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Examination of the Effect of Age, Education, Parity, Pregravid Weight, Pregnancy Weight Gain, and County of Residence on Incidence of Low Birth Weight Infants in Utah and Nevada

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EXAMINATION OF THE EFFECT OF AGE, EDUCATION, PARITY, PREGRAVID WEIGHT, PREGNANCY WEIGHT GAIN, AND COUNTY OF RESIDENCE ON INCIDENCE OF LOW BIRTH WEIGHT INFANTS IN UTAH AND NEVADA

by

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ABSTRACT

Examination of the Effect of Age, Education, Parity, Pregravid Weight, Pregnancy Weight Gain, and County of Residence on the Incidence of Low Birth Weight Infants in Utah and Nevada

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One of the primary purposes of the investigation was to examine the impact of a number of variables on the incidence of low birth weight in two states, Utah and Nevada, that have divergent low birth weight incidences. The sample size obtained from birth certificate data for this purpose was 51,147 (1969-1974) for Nevada and 26,464 (1970) and 29,422 (1974) for Utah. Additionally, separate analyses were made for Utah and Nevada data available for the year 1974. The respective sample sizes for this year were 29,422 (Utah) and 8,256 (Nevada). Least squares analysis indicated sex of the infant, race of the mother, age of the mother, parity, and county of residence were all significantly related ($P < 0.01$) to birth weight of the infant. Examination of the birth certificate data indicated, the unmarried, black adolescent is most apt to bear a low birth weight infant in both Utah and Nevada, but the incidence of young, black, unmarried adolescents is higher in Nevada accounting in part for the divergent overall incidence of low birth weight between the two states.

To supplement birth certificate information, additional questionaire sampling was conducted in Utah and Nevada. Information on pregravid weight, pregnancy weight gain, protein intake, energy intake, smoking habits, socio-economic status, exercise patterns and over-the-counter drug use was obtained from 184 women (Utah = 88, Nevada = 96). Student's t-test, stepwise regression and least squares analysis indicated pregravid weight and pregnancy weight gain were the only variables significantly related ($P < 0.01$) to birth weight.

(87 pages)

INTRODUCTION

Birth is generally a joyous occasion. Unfortunately, sometimes the birth event is met with fear, despair, and sadness. The birth of a child who is handicapped whether it be mentally or physically or the child who is stillborn or the miscarriage that regretably still take place, leave a mark of sadness where there should be joy. In some cases, the answers to why these happenings take place are known. For instance, the classic example of contracting rubella in the first three months of pregnancy is known to significantly increase the chances of pregnancy complications or fetal malformations of some type. On the other hand, not all the answers are available. Why for example, will one child be born weighing less than the critical five and a half pounds (2500 g) that is used to define prematurity (MCH Exchange, 1972). Answers to this question are not simple and straight forward. For instance, one notes that birth weight can be influenced by a number of factors such as cigarette smoking, excessive intake of drugs and/or alcohol and the quantity and quality of the expectant mother's diet (Bergner and Susser, 1970).

Addressing the question of birth weight, particularly low birth weight, this research attempts to further elucidate the etiology involved. There still exists in the United States a significant number of infants whose birth weight is less than 2500 grams. From state to state, the incidence rates for low birth weight vary considerably. Thus, North Dakota's low birth weight incidence is 5.8%, Utah's is 6.9%, Nevada's is 9.8% and Washington D.C. has a low birth weight incidence of 14.1% (the low birth weight incidence was computed as the number of live births under 2501 g divided by the total number of live births and then multiplied by 100) (MCH Exchange, 1972).

To examine the possible differences operating between states, Utah was selected as a state representing a low incidence of births under 2501 g and Nevada was selected to represent a state with a fairly high incidence of such births. The choice of Nevada and Utah was also predicated on the fact that as neighboring states they bear several commonalities - neither state is particularly densely populated, both are in the mountainous region of the United States, therefore, climatically the two states are somewhat similar, and both show a pattern of two or three large areas of population density (urban areas) and the remaining population is scattered throughout the state.

The emphasis of this investigation was to examine the interrelationships of various factors on birth weight. Answers to three basic questions were pursued in this investigation. Within a selected population, i.e., Utah and Nevada, what type of mother is most apt to bear a low birth weight infant - is the situation completely individualized or does there exist certain population groups who more frequently deliver low birth weight infants? Of certain factors, as smoking of the mother and spouse, alcoholic beverage consumption, nutritional status, exercise, age, parity, pregravid weight, employment status, pregnancy weight gain, sleep and over-the-counter drug use, which ones exert a significant impact on the subsequent birth weight? Of the factors of smoking of the mother and spouse, alcoholic beverage consumption, nutritional status, exercise, age, parity, pregravid weight, employment status, pregnancy weight gain, sleep and over-the-counter drug use, does the signficant impact remain the same between two samples of pregnant women (Utah and Nevada samples) or would there be differences between the two?

Since it is not known specifically what type of mother in Utah and Nevada is most apt to bear a low birth weight infant, efforts for prevention are limited in their effectiveness. Not knowing which group to whom education and other remedial efforts should be directed for correction and improvement of this situation would result in haphazard effectiveness. Money for personnel, the necessary materials, the communications and other costs would all be higher than necessary since they would be aimed non-specifically at all groups within the state. This investigation, by identifying the potential mother of a low birth weight infant can help alleviate such an ineffective situation. The identification of potential mothers of low birth weight infants is important in that it aids further understanding of low birth weight etiology in general.

REVIEW OF LITERATURE

General Factors

An infant's birth weight is a critical factor in his or her ability to cope with and adjust to life outside the womb. The birth weight reflects to some extent the infant's stage of development which in turn is definitive of his ability to breathe, eat and generally function on his own. The recent literature defines the critical birth weight of the human as 2500 g (Bergner and Susser, 1970). Below this weight, the infant is considered high risk in terms of survival. Scott (1966) and Niswander (1970) cite a relationship between low birth weight and increased infant mortality. Such infants are more likely to exhibit such handicaps as decreased IQ (Weiner, 1970 and Drillen, 1970) behavior anomalies and congenital malformations (Weir, 1971).

Weiner (1970) found that there was an association between low birth weight and low IQ scores and that as birth weight increased so did IQ scores.

Niswander (1970) cites a relationship between low birth weight and neurological dysfunction and between birth weight and certain forms of cerebral palsy.

Evidence that low birth weight may affect intellectual functioning, increase infant mortality rates and increase the incidence of congenital malformations give sufficient impetus to study the etiology of low birth weight. Various factors have been identified as possible causative agents ranging from smoking habits of the mother to weight gain during pregnancy and to socio-economic status of the mother. The following are discussions of such findings in the current literature.

Maternal Age

The age of the mother gives some indication as to her level of physiological maturity which in turn may affect her ability to support and maintain the fetus during the gestation period. In 1971, Erkan, Remer and Stine examined the obstetric charts of 261 adolescent patients. They found that regardless of chronological age, physiologically immature teenagers run almost double the risk of having a low birth weight infant as compared to the more mature counterparts. Increased prematurity rates were also reported by Stine, Rider and Sweeny (1964).

However, Semmens (1966) examined the records of some 12,847 expectant adolescents and found the overall incidence of infants born under 2501 grams was about the same as that reported for the overall population.

The Committee on Maternal Nutrition (1970) point out that mothers under seventeen years of age were particularly susceptible to fetal loss and infant mortality. They further state that the growth needs of the adolescent herself coupled with fetal demands, place the adolescent in a more vulnerable position with regard to caloric restriction.

A possible explanation for the divergent findings of Semmens (1966)

Stine (1964) and Erkan (1971) was offered by Zackler, Andelm, and Bauer (1969) when they reported that when adequate and early prenatal care is initiated with the adolescent, lower prematurity rates result.

Shank (1970) using 197,372 pregnant adolescent records, found that in 1965, 83 of each 1000 live births was born weighing less than 2501 g.

The effect of maternal age on infant birth weight was substantiated by Papevangelou, Papadatoa, and Alexious (1973) who found a higher incidence of small-for-date infants (born less than 2501 g but gestationally at term) among mothers less than twenty years of age. Women over thirty years of age, however, demonstrated a rise in the incidence of the small-for-date infant with mothers forty years or more having the highest incidence of all age groups considered.

Socio-economic Status and/or Racial Origins of the Mother

Since racial origin is often highly correlated with existing socio-economic status, studies relating to these factors will be discussed together.

Israel and Woutersz (1963) analyzed birth records of 3995 adolescents who were expecting. Among their findings, they noted that prematurity rates were greater among the non-white samples.

Data from the National Center for Health Statistics (NCHS) for the year 1968, within the United States, noted that Vermont was the only state whose prematurity rate for the white segment of the population was greater than that for the non-white segment. North Dakota, New Hampshire and Maine had equal prematurity rates for their non-white and white samples. In the remaining forty-six states, the prematurity rate for the non-white segment of the population exceeds that of the white population (MCH Exchange, 1972).

Shank (1970) noted that for every 1000 babies born to non-white mothers who were fifteen years or younger, 210 or more than one out of five were underweight. Babies of white mothers of similar age were somewhat better, there being 130 underweight babies per 1000.

Papevangelou, Papadatoa and Alexious (1973) reported that when examining factors that affect the incidence of small-for-date infants, social class exerted a significant effect. As the social class or socio-economic status decreased, the incidence of small-for-date infants increased.

Erhardt et al. (1964) compared the birth weights of whites and non-whites with regard to their respective mortality rates. They found that non-white infants experience a better survival rate at low birth weight than do white infants. However, the non-white population exhibited a higher rate of births less than 2501 g. The low birth weight incidence was 7.39% for the white sample and 14.80% for the non-white portion of the population. The data were based on birth records from 1958-1961 for New York City.

Evidence that socio-economic status can affect birth weight also comes from a postwar study conducted by Gruenwald et al. (1967). Utilizing Japanese birth records, it was noted that the mean birth weight was higher in the postwar years as the general socio-economic situation of Japan began to improve. The study concluded that such a birth weight increase could not be accounted for by increased gestational age but from the influence of the generally improved circumstances.

Thomson (1957) also developed the idea that socio-economic status could influence birth weight. He noted that the average birth weight decreased with a decline in social class. His hypothesis was that the social class reflected nutritional status which in turn affected the birth weight of the infant.

Nutritional Status of the Mother

When one considers the role of nutrition during pregnancy, it is often hard to develop direct cause and effect relationships. The area is not without controversy. Some authors as Bergner and Susser (1970) feel that maternal nutrition is a key to the incidence of low birth weight. Other researchers have noted that even in times of severe food restriction as in Holland and Leningrad during World War II, there was only a 5-10% reduction in birth weight (Page, 1969). In general terms, however, most would agree with Dr. Shanholtz's (1971) statement "adequate diet from the mother's own birth through growth and reproduction or what is called a 'good nutritional start early in life' is of utmost importance for both the mother and her baby."

Among the very early studies on the relationship of diet to the outcome of pregnancy was one by Bertha Burke, Vernette Harding and Harold Stuart (1943). Among their findings was that the average protein intake was related to birth length and as the birth length increased, protein intake increased. They found that the amount of protein in the mother's diet had a greater effect on the infant's length than did the height of the mother. There was also a tendency for birth weight to increase with each additional ten grams of daily protein. Prenatal diets supplying less than 70 grams of protein daily during the latter part of pregnancy tended to result in a short and lightweight infant.

