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TEEN PREGNANCY AND LOW BIRTHWEIGHT INFANTS:
AN ANALYSIS OF THREE REGIONS IN NORTHERN BRITISH COLUMBIA

by
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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE in COMMUNITY HEALTH

c Margaret Miskelly, 1999

THE UNIVERSITY OF NORTHERN BRITISH COLUMBIA

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ABSTRACT

Teen age women are expected to be at higher risk of bearing both premature and low birth weight infants. Within the North West Health Region of British Columbia an unexpectedly low number of low birth weight infants are born to teen mothers. Factors that influence the risk of both premature and low birth weight infants to teen women were reviewed and a study was conducted to examine whether the observation of reduced numbers of low birth weight infants is statistically reliable.

British Columbia provincial data from the Ministry of Health and Ministry Responsible for Seniors from 1987 to 1996 for both live births to teens (10-19 years) and low birth weight infants (<2500 grams) were analyzed to determine if a significant difference exists within the North West Health Region of British Columbia. The Upper Island / Central Coast Health Region and Northern Interior Health Region were used for comparison due to their similar profile of being rural communities with forestry as a prime economic base.

The North West Health Region of British Columbia had significantly fewer low birth weight infants born to teen mothers as determined by chi square and odds ratio analyses. These results indicate that a unique situation exists within the North West Health Region which cannot be attributed to chance alone. No specific measures have been identified as pivotal in mitigating low birth weight of infants born to teen mothers. Many potential possibilities exist which require further investigation.
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Chapter 1

Overview

This work was undertaken to begin the necessary first steps that will allow greater in depth study of the unexpectedly low number of low birth weight infants born to teen mothers within the North West Health Region of British Columbia. Provincial raw data on low birth weight infants (<2500 grams) born to teen mothers is used as the background information source. As a group, teen age women are expected to be at higher risk of bearing both premature and low birth weight infants. Therefore, both prematurity and low birth weight with their risk factors are discussed as well as variables which predispose teenage women to be at higher risk. Gestational diabetes as a possible mitigating factor in reducing the incidence of low birth weight infants is considered. The British Columbia provincial data for both teen pregnancies and low birth weight infants are analyzed to determine if a significant difference exists within the North West Health Region. A discussion of the results follows the analysis. To conclude, further necessary research which more specifically investigates the unique occurrence of a low rate of low birth weight infants to teen mothers within the North West Health Region is discussed.

Introduction

Teenage pregnancy and the resultant infants are of great interest to communities, health care workers, and decision makers. Governmental interest in teen pregnancy and its potential effects on behaviour, health, and long term life chances for both mother and infant are well documented (Provincial Health Officer's Report, 1995 & 1996). Research concerning teen pregnancy has focused upon decreasing the teen pregnancy rate (Jannke, 1996; Simkins, 1984) and working toward more positive outcomes of teen pregnancies (Kelen, Hunt, Sibeko-Stones & Varga, 1991; Krishnamoni, 1992). If teen pregnancy produces the negative outcomes of premature and low birth weight infants
then it should follow that the geographical areas with the highest teen pregnancy rates should also be the geographical areas with the poorest outcomes of infant health as determined by birthweight.

Teenage pregnancy and infant birth weight are important in relation to each other. Teenage child-bearing women are considered to be at higher risk of delivering low birth weight infants. A review of the literature with a view to ascertaining the risk to teenage mothers of infants who are either premature or of low birth weight is provided below. The differences between prematurity and low birth weight in relation to the teen population are also reviewed. A variety of risk factors which might increase the incidence of both prematurity and low birth weight infants born to teen mothers are specifically addressed. Finally, gestational diabetes, which may increase infant birth weight, thus mitigating the effects of prematurity or other factors contributing to low birth weight, is considered as it relates to teenage mothers.

**Premature Infants**

**Definition**

A premature infant is any infant that is born prior to 37 completed weeks of pregnancy. This definition of prematurity is used and accepted internationally (Adams, 1983; Beischer & Mackay, 1986; Olds, London & Ladewig, 1996). Traditionally a birth weight of less than 2500 grams has also been used to define prematurity (Carey, McCann-Sanford & Davidson, 1981) and it is this weight parameter which is more commonly used for statistical purposes (Provincial Health Officer's Report, 1995). The incidence of prematurity in Canada increased from 6.3 percent of live births between 1981 to 1983 to 6.8 percent between 1992 to 1994. This increase can be attributed primarily to the increase in multiple births and secondarily to the improved dating of pregnancies (Joseph et al., 1998). Joseph and colleagues (1998) note that the
standard deviation for gestational age among singleton live births did not change within their study period. The incidence of prematurity has remained unchanged over the last twenty years in the United States (Garbaciak, 1992) during which time the specialty of neonatology has emerged. While the incidence of prematurity among singleton live births has changed only slightly, the effect of the maturing field of neonatology has been to increase the opportunity for premature infants to survive, as infants of younger gestational ages have been treated more and more aggressively. Prematurity and the risks of prematurity are relative to the gestational age of the infant and represent a continuum. Infants who are born at younger gestational ages have both a greater variety and a greater severity of difficulties which extend and impact upon health, well-being, and quality of life while older premature infants may have only minor obstacles to overcome.

Problems of Prematurity

Prematurity presents a multiplicity of risks to the infant, of which the greatest is neonatal death. While the incidence of prematurity in Canada is approximately 6.8 percent of live births (Joseph et al., 1998), approximately 80 % of neonatal deaths are related to prematurity (Moutquin, Milot-Roy & Irion, 1996). Premature infants have systemic immaturity. For example, their lungs are not fully developed and ventilatory support is frequently needed. The central nervous system is immature resulting in apneic and bradycardic episodes. Thermoregulation also requires support to maintain the infant's temperature. Suck - swallow reflexes are uncoordinated and enteral feeds are provided via nasogastric feeding tubes. Premature infants frequently require long periods of hospitalization.

Infants who require long periods of hospitalization caused by prematurity are at greater risk of cognitive, physical development, behavioural, and attachment delays.
With the improved survival rate of infants of lower gestational ages, the rate of impairment has increased. Developmental delays were found to occur in approximately 36% of infants born between twenty-three and twenty-five completed weeks in British Columbia (Synnes et al., 1994). A nine year longitudinal study of infants born at less than 32 completed weeks of pregnancy conducted in the Netherlands reported an overall disability rate of 25% (Hille et al., 1994).

Preterm low birth weight infants have probable neurologic immaturity making them less adaptable, less predictable, and fussier than infants born at term, increasing parenting difficulties (Gennaro, 1996). Infant admission into neonatal intensive care units result in separation of the mother-infant dyad. This separation and lack of physical contact may result in a comparatively high failure of bonding or attachment increasing concerns about both infant neglect and abuse (Minde, 1984). Premature infants provide less positive parenting reinforcement as they vocalize less, smile less, and avert their gaze more than full term infants (Gennaro, 1996). Families of premature infants have different needs and challenges in parenting than do families of full term infants.

**Low Birth Weight Infants**

**Definition**

Low birth weight (LBW) infants are those whose weight falls below the tenth percentile for the gestational age of the infant. This definition is used internationally (Adams, 1983; Beischer & Mackay, 1986; Olds, London & Ladewig, 1996). The LBW rate has remained stable in British Columbia over the last thirty years (Figure 1). In British Columbia the intrauterine growth chart most commonly used to assess newborns appears as part of the "Newborn Record". This growth chart becomes part of each neonate's hospital chart in British Columbia regardless of the hospital in which the birth
Infants are routinely weighed and measured and these parameters plotted against the gestational age so that a determination of weight, head circumference and length against gestational age can be made. Infants whose measurements fall between the tenth and ninetieth percentile are considered to be appropriate for gestational age (AGA). Those under the tenth percentile are considered to be small for gestational age (SGA), and those over the ninetieth percentile are classified as large for gestational age (LGA). It can be recognized from this that infants may be premature and also AGA, SGA, or LGA. Small for gestational age (SGA), low birthweight (LBW), and intrauterine growth retarded or restricted (IUGR) are terms which are frequently used interchangeably to describe the growth pattern of premature or full term infants.

Figure 1

Low Birthweight Rates
British Columbia, 1965-1993

Source: Provincial Health Officer's Report 1994
There is a discussion in the literature of the accuracy of growth charts in assessing adequacy of fetal growth. Studies by Arbuckle, Wilkins, and Sherman (1993) have questioned current norms of birth weight when used against the Colorado growth chart produced by Lubchenco, Hansman, Dressler, and Boyd (1963). The Colorado growth chart is frequently used in other jurisdictions and though it is not the one appearing on British Columbian newborn hospital birth records, it is used by the British Columbia Ministry of Health and Ministry for Seniors which is a part of the British Columbia Vital Statistics Agency. Arbuckle and colleagues (1993) compared birth weight data from 1970-1972 and 1986-1988. Their findings for these time periods demonstrated that "...weight distributions for term deliveries have shifted to higher birth weights;...For preterm deliveries the 90th percentile birth weights have decreased, while the tenth percentile birth weights have remained almost unchanged" (Arbuckle et al., 1993, page 47). The conclusions of this study indicate that using outdated data in present situations results in too few term infants being classified as SGA and too many being classified as LGA. Use of outdated growth charts also results in too few premature infants classified as LGA. Their recommendations are that growth norm data be updated every five to ten years.

