to their delivery. The choices given were: 1. wanted trial of labour and planned to have one 2. wanted a trial of labour but planned a repeat cesarean delivery 3. did not want a trial of labour but planned to have one anyway 4. did not want a trial of labour and planned a repeat cesarean and 5. undecided and unknown. Displayed in Table 4.21 is the percent of responses to each of these options by categories of education for all women with a previous cesarean delivery and whose outcome and level of education were known.

Table 4.20

Percent Elective Repeat Cesarean Section, VBAC, and Cesarean Deliveries Following a Trial of Labour
(Excluding women with > 2 previous cesarean deliveries, placenta previa, transverse lie, vertical incisions, or other surgical uterine scars)

			Trial of Labour		Total
EDUCATION	(N)	% Elec CS	% VBAC*	%CS	Trial of Labour
University	54	25.9	57.4	16.7	74.1
Post-sec	103	22.3	61.9	14.3	77.7
HS Grad	53	18.9	55.7	14.8	81.1
< HS Grad	28	14.3	50.0	25.0	85.7
TOTAL	238	21.4	57.9	20.7	78.6

*Vaginal Birth after Cesarean

Table 4.21

Recall of attitudes towards repeat cesarean delivery (CS) vs trial of labour (TOL) during week before delivery by Mother's Education among women with a previous cesarean delivery

EDUCATION	(N)	PERCENT ATTITUDES TOWARDS TRIAL OF LABOUR (RECALL) WANTED TOL/ PLANNED TOL	WANTED TOL/ PLANNED CS	WANTED CS/ PLANNED TOL	WANTED CS/ PLANNED CS	Undecided
University	54	72.2%	3.7%	1.9%	18.5%	3.7%
Post-sec	99	64.6	7.1	6.1	18.2	4.0
HS Grad	57	59.6	7.0	3.5	21.1	8.8
<HS Grad	29	58.6	13.8	0.0	17.2	10.3
TOTAL	239	64.4	7.1	3.8	18.8	5.9

Because of the exploratory nature of this objective, modelling procedures were not used in these analyses, nor were tests of statistical significance performed. Sample sizes would have provided insufficient power to detect statistically significant differences. The results are, therefore, descriptive only, but are somewhat helpful in the interpretation of the results overall. This will be discussed in a later section.

4.6.2 Objective 5

> To explore the association of cesarean delivery and factors that could be related to an inhibition of the achievement of a woman's full growth potential during her childhood or adolescence.

Similar to objective 3, the intent of objective 5 was to explore some possible reasons for an observed difference between socioeconomic status and cesarean section rates. The covariates included in these analyses are those hypothesized to be related to environmental determinants of growth. These are: socioeconomic status of the mother's family of origin (as indicated by her father's level of completed education[20]), the number of children living in the household during the mother's childhood, oral contraceptive use during adolescence, and very low gross national product of the country where the mother was born[21]. For this

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[20]The respondent's mother's level of completed education was used if the father was said to have been absent from the home.

[21]If the respondent emigrated to Canada prior to age 12, she has been included in the higher category of gross national product.

objective, analyses were restricted to the low risk group of women who had not had a previous cesarean delivery (see objective 3).

Shown in Table 4.22 are the odds of a cesarean delivery within categories of the five covariates considered. Both the unadjusted odds ratios of cesarean delivery and the odds ratios adjusted for age and parity are presented.

Interactions of each of these covariates with education were assessed in the manner described in section 4.6.3.3. An interaction was detected between education and GNP of the participant's country of origin. The effect of adding this variable and the interaction term to the model with mother's education, age and parity is shown in Table 4.23. The odds ratios in comparison to the reference category were observed to decrease while the confidence intervals have expanded to include one. Because of the relatively small number of participants in the category of GNP less than $3000 U.S., a model was fitted restricted to the participants in the higher GNP category. Results similar to those in Table 4.23 were observed. However, the addition of GNP and the interaction of GNP and mother's education to the model previously fitted with age, parity, mother's height, birth weight, and the interaction of birth weight by education had no effect on the odds of cesarean delivery over levels of education and both GNP and the interaction of GNP and mother's education were eliminated when entered into a

Table 4.22
Odds Ratios of Cesarean Delivery by Covariates to Address Objective 5

Covariate	(N)	% CS	Unadjusted Odds Ratio (95% C.I.)	Adjusted* Odds Ratio (95% C.I.)
FATHER'S EDUCATION				
University	257	6.2	0.96 (0.53,1.74)	0.75 (0.41,1.39)
Post-Sec	307	4.9	0.75 (0.41,1.36)	0.72 (0.38,1.34)
HS Grad	473	4.9	0.74 (0.44,1.25)	0.65 (0.38,1.12)
< HS Grad	667	6.4	1.00 -	1.00 -
N CHILD-FAMILY				
1	130	3.8	1.00 -	1.00 -
2-3	970	5.4	1.42 (0.56,3.61)	1.44 (0.55,3.74)
4-6	650	6.6	1.77 (0.69,4.56)	1.89 (0.71,4.94)
7 & up	106	8.5	2.32 (0.75,7.14)	2.96 (0.91,9.56)
BIRTH ORDER				
1	609	5.3	1.00 -	1.00 -
2-3	833	6.2	1.20 (0.76,1.89)	1.17 (0.73,1.86)
4-6	323	5.6	1.06 (0.59,1.93)	1.12 (0.60,2.07)
7 & UP	55	9.1	1.50 (0.67,3.36)	1.70 (0.73,3.94)
GNP				
< $3000	109	8.3	1.33 (0.61,2.81)	1.84 (0.83,4.08)
≥ $3000	1727	5.8	1.00 -	1.00 -
OC USE @ < 20[a]				
No	726	5.9	1.00 -	1.00 -
< 1 year	319	5.3	0.89 (0.50,1.59)	1.02 (0.56,1.87)
≥ 1 year	800	5.9	0.99 (0.65,1.52)	0.98 (0.62,1.53)

*Adjusted for age (5 categories) and parity (primip, multip)
(The total number of respondents included in the calculation of the unadjusted odds ratio has been reduced to reflect observations missing for variables included in the calculation of the adjusted odds ratio)

[a] Oral Contraceptives used at < 20 years of age

Table 4.23

Adjusted Odds Ratios* of a Cesarean Delivery by Education Controlling for GNP and the Interaction of GNP with Education

EDUCATION	(N)	β	SE	Odds Ratio	95% C.I.
University	427	-.6324	.4963	0.53	(0.20,1,41)
Post-sec	768	-.3359	.4643	0.71	(0.29,1.78)
HS Grad	407	-.2622	.4865	0.77	(0.30,2.00)
< HS Grad	232	reference category		1.00	-
TOTAL	1834				

(35 missing observations)

*Variables in the model: Education, Age (5 categories), Parity (multip, primip), GNP (<$3000, >= $3000), GNP X Education

(2-way interactions of age and parity with education not significant)

backwards stepwise procedure with the variables listed above.

Other covariates presented in Table 4.22 were found not to meet the minimal criteria of a ten percent change in any of the coefficients for levels of education when entered into models with education, age, and parity. The differences in the association of number of children in the participant's family of origin and cesarean delivery are of some interest in an exploration of factors potentially important to the etiology of dystocia. This will be discussed further in chapter 5.

The final covariate considered was the use of oral contraceptives during adolescence. There was no difference in the odds of cesarean delivery associated with each of the two levels of oral contraceptive use in adolescence as shown in Table 4.22. However, for women with a late menarche, a significant increase in the percent of deliveries by cesarean was observed in women who reported that they had used these agents prior to the age of 20, with an increasing rate of cesarean delivery associated with increased duration of use (Table 4.24). This last analysis was an exploratory analysis without control for other factors.

Table 4.24

Percent Cesarean Delivery by
Oral Contraceptive Use
Prior to Age 20

(Singleton, term, vertex presentation, no previous cesarean deliveries)

Stratified by Age at Menarche

	< 12 yrs		12 - 14 yrs		15 & over	
OC USE,< 20*	(N)	%CS	(N)	%CS	(N)	%CS
No	84	6.0	528	5.9	87	2.3
< 1 year	43	4.7	239	4.6	31	9.7
>= 1 year	130	6.2	576	5.0	76	11.8
TOTAL	257	5.8	1343	5.3	194	7.2
	χ^2=0.13, 2 df, p=0.94		χ^2=0.67, 2 df, p=0.72		χ^2=5.85, 2 df, p=0.05	

(75 missing observations)

* Oral Contraceptives used at < 20 years of age

CHAPTER 5.0

DISCUSSION

5.1 Summary of the major findings

The indicator of socioeconomic status selected to be used in this study was the participant's level of education. This was selected because it was believed to be the most appropriate measure for the purposes of this study. Education allows for meaningful categorization and is the indicator most likely to be determined by a woman's own resources and background. In the current investigation, mother's education was also reported by nearly all of the participants (99.5 percent). Cesarean section rates by two other measures of socioeconomic status, occupation of the head of the household and median income of the mother's area of residence, were reported in the results of the primary analyses to observe whether results were consistent across different measures of this concept.

Overall in this population where women were assumed to have had equal access to all obstetrical services under a system of universal health insurance, there were no differences in cesarean section rates across levels of the three selected indicators of socioeconomic status. After adjustment for maternal age, parity and previous cesarean delivery, there was still no change in the association of

cesarean delivery with median income of the mother's area of residence. However, there was a slight decrease in the odds ratio of cesarean delivery for women categorized in the upper social strata on the basis of the occupation of the head of the household, and it was found that women with higher levels of education were significantly less likely to have had a cesarean delivery than women who had not completed high school.

Additional analyses were restricted to a subgroup of women meeting the following criteria: no previous cesarean delivery, a singleton fetus in a vertex presentation, a gestation of 37 weeks or more, and no absolute indication for a cesarean delivery. Of the covariates considered in the major analyses, only infant birth weight and maternal height affected the association between cesarean delivery and mother's education adjusted for age and parity. The indirect association between level of education and likelihood of cesarean delivery was most pronounced in both the low birth weight (less than 3000 grams) and the high birth weight (greater than 4000 grams) categories. Additional adjustment for birth weight, maternal height, and the interaction of birth weight and mother's education, further reduced the odds of a cesarean delivery for women with higher levels of education compared to those who had not completed high school.

The analyses to address the secondary objectives showed that after adjusting for the GNP of the mother's country of

origin and the interaction of GNP with mother's education, the odds of cesarean delivery in comparison to the reference category decreased and the corresponding confidence intervals expanded to include one. The results of additional exploratory analyses suggested that two of the proxy indicators of growth (increased size of the mother's family of origin and oral contraceptive use in adolescence among women with a late menarche) were associated with a greater likelihood of cesarean delivery.

5.2 Overall meaning of the findings

5.2.1 Socioeconomic differences are likely attributable to biological risk

The results of these analyses were consistent in not showing an increased risk of cesarean delivery among women categorized as being relatively higher on any of the scales of socioeconomic status considered.