Twelve years later, Jeans, Smith and Stearns (1955) published another report of maternal diet during pregnancy and prematurity. They divided their 404 pregnant women into five groups - (a) those receiving 85 g or more of protein daily, (b) those receiving 70-84 g daily, (c) 60-69 g and (d) 50 -59 g daily and (e) less than 50 g of protein daily. They established that the incidence of prematurity rose as the mean intake of protein declined. The low birth weight incidence was more than twice as high in the group with the poorest dietary habits (9.6%) as those with better nutrition (4.0%).

Drillien (1957) noted that 37% of the women who had premature infants were adjudged to be consuming inadequate diets.

Thomson (1959) divided his subjects into three social classes and found that as the social status decreased, the average caloric intake and the average protein intake decreased. From the highest to the lowest social class, the average daily caloric intake decreased by 269 kcal and the daily protein intake decreased by 7-8 g.

Later, Thomson and Billewicz (1963) examined the relationship between maternal size and infant birth weight. Using a general clinical assessment, women were divided into general health categories of "very good", "good", "fair", "poor", and "very poor". The prematurity rate increased with each category. Those rated "very good" had a prematurity incidence of 5.1% while those rated as "very poor" had a 12.1% incidence. Thomson and Billewicz also noted that women rated as in poor condition were often shorter and they postulated that these short women may have been malnourished during their growth period and became stunted. Additionally, the shorter women tended to belong to the lower socio-economic classes. Further associations were made between the stature of the women and their diets. The shorter women took in approximately 240 kcal less than that of taller women.

More recent research has also been conducted in the area of diet and birth weight. Naeye, Blanc, and Paul (1973) noted that in women who were counseled by their physicians to limit their caloric intake, the fetal body and organ weights were smaller than for those women who received general dietary counseling. An additional finding was that maternal undernutrition as reflected by weight gain and pregravid weight before the third trimester had little or no influence on fetal body, organ and cellular growth. However, such effects were pronounced in late gestation.

The effect of maternal dietary supplementation on birth weight was studied by several researchers in Guatamala. Four villages were examined and two types of supplements were offered - one was a high protein supplement and the other was a low caloric, no protein supplement. The total sample was 288. The results of the study indicated that women who ingest increasing amounts of calories from the food supplements had on the average increasingly larger babies. For each 10,000 calories of supplement ingested by the mother during pregnancy, the average newborn's birth weight increased by 50 g. An interesting finding was that when comparing isocaloric amounts of the two types of supplements with the birth weight of the infant, it was revealed that protein added to the calories had little if any, effect on birth weight (Habicht et al., 1974).

King and her collegues (1972) found that the nutrients most poorly supplied during pregnancy were calcium, iron, vitamin A and energy. Protein fared better, in that all the subjects met at least two-thirds of the recommended daily allowance (RDA) for protein during their pregnancies. They also found that an infant's birth weight was not related to the amount of energy or nutrients in the maternal diet during pregnancy.

A somewhat similar study to that of King's was conducted by Kaminetzky et al. (1973). His sample consisted of 142 unwed teen-age mothers. Diet recalls were conducted in each trimester of pregnancy and were then ranked according to 'Basic Four' guidelines. At the initial visit, 43% had diets rated as fair. Also 50% had protein intakes between 61-100 g/day. Sixty-four percent averaged an intake of 901-2100 kcal/day. Girls who delivered low birth weight infants had low or borderline protein intakes and low caloric intakes.

Animal studies have also examined the relationship between diet and birth weight. Utilizing McCollum rats, Chow and Lee (1964) studied the effects of dietary restriction (restriction of overall food intake) on pregnant and lactating rats. Restriction of the diet during these periods resulted in growth stunting of the progenies. Similar findings were reported when the restriction was imposed during gestation only.

Roeder and Chow (1972) summarized some animal studies where they noted an adequate diet reduced by 50% produced significantly smaller progeny. Weights of most organs as the heart, testes, etc, were significantly smaller at birth, but after nutritional rehabilitation, the weights of most organs, in contrast to body weight, did not remain significantly different from that of controls.

Animal studies altering the protein content of the diet have been conducted by several researchers. In 1968, Zamenhof reduced the normal protein content of the laboratory chow by 27% and fed this to the animals one month prior to mating and throughout gestation. This manipulation resulted in a 30% reduction in the birth weight of the litter compared to controls. A similar study where the controls received a diet with 24% casein and the restricted group received only 6% casein resulted in a 20% reduction in birth weight in the restricted group (Zeman, 1967).

Other Studies

Other studies have been done on diet during pregnancy, but in these cases, diet was not correlated to birth weight. Instead, the intent was to describe the intake patterns during pregnancy. Van de Mark (1972) conducted a study of expectant adolescents (N = 114) throughout their pregnancies. For all 114 adolescent girls, the average caloric intake for each trimester was 1865 kcal, 1913 kcal, and 1844 kcal respectively. The average protein intakes for the three trimesters were 65 g, 60 g, and 59 g respectively. Both the average kcal intake and the average protein intake were below the 1973 Recommended Daily Allowances (Appendix B).

Agnes Higgins (1974) reported relatively high average intakes of protein and calories. Her sample of 1736 cases showed an average caloric intake of 2249 kcal and an average protein intake of 68 g.

Ellen Morse and others (1975) investigated nutrition during pregnancy with respect to variations due to age. Their findings revealed that adolescent mothers were consuming higher amounts of protein and higher caloric intakes than older expectant mothers (Table 1).

Table 1. Average daily energy (kcal) and protein (g) intakes during pregnancy

	12-17 yrs	18-19 yrs	20-24 yrs	25-32 yrs
Energy	2158 $\pm$ 52	2252 $\pm$ 56	1932 $\pm$ 46	1949 $\pm$ 48
Protein	83 $\pm$ 3	88 $\pm$ 3	78 $\pm$ 2	77 $\pm$ 3

The caloric intake values are similar to those reported by Higgins (1974), but the average protein intake was considerably higher.

Two other diet related factors researched to some extent are pregravid weight and weight gain during pregnancy. Both factors are dependent to a large degree on nutritional intake or status.

Pregravid Weight

Higgins (1974) reported that the average increase in birth weight was fifteen grams per kilogram of the maternal pregravid weight.

Naeye (1973) conducted a study of 467 pregnant women and after classifying the women as to overweight with high weight gain, overweight with low weight gain, and underweight with high weight gain and underweight with low weight gain, they found that the mother's pregravid weight, as well as, her weight gain was related to fetal growth and subsequent size. Women who were overweight with high weight gain showed greatest fetal growth rates.

Thomson (1959) established in his examination of normal pregnant women that the pregravid weight of the mother was much more important in the determination of birth weight than the caloric value of her diet. British data (Love, 1965) revealed that the heavier the mother before pregnancy, the heavier her infant. These data were based on 2076 normal births in the London, England area. As with other studies, male infants were generally heavier than females. Thomson and Billewicz (1963) also found that as pregravid weight decreased the incidence of prematurity increased. Their data were based on 4215 primigravidae subjects. For the three weight groups "underweight", "average weight", and "overweight", the prematurity rates were 9.6%, 6.9%, and 4.1% respectively.

Pomerance (1974) divided the prepregnancy weights into three categories (a) 100 - 119, (b) 120 - 139, and (c) 140 - 159 pounds. The trend within each group was for greater birth weight with increased pregravid weight. He and his associates found the overall mean birth weight was 3512 $\pm$ 452 g and the average weight gain during pregnancy was 28.3 pounds.

Weight Gain During Pregnancy

Working with a population of 9289 white women and 7605 Negro patients, Niswander et al. (1969) established a strong positive association between the weight gain of the mother and the birth weight of the child. Similarly, there was a strong positive association between the prepregnancy or pregravid weight of the mother and birth weight of the infant. Niswander also reported that increasing prepregnancy weight of the mother diminishes the possible impact of her weight gain on the birth weight of the infant.

Singer, Westphal, and Niswander (1968) reporting on the 10,000 children in the Collaborative Study of Cerebral Palsy found that high weight gain was related to higher birth weight and, therefore, to a decreased prematurity rate. This holds for gestations beyond 30 weeks.

British data compiled by Love and Knich (1965) noted a significant relationship between weight gain of the mother and birth weight of the infant even after correcting for length of gestation and maternal height and prepregnancy weight.

King's study (1972) conducted with pregnant adolescent girls found no correlation between the amount of energy or nutrients in the maternal diet and subsequent birth weight. However, a significant ($P < 0.01$) relationship between maternal weight gain and the infant's birth weight was noted. Larger babies were born to the mothers gaining more weight. Also significant at the $P < 0.01$ level was the fact that girls weighing least prior to pregnancy gained the most weight. King found that weight gain of the subjects was not related to the energy or protein content of their recorded diet, but all three girls who gained less than fifteen pounds ate less than 1500 kcal/day.

With regard to weight gain during pregnancy, Hytten and Leitch (1971) state that the range of weight change in pregnancy is wide from a loss to a gain of twenty-three kilograms or more. The incidence of clinical complications rises at the extremes of the range.

Other Factors

Other factors have also been shown to influence subsequent birth weight. Higgins (1974) noted that both sex and parity affected the average birth weight. Male infants were 44 g heavier than females and the infants of primipara mothers were 65 g lighter than infants born to multipara women. Papevangelou et al. (1973) reported that with regard to small-for-date infants, there was a decline in the incidence of small-for-date infants with increasing parity. The highest incidence was encountered in primipara women and the lowest incidence was in women with a parity over three.

Naeye (1973) also found that fetal body and organ growth improved with successive pregnancies except in the most poorly nourished mothers.

A relatively early study by McKeown (1954) established that there was a positive correlation between the mother's height and the infant's birth weight. Taller mothers generally produced heavier infants. The authors found that the association between birth weight and maternal height was more marked for first born than for later born.

H. Gordon Green (1974) discussed in a review article dealing with the effects of maternal ethanol (alcohol) ingestion on the infant. Green found no acceptable evidence to show any effect of short term alcohol intoxication on abnormality of children. However, long term intake increases the incidence of stillbirths and prematurity. Indications are that malnutrition concurrent with long term alcohol ingestion are factors in these increased rates of stillbirth and prematurity.

The effect of maternal physical fitness on the outcome of pregnancy has also been explored to a limited degree. Pomerance, Gluck and Lynch (1974) tested fifty-four women in their last trimester of pregnancy on a bicycle ergometer. They found that the infant's birth weight and length were not correlated to the mother's degree of physical fitness. However, they found women who smoked ten or fewer cigarettes a day had significantly smaller babies than non-smokers. A study by Butler (1973) confirms Pomerance's (1974) study on the effects of smoking during pregnancy with regard to birth weight. He further noted the size (in this case height) differences observed at birth were still present up to seven years of age.