Problems of LBW Infants

Problems of infants who are small for gestational age often are associated with either the ability of the fetus to tolerate the labour or maladaptation to extrauterine life. Placental insufficiency can be reflected in fetal intolerance to the increased demands which are produced during contractions. Infants may become distressed and subsequently require operative delivery. Hypoglycemia results from poor intrauterine glucose storage and high energy demands which occur following birth. LBW infants may also have difficulty with thermoregulation from a lack of subcutaneous fat, depletion of brown fat, and a large surface area. Polycythemia may be present as a reaction to the

**World Health Organization and Birth Weight**

Birthweight is considered to be a key index of population health status by the World Health Organization (WHO). Indeed, along with infant mortality rates low birth weights are the most commonly used indicators of population health status since LBW is estimated to contribute to early neonatal mortality by approximately seventy-five percent (Ng & Wilkins, 1994; World Health Organization Regional Office for Europe, 1985). Birth weight is related to the health of the mother and has been determined to be a key predictor of the infant's long term survival. Birthweight is also related to the socio-economic environment of the mother. Between 1969 and 1991 in urban Canada the LBW rate was 1.4 times higher in the lowest income neighbourhoods than in the highest (Ng & Wilkins, 1994).

Birthweight has also been determined to be an indicator of global health. Infant mortality decreases as prevention measures aimed at improving maternal nutrition and decreasing maternal lifestyle risk behaviours, such as smoking and substance use, increase. These measures tend to increase infant birth weight (WHO, 1985). The World Health Organization considers birth weight of 2500 grams to be an essential global indicator for monitoring progress in improving health (Millar, Strachan & Wadera, 1991).

A birth weight of 2500 grams has also been used as a marker within Canada (Statistics Canada, 1992). While the infant mortality rate has declined steadily by 75% between 1961 and 1990 in Canada, the low birth weight rate has declined only 24% during that same time period (Ng & Wilkins, 1994). Within the 2500 gram criterion for birthweight, WHO does not differentiate between infants who are premature and those who are full term but growth restricted in their determination of predictive health status.
Maternal Risk Factors

Overview

Women who experience a premature birth or the birth of a low birthweight infant may share some of the same risk factors. The most consistent factors related to prematurity are smoking, a previous history of pregnancy loss or premature birth, low prepregnant weight, heavy alcohol use, vaginal infections, and adverse social and economic conditions (Shiono & Klebanoff, 1993). LBW is associated with small stature, primiparity, grand multiparity, smoking, lack of prenatal care, young or elderly maternal age, and adverse social and economic conditions which may be associated with poor nutritional intake, low education level, and poor living conditions (Carey, McCann-Sanford & Davidson, 1981; DiFranza & Lew, 1995; Grant, 1994; Olds, London & Ladewig, 1996). Various medical, placental, and fetal factors can also contribute to the occurrence of both of these conditions (Beischer & Mackay, 1986). It is important to note that in the majority of cases no specific cause for prematurity or LBW can be attributed.

The association between teen pregnancy and poorer birth outcomes has been explicitly stated by the Provincial Health Officer in British Columbia (1995). However, the poorer outcomes are not specifically defined. Most frequently statements are made which indicate that poorer outcomes can be improved by reducing the number of teen pregnancies. The outcomes of prematurity and low birth weight in relation to teen pregnancy require consideration to determine if a relationship actually exists.

Adolescent Age

Low birth weight is related to maternal age, occurring most frequently in women under 20 and over 40 years of age (Miller, Strachan & Wadhera, 1991). Pregnancy places adolescent women at social, educational, and obstetrical risk. In addition to maternal age, single status and parity are important factors associated with low birth weight in infants. When these factors are compiled the conclusion is that a young single
woman having her first child is at risk for giving birth to a low birth weight infant (Ng & Wilkins, 1994). In 1990 the single mothers' LBW rate in British Columbia was 7.3% while married mothers' was 5.0%. The LBW rate for primigravid women in 1990 was 6.7% versus 4.9% for multigravid women (Ng & Wilkins, 1994). Women who begin to have children at a young age are more likely to have other children and the births of those children are more likely to be closer together than those of their age peers who begin families at an older age. Frequent pregnancies which are closely spaced increase the risk of complications such as iron deficiency anemia from maternal depletion (Carey, McCann-Sanford & Davidson, 1981).

**Socio-economic Circumstances**

Early child bearing has been found to have a profound and negative socio-economic influence. Lower educational attainment, lower occupational status, higher poverty rates, higher divorce rates for those who marry, higher level and shorter interval of subsequent child bearing, and higher rates of infant mortality are all linked to adolescent pregnancy (Combs-Orme, 1993; Hayward, Grady & Billy, 1992; Health Reports, Summer 1996). Cultural beliefs ascribed to becoming a mother at an early age differ among ethnic groups and influence reproductive decisions and choices for young women (Horn, 1983; Sokoloski, 1995). Both White and African American adolescents living in a stepparent family have higher rates of pregnancy than those living with both parents (Astone & Washington, 1994). African American adolescents who live in a single parent family have lower pregnancy rates than non black adolescents, raising questions regarding the role African American adolescents may have within such families (Hayward et al., 1992). Higher educational level of the adolescent's mother has been shown to be associated with reduced probability of premarital intercourse and subsequent pregnancy for both non blacks and blacks in the United States (Hayward et al., 1992).
Adverse maternal social conditions increase the risk of low birth weight infants. Urban living, lower income, lower social class, and poor prenatal care have all been found to contribute to the risk of low birth weight. Pregnant teen-age women may seek help or care in their pregnancy later than older women. Young women may wish to conceal the pregnancy from their parents or may not be able to reach a decision regarding resolving the pregnancy. They may be unaware of the pregnancy due to irregular menstrual cycles. They may not identify a need to seek early prenatal care as they feel well. All of these reasons to delay prenatal care may affect fetal growth and maternal well-being adversely (Combs-Orme, 1993). Delayed antenatal care has been shown to contribute to some of the high-risk factors such as anemia, pregnancy induced hypertension, urinary tract infections, and genital infections (Buchholz & Gol, 1986). Adolescent women who participate in early antenatal care show no outcome differences in prenatal, neonatal, or early childhood health and development when compared to women in their early twenties (Combs-Orme, 1993).

It is probable that social conditions rather than physiological conditions contribute to the poor outcome experienced by pregnant teens living in disadvantaged conditions. The risk to young mothers is that of low income with the resultant effects of poor housing, fewer social and cultural advantages, poorer nutrition, and fewer goods and services of all kinds. Children in poor families have poorer health, and the children of teen mothers are over-represented in poor families (Combs-Orme, 1993).

**Smoking**

Poor fetal outcome can also be linked to maternal substance use. Tobacco and alcohol are two commonly used substances. Cigarette smoking has a detrimental effect on fetal weight (Alexander, 1987; DiFranza & Lew, 1995). A dose-related response between cigarettes smoked and prenatal complications has been shown (Alexander, 1987). Smoking increases both the likelihood of low birth weight and prematurity. Infants born to smoking mothers weigh 150 to 300 grams less than those born to
nonsmoking mothers. This weight difference is independent of other factors known to affect birth weight such as maternal socio-economic status, race, parity, size, gender, and gestational age of the infant (Alexander, 1987). Smoking also decreases gestation length, leading to greater incidence of prematurity among smoking mothers. Neonatal deaths among premature infants of smoking mothers are associated with smoking related problems such as placental abruption, placenta previa, bleeding during pregnancy, and prolonged rupture of membranes. Infants born to smoking mothers have shorter lengths and smaller head circumferences than their nonsmoking counterparts suggesting symmetrical growth restriction (Alexander, 1987).