Indeed the results suggest, but do not confirm, that women of lower socioeconomic status are generally at higher risk of a cesarean delivery, and that this is may be due to greater biological risk, although differences in obstetrical care, patient attitude and preference cannot be completely ruled out as having played a role.

Among women with singleton, term, vertex presentations, and whose babies were of "average" birth weight category (3000 to 4000 grams), the age and parity adjusted odds of cesarean delivery among women with higher

levels of completed education compared to women who had not completed high school were closer to one, or no association. However, in either of the extreme birth weight categories the previously observed lower risk among women with higher levels of education was more pronounced. In these circumstances that carry a higher risk to the fetus, women with a university education were less likely to be delivered by cesarean section. This may be because women with lower levels of education were at higher risk for other, concomitant reasons, such as intrauterine growth restriction, pregnancy induced hypertension, or more likely to experience a slow progress of labour because of disproportion.

When mother's height, infant's birth weight and the interaction of birth weight and education were controlled simultaneously with age and parity, the association between mother's level of education and the likelihood of cesaeran delivery was stronger, that is, women with higher levels of education were less likely to have a cesarean delivery than women with less than a high school education. When women with a university degree became the reference category, the only group that remained significantly different was the group of women with less than high school education, who were more than 6 times as likely to have a cesarean delivery than women with a university degree according to the point estimate of the odds ratio. In this population then, after adjustment for age, parity, height and birth weight, women

who had not completed high school were at much higher risk of cesarean delivery than other women, particularly when compared to women who had completed university. What distinguishes the group of women who had not completed high school is unknown. Further analyses suggested that these women may be at higher risk because of having experienced poor growth during childhood.

No association was found between risk of cesarean delivery and the woman's childhood socioeconomic circumstances, as measured by her father's education. However, control for GNP of country of origin was observed to decrease the association between mother' education and cesarean delivery, suggesting that women with less education who grew up in "poor" countries are at higher risk of cesarean section. The number of participants from these countries was small, precluding in-depth analyses of the reasons for their apparently greater risk. However, this variable was eliminated when entered into a backwards stepwise procedure when maternal height and infant birth weight were added to the model (section 4.6.2), suggesting that the increased risk observed for women with lower levels of education from "poor" countries may be explained by their stature, the infant's birth weight or a combination of the two. This is suggestive that environmental determinants of growth play a role.

An additional observation to support a belief that growth which has been inhibited because of poor nutrition

may increase risks of cesarean delivery is that an increase in the likelihood of cesarean delivery was associated with progressive increases in size of the mother's family during her childhood, but not with birth order. This suggests that influences on growth, such as growing up in a large family, may be determinants of risk of cesarean delivery.

Lastly, the observed association of oral contraceptive use among women with a late menarche was the result of an exploratory and highly stratified analysis. Although the results suggest that oral contraceptive use may retard pelvic growth in a way that leads to a higher risk of cesarean delivery[..], there were too few women in the category of late menarche and it was not possible to rule out confounding by age and parity. In addition, other factors were not measured that may have confounded the observed association as well.

5.2.2 Consideration of extraneous factors

Patient attitude and commitment to what has been termed "a politically correct vaginal delivery" (Molloy and Richardson, 1994) could have played a role if this attitude were more likely to be held by more highly educated women. Whether attitude towards a cesarean delivery played a

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[..] It is known that although growth in stature is nearly complete at the time of menarche, pelvic growth continues for a longer time (Moerman, 1982). Women experiencing menarche at earlier ages, however, are more likely to have completed their growth prior to the initiation of sexual activity. Women with later menarche are more likely to initiate sexual activity and, therefore, contraceptive use at a time when growth, particularly pelvic growth, is incomplete.

differential role among women with different levels of education is unknown for women who had not had a previous cesarean delivery. However, women with a previous cesarean delivery were asked about their attitudes towards a repeat cesarean delivery. The results suggest that women with higher levels of education were neither less likely to prefer a repeat procedure nor more willing to undertake a trial of labour (Section 4.6.1). Again, whether this attitudinal pattern would have been similar among women who had not had a previous cesarean delivery is unknown.

That none of the "management" variables that were measurable in this study had an impact on the observed association suggests that the application of "technology" and other management decisions did not differ by mother's education after adjusting for age and parity. This leads one to suspect that, in this population, women with different levels of education were not treated differently by their care providers or other hospital staff, nor did they apparently request or demand different treatment that resulted in a greater likelihood of cesarean delivery, use of epidural anaesthesia, monitoring, or weekday deliveries, aspects of care associated with the likelihood of cesarean delivery. This, therefore, does not support the often suggested but never proven contention that the likelihood of a cesarean delivery was increased because of the fear of malpractice litigation. This charge is often based on observations of higher rates of cesarean delivery among

presumably more affluent or better educated women. It is, therefore, reasoned that there is a fear among care providers that women who have the resources to engage in a litigation process would be more likely to sue in the event of an untoward outcome for the infant. Those who provided care to more affluent women or better educated women, therefore, are believed to be more likely to perform unnecessary cesarean deliveries to minimize risk to the fetus. In this study, however, women with lower levels of education had higher rates of cesarean delivery. Therefore, this reasoning does not hold, unless care providers might have been more concerned about being sued for performing a cesarean delivery rather than not performing one. It is not possible, however, to determine whether this could have been an influencing factor in the observed results.

To further underscore the absence of evidence that "technological" interventions or other extraneous factors influenced the differences in rates over levels of socioeconomic status, it was also observed that delivery at the tertiary facility where "technological" intervention could have been hypothesized to have been more likely, was not associated with greater odds of cesarean delivery among a "low risk" population of women.

In addition, components of what could be considered physician "practice style" (such as day of the week and electronic monitoring) did not have an impact on the association between cesarean delivery and mother's level of

education. It is also unlikely that individual physicians could have influenced the direction or magnitude of the observed association as participants' births were managed by more than 130 individual physicians, although perhaps groups of physicians who share particular characteristics may have treated women differently and/or have been more likely to have been selected as care providers depending on a woman's level of education. Such information was not available in the current investigation, however.

It would also have been interesting to have been able to assess the impact of prenatal care on the association between cesarean delivery and level of education, as amount of prior contact with the health care system and care providers may have had an impact on patient attitude, such as attitude towards vaginal birth after cesarean. However, information about prenatal care was not available for over 30 percent of the participants because the prenatal record was not included in the hospital chart.

Overall, however, the results of the exploratory analyses support an explanation that women with lower levels of education were possibly more likely to be delivered by cesarean section because of a likelihood of growth inhibition during childhood leading to difficulties during labour and delivery.

Current socioeconomic status may also be associated with current lifestyle practices which could also play an indirect role through increasing obstetric risk at various

times during pregnancy. Such factors may, therefore, also increase the likelihood of a cesarean delivery. These lifestyle choices were not considered, however, in the design of this study and also cannot be ruled out as having played a role in the observed results.

5.2.3 Comparison of the results of this investigation with previous investigations

The results of this investigation appear to differ from findings in previous investigations. Where previous investigators have not adjusted for any potential confounding factors, the observed association between cesarean delivery and indicators of socioeconomic status has been direct, and often significant with higher rates of cesarean delivery reported among women of upper socioeconomic status (Barros et al., 1991; Blumenthal et al., 1984; Haas et al., 1993; Janowitz et al., 1982, 1985; Renwick, 1991; Stafford et al., 1993; Zahniser, 1992; Zdeb and Logrillo, 1989). When previous investigators have adjusted simultaneously for extraneous factors, particularly maternal age, parity and previous cesarean delivery, observed direct associations have often disappeared (McCloskey et al., 1992; Parrish et al., 1994; Placek et al., 1983). In rare instances, the association has been observed to be indirect after adjustment (Parazzini et al., 1992; Tussing and Wojtowycz, 1992). The results of this study differ from results of previous investigations primarily in that no differences were observed in cesarean

section rates over indicators of socioeconomic status *before* adjustment for potential confounders, while adjustment for other potential confounders resulted in women with higher levels of education significantly *less* likely to have had a cesarean delivery compared to women who had not completed high school. These differences are likely to have been observed because two other extraneous factors were controlled in the design of the study, that have not been controlled in previous investigations. One is that the population definition excluded women likely to be referred in because of their high risk status and who might also be of higher socioeconomic status. Another is that all obstetrical services were available to this population of women; there was no reason that women of upper socioeconomic status, who would be more likely to have the necessary financial resources, would choose to leave the area to give birth elsewhere in order to have their preferences met. Thus risk, service availability, and socioeconomic differences were not likely to have been disproportionately greater or lesser as may have been the case in investigations where the population has not been as well defined and access is determined by ability to pay.

The results of the current investigation should not be taken as evidence that the equal access to obstetrical services provided by universal health insurance assures better or more appropriate obstetrical care than that obtained under other systems. It is possible that in other

populations without universal health insurance similar results might be observed if the study population were defined as in the study reported here and socioeconomic indicators were measured directly.

5.3 Limitations to generalizability

5.3.1 Participants versus non-participants

Although an attempt was made to include all eligible residents of the setting, some imbalance was observed between participants and non-participants over several of the available population characteristics. There was a higher response rate among women who delivered at the tertiary centre (80%) as compared to women who delivered at the community hospital (76.3%). This was because of the logistics of data collection; the tertiary facility was generally visited first each day. In addition women who had a cesarean delivery, a difficult vaginal delivery, or an infant in the neonatal intensive care unit, were more likely to have had a longer hospital stay, allowing these women more time to complete the questionnaire prior to leaving the hospital. These factors were likely responsible in turn for some of the imbalance in birth weight, maternal age and primiparity.

The significance of the Pearson's chi-square tests was influenced by the large sample size. The magnitude of the observed differences was small, however, and not likely to have a meaningful impact on either the generalizability or the interpretation of the study results.

5.3.2 Place, time and population characteristics

There are several elements unique to this population that affect the generalizability of findings. Among these are the level of service availability, the relatively low rate of cesarean section observed in this setting, the timing and knowledge of the study, the selected indicator of socioeconomic status, and possibly unknown characteristics of the population.

5.3.2.1 Service availability

The association between cesarean delivery and measures of socioeconomic status observed in this population cannot be generalized to settings without the level and availability of obstetric services of this community. In situations in which there may be proportionately less service, services may be differentially available, meaning that more affluent or better educated women might have better access to services, even in a system of universal health insurance. It would be beyond the scope of this study to determine whether during the course of this study the available physician time and the level of hospital service availability were adequate to meet the needs of this obstetric population. Available resources did not appear to be inadequate, but this could be an important factor to consider if similar studies were conducted in other communities or at other times even within a system of universal health insurance.

