

Effect of Nutrition Counseling on  
Maternal Nutritional Performance, Birth Outcome and  
Choice of Infant Feeding in Pregnant Teenagers

by

Padma Natarajan

Thesis submitted to the faculty of  
Virginia Polytechnic Institute and State University  
in partial fulfillment of the requirements for the degree of

Master of Science

in

Human Nutrition and Foods

APPROVED:

-----  
Dr. L Janette Taper, Chairman

-----  
Dr. Janet M Johnson

-----  
Dr. Cosby S Rogers

November 1989

Blacksburg, Virginia

**EFFECTS OF NUTRITION COUNSELING ON  
MATERNAL NUTRITIONAL PERFORMANCE, BIRTH OUTCOME AND  
CHOICE OF INFANT FEEDING IN PREGNANT TEENAGERS**

by

Padma Natarajan

Committee Chairman: L Janette Taper  
Human Nutrition and Foods

(ABSTRACT)

This study investigated the influence of nutrition education services, measured by duration of participation and frequency of nutrition counseling, on maternal nutritional performance, and pregnancy outcome, in 100 pregnant teenagers enrolled in the WIC program in North Carolina. Data on prenatal weight gain, rate of weekly weight gain, gestational duration and birth weight of infants born to these teenagers was retrieved from medical records. Twenty-four hour recalls, conducted before and after counseling, were analyzed for energy and nutrient content. Results indicated that initiation of prenatal care by trimester was earlier, and duration of participation was longer, than was reported in the literature. Mean weight gain and gestational lengths were found to be comparable to results from studies on similar populations. Rate of weekly gain was significantly higher than that recommended for

adult pregnant women. Energy, protein and iron intakes showed significant improvement after counseling, and, were comparable to RDA values. However, calcium intake was found to be significantly lower than the RDA. Mean infant birth weight was found to be 47.2 gm heavier than the state average; this was not statistically significant. Although a strong correlation between counseling and pregnancy outcome was not evident, the incidence of low birth weight was substantially lower in this population, especially among the subgroup of black infants. A decreased incidence of poor outcome of pregnancy among underweight gravidas, was also indicative of the influence of nutrition education on this high risk group. Nutrition intervention appears to have been indirectly influential in optimizing fetal outcome through improved maternal weight gain, and an extended gestation. In addition, early and appropriate prenatal care measures, probably helped reduce the race specific, risk differential for adverse outcomes. The results from this study also indicated that a very small percentage of teens chose to breast feed. Further studies are, however, recommended to identify predictors of the feeding choice, to help increase incidence of breast feeding among teens.

## ACKNOWLEDGMENTS

I would like to express my deepest appreciation to Dr. Janette Taper, for her support, guidance and friendship throughout my graduate program, and during the course of this study.

Sincere thanks go to my committee members, Dr Janet Johnson, and Dr Cosby Rogers, for their helpful suggestions and guidance during this study.

Grateful thanks to \_\_\_\_\_, for her invaluable assistance in making this study possible at the Craven County Health Department, and for making my stay at New Bern so comfortable and enjoyable.

Special thanks to \_\_\_\_\_, WIC Nutritionist, for all her assistance with the medical records, and for so patiently answering my questions.

To \_\_\_\_\_, Nursing Superintendent, \_\_\_\_\_, Nutrition Director, and the staff at the Craven County Health Department, I extend my thanks for helping me access information for this study.

To the staff at the State Center for Health Statistics, NC Department of Human Resources, and the staff at the Division of Statistics and Information Services, NC Department of Environment, Health, and Natural Resources, Raleigh, NC, I extend my sincere appreciation for their prompt assistance with state statistics required for this study.

To \_\_\_\_\_, for her assistance with the graphs and figures for this study.

To \_\_\_\_\_, for his love, and unqualified support.