Smoking has been linked to disadvantaged circumstances. Women start smoking at younger ages, consume more cigarettes, and have lower cessation rates than men (Stewart et al., 1996). In 1997, 21% of teen aged women were current smokers versus 19% of teen aged men (Teen Smoking in BC, 1997). Young women tend to start smoking with their peer group and to project an image consistent with that of their peers (Stewart et al., 1996; Teen Smoking in BC, 1997). First smoking experiences tend to occur in peer groups or with friends. Imitation of older teens, media characters and adult role models also play a role for beginning smokers. Once addiction occurs other rationalizations for smoking such as boredom, tension relief, and acceptance of physiological cravings are more likely (Teen Smoking in BC, 1997). Disadvantaged women tend to report that cigarette smoking assists in coping with the stressful aspects of their lives related to parenting and limited social opportunities and in relieving boredom and isolation, in addition to social and recreational reasons (Stewart et al., 1996). Reasons for not quitting include fear of weight gain linking smoking among young women to body image issues (Stewart et al., 1996; Teen Smoking in BC, 1997).
The Angus Reid Group, as part of a British Columbia provincial survey of smoking prevalence, used survey and focus group research methods in 1997 to investigate teenage smoking (Heart & Stroke Foundation of Canada). Their results show that typically, in British Columbia, onset of smoking is around thirteen years of age. Teen aged smokers who are economically disadvantaged represent 34% of teen smokers compared to teens with high income adequacy who comprise 13% of teen smokers. Aboriginal teens have a 39% rate of smoking compared to teens with a non Aboriginal background. The teen smoking rate in B.C. is approximately 16%. The teen smoking rate in North West B.C. is 18% which is comparable to other Northern community health regions. The percentage of 12 to 18 year olds smoking cigarettes is 18% for the Cariboo Community Health Services Society (CHSS); for Peace Liard CHSS, 21%, and for the Northern Interior Regional Health Board (RHB), 22%. The Southern Interior Regions have both the highest (26% in Okanagan Similkameen RHB) and lowest rates (10% in Central Kootenay CHSS) of 12 to 18 year old cigarette smokers. The teen smoking rates in the Lower Mainland of British Columbia range from a low of 11% in the South Fraser RHB to a high of 22% in Vancouver/Richmond RHB. Within all reported regions smoking rates increase among the 19 to 24 year groups before beginning to decline in older age groups.

Alcohol

No safe level of alcohol ingestion during pregnancy has been found. The effects of alcohol on the developing fetus have permanent consequences. Fetal alcohol syndrome (FAS) and alcohol related birth defects (ARBD) represent birth defects along a continuum among women who ingest alcohol during pregnancy. Infants affected by these birth disorders tend to be premature and growth restricted. The prevalence of fetal alcohol syndrome in British Columbia is 3 per 1000 live births (Loock, 1990a). The Canadian Centre on Substance Abuse (1994) estimates that the incidence of fetal alcohol syndrome is approximately 0.33 per 1000 nationally but cautions that the estimate is
conservative and does not include aboriginal or other minority groups. At present teen-aged women are not in the high risk group but increasing numbers of teens are ingesting alcohol during pregnancy (Loock, 1990b). Teens who smoke are more likely to also ingest alcohol (Teen Smoking in BC, 1997). Generally, later born infants of women who ingest alcohol have a greater risk of alcohol related birth defects than first born infants (Combs-Orme, 1993). Unmarried women are generally at higher risk for in utero exposure of their children to alcohol and drugs (May, 1991). Contrary to popular thought about those at risk for alcohol abuse, Loock (1990b) found that daily alcohol use is increasing in higher socio-economic groups in British Columbia.

Birth defects related to alcohol use among First Nations women have a prevalence pattern that follow alcohol use within the community in general. That is, in communities with an identified alcohol problem, the FAS rate has been reported to be as high as one in eight children (Streissguth, 1994). The North Western British Columbia prevalence rate of FAS in 1981 was reported to be 25 per 1000 births in First Nations populations versus 0.4 per 1000 births in non-First Nations populations (Robinson & Armstrong, 1988).

It is important to obtain a history from every pregnant woman regarding alcohol use. It is likely that alcohol ingestion among pregnant women is underreported. Most women are aware of the risks of alcohol to their fetus and may not accurately report alcohol use. Information solicited from women regarding the consumption of alcohol during pregancy has been found to have increased validity when asked at seven months' gestation compared to four months' (National Institute on Alcohol Abuse and Alcoholism, 1991). This leads to the suggestion that questions regarding alcohol ingestion should be asked repeatedly during pregnancy.

**Low Body Weight**

Low pre-pregnancy weight in adolescent women has been linked with premature births. Biological growth and maturation to adult height in girls usually begins at about
age ten and a half with a peak by age fourteen and completion at age eighteen (Carey, McCann-Sanford & Davidson, 1981). Weight gain curves are similar to height attainment. Women who become pregnant during their own biological growth may be prone to shortened gestational periods or low birth weight infants.

Self-image is closely related to weight in western cultures. Thinness is often seen as the chief attribute of beauty for women (Allan, 1994). Adolescent eating patterns commonly include skipping meals, eating junk and fast foods (Combs-Orme, 1993), and frequent dieting to maintain a positive self-image. Nutritional compliance with increased caloric and nutritional requirements may be difficult for adolescents. Inadequate nutrition reaching the fetus may compromise fetal growth resulting in low birth weight infants.

Maternal weight followed by maternal weight gain is the factor most consistently predictive of fetal weight (Lee-Parritz & Heffner, 1995). Body Mass Index (BMI) serves as indicator of individual risk for developing health problems related to body size. BMI compares height in meters with weight in kilograms and is calculated by kg/m$^2$. Those individuals whose BMI falls under 20 or over 27 may be at a higher risk of developing health problems (Expert Group on Weight Standards, Health and Welfare Canada). Women who are lean or underweight have a BMI of less than 20 (Cnattingius, Bergstrom, Lopworth & Kramer, 1998). Infants of mothers who are light weight at delivery, that is they have a BMI of less than 20, tend to give birth to infants with lower birth weights and higher rates of admission to special care nurseries (Cherry et al., 1991). Women who are light weight at conception but normalize their weight during pregnancy give birth to infants who have low rates of LBW and admission to special care nurseries. Adolescents require 2400 KCAL per day during pregnancy. A minimum weight gain of 10 to 12 kilograms is considered to be essential for fetal development (Carey et al.,
Women who are attempting to maintain thinness or hide their pregnancy are at risk of low weight gain during pregnancy and therefore are at greater risk for giving birth to a low birth weight infant.

**Social Support**

Birth weight and gestational time are multifaceted and interrelated. The recognition that there are competing influences of biology and environment on health and illness has led to an increased awareness of and interest in the role of social relationships in well-being and physical health. One of the most extensively studied environmental influences on health is "social support", a diffuse concept which has been found to have a relationship to a wide variety of health outcomes (Oritt, Paul & Behrman, 1985). Definitions of social support are frequently divergent leading to difficulty in replicating studies and attributing beneficial effects.

Ann Oakley (1985) has studied social support in the perinatal period extensively and particularly with regard to LBW infants. In a meta-analysis of randomized trials of social support during pregnancy she found that increases in birth weight were related primarily to smoking cessation programs but that other positive effects occurred. These positive effects included a decreased length of labour, fewer instrumental deliveries, higher 5 minute Apgar scores, improved neonatal health status, improved patient satisfaction, and decreased incidence of post partum depression. Improved maternal and infant health with fewer continuing health problems resulted from increased social support. The lack of definition and documentation of what is meant by social support was a reported difficulty in her analysis.

Social support can be defined as a process of interaction between environment and person variables occurring across time (Oritt, Paul & Behrman, 1985). Social support is dependent upon the availability of support structures to the individual, the individual's interpersonal skills to access and maintain support within a relationship, and
the actual support seeking behaviours which the individual uses during times of stress (Oritt, Paul & Behrman, 1985). Social networks are social connections in the environment. Perceived support is the subjective report that an individual believes that their need for support, information, and feedback is being met. Social support seeking behaviours are the effort of an individual to interact with others to reduce the adverse psychological effects of stressful situations (Oritt, Paul & Behrman, 1985).

The impact of support during pregnancy particularly to socially disadvantaged women to mitigate the occurrence of LBW infants may be underestimated (Collins, Dunkel-Schetter, Lobel & Scrimshaw, 1993). Collins and colleagues conceptualized three broad categories of social support: emotional, informational, and instrumental. Emotional support is defined as expressions of caring and esteem; informational support is advice or guidance; and instrumental support is provision of tangible goods or assistance with tasks. Support can be either perceived, that is anticipatory, or received, that which has actually occurred. Enacted support contributes to perceived support, to improved satisfaction with support by the baby's father, and to positively influencing coping behaviour (Collins et al., 1993; Lakey & Cassady, 1990). Women with more network supports, that is emotional, informational, and instrumental supports, gave birth to higher birth weight babies. Women who received more emotional and informational support and reported higher satisfaction with received support gave birth to infants with higher 5 minute Apgar scores. Women who received more emotional and informational support had fewer difficulties in labour (Barth & Schinke, 1984; Kennell, Klaus, McGrath, Robertson & Hinkley, 1991; Odent, 1996).

Personality and cultural perceptions of support contribute in complex ways to interpretation, acceptance, and use of support. Cultural beliefs have not been well studied in relation to teen pregnancy (Horn, 1983; Sokoloski, 1995). Available support groups within various cultures may vary. Support may be limited to the adolescent's
family or may include a diversity of support from within the cultural community. Social
and community supports increase feelings of belonging and attachment, provide positive
role models, and exert pressures to conform to the group (Collins et al., 1993).

**Gestational Diabetes: Definition and Risk Factors**

Gestational diabetes is defined as "carbohydrate intolerance of variable severity
with onset or recognition in pregnancy". This definition is used by The American
Diabetic Association, The American College of Obstetrics and Gynecology, and The
Canadian Task Force on the Periodic Health Examination (Solomon et al., 1996). While
the definition of gestational diabetes may be standardized, the acceptance of its
importance as a disease, screening recommendations, and risks to mothers and infants
remain controversial. Gestational diabetes is considered here as it has the potential to
increase the birth weight of infants whose mothers have pregnancies complicated with
this metabolic condition.