Targett, Gunesee and McBride (1973) examined a sample of 1000 pregnant women of which 38.7% were smokers. The mean birth weight decreased as cigarette consumption increased. The mean birth weights by category were: (a) non-smokers - 3300 g, (b) smokers (all) - 3141 g, (c) light smokers (1-5 cigarettes/day) - 3247 g, (d) moderate smokers (6-20 cigarettes/day) - 3140 g, and (e) heavy smokers - (21 or more cigarettes/day) - 3044 g. Differences were not significant except for comparison of non-smokers to heavy smokers. There was a highly significant positive correlation ($P < 0.01$) between smoking and intrauterine fetal growth retardation which results in a low birth weight.

A British team of researchers compiled information on the outcome of pregnancy with respect to the time interval between pregnancies. They found that the proportions of infants with low birth weights were greatest at the extremes - that is greatest with both long and short interpregnancy intervals. The incidence of prematurity was highest in the group with a short interpregnancy interval. The short interval was defined as six months or less (Fedrick, 1973).

Another factor demonstrated to affect birth weight is the presence of anemia during pregnancy. Harrison (1973) reported an incidence of fetal growth retardation in a group of women who had been diagnosed as anemic either due to sickle cell disease, folate deficiency or hemoysis from malaria and who did not respond to treatment. The effect of decreasing the birth weight was postulated as due to reduced oxygen supply to the fetus.

PROCEDURES

Profile of High Risk Mother

The first task was to develop a profile of the type of expectant mother most apt to give birth to an infant weighing less than 2501 g within Nevada and Utah.

To develop an accurate and representative profile of this nature, a large sample size was prerequisite. A profile such as this depends upon substantial sampling to reflect statewide variations. Birth certificate data were deemed the most acceptable and accessible means of developing the desired profiles. Through the cooperation of the Vital Statistics Divisions of Utah and Nevada, birth certificate data were made available. Information for the years 1969-1974 for Nevada and for 1970 and 1974 for Utah was obtained. These data provided information on: (a) mother's age, (b) sex of the infant, (c) birth weight of the infant, (d) race of the mother, (e) race of the infant, (f) level of education of the mother, (g) county of residence of the mother, (h) number of prenatal care visits, (i) parity of the mother and (j) legitimacy. The data for analysis was restricted by eliminating the records of nonresidents and those of multiple nature, i.e., twins, triplets, etc.

Environmental Impact on Birth Weight

The birth certificate data could provide a great deal of information on various factors that may influence birth weight but could not yield any clues as to the impact of such other known factors in the environment of the mother as: (a) diet during pregnancy, (b) smoking habits, (c) drinking habits, (d) employment status, and (e) exercise patterns. To assess these factors, it was necessary to collect data from a second sample. Expectant women in the last trimester of their pregnancies were identified as the target group. The last trimester of pregnancy contingency was utilized because the birth weight of the infant is primarily determined in the last three months of pregnancy (Naeye, 1973). The ideal sampling would have included the entire populations of Nevada and Utah. Statewide population sampling was beyond the resources available. Therefore, sampling was conducted in two areas utilizing prenatal classes. These two areas were Logan, Utah and Reno, Nevada. In both communities, sampling consisted of explaining the purpose of the study at these classes and soliciting volunteer cooperation. After volunteers were identified, questionaires were administered (Appendix A). Following the birth of the infant, information regarding birth weight, birth length, sex of the infant, pregravid weight, pregnancy weight gain, parity and if the mother were multipara the number of months between this pregnancy and the previous one was gathered. This procedure yielded 108 completed questionaires from Nevada women. Of this number, two were eliminated from final analysis due to the presence of a health problem that could influence birth weight, four more were eliminated due to inadequate questionaire information particularly that of the diet recall and a final six were eliminated due to an inability to complete the follow-up information. The final sample size for Nevada was ninety-six.

Prenatal contacts within the Logan, Utah area yielded 103 completed questionaires. Of these, three were eliminated due to the presence of a health condition that could affect birth weight, four were eliminated due to inadequate questionaire data - again particularly that of the diet recall and eight were omitted due to an inability to complete the follow-up information. The final sample size for Utah was eighty-eight.

The Questionaire

The questionaire (Appendix A) utilized in this study was designed to gather information on: (a) level of education of the mother and spouse, (b) occupation of the mother and spouse, (c) approximate income level of spouse, (d) smoking habits of mother and spouse, (e) consumption of alcoholic beverages by mother, (f) sleep and nap habits of mother, (g) exercise patterns of the mother, (h) drug useage of mother, (i) dietary factors (24 hour recall), and (j) race of the mother.

The socio-economic status was calculated from the education and occupation of the spouse using the Two Factor Index of Social Position published by August B. Hollingshead, 1957. The education of the spouse and his occupation were information gathered for the sole purpose of computing the socio-economic status.

The diet information was collected by means of a 24 hour recall which was an attempt to maximize participant cooperation. Protein and energy intakes were calculated from these data.

The questionaire was drafted and pre-tested on a prenatal class consisting of fifteen members. This particular prenatal class was located in Logan, Utah. Minor editing changes were made and the final form of the questionaire was obtained (Appendix A). None of the pretest sample data were utilized in the final analysis.

DATA ANALYSIS

Profile of High Risk Mother

Since the birth certificate data were obtained from variable sample sizes and because the major objective of this portion of the study was to determine the profile of the woman most apt to bear a low birth weight infant by comparing certain variables as age, race, etc to birth weight, the method of least squares analysis was employed. This allowed the predictive value of such factors as county of residence, mother's age, mother's education, mother's race, number of prenatal care visits, number of previous deliveries, and legitimacy with regard to birth weight to emerge.

Environmental Impact on Birth Weight

To analyze the questionaire data (Appendix A) it was first necessary to compare the data collected in Nevada with that collected in Utah to determine if any significant differences in birth weight existed between the two samples. The t-test was utilized for this comparison. If there were no significant differences detected between the birth weights of the two groups, then they would be combined for subsequent analysis.

Subsequent analyses would entail stepwise regression and least squares analysis. Stepwise regression was utilized with the continuous independent variables of pregravid weight, pregnancy weight gain, caloric and protein intakes, and age. The categorical variables of socio-economic status, parity, education, smoking habits of the mother and spouse, exercise patterns of the mother, employment status of the mother, drug use and alcoholic beverage consumption along with the continuous variables of pregravid weight, and pregnancy weight gain were analyzed by the least squares method.

FINDINGS

This study was undertaken to (1) identify within Nevada and Utah a profile of an expectant mother most apt to bear a low birth weight infant, and (2) assess the relative impact of selected environmental factors as smoking habits, dietary habits, etc upon subsequent birth weight. The following outlines the results.

Profile of High Risk Mother

Table 2 depicts the respective Nevada and Utah population samples.

Table 2. Nevada and Utah samples[a]

Category	Nevada	Utah, 1970	Utah, 1974
Caucasian	44,590	25,140	28,411
Negro	5,401	168	135
American Indian	1,156	353	454
Male infants	26,116	13,654	14,980
Female infants	25,031	12,819	14,441
Primipara	19,296	9,585	10,729
Multipara	31,851	16,789	18,693
Low birth weight infants	4,426	1,704	1,728
% of total - low birth weight infants	8.52	6.40	5.80

a. Nevada, 1969-1974 - N = 51,147 Utah, 1970 - N = 26,464
Utah, 1974 - N = 29,422

The initial analysis of the Nevada data revealed that for all races other than Caucasian, Negro and American Indian, the combined total number of births for the five year period was 260. This was significantly less than the sample size for other major racial categories. On this basis, the decision was made to eliminate them from the final analysis and concentrate on the Caucasian, Negro and American Indian samples. The racial composition of the Utah sample was likewise restricted.

The low birth weight incidence of 8.52% (Table 2) for Nevada is down from the figure quoted by the MCH Exchange (1972). The 1974 Utah incidence for low birth weight (Table 2) and the incidence for 1970 Utah (Table 2) are both down from the figure of 6.9% cited by MCH Exchange, 1972.

The independent variables that were available for examination or comparison with the dependent variable of birth weight were: (a) age of mother, (b) sex of the infant, (c) race of the mother, (d) race of the infant, (e) level of education of the mother, (f) county of residence of the mother and (g) number of prenatal care visits, (h) parity and (i) legitimacy of the birth. The findings are as follows:

Birth Weight as Affected by Age of Mother

The lowest incidence of infants born weighing less than 2501 g in Nevada was in the age bracket of 20-30 years, where the incidence rate was 7.73%. The highest incidence was in the age bracket of less than fifteen years of age where it rose to 14.87%. (Figure 1 and Table 3)

Utilizing the same age categories of mothers, it was revealed that for both 1970 and 1974, the age group with the lowest incidence of low birth weight was 31-36 years of age. The incidence of low birth weight was 5.02% (1970, Utah) and 4.50% (1974, Utah). Conversely, the age group with the highest incidence of low birth weight was mothers who were fifteen years or younger. This parallels the Nevada finding. In 1970 the low birth weight incidence for mothers fifteen or less was 11.54% and had risen to 13.95% in 1974. (Figure 2 and Table 4)

Available from the Nevada data but not from the Utah data was age plotted against the mean birth weight. The mean birth weights by age ranged from 3524 g at age fifteen to 3611 g at age forty. The highest mean birth weight was 3647 g at age thirty-one. (Figure 3)

Age was significantly related to birth weight at $P < 0.01$ (Least squares analysis, Table 11).

Birth Weight as Affected by Sex of the Infant

Comparison of the number of boys born weighing less than 2501 g to the number of girls weighing less than 2501 g revealed a higher ($P < 0.01$) incidence among girls. The incidence rate among the boys was 7.78% (Nevada, 1969-1974) while that for girls was 9.29% (Nevada, 1969-1974). Comparison of the low birth weight incidence for Utah revealed the same pattern. In 1970, the boy and girl low birth weight incidences were 5.69% and 7.19% respectively.