Loving appreciation to my mother, for her loving support and confidence in me.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES.....	ix
LIST OF FIGURES.....	xi
INTRODUCTION.....	1
Statement of the problem.....	5
Objectives .....	6
Hypothesis .....	8
REVIEW OF LITERATURE.....	10
Overview of Teenage Pregnancy .....	10
Trends in Teenage Childbearing in the United States .....	11
Health and Demographic Consequences of Adolescent Pregnancy and Child Bearing .....	12
- Infant mortality in relation to maternal age .....	13
- The influence of parity .....	14
Incidence of Prematurity and Low Birth Weight .....	15
Weight Gain Patterns in Pregnant Adolescents .....	18
Prepregnancy Weight, Prenatal Weight Gain and Fetal Outcomes .....	19
- Studies on this interrelationship in teenage pregnancy .....	20
Prenatal Nutrition and Pregnancy Outcome ...	21
- Dietary intake in pregnant adolescents .....	21



Demographic Data.....	46
(i) Race.....	46
(ii) Income.....	47
(iii) Education.....	47
(iv) Employment status.....	47
Maternal Nutritional Risk Characteristics.....	48
(i) Age and race distribution.....	48
(ii) Parity.....	49
(iii) Maternal preconceptual weight.....	49
(iv) Biochemical risk characteristics.....	51
(v) Behavioral risk characteristics.....	51
Nutrition Education Services.....	51
(i) Trimester or weeks when prenatal care began.....	51
(ii) Duration of participation.....	51
(iii) Nutrition education contact.....	52
- Individual contact.....	52
- Group contact.....	52
Maternal Nutritional Performance.....	53
(i) Maternal weight gain.....	53
- Duration of participation a weight gain.....	58
- Frequency of individual contact a weight gain.....	59
- Incidence of low weight gain.....	61
(ii) Pattern of weight gain.....	64
- Pattern of weight gain and duration of participation....	71
- Pattern of weight gain and nutritional counseling.....	71
- Incidence of inadequate weekly weight gain.....	73
(iii) Dietary Adequacy.....	75
- Dietary intake and duration of participation.....	87
- Dietary adequacy and frequency of individual contact.....	87
- Incidence of dietary inadequacy.....	87
Pregnancy Outcome.....	90
(i) Gestational age.....	90
- Duration of participation.....	92
- Incidence of low gestational age.....	93

(ii) Birth weight.....	96
- Duration of participation and birth weight.....	102
- Frequency of individual contact and birth weight.....	103
- Birth complications.....	103
- Incidence of low birth weight.....	104
Infant Feeding Practices.....	109
Limitations.....	112
SUMMARY AND CONCLUSIONS.....	115
REFERENCES.....	123
VITA.....	132

## LIST OF TABLES

1. Table I : Weight gain, gestational age, and infant birth weight as a function of maternal age group.....54
2. Table II : Weight gain, gestational age and infant birth weight as a function of maternal race, education and employment status.....56
3. Table III : Effect of maternal and nutritional risk variables on maternal weight gain, gestational duration and infant birth weight.....57
4. Table IV : Influence of components of nutrition counseling, on maternal weight gain, gestational age, and infant birth weight.....60
5. Table V : Relationship of total weight gain during pregnancy to infant size, gestational age, and birth weight.....62
6. Table VI : Comparison of weekly weight gain with recommended values.....65
7. Table VII : Weekly weight gain as a function of maternal age and race.....68
8. Table VIII : Effect of maternal and nutritional risk variables on weekly weight gain during each trimester period.....69
9. Table IX : Influence of components of nutrition counseling on weekly weight gain during each trimester period.....72
10. Table X : Comparison of maternal performance and pregnancy outcome parameters for subjects with adequate, and, inadequate rate of weekly gain, based on trimester period.....74

11. Table XI	: Energy and nutrient composition of diets before and after nutrition counseling services.....	77
12. Table XII	: Dietary intake of energy and nutrients before and after counseling for each age group.....	78
13. Table XIII	: Comparison of daily intake of energy and nutrients with RDA, before and after counseling, classified by age group.....	79
14. Table XIV	: Maternal weight gain, gestational age and infant birth weight, based on adequacy of nutrient intake, for each age group.....	89
15. Table XV	: Influence of length of gestation on maternal weight gain and infant size.....	95

## LIST OF FIGURES

1. Figure I : Weekly weight gain compared with recommended weekly gain for each trimester period..... 66
2. Figure II : Percent of recommended energy intake consumed by pregnant adolescents, based on age group..... 81
3. Figure III : Percent of RDA for protein consumed by pregnant adolescents, based on age group..... 83
4. Figure IV : Percent of RDA for calcium consumed by pregnant adolescents, based on age group..... 84
5. Figure V : Percent of RDA for iron consumed by pregnant adolescents, based on age group..... 85
6. Figure VI : Influence of prepregnant weight status on infant birth weight.....101
7. Figure VII : Influence of maternal weight gain on infant birth weight for different categories of weight gain.....108