Risk for both mother and fetus resulting from a diagnosis of gestational diabetes
has not been well replicated in studies. The main risk associated with gestational
diabetes is macrosomia. Macrosomia is defined as birth weight greater than the 90th
percentile at any gestational age. Larger infant size results in a greater chance for a
difficult birth, increasing risks of caesarean or operative delivery and birth trauma (Avery
& Rossi, 1994; Goer, 1995; Homko, Nyirjesy, Siven & Reece, 1995). While macrosomia
is the most consistently listed complication of gestational diabetes it has not proven itself
to be a useful screening criterion for gestational diabetes (Morsiani, 1989). Maternal
obesity is also independently related to macrosomia and related birth trauma (Lee-Parritz
& Heffner, 1995; Lucas, Lowe, Bowe & McIntire, 1993; Young, 1994). Maternal obesity
appears to increase the risk of gestational diabetes (Morsiani, 1989; Young, 1994). There
is a propensity for diabetes in the offspring of gestational diabetic mothers as well as an
increased maternal risk of developing diabetes later in life (Coustan, 1994; Lee-Parritz &
Heffner, 1995).
Ethnicity also has an impact on the specific diagnosis of gestational diabetes and the development of non-insulin dependent diabetes mellitus (NIDDM) generally. Diabetes prevalence rates for First Nations people are approximately two to four times greater than that for all Canadians (Daniel & Gamble, 1995). A study of First Nations people and diabetes conducted in Northern Manitoba and Northern Ontario by Young and colleagues (1985) found the overall prevalence rate of diabetes to be 28 per 1000. This diabetes was non-insulin dependent with the probable exception of the under 15 years age group. The prevalence rate of diabetes between the ages of 15 - 24 years was 4 per 1000 (Young, McIntyre, Dooley & Rodriguez, 1985). The most widely accepted environmental risk factors for NIDDM are obesity, reduced physical activity, and inappropriate diet (Daniel & Gamble, 1995; Young, Sevenhuysen, Ling & Moffatt, 1990).

Young (1994) has studied the health of North American Aboriginal people and particularly Canadian populations and increased our understanding of the role of ethnicity in relation to chronic diseases such as NIDDM. He found that NIDDM has been tending to occur during earlier teen years in Manitoba First Nations people. A hypothesized explanation for enhanced diabetes susceptibility in North American Aboriginal people is the "thrifty genotype". The "thrifty genotype" is posited to confer survival advantage by promoting glucose storage in the form of triglycerides in fat cells during times when plenty of food is available. Insulin is released quickly in response to rising glucose levels. When food becomes scarce, individuals will have a store of fat available to prevent starvation. With colonization and acculturation, food has become more constantly available and in such conditions the quick release of insulin is thought to result in hyperinsulinemia, hyperglycemia, obesity, and diabetes. Acculturation has also led to reduced physical activity among First Nations people who have changed from being seasonally nomadic to sedentary and who have adopted a "western" diet rather than
a traditional diet. The increase in consumption of total calories, fat, refined sugars, total and complex carbohydrates, and a decrease in consumption of fiber is characteristic of a "western" diet (Daniel & Gamble, 1995).

Teen Pregnancy and LBW in B.C.

Gathering data about life events occurs routinely within the British Columbia Department of Vital Statistics. From these data the Department of Vital Statistics disseminates statistical information which is commonly displayed graphically in publications such as the Provincial Health Officer’s Annual Report which has been issued since 1992. Birth data are collected from each birth occurring within the Province of British Columbia. Information regarding maternal age at the time of delivery as well as a variety of information regarding the newborn infant is aggregated by Health Regions. A Health Region is an arbitrary geographical area determined by the Health Ministry in British Columbia. Health Regions have been renamed recently as health care priorities, particularly in respect to regionalization, have changed. A chronological review of statistical reports reveals trends within and between Health Regions.

Statistical information compiled from current teen pregnancy and birth data is available from both Statistics Canada (1991, 1994) and The B.C. Department of Vital Statistics (1994). These results are reported as provincial rates by Statistics Canada and by Local Health Areas (LHAs) by the Department of Vital Statistics. Information on the number and rates of teen pregnancies as well as the outcome of those pregnancies is gathered and compared within and between provinces for Canada, and for other countries (Wadhera & Strachan, 1991). Provincial information provides rate comparisons between Health Regions. Figure 2, taken from the Provincial Health Officer’s Report (1996) shows the teen pregnancy rates for teens between the ages of 15 and 19 years (at the time of delivery) for the 1995/96 period. It can be seen from this graph that the North West
Health Region experienced a higher teen pregnancy rate than any other Health Region. This finding has been documented regularly since at least 1988 (Provincial Health Officer's Report, 1994).

Figure 2

Teen Pregnancy Rates,
Age 15-17 and 15-19,
Health Regions, BC, 1995/96

Source: B.C. Vital Statistics Agency and Information and Analysis Branch, B.C. Ministry of Health.

Provincial Health Officer's Annual Report 1996
Figure 3, taken from the Provincial Health Officer's 1995 report shows provincial pregnancy rates per 1000 for young women in early, middle, and late teenage years from 1985 to 1993. It can be seen that the overall rate is fairly stable for all groups over this time span.

Figure 3
Teen Pregnancy Rates.
British Columbia, 1985-93

Source: Provincial Health Officer's Annual Report 1995
Similar information is gathered on low birth weight infants (<2500 grams). The Vital Statistics Annual Report from 1995 (Figure 4) graphically demonstrates the LBW rate by Health Regions. The birth weight of 2500 grams traditionally separated infants who were assumed to be premature from those who were born at an appropriate gestational age. Gestational age of the infant is an important element to determine if infants are light weight due to prematurity or poor intrauterine growth (Joseph & Kramer, 1997); however, gestational age is not routinely reported.

Teen childbearing is reported in the 1995 Provincial Health Officer's report to be "of particular concern, as it often begins a cycle of poverty and dependence on social assistance" (p.133) and because "birth outcomes are generally poorer among teen mothers" (p.135). Observation of statistical reports between 1987 and 1996 consistently show the North West Health Region has the highest teen pregnancy rate within the province of British Columbia (Figure 2). Paradoxically, in light of the expectation that teenage pregnancy and low birth weight should be related, the low birth weight rate in the North West Region has regularly been below that the Provincial average. Figure 4, taken from the 1995 Provincial Health Officer's Report shows the LBW rate for 1991 to 1995 as percent of births less than 2500 grams. It should be noted that no distinction is made between prematurity and LBW due to intrauterine growth restriction.
Figure 4

Low Birthweight Rate

While the Provincial Health Officer's Report (1995) did not specifically define what poorer birth outcomes might apply to teen mothers, within the North West Health Region low birth weight does not appear to be a regular consequence of being teen and pregnant. These two events of highest teen pregnancy rate (for British Columbia) with infant birth weights that are not small for gestational age appear to be juxtaposed within the North West Health Region.

The North West Health Region is a vast area which extends from the Queen Charlotte Islands in the west to include Houston in the east. The British Columbia - Yukon border is the northern boundary and Kitimat with its catchment area, the southern. This area is 254,394 square kilometers or slightly larger than Great Britain. Although Health Regions have recently had changes in naming, the eight Local Health Areas
contained within the North West Health Region are unchanged. A Local Health Area is the smallest region for which health data are collected. In the past, LHA's were usually named for the School District which was analogous to it, but with changes to School Districts this is no longer quite as predictable. The LHA's which comprise the North West Health Region are LHA 50 (Queen Charlotte), LHA 52 (Prince Rupert), LHA 54 (Smithers), LHA 80 (Kitimat), LHA 87 (Stikine), LHA 88 (Terrace), LHA 92 (Nishga), and LHA 94 (Telegraph Creek).

Within the local discussion of LBW in the Skeena Health Region, gestational diabetes has been suggested as a possible explanation in reducing the LBW statistic. It is known that the risk of gestational diabetes increases with maternal age (Avery & Rossi, 1994; Coustan, 1993). As neither the American Diabetic Association nor the American College of Obstetrics and Gynecology recommend screening teen age mothers for gestational diabetes it may be a reflection of the ethnicity of the North West Health Region which prompts the belief that this metabolic disturbance could be the factor which is crucial in increasing infant birth weight.