5.3.2.2 Low rate of cesarean delivery

The overall proportion of cesarean delivery appears to be relatively low compared to other Canadian settings. We know from previous investigations that the overall rate of cesarean delivery in Canada was reported to be approximately 18 to 20 percent in the early 1990s. The proportion of deliveries by cesarean in this population of residents of London, Ontario, at the time of the study was 11.6 percent among the participants and approximately 10.7 percent among both the participants and the non-participants, considerably lower than the Canadian rate. The relatively low rate of repeat cesarean deliveries may have had quite a large impact on the observed rate, however. Although the proportion of women in the population of participants who had a previous cesarean delivery is just over 10 percent, the likelihood of these women having a repeat cesarean delivery can have considerable impact on the resulting overall rate of cesarean delivery. In this population, even with no increase in the proportion of cesarean deliveries among women who had not had one previously (90 percent of the participants), the overall rate could be as high as 17.8 percent if all women with a previous cesarean delivery had had a repeat procedure. It has been found in previous investigations that higher rates of cesarean section are associated with lack of 24 hour blood bank services and anaesthesia support (Carpenter et al., 1987). In settings without these services, then, the rate of scheduled repeat

cesarean delivery may be higher than that observed here because care providers may prefer to schedule repeat cesareans to coincide with the hours when these services are available. Correspondingly higher rates of vaginal birth after cesarean are reported in institutions with a high degree of neonatal and obstetrical specialization (Goldman et al., 1993), such as the facilities in which this study was conducted.

5.3.2.3 Timing and knowledge of the study

This study was conducted during a period that immediately followed a provincial Ministry of Health review of the cesarean birth rates in Ontario, and the resulting recommendations for alternatives to cesarean birth in situations where these may be practised without compromise to the mother or the fetus (Ontario Ministry of Health, 1991). This review process was chaired by the chief of obstetrics and gynaecology at one of the two London hospitals where this study took place, and the medical community was likely aware of this. During this time, there were many media reports as well as reports in the medical literature that the cesarean section rate had risen to levels that were causing concern. Many of these reports contained speculations that these rates were "too high," and unjustified on the basis of necessity. It cannot be ruled out that knowledge of the study and/or the level of awareness and concern about cesarean delivery rates at the time of the study influenced the results in some way.

Table 5.1

Percent cesarean delivery in three time periods

Tertiary facility and London residents only

	Total Births		Primipars		Previous CS[b]	
Time Period	N	%CS	N	%CS	N	%CS
1990-1991	1707	15.3	789	17.7	158	53.2
1991-1992	1943	12.5	830	14.5	204	44.1
1992-1993	1930	13.8	909	15.4	174	46.0

[a] Time periods run from December to July, inclusive
[b] Women having one or more previous cesarean deliveries

To better understand whether these factors influence the results, cesarean section rates for the years preceding and following the study period were compared. The study was conducted between December, 1991 and July, 1992. Data from the corresponding months in the years preceding and following the study period were available from the tertiary facility only, however, knowledge of the study and the media reports could have influenced practice at either hospital. These data are presented in Table 5.1. Both the years preceding and following the study showed higher rates of cesarean delivery overall. Rates reported separately for primiparous women and women who had a previous cesarean delivery are also higher. This suggests that either the study, the media reports or the provincial review process could have influenced the rates at this facility. The increase in the year following the study could mean that care providers at this institution were not comfortable with practices that led to such low rates, or that there had been a strategy in place to reduce the rates during the study period that was subsequently changed or abandoned. However, two other explanations are also possible. One is that because a change in the organization of obstetrical services occurred, obstetricians with higher risk patients who had previously admitted these patients to the community hospital moved to the tertiary facility. Another is that the populations of women who delivered in the years preceding

and following the study period were in some way different and at higher risk. As can be seen in this case, characteristics of the population can be observed to vary from year to year even within the same institution. We can calculate from the information displayed in Table 5.1 that the percent of primiparas in the population changed from 46.2 percent in 1990-91 to 42.7 percent in 1991-92 and up to 47.1 percent in 1992-93. It is possible that the proportion of women with other underlying risks for cesarean delivery could have changed as well. Such possible explanations for differences are concealed by comparisons of rates by year.

5.3.2.4 Measurement of socioeconomic status and control for age and parity, and previous cesarean delivery

A second consideration is that the measurement of socioeconomic status has not and perhaps cannot be done consistently across studies. There is no objective measure of this concept making measurement imprecise and easily influenced by extraneous factors. Previous studies have suggested that the purchase of different forms of health insurance is associated with social class in some way. However, in obstetric populations, there is considerable opportunity to obtain better health insurance even prior to a planned conception. Women with a previous cesarean delivery who prefer a repeat procedure to deliver their next child, for example, may be more likely to purchase a health insurance plan allowing them more assurance that their choices will be honoured, or that they will have a private

room. Previous investigations using large aggregate data bases have often not reported the primary cesarean section rates separately from the rates among women with previous cesarean deliveries. This is because previous cesarean delivery is often not available or reliably recorded in these databases. As has been shown above, the likelihood of women in the population with previous cesarean deliveries having a repeat procedure can have a pronounced effect on the overall cesarean section rate. Secondly, age plays a role for every indicator of socioeconomic status. In the case of hospital insurance, it is the older, more established women who are able to afford this insurance. Younger people who are in and out of the work force to attend school, or because of insecure employment opportunities, are less likely to have expensive insurance plans. These younger women are also at less risk of cesarean delivery. Reporting cesarean section rates by type of hospital insurance without adjustment for these known confounders, therefore, can give extremely misleading results.

5.3.2.5 Unknown population differences

In addition, the characteristics of the population of women in London, Ontario, who gave birth during the time of the study may not be comparable to populations of women living in larger or smaller communities in other provinces or in other countries. That is, there may be reasons that women in London, Ontario with lower levels of education were

at greater risk of cesarean delivery in this setting that do not pertain in other communities.

5.3.2.6 To whom is this study generalizeable?

Given all of the above possible limitations to generalizeability, it is likely that we can generalize these findings to communities of similar size and ethnic composition where there is also the same level of availability of obstetrical facilities.

5.4 Recommendations

5.4.1 Further assessment is required of the role of demographic changes in the increase in cesarean section rate.

The low proportion of cesarean deliveries in the group of women under 20 years of age and the low rate overall among multiparas suggest that demographic changes may have had a more important role in the increase in cesarean section rates than has been previously acknowledged. Childbearing patterns have changed dramatically since the 1960's with widespread availability of contraceptives. Delayed childbearing and a lowered birth rate have become the norm, meaning an increase in: the proportion of women delivering their first child at ages at which the risk of cesarean delivery is greater; the proportion of primiparas in the population who are at much greater risk of cesarean delivery at all ages; and the proportion of women with a previous cesarean delivery, where even a small increase can affect the overall rate quite dramatically. The results of

a recent investigation in Washington State showed that if the current age, parity and birth weight distribution were identical to the distribution in that state in 1970, the expected *primary* cesarean section rate would be 12.2 percent (Parrish, et al, 1994). The observed primary cesarean section rate in Washington State was 14.8 percent, somewhat higher, but not as dramatic in comparison to the expected rate, as to the actual 1970 rate of approximately 5 percent.

There is an urgent need to assess the impact of the trend towards delaying childbearing beyond the late teens and early twenties, common in the years prior to the 1960s, on the rise in cesarean section rates observed in the last 25 years.Future comparison of cesarean section rates over time, as well as interpretations of previous reports of differences in cesarean section rates must consider these demographic changes.

5.4.2 Comparisons of cesarean section rates among socioeconomic groupings must be adjusted for age, parity and previous cesarean delivery

As has been demonstrated, any measures of socioeconomic status must be adjusted for age to provide meaningful comparisons. In the case of the association of cesarean delivery with socioeconomic indicators, health insurance, or public versus private care, investigators of differences in cesarean section rates must also adjust for previous cesarean section and parity. Investigations without adequate

adjustment for these factors should be disregarded or interpreted very cautiously.

5.4.3 Comparisons of cesarean section rates in general must be controlled for demographic factors.

Comparisons and the interpretations of comparisons of cesarean section rates among institutions, care providers, countries, regions, or any other strata must similarly take into account not only the potential differences in the distribution by age, parity, and previous cesarean delivery, but also the likely proportion of women who may have grown up under conditions of disadvantage. An estimate of this may be difficult, and, therefore, all such comparisons should be interpreted with caution.

5.4.4 The role of determinants of growth as risk factors for cesarean delivery should be investigated further

While the present investigation of factors that may inhibit growth was exploratory only and was not designed to control adequately for potentially confounding factors, there is sufficient reason to believe that environmental growth inhibition may increase the risk of cesarean delivery. This warrants further investigation

5.4.5 Recommendations regarding measurement of socioeconomic status in future investigations

It was found in this investigation that mother's education was the most appropriate measure of socioeconomic status in this obstetric population, but that adjustment for age is necessary when using this as an indicator. In future

investigations, it is recommended that questionnaires not request respondents to estimate their income unless this information is essential for other reasons. Moreover, in future investigations of the association between socioeconomic status measured by level of education and any health outcome among an adult population, participation might be restricted to those who could have completed all levels of education. Measurement of current socioeconomic status among adolescents and those too young to have had an opportunity to have completed their education is imprecise and perhaps not meaningful.

It would also be of benefit to future investigations among obstetric populations to include mother's education more consistently in hospital or antenatal records.

5.4.6 Making recommendations for targeted "optimal rates" of cesarean delivery is discouraged

Although there has been much discussion in the literature about "optimal" rates of cesarean delivery (Office of Vital and Health Statistics Systems, 1993; Peach, 1991;) as well as a World Health Organization recommendation to reduce rates of cesarean delivery to 15 percent by the year 2000 (World Health Organization, 1985), this should be re-considered. "Optimal" rates of cesarean delivery vary in an overt way with the demographic composition of the population, but also possibly vary with characteristics of the population that are impossible to measure or that are unknown at present.

5.5 Summary and conclusion

The strength of this study is that it was conducted in a setting with universal health insurance and included a total population of women giving birth. This allowed a greater degree of control than in previous investigations over some factors extraneous to risk of cesarean delivery for biological reasons, and a closer examination of others. In this setting, observed differences in cesarean section rates could not be due to women of different social classes having differential access to systems of obstetrical care. Neither would observed differences be due to women at higher risk being over- or under-represented in the population because they chose to travel elsewhere to obtain preferred services, or required transfer into or out of the study region or facility to obtain tertiary care.

Overall, it was found that women categorized as being of relatively higher socioeconomic status according to three indicators of this concept did not have a greater likelihood of cesarean delivery, and that after adjustment for maternal age, parity and previous cesarean delivery, women with higher levels of education were significantly less likely to have had a cesarean delivery than women who had not completed high school. The results of additional analyses suggested that women of lower socioeconomic status are likely at higher risk of cesarean delivery. Among the reasons for their greater risk may be poor nutrition and inhibition of growth during childhood.

Because there were factors that could have affected the generalizability of these results, further study of the association between cesarean delivery and measures of socioeconomic status in other similarly constituted populations in settings both with and without universal health insurance is recommended.

If cesarean section rates are to be compared across regions, facilities, care providers or type of health insurance or care, it is essential not only that these rates be adjusted for known confounding factors, but also that consideration be given to the possibility that these rates may differ due to other differences in underlying risk that perhaps cannot be measured. It is recommended that observations of higher rates among different groups not be used as evidence that cesarean deliveries are being done unnecessarily in these groups.