## INTRODUCTION

Adolescent pregnancy and child bearing in the United States is receiving an extraordinary amount of attention. A great deal of research has focused on the negative medical outcomes of early adolescent pregnancy (American Academy of Pediatrics., 1979; Gabriel, 1981; Garn et al., 1986; McAnarney., 1985 ). Most studies, especially those analyzing population statistics, have associated teenage pregnancy with maternal and infant risk factors such as low birth weight, prematurity and impaired cognitive development (Buchanan., 1975; Eckholm & Newland., 1977; Rothenberg & Varga., 1981). Teenage pregnancies are commonly viewed as "bad" for the conceptus on the basis of two commonly used measures - prematurity and low birth weight (LBW), (Chase, 1970; Garn et al., 1986). By both of these measures, teenage pregnancy greatly increases risks by 25 - 50%, and even more, depending on the association of other risk factors such as low pregravid weight, low weight gain, smoking and socioeconomic status (Garn et al, 1986). It has also been postulated that these increased medical risks may be preferentially associated with adolescents less than 15 or 16 years of age (Horon et al., 1983) and with those teenage mothers of low gynecological age i.e., age at conception

minus age at menarche (Hollingsworth & Kotchen, 1981; Zlatnik & Burmeister, 1977).

However, these studies have been criticized for failure to control adequately for factors other than maternal age (Horon et al., 1983; Rothenberg & Varga, 1981). The younger mothers have tended to have poorer nutrition and poorer health care prenatally, and have differed significantly from older mothers in a variety of socioeconomic background variables relevant to the natal and post-natal outcome of their children.

Although the foregoing data convey the magnitude of the problems related to teenage pregnancy, risks to the adolescent mother and her infant can be mitigated through a comprehensive care program for the mother, plus a continuity care approach for the infant, involving prenatal counselling (Miller & Fields, 1984). The corollary to this is that many adverse outcomes of teenage pregnancy are not age-specific phenomena but can be avoided by appropriate medical care (McAnarney et al., 1978; Zuckerman et al., 1983). Maternal health aspects during pregnancy such as low weight gain and substance abuse may be amenable to clinical intervention strategies and, therefore, poor outcomes can be prevented. Teenage pregnancy has also been found to be characterized by late entry into the prenatal care system; however, early maternal care is associated with a more favorable outcome for

both mother and infant (Dwyer, 1974).

Major health concerns, associated with low gynecological age are the poor nutritional status and high nutrient requirements of the adolescent. In general, reported values of food intake in most of the available studies seem extremely low when compared with intake values found in older, pregnant women (Beal, 1971). It has been documented that pregnant teenagers often have nutritional deficiencies of iron, vitamin A and calcium (Bailey et al., 1980; Haider & Wheeler, 1980; Singleton et al., 1976). Research is only in its earliest stages regarding some fundamental biological problems that may be uniquely faced by younger teenagers such as exaggerated maternal-fetal nutrient competition (Naeye, 1981).

Furthermore, when the racial and economic composition of the populations studied are considered, results show an increase in negative obstetrical outcomes among nonwhite women and among those of lower socio-economic status (Horon et al., 1983).

In recognition of the important role that nutrition has in the health of young children and pregnant women, Congress in 1972 enacted legislation creating a major nutritional intervention program (Berkenfield & Schwartz, 1980). The Special Supplemental Feeding Program for Women, Infants and Children, commonly known as WIC, started as a small pilot

program but has since grown into a national program that benefits over 2.97 million women and children (Community Nutrition Institute, 1987). Eligibility is based on income and nutritional risk as assessed by a WIC nutritionist. Perhaps the most attractive aspect of the WIC program is the individualized nutrition counseling that is made available to participants. Nutritionists work with families on a number of important issues such as diet in pregnancy and infant feeding choices. Although counseling is done on a one to one basis, group counseling is also available (Berkenfield & Schwartz, 1980).