Statement of Hypotheses

When the statistics for teen pregnancy and low birth weight infants are considered together, an incongruency becomes evident. This apparent anomaly may effect random variation in the rates of LBW across regions, or it may be a feature that systematically differentiates the North West region from other areas of the province. In order to investigate this question and its implications further, two hypotheses were formulated. The first was that rates of LBW deliveries for teenage mothers in the North West Health Region would be significantly lower than those for the province at large. The second was that rates of LBW deliveries in the North West Health Region among teenage mothers would be lower than those for regions that are comparable with respect to geographic and demographic factors.
Chapter 2 - Methods

To examine the local and provincial situation more closely, the raw data of birth outcomes by maternal age were obtained from the medical advisor at the British Columbia Vital Statistics Agency. Data were obtained for each year from 1987 to 1996 inclusively for each LHA within British Columbia. A ten-year period was determined to be necessary to provide enough births that if a significant difference existed across health areas it could be observed. The medical advisor provided raw data on 'Live Births by Age of Mother' and also 'Low Birth Weight Births (<2500 gm) by Age of Mother'. Age aggregates provided were in the categories of 10 - 14 years, 15 - 19 years, 20 - 24 years, 25 - 29 years, 30 - 34 years, 35 - 39 years, 40 - 44 years, and 45 - 49 years. Due to the low numbers at either end of the distribution it was necessary to amalgamate the first two groups to provide the teen birth experience and the last two groups for the 'older' child birth experiences in some analyses in the present study.

The mainframe birth registry at the British Columbia Vital Statistics Agency contains data from all Registration of Live Birth (HLTH REV 97/04) documents filled out by parents and also from each hospital Physician's Notice of a Live Birth or Stillbirth (HLTH 403 Rev. 96/11). The information requested on the registration form filled out by parents includes three sections: child's, mother's, and father's. An address, which includes the postal code, as well as the personal health number of each parent are required in the form. The information required on the Physician's Notice of a Live Birth or Stillbirth also includes the mother's maiden name, her personal health number, and usual address. Copies of these forms are included in Appendix A.

To obtain the raw data on births the Department of Vital statistics extracts the postal code from either the Physician's Notice of a Live Birth or Stillbirth or the Birth
Registration which has been completed by the parents. Standardization (B.C. Ministry of Health) processes, for example postal code to LHA, Health Region, or census tract, are then applied. This ensures that the birth is attributed to the LHA in which the mother is a usual resident in spite of where the birth occurred. Department of Vital Statistics queries against the data are done using ACCESS and tables which are subsequently derived are usually imported into EXCEL for formatting.

The Vital Statistics Department uses Lubchenco's (B.C. Ministry of Health) birth curve to identify SGA infants. The use of this particular birth curve has been continued despite known problems in its use described in Chapter 1.

**Indirect Standardization**

The preliminary data required further manipulation to ensure that the number of births and low birth weight infants were comparable between each LHA. Indirect standardization using the entire British Columbia data of teen birth and total birth numbers as the standard was performed. Indirect standardization of low birth weight infants born to teen mothers was also performed using the British Columbia data as the standard. Indirect standardization applied the rate of the greater B.C. population for the expected number within the teen stratum and calculated the ratio of the observed number of cases divided by the expected number of cases (O/E) to determine the standardized incidence ratio (SIR) (Hennekens & Buring, 1987).

These ratios were calculated with the British Columbia rate equaling 1 and the Health Region ratio as either greater or less than 1. Indirect standardization of the data was performed in two five year aggregates: 1987 to 1991, and 1992 to 1996. This allows a visualization of trends in each Health Region and allows comparisons between Health Regions as well as a comparison of Health Regions to British Columbia.

Comparing different Health Regions with respect to both teen pregnancy rates and low birth weight infant rates leads to concerns regarding the diversities which exist
both within and between geographical regions which will have an affect on these two events. Health Regions (see Figure 5) to be compared to the North West for teen LBW infants and also teen birth were selected on the basis that they possess basic similarities to the Northwest. Namely, they are rural communities, have forestry as a main component of their economic base, and substantially occupy the northern part of the province. Based on these criteria the North West Health Region (Health Region 13) was compared to the Upper Island/Central Coast Health Region (Health Region 11) and the Northern Interior Health Region (Health Region 15). Health Region 11 includes LHA 71 - Courtney, LHA 72 - Campbell River, LHA 84 - Vancouver Island West, and LHA 85 - Vancouver Island North. Health Region 15 is comprised of LHA 55 - Burns Lake, LHA 56 - Nechako, and LHA 57 - Prince George. Health Region 14 was omitted due to the agricultural nature of that Region which is not replicated in the selected Health Regions.
Figure 5

British Columbia Health Regions
Statistical Tests

While statistical significance is important and desired in studies, it alone does not present the magnitude of the relationship between the outcome and the study question. Therefore, odds ratio and confidence intervals (CI) of the ten year aggregate data for the three Health Regions of interest were also performed.

Chi Square

Chi square as a goodness of fit statistic is a simple and common test used in epidemiological studies (Hennekens & Buring, 1987). A null hypothesis, that is, that no difference exists between the population of interest and the comparison group is the initial assumption. The alternate hypothesis is that a difference exists. The chi square test compares the observed frequency with the expected frequency. It is used to determine if the difference between the observed and expected frequency is too great to attribute to chance (Pagano & Gauvreau, 1993).

For data in which there is a frequency value, such as that obtained for teen birth and LBW rates, the chi square test is an appropriate test to determine if the differences which exist between the two groups are significant. The chi square statistic will quantify the difference in the amounts between the observed and expected numbers of LBW infants born to teen mothers and allow a determination if chance alone might account for differences which are observed or if an association exists (Page, Cole & Timmreck, 1995).

Odds Ratio and Relative Risk

The relative risk is a ratio of disease or condition among a group of people exposed to a putative risk factor compared to those who are unexposed. Relative risk is an estimate of the magnitude of the association between contracting the specified condition in groups which are exposed compared to those who are unexposed (Hennekens & Buring, 1987).
Relative risk cannot be calculated directly in retrospective studies since incidence rates which reflect the risks of developing a health effect cannot be calculated (Page, Cole & Timmreck, 1995). Relative risk can be estimated indirectly by calculating the ratio of the odds of exposure among the cases (i.e., those determined to have the condition of interest) to that among the controls (those who do not have the condition of interest). Since the data presents individuals on the basis of birth outcome status, an estimation of relative risk can only be calculated from the odds ratio. The odds ratio presents a valid estimation of the relative risk (Hennekens & Buring, 1987).

**Confidence Interval**

The confidence interval indicates that the parameter of interest lies within the upper and lower boundaries of the constructed interval. Both the magnitude of the effect and the precision of measurement are reflected by the confidence interval (Page, Cole & Timmreck, 1995).

By using the odds ratio and constructing a 95% confidence interval around that ratio, a determination of the magnitude of association can be made. This means that there is a 95% probability that the true value will be within the constructed interval (Page, Cole & Timmreck, 1995). If the constructed confidence interval includes the null value (RR=1) then the observed association is not statistically significant (Hennekens & Buring, 1987).
Chapter 3 - Results

Indirect Standardization

As described in Chapter 2, data obtained for the time period of 1987 to 1996 were indirectly standardized to compare the entire British Columbia population against the three Health Regions of interest: North West (N.West), Upper Island/Central Coast (U.Island), and Northern Interior (N.Interior). The data were divided into two, five-year aggregates of 1987 to 1991 and 1992 to 1996. These five-year combinations were used to take into account the downward trend of observed LBW within the 15 to 19 year age group during 1992-1996 across both the Health Regions and British Columbia. The LBW rate within the 10 to 14 year old group was unchanged within the North West Health Region but increased within B.C. between 1992 and 1996 (see Table I).
### Table 1

**Standardized Incidence Ratios of LBW Among Teenagers in Three Health Regions in B.C.**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed LBW</td>
<td>Expected LBW</td>
<td>Live Births</td>
<td>SIR</td>
<td>Observed LBW</td>
<td>Expected LBW</td>
<td>Live Births</td>
</tr>
<tr>
<td>N.West</td>
<td>0</td>
<td>0.60</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>1.06</td>
<td>11</td>
</tr>
<tr>
<td>U.Island</td>
<td>1</td>
<td>0.52</td>
<td>8</td>
<td>1.92</td>
<td>1</td>
<td>1.12</td>
<td>10</td>
</tr>
<tr>
<td>N.Interior</td>
<td>1</td>
<td>0.68</td>
<td>11</td>
<td>1.47</td>
<td>2</td>
<td>1.28</td>
<td>10</td>
</tr>
<tr>
<td>B.C.</td>
<td>8</td>
<td>139</td>
<td>1.00</td>
<td></td>
<td>18</td>
<td>157</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The standardized incidence ratio (SIR) of each aggregate within each Health Region was determined by dividing the observed LBW by the expected LBW (Hennekens & Buring, 1987, p. 82). To determine the prevalence ratio the total number of LBW infants born to teen age mothers for each region was divided by the number of live births to teen age mothers for that region x 100. The downward trend of LBW infants born to teens from 1992 to 1996 is again noted across the Health Regions and British Columbia as a whole (see Table II).
Table II

Prevalence Ratios of LBW per 100
in Three Health Regions in B.C.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-19 years</td>
<td>10-19 years</td>
</tr>
<tr>
<td>N.West</td>
<td>5.56</td>
<td>3.79</td>
</tr>
<tr>
<td>U.Island</td>
<td>8.19</td>
<td>5.75</td>
</tr>
<tr>
<td>N.Interior</td>
<td>6.69</td>
<td>5.12</td>
</tr>
<tr>
<td>B.C.</td>
<td>6.28</td>
<td>5.63</td>
</tr>
</tbody>
</table>

Chi Square

Using the statistical program, Minitab Student Edition (1995), the observed numbers of low birth weight infants born to teen mothers were analyzed. Since all 2x2 contingency tables have 1 degree of freedom, the value that $X^2$ must exceed to reject the null hypothesis at a significance level of 0.05 = 3.84. Table III presents the outcome of these analyses.