Lastly, it is strongly recommended that further assessment be made of the impact that demographic changes may have had on the observed increase in cesarean section rates observed over the past two and a half decades.

APPENDIX A

Formula for the sample size calculation

Formula for the sample size calculation

For the calculation of the sample size required to meet the primary study objectives, a formula for sample size calculation for observational studies was used (Freeman, 1984). It is assumed that the independent variable of interest is dichotomous. The formula is a follows:

$$n = \frac{\left[Z_\beta \sqrt{(1-f)P_1Q_1 + fP_2Q_2} + Z_\alpha \sqrt{\bar{P}\bar{Q}}\right]^2}{f(1-f)(P_1-P_2)^2}$$

where Z beta and Z alpha are the $(1-\beta)100$ and $(1-\alpha)100$ percentiles of the standard distribution[1]. Values for $P_1, P_2, Q_1, Q_2, \bar{P}$ and $\bar{P}$ and f are based on the following table:

		Outcome		
Group		Present	Absent	Total
1	(reference)	P_1	Q_1	$n_1 = fn$
2	(non-reference)	P_2	Q_2	$n_2 = (1-f)n$
Total		$\bar{P}$	$\bar{Q}$	n

The algebra required to obtain the values to be substituted into the formula is as follows:

$R = P_1 / P_2$

$\bar{P} = f\bar{P}_1 + (1 - f$

$P_1 = R\bar{P}/[1 + f(R-1)]$

$P_2 = P_1 / R$

[1] A two-tailed alpha equal to .05 and a beta equal to .20 have been used in the sample size calculation.

APPENDIX B

Letters of information and consent form

LETTER 1

(For patients at St. Joseph's Health Centre)

LETTER OF INFORMATION REGARDING A STUDY OF SOCIAL FACTORS AND CHILDBIRTH

What is the study about?

This is a study of family characteristics which are associated with childbirth. We are conducting this study at St. Joseph's Health Centre and Victoria Hospital. We want to know whether the cesarean birth rate differs among different socio-economic groups. If so, then knowledge about the make-up of the population in a particular place will be of use in planning obstetrical services and will also be useful in interpreting changes over time in cesarean birth rates. Some factors during childhood are known to be related to adult height and because of this they may also be related to labour progress. For other factors, the relationship is still unknown. You will, therefore, be asked some questions about yourself and your family while you were growing up.

What are we asking you to do?

We are asking all women who are residents of London, Ontario, and the surrounding area who give birth during this year to participate in this study. If you agree to participate, please sign the consent form, fill in the attached questionnaire and put both in the attached envelope. This will take approximately ten minutes. You may keep this letter. Also, if you have agreed to take part, we will record information about your labour and delivery (such as the length of each phase of your labour and the position of your baby before it was delivered) from your hospital chart.

Either an assistant or I will visit in a day or two. If you have decided to participate, one of us will pick up the envelope containing the questionnaire and consent form. If you wish further information before deciding whether or not to participate, we are happy to answer any questions. If you do not wish either of us to come to your room, you may use your call button and tell this to the nursing station and we will not come by.

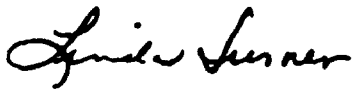
Whether or not you agree to take part in this study will in no way affect your medical care. You may refuse to answer any or all of the questions and may withdraw from the study at any time without jeopardy to your future care. Your name will not appear on any of the research forms and the information will be

(over, please)

completely confidential. When the results of this study are published, only a summary of all of the information from all of the women who take part will be reported.

If you have any questions regarding this study, please feel free to call me any time.

Sincerely,



Linda Turner, M.Ed.
Department of Epidemiology and Biostatistics
The University of Western Ontario
Phone: 661-2162

You are also free to contact any of the people listed below if you have additional questions.

Dr. M.K. Campbell, Ph.D.
Epidemiologist, Dept. of Obstetrics/Gynaecology
Lawson Research Institute
Phone: 439-3271 Ext 4775

Dr. J.K. Milne
Chief, Dept. of Obstetrics/Gynaecology
St. Joseph's Health Centre
Phone: 439-3271 Ext 4340

Dr. J.A. Silcox
Chief, Dept. of Obstetrics/Gynaecology
Victoria Hospital
Phone: 685-8176

Dr. J.L. Reynolds
Chief, Dept. of Family Medicine
St. Joseph's Health Centre
Phone: 439-3271

Thank-you very much for your time.

LETTER 2

(For patients at Victora Hospital)

LETTER OF INFORMATION REGARDING
A STUDY OF
SOCIAL FACTORS AND CHILDBIRTH

What is the study about?

This is a study of family characteristics which are associated with childbirth. We are conducting this study at St. Joseph's Health Centre and Victoria Hospital. We want to know whether the cesarean birth rate differs among different socio-economic groups. If so, then knowledge about the make-up of the population in a particular place will be of use in planning obstetrical services and will also be useful in interpreting changes over time in cesarean birth rates. Some factors during childhood are known to be related to adult height and because of this they may also be related to labour progress. For other factors, the relationship is still unknown. You will, therefore, be asked some questions about yourself and your family while you were growing up.

What are we asking you to do?

We are asking all women who are residents of London, Ontario, and the surrounding area who give birth during this year to participate in this study. If you agree to participate, please sign the consent form, fill in the attached questionnaire and put both in the attached envelope. This will take approximately ten minutes. You may keep this letter. Also, if you have agreed to take part, we will record information about your labour and delivery (such as the length of each phase of your labour and the position of your baby before it was delivered) from your hospital chart.

Either an assistant or I will visit in a day or two. If you have decided to participate, one of us will pick up the envelope containing the questionnaire and consent form. If you wish further information before deciding whether or not to participate, we are happy to answer any questions. If you do not wish either of us to come to your room, please put your room and bed number on the form labelled "Attention Study Coordinator" and give this to the nurse and we will not come by.

Whether or not you agree to take part in this study will in no way affect your medical care. You may refuse to answer any or all of the questions and may withdraw from the study at any time without jeopardy to your future care. Your name will not appear on any of the research forms and the information will be

(over, please)

completely confidential. When the results of this study are published, only a summary of all of the information from all of the women who take part will be reported.

If you have any questions regarding this study, please feel free to call me any time.

Sincerely,

Linda Turner, M.Ed.
Department of Epidemiology and Biostatistics
The University of Western Ontario
Phone: 661-2162

You are also free to contact any of the people listed below if you have additional questions.

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Phone: 685-8176

Dr. J.L. Reynolds
Chief, Dept. of Family Medicine
St. Joseph's Health Centre
Phone: 439-3271

Thank-you very much for your time.

Attention Study Coordinator

I do not wish to participate in the study of Social Factors and Childbirth.

Room Number _____

Bed Number _____

LETTER 3

(Special Circumstances)

LETTER OF INFORMATION REGARDING A STUDY OF SOCIAL FACTORS AND CHILDBIRTH

What is the study about?

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If you have decided to take part, you may either give the envelope to the nurse at the nursing station or when she comes to your room.

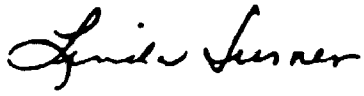
Whether or not you agree to take part in this study will in no way affect your medical care. You may refuse to answer any or all of the questions and may withdraw from the study at any time without jeopardy to your future care. Your name will not appear on any of the research forms and the information will be

(over, please)

completely confidential. When the results of this study are published, only a summary of all of the information from all of the women who take part will be reported.

If you have any questions regarding this study, please feel free to call me any time.

Sincerely,



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The University of Western Ontario
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Victoria Hospital
Phone: 685-8176

Dr. J.L. Reynolds
Chief, Dept. of Family Medicine
St. Joseph's Health Centre
Phone: 439-3271

Thank-you very much for your time.

Social Factors and Childbirth

CONSENT FORM

I (please print name)_____ have read the letter of information and agree to take part in the study. I have been given the opportunity to ask questions. I have been informed that some information from my hospital chart will be recorded for study purposes.

Signed _____ Date_____

***PLEASE PUT THIS FORM IN THE ENVELOPE WITH YOUR COMPLETED QUESTIONNAIRE IF YOU WISH TO TAKE PART.**

APPENDIX C

Study questionnaire and chart abstraction form

STUDY NUMBER _____

SOCIAL FACTORS RELATED TO CHILDBIRTH

AS YOU COMPLETE THESE QUESTIONS REMEMBER THAT ALL OF THE INFORMATION WILL BE KEPT COMPLETELY CONFIDENTIAL. NO RESULTS WILL BE RELEASED THAT COULD IDENTIFY YOU IN ANY WAY.
IF THERE ARE QUESTIONS WHICH YOU WOULD PREFER NOT TO ANSWER, PLEASE FEEL FREE TO LEAVE THEM BLANK.

THE FIRST GROUP OF QUESTIONS ARE ABOUT YOUR LABOUR AND DELIVERY. PLEASE ANSWER BY PLACING A CHECK MARK IN FRONT OF THE RESPONSE THAT APPLIES TO YOU.

1 *WAS THIS DELIVERY BY CESAREAN SECTION?*

___ YES ___ NO > *GO TO QUESTION 03*

2 *DID YOU EXPERIENCE ANY LABOUR PRIOR TO THIS CESAREAN DELIVERY?*

___ YES ___ NO > *GO TO QUESTION 05*

3 *APPROXIMATELY HOW LONG DID YOU LABOUR BEFORE GOING TO THE HOSPITAL?*

_____ HOURS

___ LABOUR BEGAN IN THE HOSPITAL

4 *WAS ANYONE WITH YOU IN THE HOSPITAL DURING YOUR LABOUR?*

___ NO

___ YES > *CHECK ALL THAT APPLY*

___ FATHER OF THE BABY

___ MY MOTHER

___ NURSE(S)

___ OTHER FRIEND OR RELATIVE

___ MIDWIFE

5 *HAVE YOU EVER HAD A CESAREAN DELIVERY PRIOR TO THIS BIRTH?*

___ YES ___ NO > *GO TO QUESTION 08*

6 *WHAT WAS THE REASON FOR YOUR PREVIOUS CESAREAN DELIVERY? (IF YOU HAVE HAD MORE THAN ONE, GIVE THE REASON FOR EACH)*

_____

_____

_____

_____

7 *FOR THIS DELIVERY, DID YOU CONSIDER HAVING A TRIAL OF LABOUR TO SEE IF IT WAS POSSIBLE TO DELIVER VAGINALLY THIS TIME? (CHECK THE RESPONSE WHICH IS CLOSEST TO YOUR FEELINGS DURING THE 1 WEEK BEFORE YOUR DELIVERY)*