Carefully designed studies have assessed the effects of WIC and data from these studies have indicated positive results in terms of weight gain during pregnancy, higher birth weight of infants born to WIC mothers, accelerated growth of WIC children and a decrease in incidence of anemia (Edozien et al., 1979; Kennedy and Kotelchuck, 1984). However, few studies have looked into the effect of counseling services on dietary intake patterns and choice of infant feeding practices among adolescents. Adolescents' food selection habits and eating patterns have been the cause of inadequate nutrition (Caghan, 1975). With the additional stress of pregnancy, nutritional management is of concern in determining outcome of pregnancy. Studies on infant feeding decisions made by teenagers, based on information provided

by nutrition counseling services, have been few.

### STATEMENT OF THE PROBLEM

The present study was designed to determine the effect of nutritional counseling through the services of the WIC program on

(a) maternal nutritional performance, and

(b) outcome of pregnancy,

of 100 pregnant teenagers and who were participating in the WIC program, and, to study their

(c) intended method of infant feeding.

For the purpose of this study, nutritional counseling was described by

(a) trimester and weeks when prenatal care was initiated; and

(b) duration of participation, in terms of number of months;

(c) frequency of counseling sessions, in terms of individual and group contacts that each subject received.

This investigation was also designed to develop a profile of the pregnant teenage population sampled, with respect to sociodemographic and nutritional risk factors.

The effects of nutritional counseling on maternal

nutritional performance was measured by

- (a) total weight gain;
- (b) pattern of weight gain during pregnancy; and
- (c) dietary intake before and after counseling.

The pregnancy outcome was determined by

- (a) gestational duration;
- (b) birth weight of the infant;
- (c) incidence of low birth weight and prematurity; and
- (d) birth complications, if any.

Choice of infant feeding was described with respect to the mother's choice of breast or bottle feeding methods. The sociodemographic factors influencing choice of feeding was analyzed.

### OBJECTIVES

1. To describe a segment of the population of teenage pregnant women enrolled and participating in the WIC program at the Craven County Health Department in North Carolina in terms of their sociodemographic and nutritional risk characteristics. Socio-demographic factors included: (a) race, (b) income, (c) education, and, (d) employment. Nutritional risk factors were measured by the following

characteristics : (a) Maternal age, (b) Parity, (c) Preconceptual weight and weight status (underweight, overweight, or normal), (d) Biochemical risk characteristics (presence of anemia), (e) Behavioral risk factors (history of substance abuse such as smoking, alcohol, and drugs).

2. To relate maternal nutritional performance to nutritional counseling by:

(a) assessing total weight gain in this population of pregnant teenagers, against customary recommendations of 24 lbs for adult pregnant women (Task Force on Adolescent Pregnancy, 1979).

(b) assessing average weekly weight gain against a suggested 0.8 lb per week from the 16th to 18th week, 1 lb per week until 26th/28th week, and, 0.8-0.9 lb per week until term (Hyttén and Leitch, 1971).

(c) estimating the adequacy of dietary intake in terms of four indicator nutrients: calories, protein, calcium, and, iron, using the recommendations of the National Research Council's (1980) Committee on Dietary Allowances for adolescents, modified for pregnancy (Mahan & Rees, 1984).

3. To determine pregnancy outcomes of the sample population

in terms of

(a) gestational age, and incidence of premature births, and, corresponding birth weights, and relate these to nutritional counseling.

(b) infant birth weights, and incidence of low birth weight, in this WIC population, and,

(i) relate these to nutritional counseling, and

(ii) compare with state vital statistics

5. To describe infant feeding practice based on the mother's choice of bottle or breast feeding method, and, to examine the sociodemographic predictors of breast feeding.

### HYPOTHESES

The following hypotheses will be tested :

1. Total weight gain during pregnancy will be positively correlated with the three components of nutritional counseling, namely trimester or weeks when prenatal care began, duration of participation and frequency of contact with the WIC nutritionist.

2. Weekly weight gains will be positively correlated with the

three components of nutritional counseling stated in Hypothesis 1.

3. Adequacy of dietary intake of calories, protein, calcium and iron will be significantly positively correlated with duration of participation in the WIC program, and frequency of individual and group counseling received by the subjects.

4. Increased duration of participation, early initiation of prenatal care and frequency of individual and group contact with the WIC nutritionist, will correlate positively with the gestational age of infants.