Table III

Comparison of LBW infants
Born to B.C. Teen Mothers,
Ages 10-19 years, in Three Health Regions,
1987 - 1996.

<table>
<thead>
<tr>
<th></th>
<th>p value</th>
<th>chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.West</td>
<td>0.006</td>
<td>4.77</td>
</tr>
<tr>
<td>U.Island</td>
<td>0.008</td>
<td>4.02</td>
</tr>
<tr>
<td>N.Interior</td>
<td>0.498</td>
<td>0.00</td>
</tr>
</tbody>
</table>

By this technique both the North West Health Region and the Upper Island/Central Coast Health Region have a number of low birthweight infants born to
teen mothers that differs significantly from that which would be expected from the British Columbia data. The Upper Island/Central Coast Health Region's rate of low birth weight infants born to teen mothers was higher than the British Columbian rate (Table II). There was a lower rate within the North West Health Region.

**Odds Ratio and Confidence Intervals**

Since statistical significance does not establish the magnitude of association, both odds ratios and their confidence intervals at 95% were obtained for the data. Results are presented in Table IV.

Table IV

<table>
<thead>
<tr>
<th>Estimated Risk of LBW Infants</th>
<th>Among Teen Age Mothers</th>
<th>in Three Health Regions of B.C., 1987-1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odds Ratio</td>
<td>95% Confidence Interval</td>
<td></td>
</tr>
<tr>
<td>Lower Limit</td>
<td>Upper Limit</td>
<td></td>
</tr>
<tr>
<td>N.West</td>
<td>0.772</td>
<td>0.61</td>
</tr>
<tr>
<td>U.Island</td>
<td>1.275</td>
<td>1.01</td>
</tr>
<tr>
<td>N.Interior</td>
<td>0.99</td>
<td>0.81</td>
</tr>
</tbody>
</table>

The odds ratio analyses indicate that the North West Health Region's chance of having a LBW infant born to a teen mother is 0.77 times that of British Columbia as a whole. The Upper Island/Central Coast Health Region's odds are 1.28 times greater while the Northern Interior Health Region at 0.99 is nearly identical to the British Columbian odds ratio which is 1.

Confidence intervals which encompass the value 1 (one) have identical odds as that of the entire British Columbian population. The Northern Interior Health Region does encompass the value 1 and at the 95% level can be assumed to have the same
number of low birth weight infants born to teen mothers as British Columbia in general. The Upper Island/Central Coast Health Region has more low birth weight infants born to teen mothers than British Columbia in general while the North Coast Health Region has fewer.

**Summary**

The North West Health Region possesses a unique situation which is statistically significant and which cannot be attributed to chance alone. The LBW and teen pregnancy rate, when analyzed, show that teens within the North West Health Region have a greater risk of becoming pregnant but the resultant pregnancy has a reduced risk of resulting in a LBW infant when compared to British Columbia at large and also regionally to Northern Interior Health Region or Upper Island/Central Coast Health Region. This analysis of the data supports the hypotheses that there is a reduced risk of low birth weight infants among teenage mothers living within the North West Health Region relative to the rest of the province and relative to selected regions that are geographically and demographically comparable.
Chapter 4 - Discussion

The data have shown that within the North West Health Region a juxtaposition exists of the largest number of teen pregnancies in British Columbia with fewer than expected low birth weight infants born to teen mothers. Other rural areas with teen pregnancy rates lower than that of the North West Health Region exhibit low birth weight infant rates which are equal to or higher than the British Columbian rate. Teens within this Health Region are 0.23 times less likely to have a low birth weight infant compared to other British Columbian teens. The confidence interval of .61 to .97 confirms that this association is a real phenomenon and not one which occurred by chance.

It is important to consider if there are any obvious differences within the North West Health Region to account for this anomalous finding. If a regional difference is found which is affecting teens and increasing the weight of infants, it could theoretically be replicated in other health areas to increase infant weights. Influences which affect both prematurity and low birth weight are reviewed with particular attention to the teen population within the North West Health Region. A proposed nested case - control study is described to isolate regional differences which might influence infant weights. It will become obvious within the discussion of teen pregnancy and low birth weight infants that more questions about than explanations for this anomalous occurrence ensue.

Teen Population

By using the British Columbia census reports for 1986 (Ministry of Finance and Corporate Relations) it is obvious that the statistical significance does not occur due to skewed data resulting from a smaller than average number of teens within this region. As demonstrated in Table V the electoral areas in which the North West Health Region, Upper Island/Central Coast Health Region, and Northern Interior Health Regions are situated have more teen residents than the British Columbian average. Within Skeena
Electoral Region 10% of the residents are teens versus 7% for the province of British Columbia.

Table V

Teen (15-19 years) Rate by Electoral Region 1986

<table>
<thead>
<tr>
<th>Region</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulkley Valley/Stikine</td>
<td>9%</td>
</tr>
<tr>
<td>North Coast</td>
<td>8%</td>
</tr>
<tr>
<td>Skeena</td>
<td>10%</td>
</tr>
<tr>
<td>North Island</td>
<td>8%</td>
</tr>
<tr>
<td>Powell River/Sunshine Coast</td>
<td>7%</td>
</tr>
<tr>
<td>Prince George - Ominica</td>
<td>9%</td>
</tr>
<tr>
<td>Prince George North</td>
<td>9%</td>
</tr>
<tr>
<td>British Columbia</td>
<td>7%</td>
</tr>
</tbody>
</table>

Ministry of Finance and Corporate Relations 1985

Smoking

Smoking has been shown to be a consistent factor in both the events of prematurity and low birth weight infants (Shiono & Klebanoff, 1993). The Teen Smoking Survey (Heart & Stroke Foundation of Canada, 1997) reported percentages of current cigarette smoking for individuals aged twelve or more throughout the province. For British Columbia this rate was 22%; for the North West Health Region 29%; for the Northern Interior Regional Health Board 28%; and 26% in the Upper Island/North Coast Health Region. When that information is further divided by age group, the 12 to 18 year (or teen) rate reverses to 18% within the North West Health Region; 22% within the Northern Interior Health Region; and 24% within the Upper Island/Central Coast Health Region. Total provincial teen rates are not reported. Generally, fewer teenagers are smoking within the North West Health Region relative to the comparison regions used in this study. These regional statistics are not broken down by gender and therefore it is not
known what number of females versus males are smoking. The report also states that teenagers between the ages of 15 to 19 years tend to smoke more cigarettes per day than younger teens and that males tend to smoke more per day than female teens. However, in the entire 12 to 19 years group, more females (21%) are reported to be smokers than males (19%). It is not possible to determine if smoking cessation during pregnancy affects the total number of smoking teens within the North West Health Region. Further, it is unclear what the number of cigarettes smoked per day among this group of teen women is. It is possible that a reduced rate of smoking among pregnant teenaged women within the North West Health Region is, in part, responsible for the higher infant birth weights.

**Socio-economic Circumstances**

Adverse social conditions increase the risk of low birth weight infants. Being teen and pregnant decreases educational opportunities and thereby decreases vocational and economic opportunities (Wadhera & Miller, 1996). In some research into social support and adverse pregnancy outcomes such as prematurity and low birth weight, social disadvantage has been found to be a commonality among the participants (Oakley, 1985). While there are urban comparisons between pregnancy rates and outcomes within high and low socioeconomic neighbourhoods there is a dearth of information concerning rural teens and pregnancy outcomes.

Within the literature, First Nations People have been found to have poorer health outcomes, higher fertility rates, and to be chronically economically disadvantaged when compared to non First Nations people (Provincial Health Officer's Report, 1995 & 1996). The Teen Smoking Survey (Heart & Stroke Foundation of Canada, 1997) revealed that within the teen and preteen population, smoking is particularly prevalent within disadvantaged groups such as low income or First Nations households. Since demographic characteristics relating to health and socio-economic advantages have known differences for First Nations populations it is important to be aware of the
percentage of First Nations people who reside in each region of interest. Table VI uses the British Columbia 1986 census report to obtain the Aboriginal Rate by Electoral Region in the areas of comparison used in this study. Table 6 clearly demonstrates that within the compared areas the electoral regions which are analogous to the North West Health Region have the greatest percentage of Aboriginal residents.