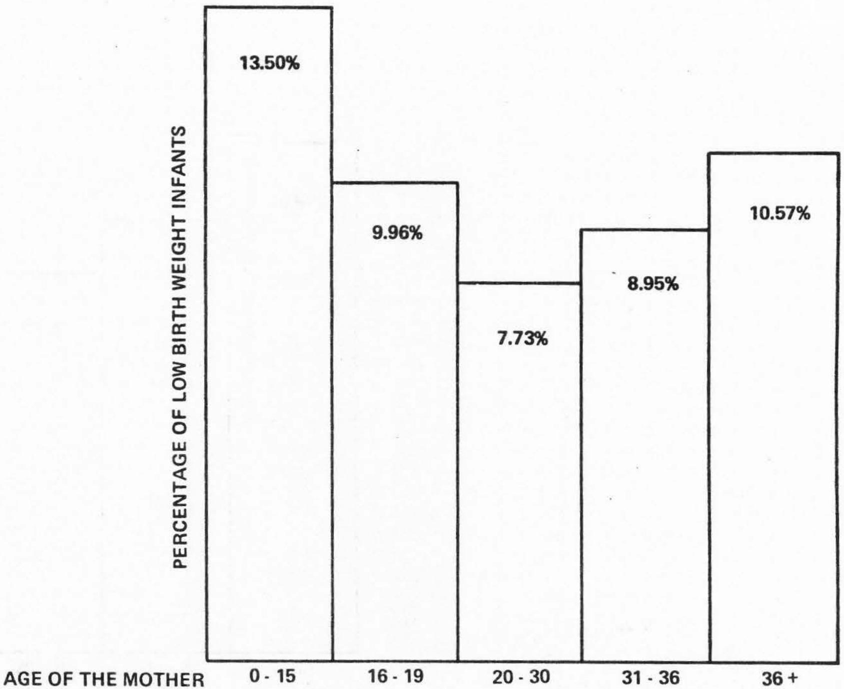

Figure 1. Percentage of low birth weight infants by age groups: Nevada data, 1969-1974

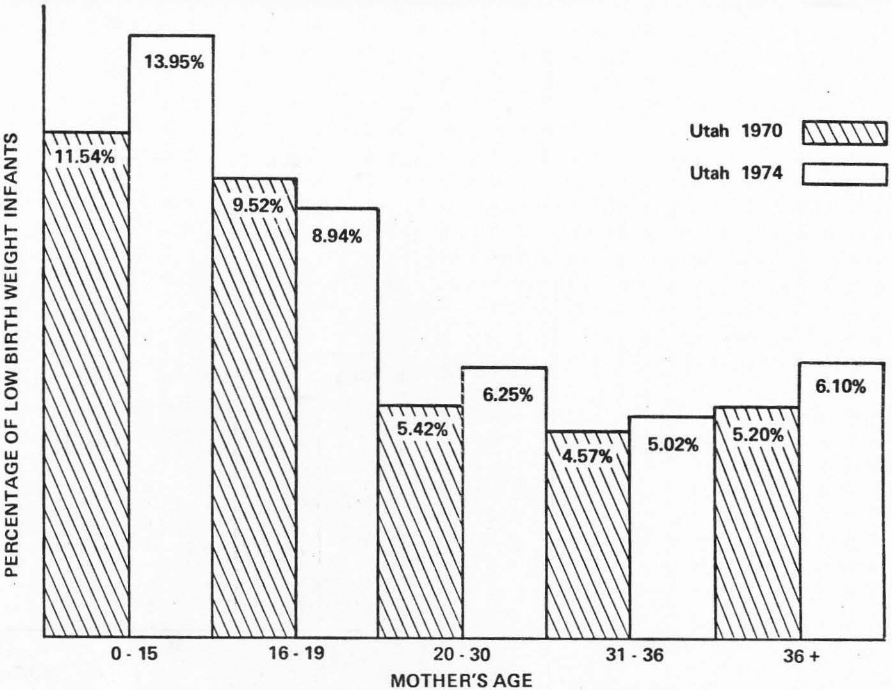

Figure 2. Percentage of low birth weight infants by age groups: Utah Data, 1970 and 1974

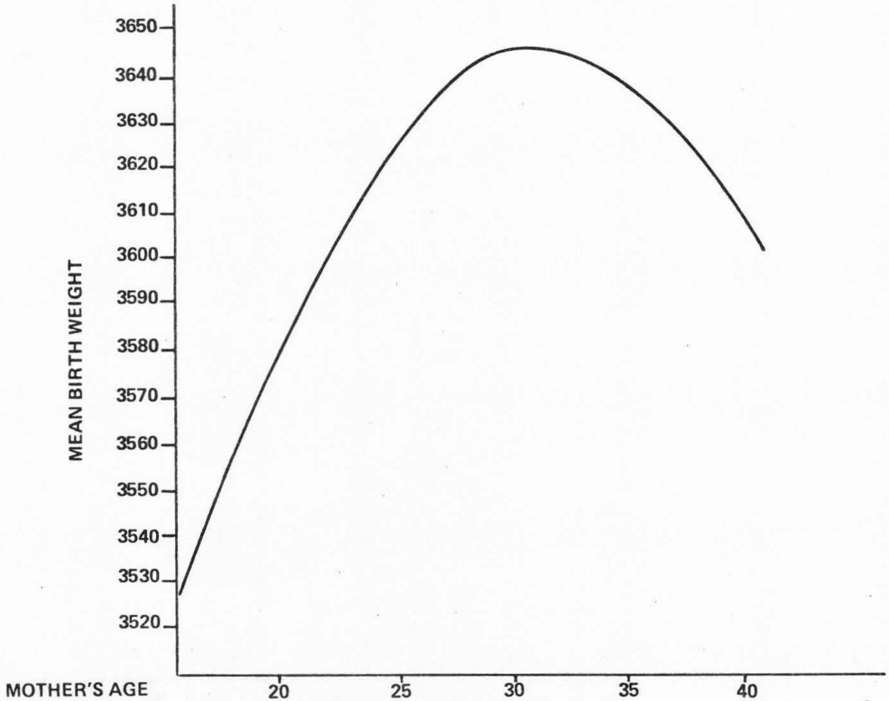

Figure 3: Mother's age x mean birth weight: Nevada data, 1969-1974
N = 51,147 Y = 3190 + 29.33 x I - 47 x I x I r = 0.0549 (P < 0.001)

Table 3. Incidence of low birth weight by mother's age
Nevada data - 1969-1974 continuous

Age of Mother	Number of Births < 2501 grams	Total Number of Births per Age Group	% of Total Births per Age group
0 - 15 years	265	1963	13.50
16 - 19 years	849	8525	9.96
20 - 30 years	2695	34,862	7.73
31 - 36 years	454	5071	8.95
> 36 years	163	1549	10.52

Table 4. Incidence of low birth weight by mother's age
Utah data - 1970 and 1974

	Number of Births < 2501 grams		Total Births per Age Group		% of Total Births per Age Group	
Age of Mother	1970	1974	1970	1974	1970	1974
0 - 15 years	18	18	156	129	11.54	13.95
16 - 19 years	326	286	3426	3199	9.52	8.94
20 - 30 years	1158	1171	21353	18791	5.42	6.23
31 - 36 years	161	167	3521	3329	4.57	5.02
> 36 years	56	62	966	1016	5.80	6.10

In 1974, the rates were 5.39% for boys and 6.38% for girls.

Birth Weight as Affected by Maternal Age

The low birth weight incidence was considerably high for the Negro sample both in Utah and Nevada (Table 5).

Table 5. Incidence of low birth weight (expressed as %) among racial groups.[a]

Race	Nevada	Utah, 1970	Utah, 1974
Caucasian	7.80	6.28	5.69
Negro	24.38	15.00	20.24
American Indian	7.00	10.37	7.65

a. Nevada data (1969 - 1974), N = 51,147; Utah data (1970), N = 26,464 Utah data (1974), N = 29,422

Least squares analysis (Table 11) indicated race was significantly related to birth weight ($P < 0.01$).

Birth Weight as Affected by Race of the Infant

The comparison of the race of the infant to subsequent birth weight and the incidence of low birth weight, as would be anticipated, followed the same pattern as the comparison of the mother's race to birth weight. (Table 6)

The race of the infant is determined by coding systems established in the states. Generally, if a minority race is representing one of the parents, the infant is assigned to that minority race.

Comparison among the various groups in Utah and Nevada revealed the following incidence rates (Table 6):

Table 6. Low birth weight as influenced by baby's race[a] (expressed as % incidence of low birth weight)

Race of Baby	Utah, 1970	Utah, 1974	Nevada, 1969-1974
Caucasian	6.15	5.68	7.38
Negro	13.10	16.30	14.13
American Indian	10.48	7.71	7.29

a. Nevada data (1969-1974), N = 51,147; Utah data (1970), N = 26,464
Utah data (1974), N = 29,422

In both Utah and Nevada for the years observed, the incidence of low birth weight is twice as high for the Negro population as for the Caucasian segment.

Birth Weight as Affected by Mother's Education

A tendency for the incidence of infants weighing less than 2501 g to decrease with increased education was demonstrated. The exception to the trend was with mothers who had graduate educations where the low birth weight incidence rose somewhat. Tables 7 and 8 depict the various low birth weight incidences by education of the mother.

Table 7. Education of the mother and its affect on birth weight
Nevada data 1969-1974 continuous

Education of Mother	Number of Births < 2501 grams	Total Births per education Group	% of Total Births per Education Group
less than 12th grade	1738	15099	11.51
12th grade	1901	24219	7.85
less than 16 years	554	8758	6.33
16 years	170	2987	5.69
> 16 years	48	791	6.07

Table 8. Education of the mother and its affect on birth weight
Utah data 1970 and 1974

	Number of Births < 2501 grams		Total Births per Education Group		% Total Births per Education Group	
Education of Mother	1970	1974	1970	1974	1970	1974
less than 12th grade	517	447	5192	4546	9.96	9.83
12th grade	691	569	10836	10734	6.38	5.30
less than 16 years	333	414	7034	8820	4.73	4.69
16 years	139	164	2811	3886	4.95	4.22
> 16 years	24	125	591	1436	4.06	8.71

Birth Weight as Affected by County of Residence of Mother

The county of residence appears to have some impact on the incidence of low birth weight, but no particular trend or pattern emerged. Attempts were made to explain the effect of county of residence on birth weight in terms of other significant variables. The percent of young mothers (0 - 15 years and 16 - 19 years) was calculated for each county and then counties were ranked. This procedure was conducted calculating the percents of Negro, American Indian and Caucasian for counties and the percent of illegitimacy per county and then ranked. No particular or consistent pattern emerged as a result of the rankings. Tables 9 and 10 depict the incidence of low birth weight per county. Least squares analysis (Table 11) indicates county of residence was significantly related to birth weight ($P < 0.01$).

Birth Weight as Affected by
Number of Prenatal Care Visits

Comparison of the incidence of low birth weight infants with the number of prenatal care visits reported by the mother revealed that the highest incidence of low birth weight infants occurs in those Nevada women reporting nine or less prenatal care visits. The incidence of infants less than 2501 g for this group was 15.63%, whereas, for the Nevada women reporting ten or more visits, the incidence rate was 5.76%.