5. Mean birth weight will be significantly higher in groups of subjects associated with early participation, increased duration of participation, and number of individual and group contacts.

## REVIEW OF LITERATURE

### OVERVIEW OF TEENAGE PREGNANCY

In 1970 the National Research Council's Committee on Maternal Nutrition reported that the problems of pregnant adolescents were of particular importance because of the trend in the United States toward marriage at earlier ages and increases in the proportion of infants born to young mothers (National Research Council, 1970). Infant mortality rates in the United States have not decreased as much as those of some other developed nations (Worthington-Roberts, 1985) and those rates are particularly high among infants born to very young mothers (Campbell, 1980). The Working Group of the Committee (National Research Council, 1970) acknowledged the great biological and psychological risks that girls under 17 years of age face when they become pregnant before cessation of their own growth. Because they are growing, most girls under 17 years of age have greater nutritional requirements in relation to body size than do adult women (National Research Council, 1970). The additional nutrient demands of pregnancy may compromise their growth potential. Statistics on adolescent pregnancy reveal

the medical and non-medical risks that a teenage mother and her offspring are exposed to (Stickle, 1981). Following is the review of literature on medical risks involved and factors affecting maternal and fetal health and outcome of pregnancy.

#### TRENDS IN TEENAGE CHILD BEARING IN THE UNITED STATES

Findings from research indicate that the absolute number of live births to females aged 10 to 14 years has increased threefold from 1940 to 1983, although the rate peaked in 1975 (Lee & Corpuz, 1988). In 1985, more than 10,000 babies were delivered to girls under the age of 15. (National Center for Health Statistics, 1987). At ages 16 and 17 the relative increases have been smaller and at ages 18 and 19, the values have dropped below those observed in the 1930s (Campbell, 1980). There were more than 467,000 births to teenage mothers aged 15 to 19 years, over one third between 15 and 17. These changes in the age distribution were found to be only partly a result of increasing numbers of teenagers in the population. In 1983, the number of births to teens under twenty was just under one-half million, accounting for almost 14% of all births (Select Committee on Children, Youth, and Families, 1986). In 1985, the latest year for which final natality statistics are available, the birth rate was 31.1 live births/1000 women aged 15-17 years and 80.8 live

births/1000 women aged 18-19 years (Henshaw & Van Vort, 1989). The trend in teenage childbearing are similar for white and non-white women, although the levels of age specific birth rates are substantially higher for the non-white population (Lee & Corpuz, 1988). Both groups show the greatest increases at ages 14, 15, and 16. In 1983 however, the rate of teenage childbearing among nonwhite women was much higher than among whites (Lee & Corpuz, 1988). Black adolescents also began childbearing at younger ages than whites, increasing the likelihood of subsequent births during the teenage years (Select Committee on Children, Youth, and Families, 1986). The race contrast was especially great for girls under age 15. In 1985, nonwhites accounted for 60% of the births to women under 15. (Henshaw & Van Vort, 1989). This has been attributed to a high fertility rate among blacks in this age group. However, among nonwhite teenagers aged 15-19, the birth rate fell sharply from 95 per 1000 to 90, between 1980 and 1985.

#### HEALTH AND DEMOGRAPHIC CONSEQUENCES OF ADOLESCENT PREGNANCY AND CHILDBEARING

The Center for Disease Control which publishes data on legal abortions in the United States reported that in 1975, 33.1% of abortions , in which the age of the women was known, were performed on teenagers (Menken, 1980). In 1985, the

rate showed a decrease, with women younger than 20 accounting for 26% of all abortions. Much of the medical and statistical literature related to age at childbearing examines reproductive loss at specified stages, with neonatal and post-neonatal mortality being standard measures of infant mortality.