Table VI

<table>
<thead>
<tr>
<th>Aboriginal Rate by Electoral Region 1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulkley Valley/Stikine</td>
</tr>
<tr>
<td>North Coast</td>
</tr>
<tr>
<td>Skeena</td>
</tr>
<tr>
<td>North Island</td>
</tr>
<tr>
<td>Powell River/Sunshine Coast</td>
</tr>
<tr>
<td>Prince George - Ominica</td>
</tr>
<tr>
<td>Prince George North</td>
</tr>
<tr>
<td>British Columbia</td>
</tr>
</tbody>
</table>

Ministry of Finance and Corporate Relations, 1986

The data collection forms (Appendix A) which were used for this study include inquiries as to Aboriginal Status. However, the data used for this study did not specifically inquire about the ethnicity of pregnant teens. This is an area which requires further investigation.

Gestational Diabetes

The attribution of higher birth weight infants to gestational diabetes in teenage women is an explanation which is difficult to sustain. There is no support in the literature for rampant gestational diabetes during teenage years. Further, there is considerable discussion regarding the usefulness of universal screening and the legitimacy of a diagnosis of gestational diabetes since pregnancy is known to alter
carbohydrate metabolism (Howard, 1992; Goer, 1995; Lee-Parritz & Heffner, 1995; Solomon et al., 1996).

The American Diabetic Association recommends universal screening of all pregnant women while the American College of Obstetrics and Gynecology and The Canadian Task Force on the Periodic Health Examination recommend screening for pregnant women aged 24 years and older (Solomon et al, 1996). Screening is carried out between 24 to 28 weeks of gestation and uses a 50 gram glucose screen. Studies have repeatedly shown that gestational diabetes increases with maternal age (Avery & Rossi, 1994; Coustan, 1994). Only one study (Coustan, 1993) cites a rate of 7 per 1000 for gestational diabetes in women under 20 years of age. This leads to questions about the economic rationale of screening in the pregnant teen population. The lack of specific screening criteria for teen age women makes it difficult to evaluate the argument for mitigation of infant weight. Further, the general lack of data citing gestational diabetes within the pregnant teen population raises questions about the plausibility of that argument. In spite of the recommendations and lack of findings, universal screening using a 50 gram glucose screen is common within the North West Health Region.

Anecdotally, it is uncommon to find a teenage woman who is a gestational diabetic. Even within the First Nations population gestational diabetes is an uncommon complication among teen age mothers. "Thrifty gene" is a consideration which might be attributed to this group (Young, 1994), making the diagnosis of gestational diabetes more prevalent, but in actual practice, gestational diabetes occurs only occasionally in older teens. This finding would be congruent with Coustan's (1993) findings among women under 20 years in which the gestational diabetic rate was 7 per 1000. It is common to find First Nations women who have had large weight gains in their pregnancies and who give birth to macrosomic infants. It is the norm that young First Nations women have adopted a 'western' diet. It is also common to find non-insulin-dependent diabetes as part of the family history within First Nations populations. It is my belief that First Nations
teenaged women are not likely to have gestational diabetes as the original cause of fetal macrosomia. Again, lack of specific investigation into the rate of gestational diabetes within the pregnant teen population as a whole and the Aboriginal teen subgroup reduces the ability to make any generalizations regarding larger infant weights.

Weight Gain

A linear correlation has been found between maternal weight and neonatal weight (Lucas, Lowe, Bowe & McIntire, 1993). Birth weight is influenced by the weight gain of the mother (Jacobson, 1988). Women who are obese have problems which are similar to those of gestational diabetics, namely macrosomic infants, with the concurrent risks of birth trauma and operative interventions (Goer, 1995; Lee-Parritz & Heffner, 1995).

Since many pregnant teen age women gain greater amounts of weight than the recommended twenty-five to thirty-five pounds (Lederman, 1993), the resultant weight of the infants could be higher due to maternal weight gain. Weight gain during pregnancy does not seem to be curtailed by teens within the area served by Mills Memorial Hospital in Terrace. It is more common to find teens who have gained well in excess of forty pounds than teens who attempt to control weight gain. Again, there is a paucity of information within the literature and the region to correlate weight gain in pregnant teen age women with the weight of their infants. Further investigation into this correlation is necessary.

Social Support

Social support of women in relationship to infant weight and pregnancy outcome has not been well studied. Teen age pregnant women, social support, and pregnancy outcome have been studied even less. Social support is a complex and multifaceted issue in which definitions of support have lacked consensus, making studies and outcomes hard to compare. Common themes of social support include tangible, emotional, and informational support (Oakley, 1985). The relationship between length of pregnancy and infant weight is also complex and multifaceted. It appears that the events of social
support and infant weight have a relationship to each other. In spite of the increasing amount of technological interventions over the past twenty years no fall in LBW has occurred (Oakley, 1985).

Pregnancy is not only a biological event; it is also embedded in each woman's social context. Pregnancy also occurs within the continuum of a young woman's life and is affected by the concurrent events in her life. It can not be separated into a discrete event. At any age successful mothering relies on knowledge, emotional encouragement, decision-making assistance, and material support (Barth & Schinke, 1984). Teen age women and their infants frequently live within their childhood homes while pregnant and during the preschool years. Within their childhood home many women are able to obtain all of these supports and assistance with navigating not only external institutions, such as is entailed in seeking social assistance, but also the normal physiological discomforts which pregnancy and mothering may bring. Psychological health and feelings of satisfaction during pregnancy translate positively to include promotion of breast feeding, male domestic assistance, and reduction of the occurrence of worrisome health problems in infancy (Oakley, 1985).

Pregnancy is a social event in the life of a teen. From personal observation, there is generally a lack of stigma associated with being teen and pregnant within this Health Region. It is not uncommon to find that members of a particular peer group are pregnant at the same time. A lack of stigma does not imply that parents are not distressed by their teenage daughter's pregnancy, only that when the event of pregnancy occurs it generates support within the peer, family, and the extended family groups.

Many young women find that the event of motherhood generates increased support and they may find that their own self-worth is enhanced. Young women find the informational, material, and psychological support necessary to be teen and pregnant from peers, mothers, aunties, cousins, and elders. Many teenage women spend their early labour phoning all their friends and relatives to come and share in the birth, reaffirming
birth as a social event. Frequently three generations of women accompany and assist labouring teen-aged mothers with friends and extended family members waiting in the hallway.

Cultural norms for larger infants may also have an impact on an infant's weight. When speaking with elderly First Nations women who are attending a birth, stories are told not only of the older person's own births but of births of people who were old when the story teller was having babies. In these stories, which may cover one hundred years of child-bearing, I am told how First Nations women would consider a 'small' baby to weigh about seven pounds. It would seem that low birth weight infants have always been uncommon to some of the First Nations cultures within this area. Young women who have been reared with these stories may have a strong wish to also give birth to infants who fit into their cultural norms. Recording older persons' experiences surrounding childbirth within their lifetime may also enhance understanding of some factors which lower the incidence of LBW infants.

Study of social support during pregnancy has been complicated by differences in definition and a lack of comparability. It has also been difficult to attribute outcomes to improved infant weight since specific interventions have not been filtered out from other supports (Oakley, 1985). Further research is necessary to determine the role of social support in improving birth weight and birth outcomes.

Study Limitations

As with all studies, caution must be used with this study and vigilance should precede generalization. Several biases may be present within the present study.

The data that were used were collected by others for purposes other than that for which it was used in the present study. An obvious difficulty surrounds the use of growth charts to classify data. The British Columbia Ministry of Health and Ministry Responsible for Seniors uses the growth chart produced by Lubchenco and colleagues
(1963) to assess intrauterine growth while within hospitals growth is assessed based on
Kitchen and colleagues (1983). It is possible that an information bias in the incorrect
labeling of characteristics of low birth weight (Page, Cole & Timmreck, 1995) occurs
from this discrepancy in growth charts.

It is also possible that if the data collection was performed with the intention of
observing differences between the observed and expected LBW infants born to teen
mothers, then statistical tests may have been more powerful. The differences observed in
this study would be even greater if the data had been gathered specifically for observing
differences in teen pregnancy and low birth weight infants across Health Regions. Such
specific data collection might be more complete.

In order to obtain the large numbers required for statistical testing a ten-year
period from 1987 to 1996 was arbitrarily chosen. It is possible that a different statistic
would have been obtained by using a different time frame. While the rate of teen
pregnancy decreased in the second five-year aggregate, the North West Health Region
still had the greatest number of teen births within British Columbia. It is possible that
statistical significance would be influenced by the variation in numbers of births to teens
using different intervals.

Peculiarities in the data may exist as a result of the manner in which individuals
were assigned to a particular LHA using postal codes. Area of residence may present a
form of selection bias.

**Proposed Case - Control Study**

In order to study some of the identified variations which might affect birth weight
among pregnant teen women within this Health Region more precisely, a nested case-
control study is proposed. Some of the local determinants of larger infants might become
more obvious if the local LBW infant population born to teen mothers was studied in
greater depth.