___ YES, I WANTED A TRIAL OF LABOUR AND PLANNED TO HAVE ONE

___ YES, I WANTED A TRIAL OF LABOUR BUT PLANNED TO HAVE A REPEAT CESAREAN

___ NO, I DID NOT WANT A TRIAL OF LABOUR BUT PLANNED TO HAVE ONE ANYWAY

___ NO, I DID NOT WISH TO HAVE A TRIAL OF LABOUR AND PLANNED TO HAVE A REPEAT CESAREAN

___ I WAS UNDECIDED

___ DON'T KNOW

THE FOLLOWING QUESTIONS ARE ABOUT YOURSELF AND YOUR FAMILY

8 *WHAT IS YOUR DATE OF BIRTH?*

_____/_____/ 19_____
month day year

QUESTIONS CONTINUE ON THE BACK OF THIS PAGE

STUDY NUMBER _____

9. *WHAT IS YOUR HEIGHT?* _____

10. *WHAT WAS YOUR WEIGHT BEFORE YOU BECAME PREGNANT THIS TIME?* _____

11. *WHAT IS THE HEIGHT OF THE BABY'S FATHER?* _____

12. *IN WHAT COUNTRY WERE YOU BORN?*

____ CANADA > *GO TO QUESTION 014*

____ OTHER, PLEASE SPECIFY

_____

13 *IN WHAT YEAR DID YOU COME TO CANADA?*

19_____

14. *WHAT IS THE HIGHEST LEVEL OF EDUCATION YOU HAVE COMPLETED?*

____ 1. UNIVERSITY DEGREE

____ 2. DIPLOMA OR CERTIFICATE FROM COMMUNITY COLLEGE, CEGEP, NURSING, BUSINESS, TECHNICAL, OR VOCATIONAL SCHOOL

____ 3. SOME UNIVERSITY, COMMUNITY COLLEGE, TRADE OR TECHNICAL SCHOOL, ETC.

____ 4. SECONDARY/HIGH SCHOOL GRADUATION

____ 5. SOME SECONDARY SCHOOL

____ 6. ELEMENTARY

____ 7. NO SCHOOLING

15 *DURING THE 12 MONTHS BEFORE YOU BECAME PREGNANT, WHAT BEST DESCRIBES YOUR MAIN ACTIVITY?*

____ WORKING AT A JOB OR BUSINESS

____ LOOKING FOR WORK >*GO TO QUESTION 017*

____ A STUDENT > *GO TO QUESTION 017*

____ KEEPING HOUSE >*GO TO QUESTION 017*

____ OTHER > *GO TO QUESTION 017*

16 *WHAT KIND OF BUSINESS, INDUSTRY, OR SERVICE WAS THIS? (Eg. retail shoe store, school board)*

_____

_____

17 *WHAT KIND OF WORK DO YOU DO NOW? IF YOU ARE NOT PRESENTLY WORKING, WHAT KIND OF WORK DO YOU USUALLY DO? (Eg. store clerk, elementary school teacher, assembly work, etc.)*

_____

_____

THE FOLLOWING QUESTIONS ARE ABOUT YOURSELF AND YOUR FAMILY WHEN YOU WERE GROWING UP.

18. *WHAT TYPE OF WORK DID YOUR PARENTS DO AT ABOUT THE TIME THAT YOU WERE IN ELEMENTARY SCHOOL?*

FATHER _____

_____

MOTHER _____

_____

GO ON TO THE NEXT PAGE

STUDY NUMBER _____

19 *WHAT WAS THE HIGHEST LEVEL OF EDUCATION COMPLETED BY YOUR PARENTS? (USE THE NUMBER OF THE EDUCATION CATEGORY FROM QUESTION #14)*

FATHER _____

MOTHER _____

20 *HOW MANY CHILDREN LIVED IN YOUR HOUSEHOLD WHEN YOU WERE TWELVE YEARS OLD, INCLUDING YOURSELF?*

_____

21 *OF ALL OF THE CHILDREN BORN TO YOUR MOTHER AND FATHER, WHICH CHILD WERE YOU? FOR EXAMPLE, WERE YOU THE FIRST, SECOND, THIRD, ETC.?*

_____

22 *HOW OLD WERE YOU WHEN YOU HAD YOUR FIRST MENSTRUAL PERIOD?*

_____ YEARS OLD

23 *DID YOU TAKE BIRTH CONTROL PILLS EITHER AS A CONTRACEPTIVE OR TO REGULATE YOUR MENSTRUAL CYCLE PRIOR TO THE AGE OF 20?*

___ NO

___ YES, FOR LESS THAN 1 YEAR

___ YES, FOR 1 YEAR OR LONGER

24 *WITH WHOM DO YOU LIVE NOW?*

___ HUSBAND

___ PARTNER

___ LIVE ALONE > *GO TO #25, BACK, THIS PAGE*

___ LIVE WITH OTHER CHILDREN ONLY >*GO TO #25, BACK, THIS PAGE*

___ LIVE WITH ONE OR BOTH OF MY PARENTS > *GO TO #25, BACK, THIS PAGE*

___ LIVE WITH OTHER RELATIVES OR FRIENDS > *GO TO #25, BACK, THIS PAGE*

THE LAST FEW QUESTIONS ARE ABOUT YOUR HUSBAND OR PARTNER

25. *WHAT IS THE HIGHEST LEVEL OF EDUCATION YOUR HUSBAND OR PARTNER HAS COMPLETED?*

___ UNIVERSITY DEGREE

___ DIPLOMA OR CERTIFICATE FROM COMMUNITY COLLEGE, CEGEP, NURSING, BUSINESS TECHNICAL, OR VOCATIONAL SCHOOL

___ SOME UNIVERSITY, COMMUNITY COLLEGE, TRADE OR TECHNICAL SCHOOL, ETC.

___ SECONDARY/HIGH SCHOOL GRADUATION

___ SOME SECONDARY SCHOOL

___ ELEMENTARY

___ NO SCHOOLING

26 *DURING THE PAST 12 MONTHS, WHAT BEST DESCRIBES YOUR HUSBAND OR PARTNER'S MAIN ACTIVITY?*

___ WORKING AT A JOB OR BUSINESS

___ LOOKING FOR WORK

___ A STUDENT > *GO TO #28, BACK OF PAGE*

___ KEEPING HOUSE >*GO TO #28, BACK OF PAGE*

___ OTHER > *GO TO #28, BACK OF THIS PAGE*

27 *WHAT KIND OF BUSINESS, INDUSTRY OR SERVICE WAS THIS? (Eg. retail shoe store, school board)*

_____

_____

28 *WHAT KIND OF WORK DOES HE DO? IF HE IS NOT WORKING NOW, WHAT KIND OF WORK DOES HE USUALLY DO?*
(Eg. store clerk, elementary school teacher, police officer)

_____

_____

PLEASE TURN THE QUESTIONNAIRE OVER, THERE IS ONE MORE QUESTION ON THE BACK OF THIS PAGE.

STUDY NUMBER _____

29. *WHAT IS AN ESTIMATE OF YOUR TOTAL HOUSEHOLD INCOME IN 1991 BEFORE INCOME TAXES?*

____ PREFER NOT TO ANSWER	____ 45,000 - 54,999
____ LESS THAN $15,000	____ 55,000 - 64,999
____ 15,000 - 24,999	____ 65,000 - 74,999
____ 25,000 - 34,999	____ 75,000 - 84,999
____ 35,000 - 44,999	____ 85,000 OR OVER
	____ DON'T KNOW

• PLEASE PUT THIS FORM AND YOUR SIGNED CONSENT FORM IN THE ENVELOPE.
YOU MAY KEEP THE LETTER OF INFORMATION.
THANK-YOU VERY MUCH FOR YOUR ASSISTANCE WITH THIS STUDY.

Study number _____

Social Factors and Childbirth

Chart Abstraction Form

HOSPITAL _____ TRANSFER FROM ST. JOE'S _____ MOTHER'S POSTAL CODE _____

1. MOTHER: Age ___ Marital status _____ Gestation ___ Method to determine _____

Height _____ Weight _____ Pre-Preg. Wt _____

TPAL: T_____ P_____ A_____ L_____

PN Care: Week of first visit ____ Number of visits ___ K-Index ___

Accommodation requested at admission _____

2. INFANT: Multiple: 1 2 3 4 5 Plct. Wt. _____

Bwt 1._____ 2. _____ 3. _____ 4. _____ 5. _____

Fetal Outcome. Live ___ SB or NND (days) _____ Anomalies noted: Y N

3 AT ADMISSION: Time _____ Plan: Labour ___
Induction _____ (Go to #4)
Date _____ Elective C-Section ___ (Go to #5)

Indication _____

Dilatation ___ Effacement ___ Station ___ Membranes ____

4. ADMISSION TO DELIVERY:

A. Management

___ ARM (Time _____) ___ Syntocinon (Time _____) ___ Foley (Time _____)

___ Other _____ (Time _____)

___ Monitor (Time _____) ___ Epidural (Time _____) ___ Analgesia (Time _____)

B. Labour Start of active phase (Time noted _____)

Membrane rupture (Time _____) Full dilation (Time _____)

Indicators of Fetal Distress:

___ Meconium ___ FHR decelerations ___ Prolonged Bradycardia

C. Delivery Time _____ Date _____

___ Vaginal ___ C/S (Indication _____) ___ Forceps (Station _____)

5. FACTORS ASSOCIATED WITH MODE OF DELIVERY

Malposition/malpresentation (specify) _____

Uterus: previous c/s _____(number) other scar or anomaly _____

Antepartum hem: abruption _____ plac. previa _____

Toxemia _____ Diabetes _____ Prolapsed cord _____ Infection _____

IUGR _____ Other _____

APPENDIX D

Blishen scale and coding of occupations

Blishen Scale and Coding Occupations

The Blishen scale used in this investigation is a revision of previous indexes developed by Blishen (1958, 1967), Blishen and Carroll (1978) and Blishen and McRoberts (1976). This revision uses gender-specific median incomes taking into account the proportions of men and women in each occupation and is based on data from the 1981 Census of Canada. Blishen argued that this index would be appropriate for either gender (Blishen et al., 1987).

The scale is actually a composite measure that incorporates adjustment for the educational levels and the median incomes of persons holding similar positions. In constructing the scale, Blishen incorporated median income, education, and occupational prestige of 514 CCDO occupational unit group categories of the employed labour force as tabulated by Statistics Canada from the 1981 Census of Canada.

The 1981 version of the Blishen scale has been "calibrated" in a way that makes it somewhat consistent with earlier versions that relied more on judgements of occupational "prestige." Scores for each of the 514 occupations were derived using the following formula:

$$SES = 42.739 + 7.658\ \frac{(INC - 15140}{6971.4} + \frac{EDN - (-0.13491))}{0.47046}$$

where INC and EDN are the prevailing 1981 income and education levels for the occupation being scored, having taken into account gender-specific levels of income and

education and the proportion of men and women in each occupation. The intercept (42.739) and the slope (7.658) used in the equation are taken from a regression of the occupational prestige of 75 occupations using an occupational prestige scoring system by Pineo and Porter (1967) on the standard-scored income and education indicators for these occupations. The other values in the equation are the mean of the pooled median income for men and women across the 514 occupations in 1981 ($15,140) and the mean of the net proportions of well-education men and women in the occupations (-0.13491). The denominators (6971.4 and 0.47046) are the respective standard deviations. The resulting Blishen scores over the 514 occupations have a mean of 42.74, a standard deviation of 13.28, and range from 17.81 to 101.74

To code occupations as described by the respondent, directions given in The Canadian Classification Dictionary of Occupations (CCDO) were followed. The CCDO contains both an alphabetical listing of occupations as well as hierarchical listings or specific occupational titles such as barber, dentist, sales manager, etc. These specific occupational titles are termed "unit groups" and are each assigned a four digit code. Occupations that could not be located in the alphabetical listing were located using the hierarchical categories by looking under the major classification headings and then locating the more specific unit group that contained the individual occupation

described by the respondent. Occupations that were not a close match to the CCDO description were given the code supplied by the closest "residual" category. These categories are provided by the CCDO to allow coding of occupations that cannot be satisfactorily classified using the hierarchical structure of the major, minor, and unit groups.