INFANT MORTALITY IN RELATION TO MATERNAL AGE : Age is a rough indicator of whether a young pregnant women has reached full physical maturity or whether the reproductive effectiveness of the older women has begun to decline. Only a handful of large scale studies exist, and those in the United States and United Kingdom have shown consistently that infant mortality follows a U-shaped curve with respect to maternal age from 15-44 years (Heady et al., 1955; National Research Council, 1970). The mortality rate is extremely high for very young mothers (less than 15 years). Investigations carried out by the National Center for Health Statistics demonstrate racial differences in infant death rates, the mortality rate being considerably higher among non-whites than among whites. The mortality rate among infants born to mothers under age 20 was also far greater in the first month of life than among those whose mothers were ages 20-30 years (Heady et al., 1955). Post-natal death rates were high and racial differences were least in mothers

under 15, suggesting large negative environmental influences for infants of youngest mothers, regardless of race. For those States able to report infant mortality rates for teens in 1982, the rates were much higher than the national rate of 11.2/1000 live births to mothers of all ages (Select Committee on Children, Youth, and Families, 1986).

Data gleaned from a 1972 study of infant mortality among infants born to mothers aged less than 15 years revealed a mortality rate that varied (6-50/1000 live births) as a function of medical care and social factors (Dott & Fort, 1976). Adolescent mothers who were poor, white, married or receiving limited prenatal care (generally decreasing with decreasing age) had the highest infant mortality risk.

THE INFLUENCE OF PARITY : Parity reflects previous experience with the reproductive process. Risks of reproductive loss are highest for young mothers who have already had several births (Morrison et al., 1959). At all levels of parity the risks for young women are high and they increase rapidly with parity after the first birth.

A study by Jekel et al., (1975) focused on young mothers experiencing subsequent pregnancies. Their five year prospective evaluative study of a comprehensive program for school-age mothers showed that the risk of prematurity and perinatal death increases greatly in the second and third

trimester of pregnancies. They reported a risk of less than 1% of perinatal death for first births, 7% for second births and 14% for third births. The mothers in this study received special services during their pregnancy, but obtained prenatal care in the regular obstetric clinics for subsequent deliveries.

#### INCIDENCE OF PREMATURITY AND LOW BIRTH WEIGHT

One of the most important themes that runs through any consideration of infant mortality is the critical role of the maturity of the infant at birth. In fact, the increased risk of prematurity may be the single most important aspect of teenage pregnancy. For non-whites and whites the percentage of infants weighing less than 2500g is greatest for very young mothers (Chase, 1970). However, Lee & Corpuz (1988) examined the entire period of 1960 to 1983, and indicated that, although low birth weight outcomes and neonatal mortality rate were high in the adolescent population, teenage pregnancy appeared to influence overall national birth weight distribution and neonatal mortality only minimally.

In 1965, 18.7% of low birth weight [LBW] babies born alive in the United States were born to mothers under 15 years of age (Vital Statistics of the US, 1967). The median

birth weight of infants of very young non-white mothers was 250 g less than the median birth weight of infants of very young white mothers. The lightest babies were those born to non-white girls under 15 years of age. In 1983, there were 47,500 low birth weight infants born to teens under age 20, almost 10% of all births to teens. Teenage mothers typically accounted for 1 in 5 LBW infants (Select Committee on Children, Youth, and Families, 1986). Low birth weight rates for the United States in 1983 showed that there has been little or no reduction in the rates among infants born to teens since 1978 (Lee & Corpuz, 1988).

Socioeconomic factors may be strongly associated with factors such as medical care in influencing the incidence of LBW. Lee et al., (1988) studied over 180,000 singleton births in Illinois, and their results indicated that the high incidence of low birth weight in mothers <17 years, was primarily a reflection of their sociodemographic and prenatal care status.

Maternal age and prenatal care were found to influence the risk of having a small for gestational age infant in white adolescent mothers who had both one or two previous live births (Elster, 1984). In a study of data obtained from computerized records of 1974-1979 Utah birth certificates, it was found that poor care exerted a relatively stronger effect than young age, in primiparous mothers. The reverse

was found for multiparous mothers. Moreover, for women with first births, there was an interaction between variables in that, early prenatal care promoted better pregnancy outcome for younger teens than for older teens. Thus, both parity and prenatal care appear to be key variables mediating the relationship between maternal age and suboptimal outcome of pregnancy.

However, in a study of infants in Baltimore between 1961 and 1965, birth weight was found to be related more, within each racial group, to the trimester of pregnancy in which prenatal care began, than to age, parity or socio-economic status per se (Weiner & Milton, 1970). The group at greatest risk for delivering LBW infants were unmarried black females who had received no medical care, were under 15 years of age, and were in the study's lowest socio-economic group. Just under 30% of the infants born to mothers in this group were estimated to weigh less than 2,500g. The National Natality Survey (Kovar, 1968) also found that when women were classified according to family income, their age had little effect on the percentage of premature infants.