Such a study would entail some of the following features with low birth weight as the outcome of interest. Hospital delivery records for all LBW infants born at Mills Memorial Hospital in Terrace, B.C. for the period of time 1987 to 1996 would be identified. The specific information to be sought from the records include:

- maternal age at delivery
- gestational age at time of birth
- birth weight
- percentile for gestational age and birth weight
- ethnicity of mother
- occupation of mother
- gestational diabetic screen result
- prepregnant weight
- weight gain
- smoking with amount smoked

The proposed study would exclude infants attributed to LHAs other than Skeena (LHA 88), twins, and Asian and Filipino ethnicity as the number of births to these ethnic groups are too small to be able to analyze. It should also be noted that only birth records in Mills Memorial Hospital in Terrace would be accessed.

The study would propose to match twenty LBW infants and fifty controls. Matches would be made based on parity of the mother, maternal age, ethnicity, and gestational age.

Preliminary attempts were made to undertake such an analysis, but when the records for the LBW infants were examined several problems prevented further progression of this study. The initial difficulty was that the population of teens giving birth to LBW infants in Mills Memorial Hospital did not reach the proposed number of
twenty cases within the ten year study time frame. Secondly, prenatal forms were regularly inadequately completed making information retrieval incomplete and impossible. Most frequent missing data from the form were:

- occupation of the mother
- ethnicity
- glucose tolerance test - whether requested, completed or results obtained
- smoking - most frequently smoking was recorded only as yes/no which does not allow for any dose relationship to be observed
- prepregnant weight - therefore no determination of weight gain could be made

The examination of the LBW infant's hospital charts did produce the observation that prematurity was a greater problem than LBW within the local population. When the gestational age and birth weight were plotted on the growth chart, it was found that few premature infants are LBW for gestational age.

This particular case - control study could not be completed. However, a redefined study should be undertaken as well as qualitative studies which probe into the strengths which young pregnant women utilize and which result in statistically fewer LBW infants born.

**Chapter Summary**

Pregnancy, birth and the postnatal period involve not only the natural biological and psychological processes but also the social processes which are influenced by the culture in which they exist. It is undeniable that a unique situation exists within the North West Health Region which influences teen women to bear heavier infants. While no specific measures have been identified as pivotal in mitigating low birth weight of infants born to teen mothers, many potential possibilities exist which require further investigation.
Chapter 5 - Summary

A unique and statistically significant reduction in the number of LBW infants exists among teen mothers within the North West Health Region. While no apparent attributable causes have been identified, many questions have been raised which, if answered, would help identify those characteristics which influence birth weight within this region.

Recommendations

Further research is required to investigate this anomalous finding which is apparently unexpected by health professionals and government resource bodies. An extensive qualitative study is required. This study could examine specific aspects which teens identify as integral to increasing their ability to give birth to babies which have appropriate weight for gestational age.

Implications for Policy

At the provincial level, growth charts should be standardized so that all facilities with delivery capabilities use the same chart. The Information and Resource Management Department of the Ministry for Health and Ministry Responsible for Seniors should consult with various agencies within B.C. that are responsible for designing and standardizing forms used within facilities so that uniformity results. More congruence would follow allowing more generalization of trends and the ability of each facility to correctly interpret findings published by the Provincial Government.

Further, the two events of prematurity and LBW of term infants should be separated. These two circumstances have many differences of risk and outcome and should not be grouped together simply by birth weight under 2500 grams. Infants who are premature should further be classified as LBW, AGA, or LGA. Clinical implications of IUGR at term and prematurity are vastly different.
Further Research

Many aspects of this study indicated a need for further research. To reiterate, these are:

- ethnic specificity of pregnant teens with the outcome of those pregnancies
- cultural norms past and present which are passed on to pregnant women
- specific information regarding gestational diabetes within the teen population
- specific information on gestational diabetic teens with regard to ethnicity
- information correlating weight gain during pregnancy with infant birth weight within the teen population
- useful definitions of social support and the role and uses which teen women assign to social support
- the social event aspects of teen pregnancy as conceptualized by teen women
- the role of culture as it affects birth weight of infants
- a local retrospective study to investigate differences which increase birth weight of infants born to teen mothers.

Pregnancy is an event which produces changes that are physical, physiological, psychological, and social. Teenage women progress through these changes with the additional considerations common to their developmental stages. Young women in the North West Health Region have overwhelmingly managed to produce infants whose weight does not impose risks commonly attributed to infants of teen mothers.
References


Appendix A
**REGISTRATION OF LIVE BIRTH**

This is the permanent record of your child's birth and legal name.

**PLEASE PRINT**

<table>
<thead>
<tr>
<th>Name:</th>
<th>MIDDLE NAME(S)</th>
<th>SURNAME</th>
<th>SEX OF CHILD</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date of Birth:</th>
<th>KIND OF BIRTH</th>
<th>BIRTH ORDER, IF TWIN, STATE WHETHER THIS CHILD WAS BO</th>
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<tbody>
<tr>
<td>FIRST NAME</td>
<td>MIDDLE NAME</td>
<td>Surname</td>
</tr>
<tr>
<td>MONTH</td>
<td>DAY</td>
<td>YEAR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time of Birth:</th>
<th>HOSPITAL BIRTH?</th>
<th>NAME OF HOSPITAL</th>
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</thead>
<tbody>
<tr>
<td>24 HOUR CLOCK</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
</tbody>
</table>

**Place of Birth in BC:**

If birth did not occur in hospital give exact location where birth occurred

**Children ever born to this mother (including this birth):**

- [ ] Single
- [ ] Twins
- [ ] Triolets
- [ ] 4+ or more

**Full name of attending physician (or midwife):**

**Attending Physician:**

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<thead>
<tr>
<th>FIRST NAME</th>
<th>MIDDLE NAME(S)</th>
<th>MAIDEN SURNAME</th>
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<tr>
<th>Date of Birth:</th>
<th>CITY OF BIRTH</th>
<th>PROVINCE/STATE OF BIRTH</th>
<th>COUNTRY OF BIRTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MONTH</td>
<td>DAY</td>
<td>YEAR</td>
<td>[ ] Single [ ] Twin [ ] Triplet [ ] 4+</td>
</tr>
</tbody>
</table>

**Usual Residence Street:**

**City, Province/State, Country, Postal Code:**

**I certify that the foregoing is true and correct to the best of my knowledge and belief.**

**Signature of Mother**

**Date Signed**

<table>
<thead>
<tr>
<th>Name:</th>
<th>MIDDLE NAME(S)</th>
<th>SURNAME</th>
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<th>AGE AT TIME OF BIRTH</th>
<th>BC RESIDENT?</th>
<th>PERSONAL HEALTH NUMBER (CARECARD NUMBER)</th>
<th>ABORIGINAL?</th>
<th>IF YES, REGISTRATION NUMBER (DIANID)</th>
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<tbody>
<tr>
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<td>YEAR</td>
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<td>[ ] 1st [ ] 2nd [ ] 3rd [ ] 4+</td>
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</table>

**Usual Residence Street:**

**City, Province/State, Country, Postal Code:**

**I certify that the foregoing is true and correct to the best of my knowledge and belief.**

**Signature of Father**

**Date Signed**

**STATUTORY DECLARATION**

(IF BOTH PARENTS HAVE SIGNED THE ABOVE FORM, LEAVE THIS SECTION BLANK)

I [ ] the [ ] mother, [ ] father, [ ] no relation of [ ] child's name, do solemnly declare that I am the [ ] mother, [ ] father, [ ] no relation of [ ] child's name, who was born at [ ] child's place of birth, BC on [ ] child's birth date, and I make this solemn declaration believing it to be true, and knowing that it is of the same force and effect as if made under oath.

Declared before me at [ ] City/County where statutory declaration was signed in the Province of British Columbia this [ ] day of [ ].

**Signature of Declarant**
### PHYSICIAN'S NOTICE

**OF A LIVE BIRTH OR STILLBIRTH**

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<th>CHILD</th>
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<th>FATHER</th>
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<td>(Given names)</td>
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<tr>
<td></td>
<td>Date of Birth</td>
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<td>Age</td>
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<td></td>
<td>Personal Health Number</td>
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<tr>
<td>Was child born alive?</td>
<td>Time of birth</td>
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</table>

#### PLACE OF BIRTH

| Kind of birth | Birth order | Child's Personal Health Number | If parents not legally married to each other, is not non aboriginal | or registered aboriginal |
|---------------|-------------|--------------------------------|---------------------------------------------------------------|
| Single | | | | |
| Twin | | | | |
| Triplets | | | | |
| 4+ | | | | |

#### FATHER

| (Surname) | (Given names) | Personal Health Number | If parents legally married to each other, is father non aboriginal | or registered aboriginal |
|-----------|--------------|------------------------|---------------------------------------------------------------|
| | | | | |

#### PHYSICIAN'S INFORMATION

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<th>(Printed) Surname</th>
<th>Given names</th>
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#### BIRTH

<table>
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<th>Complications of pregnancy, labour or delivery</th>
<th>Operative procedure (specify):</th>
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</thead>
<tbody>
<tr>
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<td>No</td>
<td>If yes, describe:</td>
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<th>Forceps</th>
<th>Breech</th>
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<th>2nd</th>
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