APPENDIX E

Cesarean delivery by mother's education stratified by age and parity. Assessment of associations

Table E.1

Percent of deliveries by cesarean section
by mother's education within age groups

PRIMIPARAS

	AGE GROUP									
	16-19		20-24		25-29		30-34		35 & UP	
MOTHER'S EDUCATION	(N)	% CS	(N)	% CS	(N)	% CS	(N)	% CS	(N)	% CS
University Degree	(0)	0.0	(8)	25.0	(128)	12.5	(83)	7.2	(26)	23.1
Post Secondary	(2)	0.0	(96)	14.6	(206)	15.0	(89)	13.5	(21)	19.0
High School Grad	(25)	0.0	(82)	8.5	(65)	21.5	(34)	17.6	(7)	57.1
Less then HS Grad	(71)	5.6	(40)	12.5	(8)	37.5	(9)	33.3	(2)	50.0
ALL LEVELS	(98)	4.1	(226)	12.4	(407)	15.7	(215)	12.6	(56)	26.8

Table E.2

Percent of deliveries by cesarean section
by mother's education within age groups

MULTIPARAS

No previous cesarean deliveries

	AGE GROUP									
	16-19		20-24		25-29		30-34		35 & UP	
MOTHER'S EDUCATION	(N)	% CS	(N)	% CS	(N)	% CS	(N)	% CS	(N)	% CS
University Degree	(0)	0.0	(1)	0.0	(57)	3.5	(125)	1.6	(54)	1.9
Post Secondary	(0)	0.0	(36)	0.0	(195)	2.6	(179)	0.0	(47)	6.4
High School Grad	(2)	0.0	(51)	3.9	(103)	2.9	(85)	0.0	(26)	11.5
Less then HS Grad	(9)	0.0	(67)	1.5	(32)	6.3	(32)	9.4	(9)	11.1
ALL LEVELS	(11)	0.0	(155)	1.9	(387)	3.1	(421)	1.2	(136)	5.9

Table E.3

Assessment of the effects of age, parity and the interactions of age and parity on the association between cesarean delivery and mother's education

EDUC-ATION	N	Model 1 Odds Ratio (95% CI)	Model 2 Odds Ratio (95% CI)	Model 3 Odds Ratio (95% CI)	Model 4 Odds Ratio (95% CI)	Model 5 Odds Ratio (95% CI)	Model 6 Odds Ratio (95% CI)
Univ	482	0.87 (0.50,1.51)	0.66 (0.36,1.23)	0.81 (0.46,1.42)	0.31 (0.16,0.60)	0.69 (0.30,1.59)	0.44 (0.14,1.40)
Post	871	0.96 (0.59,1.57)	0.73 (0.42,1.26)	0.94 (0.57,1.56)	0.41 (0.23,0.74)	0.30 (0.00,8070.0)	0.36 (0.13,1.02)
HS Grad	480	0.98 (0.57,1.69)	0.79 (0.45,1.39)	1.02 (0.59,1.78)	0.55 (0.30,1.01)	0.35 (0.02,5.85)	0.62 (0.22,1.76)
< HS	279	1.00 -	1.00 -	1.00 -	1.00 -	1.00 -	1.00 -
-2 LL*		1162.66	1143.04	1063.30	1025.21	1127.83	1059.23
df		3	7	4	8	18	7

* -2 X Log Likelihood

Variables in the Models

Model 1: Education

Model 2: Education, Age

Model 3: Education, Parity

Model 4: Education, Age, Parity

Model 5: Education, Age, Age x Education

Model 6: Education, Parity, Parity x Education

REFERENCES

Abramson JH, Gofin R, Habib J, Pridan H, Gofin J. Indicators of social class. Soc Sci Med 1982; 16: 1739-1746.

Adashek JA, Peaceman AM, Lopez-Zeno JA, Minogue JP, Socol ML. Factors contributing to the increased cesarean birth rate in older parturient women. Am J Obstet Gynecol 1993; 169: 936-940.

Alberman E. Are our babies becoming bigger? J Roy Soc Med 1991; 84: 257-260.

American College of Obstetrics and Gynaecologists. Guidelines for vaginal delivery after cesarean birth. American College of Obstetrics and Gynaecology Committee Opinion 1988; 64.

Anderson GM, Lomas J. Explaining variations in cesarean section rates: patients, facilities or policies? Can Med Assoc J 1985; 132: 253-259.

Anderson GM, Lomas J. Determinants of the increasing cesarean birth rate: Ontario data 1979 to 1982. N Engl J Med 1984; 311: 887-892.

Auer, L., Canadian Hospital Costs and Productivity. Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, 1987.

Avard DM, Nimrod CM. Risks and benefits of obstetric epidural analgesia: a review. Birth 1985; 12(4): 215-225.

Baird D. Epidemiologic patterns over time. In Reed DM and Stanley FJ (Eds). Urban & Schwartzenberg, Inc., Baltimore, 1977.

Baird D. The interplay of changes in society, reproductive habits, and obstetric practice in Scotland between 1922 and 1972. Brit J Prev Soc Med 1975; 29: 135-146.

Baird D. Cesarean section: its use in difficult labour in primigravidae. Brit Med J 1955; 2: 1159-1163.

Baird D, Thompson AM, Duncan EHL. The causes and prevention of stillbirths and first week deaths. Part II: evidence from Aberdeen clinical records. J. Obstet Gynaecol Brit Emp 1953; 60: 17-30.

Barker DJP and Osmond C. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. Lancet 1986; 1: 1077-1081.

Barros FC, Vaughan JP, Victora CG, Huttly SRA. Epidemic of caesarean sections in Brazil. Lancet 1991; 338: 167-169.

Baskett TF. Cesarean section: what is an acceptable rate. (editorial).Can Med Assoc J 1978; 118: 1019-1020.

Baskett TF, McMillen RM. Cesarean section: trends and morbidity. Can Med Assoc J 1981; 125: 723-726.

Bergsjø P, Schmidt E, Pusch D. Differences in the reported frequencies of some obstetrical interventions in Europe. Brit J Obstet Gynaecol 1983; 90: 628-632.

Bertollini R, DiLallo D, Spadea T, Perucci C. Cesarean section rates in Italy by hospital payment mode: an analysis based on birth certificates. Am J Public Health 1992; 82: 257-261.

Blickstein I, Lancet M, Kessler I. Re-evaluation of the obstetrical risk for the older primipara. Int J Gynaecol Obstet 1987; 25: 107-112.

Blishen BR. A socio-economic index for occupations in Canada. Canad Rev Soc & Anth 1967; 4: 41-52.

Blishen BR. The construction and use of an occupational class scale. Canad J Econ & Pol Sci 1958; 24: 519-531.

Blishen BR and Carroll WK. Sex differences in a socio-economic index for occupations in Canada. Canad Rev Soc & Anth 1978; 15: 352-371.

Blishen BR, Carroll WK, Moore C. The 1981 socioeconomic index for occupations in Canada. Canad Rev Soc & Anth 1987; 24(4): 465-488.

Blishen BR, McRoberts H. A revised socioeconomic index for occupations in Canada. Canad Rev Soc & Anth 1976; 13: 71-79.

Blumenthal NJ, Harris RS, O'Connor MC, Lancaster AL. Changing caesarean section rates experience at Sydney obstetric teaching hospital. Aust NZ J Obstet Gynaec 1984; 24: 246-251.

Bodmer B, Benjamin A, McLean FH, Usher RH. Has use of cesarean reduced the risks of delivery in breech presentation? Am J Obstet Gynecol 1986; 154: 244-250.

Borten M. Breech presentation. In Cohen WR, Acker DB, and Friedman EA (Eds), Management of Labor, 2nd Edition, Aspen Publishers, Rockville, Md., 1989.

Bottoms SF, Rosen MG, Sokol RJ. The increase in the cesarean birth rate. New Eng J Med 1980; 302(10): 559-563.

Boyd ME, Usher RH, McLean FH, Norman BE. Failed forceps. Obstet Gynecol 1986; 68: 779-783.

Browning EB. Sonnets from the Portuguese and Other Poems, 1844, 1850, Dolphin Books, Garden City, N.Y.

Carpenter MW, Soule D, Yates WT, Meeker CI. Practice environment is associated with obstetric decision making regarding abnormal labor. Obstet Gynecol 1987; 70: 657-62.

Catalano PM, Merritt AO, Mead PB. Incidence of genial herpes simplex virus at the time of delivery in women with known risk factors. Am J Obstet Gynecol 1991; 164: 1303-1306.

Chazotte C and Cohen WR. Catastrophic complications of previous cesarean section. Am J Obstet Gynecol 1990; 163: 738-742.

Clark S, Koonings P, Phelan J. Placenta previa/accreta and prior cesarean section. Obstet Gynecol 1985; 66: 88-92.

Cohen WR, Newman L, Friedman EA. Risk of labor abnormalities with advancing maternal age. Obstet Gynecol 1980; 55(4): 414-416.

Consensus Conference Report. Indications for cesarean section: final statement of the panel of the national consensus conference on aspects of cesarean birth. Can Med Assoc J 1986; 134: 1348-1352.

Conte FA, Grumbach MM. Estrogen use in children and adolescents: a survey. Pediatrics 1978; 62 suppl: 1091-7.

Crawford JD. Treatment of tall girls with estrogen. Pediatrics 1978;62 suppl:1189-95.

Dean AD, Dean JA, Burton JH, Dicker RC. Epi Info, Version 5: a work processing, database, and statistics program for epidemiology on micro-computers. Centers for Disease Control, Atlanta, Georgia, U.S.A., 1990.

Delgado LR, Nieto F, Diaz AG, Schwarcz R. Cesarean section and maternal age in low-risk nulliparas. Int J Gynecol Obstet 1991; 36: 271-276.

DeMott RK and Sandmire HF. The Green Bay cesarean section study. I. The physician factor as a determinant of cesarean birth rates. Am J Obstet Gynecol 1990; 162: 1593-1602.

DeMott RK and Sandmire HF. The Green Bay cesarean section study. II. The physician factor as a determinant of cesarean birth rates for failed labor. Am J Obstet Gynecol 1992; 166: 1799-1810.