Due to various recording systems for vital statistics employed

Table 9. Impact of county of residence of mother on birth weight
Nevada data 1969-1974 continuous

County	Number of Births ≤ 2501 grams	Total Number of Births/County	% of Total Births/County
Carson City	113	1518	7.44
Churchill	98	1200	8.17
Clark	2430	29212	8.32
Douglas	249	2804	8.88
Elko	118	1379	8.56
Esmeralda	18	127	14.17
Eureka	6	63	9.52
Humboldt	44	566	7.77
Lander	31	360	8.61
Lincoln	16	92	17.39
Lyon	59	797	7.40
Mineral	65	795	8.18
Nye	28	380	7.37
Pershing	20	243	8.23
Storey	3	39	7.69
Washoe	995	11253	8.84
White Pine	133	1142	11.65

Table 10. Impact of county of residence of mother on birth weight Utah data 1970 and 1974

County	Number of Births < 2501 grams		Total number of Births/County		% of Total Births/County	
	1970	1974	1970	1974	1970	1974
Beaver	6	7	89	93	6.74	7.53
Box Elder	24	32	602	633	3.99	5.06
Cache	47	66	1189	1243	3.95	5.31
Carbon	20	40	265	363	7.55	11.02
Dagget	0	3	13	17	0.00	17.65
Davis	143	140	2396	2610	5.97	5.36
Duchesne	10	18	182	458	5.49	3.93
Emery	7	9	91	132	7.69	6.82
Garfield	3	3	61	58	4.92	5.17
Grand	10	9	140	105	7.14	8.57
Iron	13	18	300	357	4.33	5.04
Juab	6	7	98	118	6.12	5.93
Kane	11	2	51	85	21.57	2.35
Millard	6	8	130	172	4.62	4.65
Morgan	8	4	89	101	8.99	3.96
Piute	1	0	20	24	5.00	0.00
Rich	0	4	26	40	0.00	10.00
Salt Lake	773	729	11218	11765	6.89	6.20
San Juan	29	23	301	278	9.63	8.27
Sanpete	14	14	207	252	6.76	5.56
Sevier	11	14	198	253	5.56	5.53
Summit	15	8	135	137	11.11	5.84
Tooele	52	40	521	548	9.98	7.30
Uintah	21	17	294	466	7.14	3.65
Utah	232	285	4270	5504	5.43	5.18
Wasatch	13	12	140	162	9.29	7.41
Washington	13	16	361	485	3.60	3.30
Wayne	1	1	27	32	3.70	3.13
Weber	212	190	3034	2931	6.99	6.48

by Utah during 1970 and 1974, comparison could be made for only two groups, i.e., women reporting less than eight prenatal care visits and women reporting eight or more visits. The low birth weight incidence in 1970 and in 1974 for women reporting less than eight prenatal care visits was 11.26% and 15.75% respectively. Whereas, the incidence rates declined to 4.88% and 4.77% for women reporting eight or more prenatal care visits in 1970 and 1974.

Birth Weight as Affected by Parity of Mother

The incidence of low birth weight infants for the Nevada primipara women was 8.32% while for the multipara women of Nevada it was 8.64%. The incidence rate is surprisingly slightly higher for the multipara group, but not significantly so.

In 1970, the incidence of low birth weight infants for the Utah sample was 7.22% and for the primipara women in 1974 it was 6.85%. In 1970 the multipara women evidenced a low birth weight incidence of 6.00% and 5.26% in 1974.

Birth Weight as Affected by Legitimacy of the Birth

In Nevada for the period 1969-1974, 12.25% of the illegitimate births were less than 2501 g. For the legitimate births recorded for the same period the low birth weight incidence was 8.09%.

In Utah, in 1970, the low birth weight incidence was 6.10% for legitimate births and 12.17% for the illegitimate births. In 1974, the respective low birth weight incidences for legitimate and illegitimate groups were 5.82% and 14.58%.

1974 - Utah/Nevada Comparisons

Within the Nevada and Utah data it was possible to compare the states with regard to factors that influence the incidence of low birth weight for 1974.

Sample Size

Utah births in 1974 were 29,422 and for Nevada there were 8256 births. Utilizing the variables of sex of the infant, county of residence of the mother, race of the mother, parity and age of the mother a least squares analysis of variance was conducted for the samples (Table 11).

The mean birth weights for Utah and Nevada, 1974 by the race of the mother are presented in Table 12. In both Utah and Nevada samples, the Negro population exhibited the lowest mean birth weight. In the Nevada sample, the American Indian had the highest mean birth weight while the Caucasian in the Utah sample had the highest mean birth weight.

Environmental Impact on Birth Weight

The second focus of this investigation was to assess the impact of certain environmental factors upon subsequent birth weight utilizing two different populations - one with a high incidence of low birth weight and one with a low incidence of low birth weight.

Since there were two samples of expectant women drawn from two different geographic locations, it was first necessary to determine if the birth weights were significantly different. The average birth

Table 11. Least squares analysis - Utah and Nevada, 1974
Nevada N = 8256 Utah N = 29,422

Utah

Variable	Degrees of Freedom	Mean Square	"F" Ratio
sex of infant	1	98063491	288.18 (0.01)
county of residence	28	1071180	3.15 (0.01)
race of mother	2	1858058	5.46 (0.01)
parity	1	14179449	41.67 (0.01)
age of mother	1	51391277	151.03 (0.01)
remainder	29,401	340283	

$r^2 = 0.014$

Nevada

Variable	Degrees of Freedom	Mean Square	"F" Ratio
sex of infant	1	25709463	76.89 (0.01)
county of residence	16	1147135	3.43 (0.01)
race of mother	2	27140404	81.17 (0.01)
parity	1	5568848	16.65 (0.01)
age of mother	1	1366845	4.09 (0.01)
remainder	8,234	334378	

$r^2 = 0.004$

Table 12. Mean birth weight by race of mother - Utah/Nevada 1974
Nevada N = 8256 Utah N = 29,422

Race	Mean Birth Weight in grams, Nevada	Mean Birth Weight in grams, Utah
Caucasian	3304 ± 26[a]	3322 ± 12[a]
Negro	3043 ± 34	3152 ± 57
American Indian	3456 ± 51	3277 ± 35

a. Mean ± sd

weight for the Nevada sample (N = 96) was 3402 ± 352 g and the average birth weight for the Utah sample (N = 88) was 3323 ± 516 g. A t-test revealed no significant differences between the two samples. Hence, the two samples were combined for the purposes of further analysis. The resulting sample consisted of 184 subjects.

Sample Description

There were 179 Caucasians, 3 Orientals, 1 Negro and 1 American Indian. With regards to socio-economic status, there were 8 subjects in the upper class, 21 in the upper middle class, 50 in the lower middle class, 92 in the upper lower class and 13 in the lower class. There were 92 girls and 92 boys born to the group. Primipara women numbered 140 while 44 were multipara. Of the total 184, 11 had less than 12th grade educations and 57 had graduated from high school, while 116 had gone on to some further amount of schooling. The sample was primarily composed of non-smokers (168 of 184). Of the smokers six reported cigarette consumption of less than one-half a pack a day and eight reported smoking between one-half and a full pack a day and only two subjects indicated a cigarette consumption of more than a pack a day. The average amount of sleep reported by the subjects was 8.02 ± 0.28 hr. and 73 reported napping during the day. Of the total, 79 were working during their last trimester. As to over-the-counter drug use, 105 reported taking no drugs, 37 reported taking some occasionally as needed and 16 took some type of medication or drug at least once a week and an additional 16 reported daily intake of some type of over-the-counter medication. With regards to alcohol consumption, there were 111 who reported never consuming alcohol during the pregnancy and 38 who noted a rare intake and 30 who occasionally consumed alcoholic beverages. There were 16 who noted a frequent, i.e., daily or weekly intake of alcoholic beverages. The majority (116) of the women indicated they indulged in a mild form of exercise as walking daily, 13 had moderate exercise and 31 reported limited exercise and the remaining 24 indicated no exercise. Utilizing these 184 subjects, subsequent statistical analyzes were employed to examine the effect of the following variables on birth weight: (a) age of mother, (b) caloric intake of mother, (c) protein intake of mother, (d) weight gain of mother, (e) parity, (f) pregravid weight of mother, (g) socio-economic status, (h) education of the mother, (i) smoking habits, (j) spouse smoking habits, (k) employment status, (1) sleep habits, (m) alcohol consumption, (n) over-the-counter drug use, and (o) exercise patterns.

Intra-Sample Differences

To determine what differences may exist between various subsamples as smokers versus non-smokers with regard to birth weight, t-tests were conducted. The following comparisons were not significant:

Socio-economic status comparisons

upper class (8) and upper middle class (21)
upper class (8) and lower middle class (50)
upper class (8) and upper lower class (92)
upper class (8) and lower class (13)
upper middle class (21) and lower middle class (50)
upper middle class (21) and upper lower class (92)
upper middle class (21) and lower class (13)
lower middle class (50) and upper lower class (92)
lower middle class (50) and lower class (13)
upper lower class (92) and lower class (13)
upper and upper middle classes (29) and lower and upper lower classes (105)
upper, upper middle and lower middle classes (79) and lower and upper lower classes (105)

Smoking Comparisons

one-half pack or less/day smokers (6) and non-smokers (168)
half a pack or more/day (10) and non-smokers (168)
smokers (16) and non-smokers (168)
one-half a pack or less/day smokers (6) and half a pack or more/day smokers (10)

Spouse Smoking Comparison

smokers (39) and non-smokers (145)

Diet Intake Comparisons

protein intake of women weighing 100-119 lbs (63) and protein intake of women weighing $>$ 145 lbs (36)
kcal intake of women weighing 110-119 lbs (63) and kcal intake of women weighing $>$ 145 lbs (36)
protein intake of women weighing 120-145 lbs (86) and protein intake of women weighing $>$ 145 lbs (36)
kcal intake of women weighing 120-145 lbs (86) and kcal intake of women weighing $>$ 145 lbs (36)
women consuming less than 2/3's RDA for kcal (50) and women consuming more than 2/3's RDA for kcal (134)
women consuming less than 2/3's RDA for protein (32) and women consuming more than 2/3's RDA for protein (152)

Over-the-counter Drug Use Comparisons

non-users (105) and occasional users (37)
non-users (105) and weekly users (16)
non-users (105) and daily users (16)
occasional users (37) and weekly users (16)
occasional users (37) and daily users (16)
weekly users (16) and daily users (16)

Exercise Pattern Comparisons

non-exercisers (24) and mild exercisers (116)
non-exercisers (24) and moderate exercisers (13)
non-exercisers (24) and limited exercisers (31)
mild exercisers (116) and moderate exercisers (13)
mild exercisers (116) and limited exercisers (31)
moderate exercisers (13) and limited exercisers (31)

Employment Status Comparisons

workers (79) and non-workers (105)

Parity Comparisons

multipara (44) and primipara (140)

Education Comparisons

12 or less years of school (51) and more than 12 but less than 16 years of school (56)
12 or less years of school (51) and 16 or more years of school (32)
12 to 15 years of school (56) and 16 or more years of school (32)
less than 12 years of school (11) and 12 or more years of school (173)
less than 12 years of school (11) and 12 years of school (57)
less than 12 years of school (11) and 12 to 15 years of school (56)
less than 12 years of school (11) and 16 or more years of school (32)

Age Comparisons

less than 20 years of age (21) and 20-30 years of age (158)
less than 20 years of age (21) and 31-36 years of age (5)
20-30 years of age (158) and 31-36 years of age (5)

Of the intra-sample comparisons, pregravid weight and pregnancy weight gain were the only variables that showed significant effects (Tables 13 and 14) also (Figures 4 and 5).

Table 13. Differences in birth weight by pregravid weight groups Utah and Nevada questionaire data N = 184

Pregravid Weight Comparisons	"t" value
90 - 119 lbs (84) versus 120 -145 lbs (63)	-1.79 NS
90 - 119 lbs (84) versus > 145 lbs (75)	-3.71 (0.01)
120 - 145 lbs (63) versus > 145 lbs (75)	-2.49 (0.05)

Table 14. Differences in birth weight by pregnancy weight gain Utah and Nevada questionaire data N = 184

Pregnancy Weight Gain Comparisons	"t" value
20 lbs gain (23) versus ≥ 30 lbs gain (76)	-2.25 (0.05)
20 - 29 lbs (85) versus ≥ 30 lbs gain (76)	-1.09 NS
20 lbs gain (23) versus 20 - 29 lbs gain (85)	-1.34 NS

Regression Analysis

The continuous variables of age, pregravid weight, pregnancy weight gain, caloric intake and protein intake were identified as the independent variables of the regression model. Birth weight was identified as the dependent variable. The results are given in Table 15.

Table 15. Regression analysis with certain variables deleted Utah and Nevada questionaire data N = 184

Variable	Regression Coefficient	Std. Error of Reg. Coefficient	"t" value
Pregravid weight	0.012	0.003	4.00 (0.01)
Pregnancy weight gain	0.002	0.008	3.03 (0.01)
Protein intake - g	0.006	0.181	0.31 NS
Age of mother	3.970	8.890	0.45 NS
Caloric intake - kcal	0.001	0.008	0.14 NS
$r^2 = 0.11$			

Least Squares Analysis

The least squares analysis of variance was also utilized to assess the relative impact of the categorical independent variables of socio-economic status, sex of the infant, parity, education, smoking habits of the mother and spouse, exercise patterns, employment status, drug use and alcoholic beverage intake along with pregravid weight and pregnancy weight gain on birth weight. Since age, protein intake and energy intake had not been significantly related to birth weight in the regressiona analysis (Table 15), they were not included in the least squares analysis. The results of the least squares analysis is presented in Table 16.

A third set of analyses were conducted on the questionaire data. These consisted of first reducing the least squares model in an effort to more clearly identify the sources of variation. The

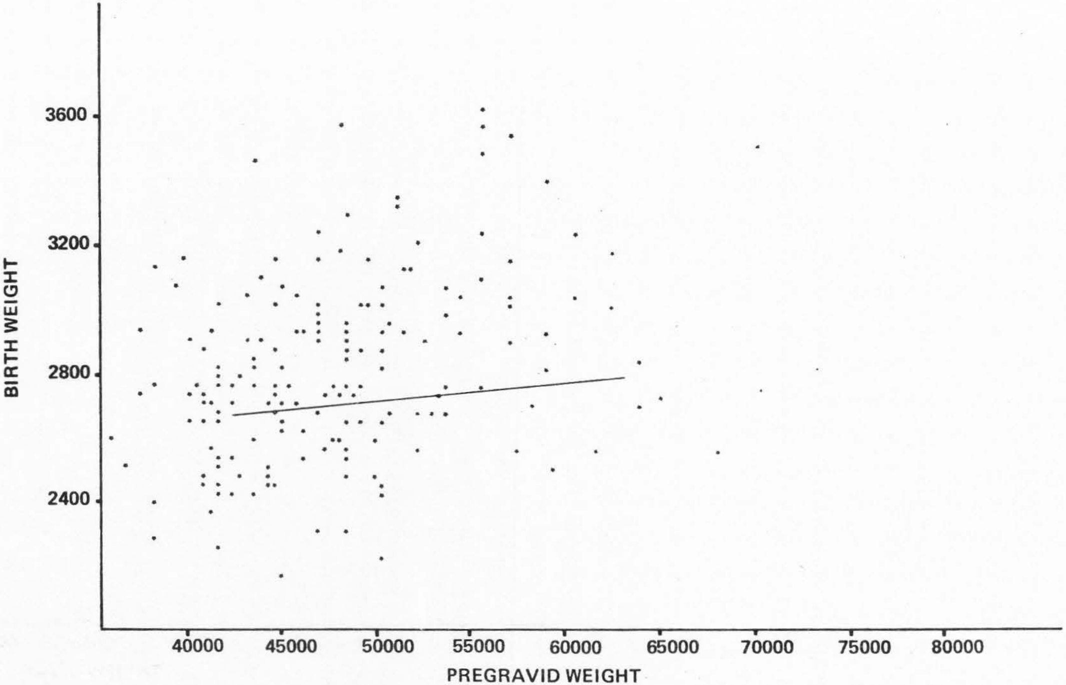

Figure 4: Birth weight x pregravid weight, Utah and Nevada questionnaire data, 1974

N = 184 Equation of the Line: Y = 2831.84 + 0.009x r = 0.238

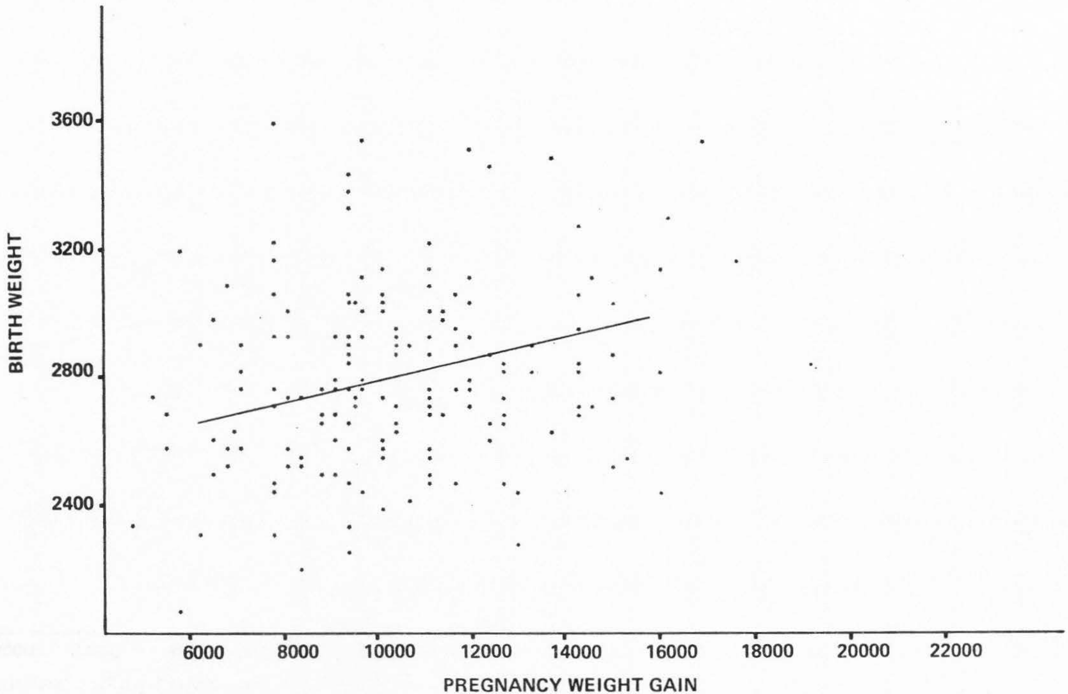

Figure 5: Birth weight x pregnancy weight gain: Utah and Nevada questionnaire data, 1974

N = 184 Equation of the Line: Y = 3017.96 + 0.027x r = 0.203

Table 16. Least squares analysis - questionaire data
N = 183

Source	Degrees of Freedom	Mean Square	"F" Ratio	
Socio-economic status	4	82117	0.47	NS
Sex of infant	1	263050	1.49	NS
Parity	1	72305	0.41	NS
Education of mother	2	2137	0.12	NS
Smoking of mother	3	277922	1.58	NS
Exercise	3	327183	1.86	NS
Employment Status	1	65970	0.37	NS
Drug Use	3	99806	0.57	NS
Alcohol Consumption	3	48827	0.28	NS
Weight Gain	1	1976125	11.21	(0.01)
Pregravid Weight	1	1668952	9.47	(0.01)
Remainder	160	176272		

r^2 weight gain = 0.04

r^2 pregravid weight = 0.05

results are given in Table 17. To identify any interaction between variables that might be taking place, the mean birth weight for various cross tabulations were computed. These cross tabulations included: (a) socio-economic status and education of the mother, (b) socio-economic status and smoking habits of the mother, (c) socio-economic status and exercise patterns of the mother, (d) socio-economic

Table 17. Reduced least squares model - questionaire data
N = 184

Source	Degrees of Freedom	Mean Square	"F" Ratio
Socio-economic status	4	77489	0.46 NS
Sex of infant	1	276178	1.63 NS
Smoking of mother	3	369766	2.19 NS
Exercise	3	320062	1.90 NS
Weight Gain	1	1899754	11.22 (0.01)
Pregravid Weight	1	1911932	11.30 (0.01)
Sex of the infant	1	308282	1.84 NS
Smoking of mother	2[a]	384364	2.29 NS
Exercise	3	233001	1.39 NS
Weight Gain	1	2164714	12.90 (0.01)
Pregravid Weight	1	1918549	11.43 (0.01)
Remainder	174	167805	

r^2 weight gain = 0.04

r^2 pregravid weight = 0.05

a. smoking categories were collapsed to three for this analysis hence 2 degrees of freedom

status and employment status of the mother, (e) socio-economic status and over-the-counter drug use of the mother, (f) socio-economic status and alcoholic beverage consumption patterns of the mother, (g) smoking habits of the mother and alcoholic beverage consumption patterns of the mother, (h) smoking habits of the mother and over-the-counter drug use of the mother and (i) over-the-counter drug use of the mother and alcohol consumption patterns of the mother. After this examination, it was concluded that sub-sets of variables would not yield any significant results over the original least squares model. An example of the cross tabulation comparison is given in Table 18.

Table 18. Mean birth weight (g) of various socio-economic status groups compared to educational level - questionaire data for Utah and Nevada N = 183

	Less than High School	High School	Greater than High School
Upper Class	0	0	3338 (8)[a]
Upper Middle Class	0	3145 (3)	3348 (18)
Lower Middle Class	2963 (1)	3418 (9)	3382 (39)
Upper Lower Class	3267 (8)	3358 (39)	3348 (45)
Lower Class	3033 (2)	3679 (6)	3427 (5)

a. values in ( ) indicate number of observations

DISCUSSION

From analysis of the data, the profile of a high risk mother for both Utah and Nevada is best described as:

> A primipara woman, who is less than fifteen years of age, of Negro origin, with less than a high school education, who sees a physician less than eight or nine times during the course of her pregnancy and who is not married at the time of the birth.

For both Utah and Nevada, the incidence of low birth weight in both states was greatest among mothers fifteen years of age and younger. The low birth weight incidence for this age group was 13.50% in Nevada and 11.54% (1970) and 13.95% (1974) in Utah. The lowest incidence (7.73%) for Nevada was in the twenty to thirty year age bracket. In Utah, the lowest incidences were in the thirty-one to thirty-six year age bracket, with incidence rates of 4.57% (1970) and 5.02% (1974). This finding is substantiated by Dwyer (1974) who reported an increased prematurity rate (16.9%) among a sample of 231 pregnant adolescents ranging in age from twelve to sixteen years. Selvin and Garfinkel (1972) report a higher percentage (14.38%) for 14 year old primipara girls versus 8.66% for women 30 - 34 years old and 6.55% for women 25 - 29 years of age, of low birth weight infants with decreasing maternal age. These findings also concur with those of Stine et. al. (1964).