Douglas RG, Birnbaum SJ, MacDonald FA. Pregnancy and labor following cesarean section. Am J Obstet Gynecol 1963; 86:961-71.

Dunkley G and Stewart PJ. Antenatal care utilization among high-risk groups is Ottawa-Carleton. Final report, 1984 (Unpublished document).

Ekblad U and Grenman S. Maternal weight, weight gain during pregnancy and pregnancy outcome. Int J Gynecol Obstet 1992; 39: 277-283.

Evans MI, Richardson DA, Sholl JS, Johnson BA. Cesarean section: assessment of the convenience factor. J Reprod Med 1984; 29(9): 670-676.

Evrard JR and Gold EM. Cesarean section and maternal mortality in Rhode Island; incidence and risk factors, 1965-1975. Obstet Gynecol 1977; 50(5): 594-597.

Evrard JR, Gold EM, Cahill TF. Cesarean section; a contemporary assessment. J Reprod Med 1980; 24(4): 148-152.

Flanagan TA, Mulchahey KM, Korenbrot CC, Green JR, Laros RK. Management of term breech presentation. Am J Obstet Gynecol 1987; 156: 1492-1502.

Fleischman AR and Rhoden K. Ethical dilemmas in labor management. In Cohen WR, Acker DB, and Friedman EA (Eds), Management of Labor, 2nd Edition, Aspen Publishers, Rockville, Md., 1989.

Fraser W, Usher RH, McLean FH, Bossenberry C, Thomson ME, Kramer MS, et al. Temporal variation in rates of cesarean section for dystocia: does "convenience" play a role? Am J Obstet Gynecol 1987; 156: 300-304.

Friedman EA. Effects of labor and delivery procedures on the fetus. In Cohen WR, Acker DB, and Friedman EA (Eds), Management of Labor, 2nd Edition, Aspen Publishers, Rockville, Md., 1989.

Garel M, Lelong N, Marchand A, Kaminski M. Psychosocial consequences of caesarean childbirth: a four-year follow-up study. Early Human Development 1990; 21: 105-114.

Goldman G, Pineault R, Potvin L, Blais R, Bilodeau H. Factors influencing the practice of vaginal birth after cesarean section. Am J Public Health 1993; 83: 1104-1108.

Gordon D, Milberg J, Daling J, Hickok D. Advanced maternal age as a risk factor for cesarean delivery. Obstet Gynecol 1991; 77: 493-497.

Gortmaker SL. The effects of prenatal care upon the health of the newborn. Am J Public Health 1979; 69(7): 653-660.

Gould JB, Davey B. Stafford RD. Socioeconomic differences in rates of cesarean section. N Engl J Med 1989; 321: 233-239.

Green JE, McLean F, Smith LP, Usher R. Has an increased cesarean section rate for term breech delivery reduced the incidence of birth asphyxia, trauma, and dearh? Am J Obstet Gynecol 1982; 142: 643-648.

Green JM, Coupland VA, Kitzinger JV. Expectations, experiences, and psychological outcomes of childbirth: a prospective study of 825 women. Birth 1990; 17(1): 15-24.

Greenland S. Modeling and variable selection in epidemiologic analysis. Am J Public Health 1989; 79: 340-349.

Gribble RK and Meier PR. Effect of epidural analgesia on the primary cesarean rate. Obstet Gynecol 1991; 78: 231-234.

Guillemette J and Fraser WD. Differences between obstetricians in caesarean section rates and the management of labour. Brit J Obstet Gynaecol 1992; 99: 105-108.

Gunn, ADG. The impact of social changes due to the pill. In: Oral contraception in perspective. Canforth: the Parthenon Publishing Group Ltd., 1987: 39-43.

Haas JS, Udvarhelyi S, Epstein AM. The effect of health coverage for uninsured pregnant women on maternal health and the use of cesarean section. JAMA 1993; 270: 61-64.

Haddad H and Lundy LE. Changing indications for cesarean section: a 38-year experience at a community hospital. Obstet Gynecol 1978; 51(2): 133-137.

Hall MH, Campbell DM, Fraser C, Lemon. Mode of delivery and future fertility. Brit J Obstet Gynaecol 1989; 96: 1297-1303.

Harrison KA. Predicting trends in operative delivery for cephalopelvic disproportion in Africa. (letter) Lancet 1990; 335: 861-862.

Haynes de Regt RH, Minkoff HL, Feldman J, Schwarz RH. Relation of private or clinic care to the cesarean birth rate. N Engl J Med 1986: 315: 619-24.

Hobbins JC, Freeman R, Queenan JT. The fetal monitoring debate [editorial]. Obstet Gynecol 1979; 54: 103-9.

Hofmann AD. Contraception in adolescence: a review. 2. Biomedical aspiects. Bull World Health Organ 1984; 62(2): 331-44.

Hosmer DH and Lemeshow S. Applied Logistic Regression. John Wiley & Sons, New York, 1989.

Huchcroft SA, Wearing MP, Buck CW. Late results of cesarean and vaginal delivery in cases of breech presentation. CMAJ 1981; 125: 726-730.

Hughey MJ, LaPata RE, McElin TW, Lussky R. The effect of fetal monitoring on the incidence of cesarean section. Obstet Gynecol 1977; 49(5): 513-518.

Institute of Medicine. Preventing Low Birthweight. National Academy Press, Wash. D.C., 1985.

Janowitz B, Nakamura MS, Lins FE, Brown ML, Clopton D. Cesarean section in Brazil. Soc Sci Med 1982; 16: 19-25.

Janowitz B, Rodriques W, Covington DL, Arruda JM, Morris L. Cesarean delivery in Northeast region of Brazil, 1978-80. Am J Public Health 1985; 75: 560-562.

Johnson JWC, Longmate JA, Frentzen B. Excessive maternal weight and pregnancy outcome. Am J Obstet Gynecol 1992; 167: 353-372.

Kajonoja P. Pregnancy at age 40 and over. Obstet Gynecol 1978; 51: 47-51.

Katz VL and Cefalo RL. History and evolution of cesarean delivery. In Phelan JP and Clark SL (eds), Cesarean Delivery, Elsevier Science Publishing, Inc. New York, 1988.

Kazandijan VA, Summer SJ. Cesarean section guidelines: the Maryland experience. (letter). JAMA 1990; 263(11): 1491.

Kazandijan VA, Summer SJ. Evaluating the appropriateness of care: a study of cesarean section rates. QRB July 1989: 206-214.

Keller W and Fillmore CM. Prevalence of protein-energy malnutrition. Wld Hlth Statist Quart 1983; 36: 129-140.

Kessler I, Lancet M, Borenstein R, Steinmetz A. The problem of the older primipara. Obstet Gynecol 1980; 56(2): 165-169.

Kirk EP, Doyle KA, Leigh J, Garrard ML. Vaginal birth after cesarean or repeat cesarean section: medical risks or social realities. Am J Obstet Gynecol 1990; 162: 1398-1405.

Kirsop R, Jenkins GJ, Saunders DM. The influence of maternal age on caesarean section rates. Aust NZ J Obstet Gynaecol 1992; 32(3): 206-207.

Kirz DS, Dorchester W, Freeman RK. Advanced maternal age: the mature gravida. Am J Obstet Gynecol 1985; 152: 7-12.

Kuh D and Wadsworth M. Parental height: childhood environment and subsequent adult height in a national birth cohort. Int J Epidemiol 1989; 18(3): 663-668.

Leyland A. Socioeconomic and racial differences in obstetric procedures. (letter). Am J Public Health 1993; 83(8): 1178-1179.

Libertos P, Link BG, Kelsey JL. The measurement of social class in epidemiology. Epidemiol Rev 1988; 10: 87-121.

Lilford RJ, Van Coeverden de Groot HA, Moore PJ, Bingham P. The relative risks of caesarean section (intrapartum and elective) and vaginal delivery: a detailed analysis to exclude the effects of medical disorders and other acute pre-existing physiological disturbances. Brit J Obstet Gynaecol 1990; 97: 883-892.

LoCicero AK. Explaining excessive rates of cesareans and other childbirth interventions: contributions from contemporary theories of gender and phychosocial development. Soc Sci Med 1993; 37(10): 1261-1269.

Lomas J, Enkin M. Variations in operative delivery rates. In Chalmers I, Enkin M, Keirse M (eds), Effective Care in Pregnancy and Childbirth, Vol. 2. Oxford University Press, New York, 1989.

Mabie WC. Placenta Previa. Clin Perinatol 1992; 19(2): 425-435.

Mahmood TA, Campbell DM, Wilson AW. Maternal height, shoe size, and outcome of labour in white primigravidas: a prospective anthropometric study. Brit Med J 1988; 297: 515-517.

Marieskind HI. An Evaluation of Cesarean Section in the United States. Washington D.C. Department of Health Education and Welfare, 1979.

Marieskind HI. Cesarean section in the United States: has it changed since 1979? Birth 1989; 16(4): 196-202.

McCloskey L, Petitti DB, Hobel CJ. Variations in the use of cesarean delivery for dystocia: lessons about the source of care. Med Care 1992; 30: 126-135.

Minister of Supply and Services. Canadian Classification and Dictionary of Occupations (Eighth edition). Canadian Government Publishing Centre, Ottawa, 1987.

Moerman ML. Growth of the birth canal in adolescent girls. Am J Obstet Gynecol 1982; 143: 528-32.

Molloy D and Richardson P. Caesarean section-public versus private. Why the differential? A reply to Obstetric intervention and the economic imperative. (letter). Brit J Obstet Gynaecol 1994; 101(1): 88-89.

Mueller CW and Parcel TL. Measures of socioeconomic status: alternatives and recommendations. Child Development 1981; 52: 13-30.

Nair C. Trends in cesarean deliveries in Canada. Health Rep 1991;3(3):203-19.

National Institutes of Health. Consensus Development Statement on Cesarean Childbirth (NIH Publ. 82-2067). U.S. Department of Health and Human Services, Bethesda, Md., 1981.

Neuhoff D, Burke S, Porreco RP. Cesarean birth for failed progress in labor. Obstet Gynecol 1989; 73: 915-920.

Neutra RR, Greenland S, Friedman EA. Effect of fetal monitoring on cesarean section rates. Obstet Gynecol 1980; 55

Newton ER, Higgins CS. Factors with hospital-specific cesarean birth rates. J Reprod Med 1989; 34(6): 407-411.

Norusis/SPSS Inc. SPSS/PC+ Base System User's Guide, Version 5.0. SPSS Inc., Chicago, 1992.

Notzon FC, Palcek PJ, Taffel SM. Comparisons of national cesarean-section rates. N Engl J Med 1987; 316(7): 386-389.

Notzon FC. Internation differences in the use of obstetric interventions. JAMA 1990; 263(24): 3286-3291.

Notzon FC, Cnattingius S, Bergsjo P, Cole S, Taffel S, Irgens L, Daltveit K. Cesarean section delivery in the 1980s: International comparison by indication. Am J Obstet Gynecol 1994; 170: 495-504.