The Negro segments of both Utah and Nevada exhibited the highest incidences of low birth weight. In Nevada, the Negro low birth weight incidence was 24.38% compared to 7.80% for the Caucasian segment. In Utah, the low birth weight incidence among the Negro population was 15.00% (1970) and 20.24% (1974). These compare to the Caucasian rates of 6.28% (1970) and 5.69% (1974). There is an approximate two-fold difference in the rates. It is interesting to note that in the Nevada sample, the American Indian had the lowest incidence of low birth weight, whereas, in the Utah sample the American Indian was in between the Caucasian and Negro incidence rates. The racial effect on birth weight has been noted by other researchers as well. Chase (1970) in his review of prematurity incidences in the United States, makes note of the fact the low birth weight incidence from 1950-1967 was about 7.00% for white infants but rose to 13.70% for non-white infants. This finding also concurs with the findings of the earlier studies of Israel and Woutersz (1963) and Erhardt (1964).

Few studies cite a relationship between birth weight and education of the mother. Generally education is included in the socio-economic status determination and not singled out for comparison. Within Nevada, those mothers with less than a high school education evidenced a low birth weight incidence of 11.51%. Utah mothers also exhibited the highest incidence of low birth weight in this educational grouping; the respective low birth weight incidences for Utah mothers with less than a high school education were 9.96% (1970) and 9.83% (1974). As a general rule, as the mother's education increases, the incidence of low birth weight decreases until comparison is made of mothers with graduate education. In

Nevada the incidence of low birth weight rose from 5.69% for mothers with college educations to 6.07% for those with graduate educations. In Utah, in 1970, the pattern was slighly different. Here the incidence of low birth weight continued to decrease with women with graduate educations exhibiting the lowest incidence of low birth weight. However, in 1974 the Utah pattern paralleled that for Nevada where the low birth weight incidence rose in those women with graduate education. It must be noted, however, that the education effect may be a function of age rather than a direct expression of educational training. If it were a direct reflection of education, it would be theorized that as the mother's level of education increased, the incidence of low birth weight infants would decrease. However, as previously noted, the low birth weight incidence rises in mothers with graduate education. Papavangelou et al. (1973) noted in women over 30 the incidence of small-for-date infants increased. This finding is suggestive of decreased maternal efficiency with increased age. Also noting that the mean birth weight plotted against age is a quadratic rather than linear function gives further support to the concept that with age (which may be indirectly reflected in education) the mean birth weight reaches a maximun and then declines.

As would be expected, the number of prenatal care visits has been shown to affect the incidence of low birth weight. Miller and Hassanein (1974) indicated that in their examination of 188 infants of white and non-white origins that prenatal care was significantly associated with birth weight. As prenatal care diminished, the incidence of low birth weight rose. This pattern was very apparent in both the Utah and Nevada samples under investigation. Women in Nevada who reported nine or less prenatal care visits exhibited a low birth weight incidence of 15.63%, whereas, for women reporting ten or more prenatal care visits, the incidence rate declined dramatically to 5.76%. The same pattern emerges for Utah women. In the group reporting less than eight visits, the incidence rates were 11.26% (1970) and 15.75% (1974). In the women reporting eight or more prenatal care visits, the incidence rates were 4.88% (1970) and 4.77% (1974).

Within both Utah and Nevada, the incidence of low birth weight was higher among the primipara women as compared to the multipara women. This concurs with the findings of Papevangelou et al. (1973) and Naeye (1973). Naeye (1973) indicated that generally the fetal body and organ growth improved with successive pregnancies.

Legitimacy of the birth also demonstrated an impact on the incidence of low birth weight. The incidence of low birth weight for legitimate births was 8.09% for the Nevada sample, but it rose to 12.25% for the illegitimate births. In Utah, a similar finding was noted in that for the legitimate births the low birth weight incidence was 6.10% (1970) and 5.82% (1974), whereas, the illegitimate groups evidenced rates of 12.17% (1970) and 14.58% (1974). This agrees with Emanuel's findings (1972). Examination of legitimacy rates indicate that the younger mothers have a higher rate of illegitimacy, hence this finding may also be an indirect reflection of the

the impact of maternal age on birth weight.

Additionally, the least squares analysis for the Utah and Nevada data indicated that for both populations, the variables of (a) sex of the infant, (b) county of residence of the mother, (c) age of the mother, (d) race of the mother and (e) parity of the mother were significantly related to birth weight (Table 11).

Sex of the infant as a factor in birth weight has previously been identified by such researchers as Higgins (1972) and Love (1965), therefore, this was not a surprising finding.

Relationships of age of the mother and race of the mother to birth weight were also not surprising since a number of studies have previously indicated these correlations, Dwyer (1974), Selvin and Garfinkel (1972), Stine (1964) and Shank (1970), Chase (1970) and Israel (1963).

The relationship of parity to birth weight concurs with the earlier findings of Papevangelou (1972) where birth weight tends to be higher among multipara women.

While the findings of this study do not appear as "new" findings, it was information that was not previously available for Nevada and Utah. Also previous studies similar to this one were conducted primarily with large metropolitan populations of the eastern United States - Dwyer (1974) in New York and Israel (1963) in Philadelphia and Selvin and Garfinkel (1972) in New York City. These areas have a greater population density and Negro representation than is true for either Utah and Nevada, so it was not known if in an area of less overall population density and significantly less minority race representation if the same pattern would emerge. From this study, it was found that the pattern with regard to race of the mother did hold even though Nevada and Utah have limited minority race representation.

The fact that the profile of a high risk mother is the same for Utah and Nevada is also interesting, particularly in view of the fact, that they have divergent overall incidences of low birth weight. In all cases where mean birth weight data was available for comparison between Utah and Nevada (1974), Nevada exhibited a lower mean birth weight which gives some indication that although the same factors that affect birth weight are operating in Utah and Nevada, the impact is greater with Nevada. In each instance, significance was inverse to incidence.

Closer examination reveals two pivotal points that could be accounting in large part for the differences in overall low birth weight incidences between Utah and Nevada. These two points are (1) race of the mother and (2) age of the mother.

In both Utah and Nevada, a mother is at higher risk to bear a low birth weight infant if she is of Negro origin. However, Nevada had a Negro population representing 10.56% of the total population under study. The Negro population in Utah is only 0.46% of the total in 1970 and 0.29% of the total in 1974. In an effort to determine how much impact race exerts on birth weight, calculations were made comparing the mean birth weight for the total sample with mean birth weights of the Negro and Caucasian. The comparisons indicated that by controlling for the impact of the mean birth weight of the Negro sample on the total sample, the estimate is within 99% of the Caucasian birth weight mean. Hence the incidence of Negros within a population can be used quite successfully to predict the overall sample mean. This gives an indirect clue as to the low birth weight incidence. This finding gives greater substantiation to the concept that differences in Negro representation in Utah and Nevada account in large part for the divergency in the low birth weight incidences in the two states.

With regard to the mother's age, the incidence of mothers less than fifteen years of age in the Nevada sample was 1.45% but only 0.50% in Utah in 1970 and 1974.

Additionally, Nevada during the period under study had approximately 29% of the mothers reporting less than a high school education while there were only 19% in Utah in 1970 who indicated less than a high school education and 15% who so indicated in 1974. Nevada from 1969-1974 also had a rate of 9% for illegitimate births compared to 4% in Utah in 1970 and 1% in 1974. Here again, both the education and legitimacy as previously discussed, may be reflecting the impact of maternal age on birth weight.

It would appear that the race of the mother and the age of the mother may be exerting considerable impact on subsequent birth weight.

Environmental Impact on Birth Weight

A second question this study undertook to examine was "Of certain factors, namely, smoking, alcohol beverage consumption, nutritional status, exercise, age, parity, pregravid weight, pregnancy weight gain, employment status, sleep and over-the-counter drug use, which ones exert the greatest impact on subsequent birth weight?". The study additionally considered the question, "Of such factors as smoking, alcoholic beverage consumption, nutritional status, exercise, age, parity, pregravid weight, pregnancy weight gain, employment status, sleep and over-the-counter drug use, does their impact remain the same between two different populations, i.e., one taken from a state with a low incidence of low birth weight (Utah) and one taken from a state with a high incidence of low birth weight (Nevada) or are there differences between the impact on the two groups?".

The t-test revealed that there were no significant differences between the Utah and Nevada samples with regard to birth weight. Consequently they were treated as one sample. Regression analysis indicated that pregravid weight and pregnancy weight gain were correlated to birth weight (Table 15). Least squares analysis indicated that only pregravid weight and pregnancy weight gain were significantly related to birth weight (Table 16).

Pregravid Weight

A highly significant factor found to be affecting birth weight is pregravid weight. The pregravid weight in itself can reflect at least two indices - (a) genetic potential and (b) previous nutritional status. Animal breeding studies have demonstrated that maternal size has a limiting effect on birth weight of the fetus. That is, there is a certain fetal capacity that the maternal organism is able to support. Consequently, larger mothers can support larger fetuses (Thomson, 1959).

The pregravid weight can not only reflect the relative size of the mother (genetic potential) but also it can serve to some degree to reflect the nutritional status of the mother. Thomson (1959) expressed the idea that the smaller mothers, as a group, represent the lower socio-economic classes and as such reflect perhaps inadequate nutrition that eventually led to shorter statures and lower pregravid weight.

Within this particular study, the mothers were placed into three categories of weight - (a) 90 -119 pounds, (b) 120 -145 pounds and (c) greater than 145 pounds. These are similar to Pomerance's (1974) groupings. Also the weight groups were arrived at by assuming the average woman today is approximately five feet six inches tall and the normal non-pregnant weight range for that height is 114-146 pounds (Runyan, 1976). The t-test between the weight groups indicated that there was a significant difference in the birth weights between the 90 - 119 pound group and the greater than 145 pound group ($P \angle 0.01$). Also, there is a significant ($P \angle 0.05$) difference in the birth weights of the 120 -145 pound group and the greater than 145 pound group. The mean birth weights per pregravid weight group were: (a) 90 - 119 pounds = 3239 g, (b) 120 - 145 pounds = 3356 g, (c) greater than 145 pounds = 3595 g. There were thirty-five (19%) women whose pregravid weight was greater than 145 pounds, nine (5%) weighed between 146-150 pounds, seven (4%) weighed between 151-159 pounds, seven (4%) weighed between 170-179 pounds and one (0.05%) weighed between 180-189 pounds and two (1%) weighed between 190 - 199 pounds and two (1%) had a pregravid weight of 200 pounds or more.

This distribution indicates that slightly over one-third (34.5%) of the sample had pregravid weight in excess of 145 pounds. It could be assumed that this group (greater than 145 pounds) represents to some degree tall women, however, the weight distribution also suggests a group of women who would probably be classified as overweight to some extent. For a woman who is six feet tall, the maximum desirable weight is listed as 173 pounds (Runyan, 1976). In this group, ten women had a pregravid weight of greater than 173 pounds. Such weight would then indicate a relative potential energy source during pregnancy which could be drawn on to support and maintain the growth of the fetus.

Weight Gain During Pregnancy

This factor was also a significant variable affecting subsequent birth weight. King (1972) found in her studies that the women with the lowest pregravid weights tended to gain the most weight. In this particular study, there was not any significant difference in the mean weight gain between those women who indicated pregravid weights of 90 - 119 pounds and 120 - 145 pounds. It was only when comparisons were made with those women whose pregravid weights were in excess of 145 pounds that significant differences in birth weights arose. The women whose pregravid weights were in the range of 90 - 119 pounds had a mean pregnancy weight gain of 28.31 pounds and the mean pregnancy weight gain for women whose pregravid weights were 120 - 145 pounds was 28.15 pounds. However, both these mean pregnancy weight gains were significantly ($P < 0.05$)

greater than the mean pregnancy weight gain for women whose pregravid weight was greater than 145 pounds. The mean pregnancy weight gain was 25.23 pounds for the group whose pregravid weights were greater than 145 pounds. Unlike the findings of King (1972), the women who had larger infants gained less weight in the pregnancy but were heavier beginning their pregnancies.

It would seem that since both pregravid weight and weight gain are significantly related to subsequent birth weight, there is an interaction in the two variables. It appears that when the pregravid weight is high, the pregnancy weight gain is not as important. The maternal energy stores are available in large part to supplement dietary intake in meeting fetal energy needs. On the other hand, for a woman of lower pregravid weight, the amount of weight she gains during her pregnancy is more highly related to subsequent birth weight.

Of interest, is the fact that although the pregnancy weight gain is related to birth weight, neither protein or caloric intake are related. This would lend further support to the role maternal energy stores are playing in sustaining and supporting fetal growth, particularly in this group of somewhat heavier mothers. It should be noted, however, that the four women who gave birth to an infant weighing less than five and half pounds (2501 g) all consumed less than 2/3's the RDA for caloric intake and three of the four women had caloric intakes of less than 1100 kcal.

RECOMMENDATIONS

The obvious recommendation is to recognize the unmarried, Negro adolescent as a particular obstetric risk in terms of low birth weight infants. Also the recommendation would be to provide this information not only to the medical community, but more importantly provide this information to persons who come in contact with them prior to the actual pregnancy. These key people should include educators, counselors and other individuals who in their contacts with the young people could disseminate important preventive information as it relates to low birth weight and could urge those young adolescents to seek early prenatal care. Additionally, the prenatal care instructions should include strong recommendations regarding weight gain during pregnancy for those underweight at the beginning of the pregnancy.

Recommendations from the second portion of the study which assessed the impact of the various environmental factors as exercise, smoking, etc on subsequent birth weight should include educational efforts to alert women to the effect of pregravid weight on birth weight. Presently, there are few restrictions placed on pregnancy weight gains by the medical community, but little has been said about the possible risk of low birth weight to underweight mothers. Nutritional counseling is extremely important here to help the mother overcome the underweight condition and to re-educate them as to improved eating habits that may be resulting in the weight problem.

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APPENDICES

Appendix A

Prenatal Questionaire

PLEASE COMPLETE THE FOLLOWING QUESTIONS AS ACCURATELY AS YOU CAN.
YOUR COOPERATION IS APPRECIATED - THANK YOU.

I. GENERAL INFORMATION - this information is requested so that I may classify those people in the study into different categories for identification purposes. I have requested the name and telephone number should I need to clarify anything and get in touch with you again. The names will not be used in the study.

1. Name ______________________________ Age __________

   Race ____________________ Due Date _______________

   Telephone _______________

   Do you have any health conditions as diabetes, heart condition, etc? ( ) yes ( ) no. If yes, please specify __________

Highest Grade completed in school _____________

Highest Grade completed in school by Spouse __________

Spouse's Occupation __________________

Your Occupation if working ____________________

Please check the most appropriate income level for you and/or your spouse below: (if you both work include both incomes)

a) less than 5,000 b) 5,000 - 10,000 c) 10,000 - 15,000 d) more than 15,000

II. Information on Factors which are known to influence the birth weight of an infant. Please mark the appropriate answer with an X: Please be honest.

1. Do you smoke? ( ) yes ( ) no
   If you do smoke, do you smoke:
   ( ) less than ½ pack or 10 cigarettes a day
   ( ) ½ to full pack of cigarettes a day
   ( ) more than a pack of cigarettes a day

2. Does your spouse smoke? ( )yes ( ) no
   If your spouse smokes, does he smoke:
   ( ) less than ½ pack a day
   ( ) ½ to a full pack of cigarettes a day
   ( ) more than a pack of cigarettes a day

3. Do you drink alcoholic beverages (beer and wine included) ( ) yes ( ) no
   If you drink alcoholic beverages do you drink them:
   ( ) rarely
   ( ) occasionally - on special occasions as dining out
   ( ) frequently - on a weekly or daily basis

4. How much sleep do you usually get a night? (please state approximate number of hours) ________hours.

5. Do you nap during the day? ( ) yes ( ) no
If you do nap, please state how many naps you usually take and the approximate length of time for each nap.

6. Do you exercise during the day? ( ) yes ( ) no
If yes, is your exercise;
( ) limited - breathing or relaxation types of exercise
( ) mild - as walking daily
( ) moderate - cycling or jogging or swimming on a regular basis

7. In the space below, list the drugs that you take - both those prescribed and recommended by your doctor and those you have taken at home on your own. Indicate for each one, how often you have taken it - once a day, once a week, occasionally as needed, etc.

Drugs including vitamin tablets and mineral tablets prescribed or recommended by your doctor	How Often Taken

Drugs I have taken at home such as cold tablets, tums, etc.	How Often Taken

8. On the following pages, please record <u>everything</u> you ate and drank yesterday. This will be used to help determine your nutritional status. I am more interested in what you <u>really</u> ate and drank, than what you think you <u>should say</u> you ate and drank, so please be honest - do not omit or add foods because you think it will look better. In the case of casseroles and other dishes of mixed foods, please indicate the ingredients and for all foods, please indicate the approximate amount you ate, as 1 cup of green peas, ½ cup of carrots, etc. Don't forget snacks.

Food or Beverage	Amount Eaten or Drunk	Ingredients

Appendix B

Recommended Daily Allowances

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Food and Nutrition Board, National Academy of Sciences-National Research Council Recommended Daily Dietary Allowances; Revised 1973

Designed for the maintenance of good nutrition of practically all healthy people in the U.S.A.

	Age (Years)	Weight		Height		Energy	Protein	Fat-Soluble Vitamins: Vitamin A Activity		Vitamin D	Vitamin E Activity[5]	Water-Soluble Vitamins: Ascorbic Acid	Folacin[6]	Niacin[7]	Riboflavin	Thiamin	Vitamin B_6	Vitamin B_{12}	Minerals: Calcium	Phosphorus	Iodine	Iron	Magnesium	Zinc
	From up to	(kg)	(lbs)	(cm)	(in)	(kcal)[2]	(g)	(RE)[3]	(IU)	(IU)	(IU)	(mg)	(ug)	(mg)	(mg)	(mg)	(mg)	(ug)	(mg)	(mg)	(ug)	(mg)	(mg)	(mg)
Infants	0.0-0.5	6	14	60	24	kg x 117	kg x 2.2	420[4]	1,400	400	4	35	50	5	0.4	0.3	0.3	0.3	360	240	35	10	60	3
	0.5-1.0	9	20	71	28	kg x 108	kg x 2.0	400	2,000	400	5	35	50	8	0.6	0.5	0.4	0.3	540	400	45	15	70	5
Children	1-3	13	28	86	34	1300	23	400	2,000	400	7	40	100	9	0.8	0.7	0.6	1.0	800	800	60	15	150	10
	4-6	20	44	110	44	1800	30	500	2,500	400	9	40	200	12	1.1	0.9	0.9	1.5	800	800	80	10	200	10
	7-10	30	66	135	54	2400	36	700	3,300	400	10	40	300	16	1.2	1.2	1.2	2.0	800	800	110	10	250	10
Males	11-14	44	97	158	63	2800	44	1,000	5,000	400	12	45	400	18	1.5	1.4	1.6	3.0	1200	1200	130	18	350	15
	15-18	61	134	172	69	3000	54	1,000	5,000	400	15	45	400	20	1.8	1.5	1.8	3.0	1200	1200	150	18	400	15
	19-22	67	147	172	69	3000	52	1,000	5,000	400	15	45	400	20	1.8	1.5	2.0	3.0	800	800	140	10	350	15
	23-50	70	154	172	69	2700	56	1,000	5,000		15	45	400	18	1.6	1.4	2.0	3.0	800	800	130	10	350	15
	51+	70	154	172	69	2400	56	1,000	5,000		15	45	400	16	1.5	1.2	2.0	3.0	800	800	110	10	350	15
Females	11-14	44	97	155	62	2400	44	800	4,000	400	10	45	400	16	1.3	1.2	1.6	3.0	1200	1200	115	18	300	15
	15-18	54	119	162	65	2100	48	800	4,000	400	11	45	400	14	1.4	1.1	2.0	3.0	1200	1200	115	18	300	15
	19-22	58	128	162	65	2100	46	800	4,000	400	12	45	400	14	1.4	1.1	2.0	3.0	800	800	100	18	300	15
	23-50	58	128	162	65	2000	46	800	4,000		12	45	400	13	1.2	1.0	2.0	3.0	800	800	100	18	300	15
	51+	58	128	162	65	1800	46	800	4,000		12	45	400	12	1.1	1.0	2.0	3.0	800	800	80	10	300	15
Pregnant						+300	+30	1,000	5,000	400	15	60	800	+2	+0.3	+0.3	2.5	4.0	1200	1200	125	18+[8]	450	20
Lactating						+500	+20	1,200	6,000	400	15	60	600	+4	+0.5	+0.3	2.5	4.0	1200	1200	150	18	450	25

[1] The allowances are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined. See text for more-detailed discussion of allowances and of nutrients not tabulated.

[2] Kilojoules (KJ) = 4.2 x kcal.

[3] Retinol equivalents.

[4] Assumed to be all as retinol in milk during the first six months of life. All subsequent intakes are assumed to be one-half as retinol and one-half as β-carotene when calculated from international units. As retinol equivalents, three-fourths are as retinol and one-fourth as β-carotene.

[5] Total vitamin E activity, estimated to be 80 percent as α-tocopherol and 20 percent other tocopherols. See text for variation in allowances.

[6] The folacin allowances refer to dietary sources as determined by *Lactobacillus casei* assay. Pure forms of folacin may be effective in doses less than one-fourth of the RDA.

[7] Although allowances are expressed as niacin, it is recognized that on the average 1 mg of niacin is derived from each 60 mg of dietary tryptophan.

[8] This increased requirement cannot be met by ordinary diets; therefore, the use of supplemental iron is recommended.

Source: Food and Nutrition Board, National Research Council 1973 Recommended Dietary Allowances, 8th rev. ed., National Academy of Sciences, Washington, D.C. (In press).

Appencix C

Glossary of Terms

The following terms are defined as used in the context of this investigation:

Prematurity rate - the percentage of total newborns delivered at weights under 2501 grams ($5\frac{1}{2}$ pounds) (MCH Exchange, 1972)

Primipara - pregnant for the first time (Dorland's Medical Dictionary)

Nutritional Status - the relationship of nutrient intake to the recommended daily allowance for total calories and protein; a comparison of which allows for some assessment of adequacy of the diet. A two-thirds of recommended daily allowance will be used as the cut-off point for adequacy in this study

Twenty-four Hour Recall - method of determining food intake by asking participants to write down the kind of food and the amount of food eaten in the previous twenty-four hour period (Fleck, 1976)

VITA

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Published Articles:

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