Office of Vital and Health Information Systems. Rates of cesarean delivery-United States, 1991. JAMA 1993; 269(18): 2360.

Ontario Ministry of Health. Provincial Perinatal Information System, Ontario Ministry of Health, Toronto, 1987.

Ontario Ministry of Health. Appropriate use of cesarean section. Recommendations for a quality assurance program. Ontario Ministry of Health, Toronto, 1991.

Oxorn H. Human Labor and Birth, 5th edition, Appleton-Century Crofts, Norfolk, Ct, 1986.

Parker JD and Abrams B. Prenatal weight gain advice: an examination of the recent prenatal weight gain recommendations of the Institute of Medicine. Obstet Gynecol 1992; 79: 664-669.

Parazzini F, Pirotta N, Vecchia CL, Fedele L. Determinants of caesarean section rates in Italy. Brit J Obstet Gynaecol 1992; 99: 203-206.

Parrish KM, Holt VL, Easterling TR, Connell FA, LoGerfo JP. Effect of changes in maternal age, parity, and birth weight distribution on primary cesarean delivery rates. JAMA 1994; 271: 443-447.

Parsons MT, Winegar A, Siefert L, Spellacy WN. Pregnancy outcomes in short women. J Reprod Med 1989; 34: 357-361.

Paul RH. Reducing the cesarean delivery rate. In Phelan JP and Clark SL (eds), Cesarean Delivery, Elsevier Science Publishing, Inc. New York, 1988.

Peach CA. Cesarean section rates. (letter). JAMA 1991; 265(5): 595-596.

Peck AMN and Vagero D. Adult body height and childhood socioeconomic group in the Swedish population. J Epidemiol Com Health 1987; 41: 333-337.

Peck RE, Chuang M, Robbins GE, Nichman MZ. Nutritional status of Southeast Asian refugee children. Am J Public Health 1981. 71: 1144-1148.

Peipert JF and Bracken MB. Maternal age: an independent risk factor for cesarean delivery. Obstet Gynecol 1993; 81: 200-205.

Perlow JH, Morgan MA, Montgomery D, Towers CV, Porto M. Perinatal outcome in pregnancy complicated by massive obesity. Am J Obstet Gynecol 1992; 167: 958-962.

Pettiti DB, Cefalo RC, Shapiro S, Whalley P. In-hospital maternal mortality in the United States: time trends and relation to method of delivery. Obstet Gynecol 1981: 59: 6-12.

Phillips RN, Thornton J, Gleicher N. Physician bias in cesarean sections. JAMA 1982; 248: 1082-1084.

Phillips LS, Vassilopoulou-Sellin R. Somatomedins. Parts 1 and 2. N Engl J Med 1980; 302: 371-80, 438-46.

Pineo PC and Porter J. Occupational prestige in Canada. Canad Rev Soc & Anth 1967; 24(4): 24-40.

Pineo PC, Porter J, McRob_rts HA. The 1971 census and the socioeconomic classification of occupations. Rev Canad Soc & Anth 1977; 14(1): 91-102.

Placek PJ and Taffel SM. Recent patterns in cesarean delivery in the United States. Obstet Gyn Clin NA 1988; 15: 607-627.

Placek PJ, Taffel SM, Keppel KG. Maternal and infant characteristics associated with cesarean section delivery. Health United States 1983. DHHS Pub. No. (PHS) 84-1232. Hyattsville, Md: National Center for Health Statistics, Dec. 1983; 39-44.

Placek PJ. Type of delivery associated with social and demographic, maternal health, infant health, and health insurance factors: findings from the 1972 U.S. National Natality Survey. Proceedings of the Social Statistics Section, 1977, Part II. Washington DC, American Statistical Association 1978: 608-613.

Richards MPM. The induction and acceleration of labour: some benefits and complications. Early Human Dev 1977; 1(1): 3-17.

Reid AJ, Carroll JC, Ruderman J, Murray MA. Differences in intrapartum obstetric care provided to women at low risk by family physicians and obstetricians. CMAJ 1989; 140: 625-633.

Renwick MY. Cesarean section rates, Australia 1986: variations at state and small area level. Aust NZ Obstet Gynaecol 1989; 29: 99-106.

Rock SM. Malpractice premiums and primary cesarean section rates in New York and Illinois. Public Health Reports 1988; 103(5): 459-463.

Sakala C. Medically unnecessary cesarean section births: introduction to a symposium. Soc Sci Med 1993; 37(10): 1177-1198.

Schumacher LB, Pawson G, Kretchmer N. Growth of immigrant children in the newcomer schools of San Francisco. Pediatrics 1987; 80: 861-868.

Scott RT, Strickland DM, Hankins GDV, Gilstrap LC. Maternal height and weight gain during pregnancy as risk factors for cesarean section. Milit Med 1989; 154(7): 365-367.

Seeds JW, Cefalo RC. Malpresentations. Clin Obstet Gynecol 1982; 25(1): 145-155.

Seiler JS. The demise of vaginal operative obstetrics: a suggested plan for its revival. Obstet Gynecol 1990; 75: 710-713.

Seitchik J, Holden AEC, Castillo M. Spontaneous rupture of the membranes, functional dystocia, oxytocin treatment, and the route of delivery. Am J Obstet Gynecol 1987; 156: 125-130.

Silins J, Semenciw RM, Morrison HI, Lindsay J, Sherman GJ, Mao Y, Wigle DT. Risk factors for perinatal mortality in Canada. Can Med Assoc J 1985; 133: 1214-1219.

Silver L, and Wolfe SM. Unnecessary Cesarean Sections: How to Cure a National Epidemic. Washington, DC: Public Citizen Health Research Group, 1989.

Simini F, Maillard F, Breart G. Cesarean section odds ratios. Eur J Obstet Gynecol Rep Bio 1990; 34: 1-13.

Sokol RJ, Rosen MG, Bottoms SF, Chik L. Risks preceding increased primary cesarean birth rates. Obstet Gynecol 1982; 59: 340-346.

Stafford RS. Cesarean section use and source of payment: an analysis of California hospital discharge abstracts. Am J Public Health 1990; 80: 313-315.

Stafford RS. The impact of nonclinical factors on repeat cesarean section. JAMA 1991; 265(1): 59-63.

Stafford RS, Sullivan SD, Gardner LB. Trends in cesarean section use in California, 1983 to 1990. Am J Obstet Gynecol 1993; 168: 1297-1302.

Statistics Canada. Population and Dwelling Characteristics - Census Divisions and Subdivisions, Ontario: Parts 1 and 2, 1986 Census. Ministry of Supply and Services Canada, Ottawa, 1986.

Statistics Canada, 1991. In Teahen, Kelly. So, are you in the money? -depends where you live. London Free Press, July 29, 1992.

Stephenson PA, Bakoula C, Hemminki E, et al. Patterns of use of obstetrical interventions in 12 countries. Paediatr Perinat Epidemiol 1993; 7: 45-54.

Stewart PJ, Dunkley GC. Smoking and health care patterns among pregnant women. Can Med Assoc J 1985; 133: 989-994.

Stewart PJ, Dunkley G, Wright A, Andrews J. Use of the hospital postpartum period for population - based research. Can J Pub Health 1989; 80: 63-66.

Taffel SM, Placek PJ, Moien M. 1988-U.S. cesarean-section rate at 24.7 per 100 births - a plateau? (letter) N Engl J Med 1990; 323(3): 199.

Taffel SM, Placek PJ, Liss T. Trends in the United States cesarean section rate and reasons for the 1980-85 rise. Am J Public Health 1987; 77: 955-959.

Tanio C, Manley M, Wolfe SM. Unnecessary Cesarean Sections: A Rapidly Growing National Epidemic. Washington, DC: Public Citizen Health Research Group, 1987.

Thonneau P, Gratton J, Desrosiers G. Health profile of applicants for refugee status (admitted into Quebec between August 1985 and April 1986). Can J Public Health 1990; 81: 182-186.

Thorp JA, Parisi VM, Boylan PC, Johnston DA. The effect of continuous epidural analgesia on cesarean section for dystocia in nulliparous women. Am J Obstet Gynecol 1989; 161: 670-675.

Thorp JA, McNitt JD, Leppert PC. Effects of epidural analgesia: some questions and answers. Birth 1990; 17(3): 157-162.

Trowell J. Emotional effects of a cesarean. Nursing Times 1986; May 28: 64-65.

Tsu VD. Maternal height and age: risk factors for cephalopelvic disproportion in Zimbabwe. Int J Epidemiol 1992; 21: 941-947.

Turner MJ, Rasmussen MJ, Turner JE, Boylan PC, MacDonald D, Stronge JM. The influence of birth weight on labor in nulliparas. Obstet Gynecol 1990; 76: 159-163.

Tussing AD and Wojtowycz MA. The cesarean decision in New York State, 1986. Economic and noneconomic aspects. Med Care 1992; 30: 529-540.

Vaclavinkova V. Breech delivery in a Middle East hospital. Int J Gynecol Obstet 1989; 30: 241-244.

van Roosmalen J and Brand R. Maternal height and the outcome of labor in rural Tanzania. Int J Gynecol Obstet 1992; 37: 169-177.

Wadhera S, Nair C. Trends in cesarean section deliveries, Canada, 1968-1977. Can J Public Health 1982; 73: 47-51.

Walker M, Shaper AG, Wamamethee G. Height and social class in middle-aged British men. J Epidemiol Com Health 1988; 42: 299-303.

Weissman A. "Race-ethnicity": a dubious scientific concept. Public Health Rep 1990; 105(1): 102-103.

Westgren LMR. Delivery of the low-birth-weight infant. In Phelan JP and Clark SL (eds), Cesarean Delivery, Elsevier Science Publishing, Inc. New York, 1988.

Williams RL, Hawes WE. Cesarean section, fetal monitoring and perinatal mortality in California. Am J Public Health 1979; 69(9): 864-870.

Wilson JR. Obstetric care: the effects of consumerism. Postgrad Med 1984; 75(4): 19-26.

The World Bank, World Development Report 1981. Washington D.C., the International Bank for Reconstruction and Development/The World Bank, 1981.

World Health Organization. Methods of fertility regulation: advances in research and clinical experience. Report of a WHO Scientific Group. Technical Report Series No. 473. Geneva: World Health Organization, 1971.

World Health Organization. Appropriate technology for birth. Lancet 1985; August 24: 436-437.

World Health Organization. Evaluation of the Strategy for Health for all by the Year 2000. Seventh report on the world health situation. Vol. 1. Global review. World Health Organization, Geneva, 1987.

Zahniser SC, Kendrick JS, Franks AL, Saftlas AF. Trends in obstetric operative procedures, 1980 to 1987. Am J Public Health 1992; 82: 1340-1344.

Zdeb MS and Logrillo VM. Cesarean childbirth in New York State: trends and directions. Birth 1989; 16(3): 203-208.

Zurayk H, Halabi S, Deeb M. Measures of social class based on education for use in health studies in developing countries. J Epidemiol Community Health 1987; 41: 173-179.