According to statistics reported in 1983 by the National Center for Health Statistics, the percent of live births for teenage women aged 15-19, who received no prenatal care was as low as 3.2%, but this increased to 33.4% when prenatal care began in the 4th-6th month (Select Committee on

Children, Youth, and Families, 1986). The percent of live births to adolescent women receiving prenatal care in the first trimester, by state ranged between 26.0 to 64.0 in 1983.

#### WEIGHT GAIN PATTERNS IN PREGNANT ADOLESCENTS

Preliminary research carried out has confirmed that adolescents tend to gain more weight during pregnancy than adults (Ancrì et al., 1977).

Garn & Petzold (1983) found that weight gain in pregnancy is maximal at the age of 13 years and decreases thereafter. This trend for decreasing pregnancy weight gain with increasing age persisted even after 'growth correction' i.e., accounting for weight normally gained during a nine month period. However, a larger weight gain for teenagers was not recommended since this could lead to an elevated postpartum weight and an excess of body fat.

Horon et al., (1983) also found that the proportion of weight gained, to prepregnancy weight, was higher among the younger group as compared to the young adults.

A study by Meserole (1984) compared prenatal weight gain patterns of 80 adolescent girls [13 - 17 years] with the standard weight gain curve for pregnant females. Chronologically and physiologically younger girls had higher

prenatal weight gain than did older girls, while girls who were underweight before pregnancy had a higher prenatal weight gain than those who were not. The mean prenatal weight gain at term, in this study was 37 lbs.

Frisancho et al., (1983) have shown in their study that young Peruvian adolescents [13 - 15 years] needed to gain more weight than did their older counterparts [16 years or older] to produce babies of equal size.

Optimal weight gain for pregnant adolescents will however, theoretically be made up of that recommended for a normal pregnancy plus the amount women of the comparable postmenarcheal year will gain in the process of maturation (Worthington-Roberts & Vermeersch, 1985).

#### PREPREGNANCY WEIGHT, PRENATAL WEIGHT GAIN AND FETAL OUTCOMES

Maternal body size as measured by prepregnancy weight, and the amount of weight gained during the pregnancy itself have shown consistent associations with birth outcomes.

Naeye (1979) analyzed data from 60,000 pregnancies to discover causes of fetal and neonatal mortality among different racial groups. The findings from this Collaborative Perinatal Project supported the view that mothers with low prepregnancy weights have much lighter placentas than do heavier mothers. This factor was

associated with a significantly higher perinatal mortality rate.

In evaluating the relationship between maternal pregravid weight and low birth weight infants, Rosso and Luke (1978) found the incidence of LBW to be 2% among women of normal pregravid weight with adequate gain compared with 33% among those with inadequate [7kg or less] gain.

Data available tend to suggest that underweight women may reduce their risk of adverse pregnancy outcome by gaining extra weight during the prenatal period. Naeye (1981) has shown this in his evaluation of 60,000 pregnancies, from the US Collaborative Perinatal Project.

Several other studies have shown the inverse relationship between maternal weight gain and unfavorable pregnancy outcomes (Gormican, 1980; Tavris & Read, 1982).

**STUDIES ON THIS INTERRELATIONSHIP IN TEENAGE PREGNANCY:** Low maternal weight gain during pregnancy correlates with a higher incidence of LBW infants and higher mortality rates among neonates born to teenagers (Olson, 1979).

Birth weights of 422 infants born to primigravid patients under the age of 16 years were compared with the birth weights of 422 infants born to a racially comparable group of primigravid patients 20-24 years old (Horon et al., 1983). Race and sex of the infant were reported to be

important predictors of birth weight among the adult group, whereas maternal weight gain was a more important factor among the adolescent group. The adolescents had lower prepregnancy weights and shorter lengths of gestation but they appeared to compensate for these potential deficits by gaining more weight, relative to body size.

The findings of Garn & Petzold (1983) on 11,464 teenage participants show that teenage mothers tend to be of small stature and weight, consistent with age and maturation. They attributed the smaller birth weights of the progeny of teenage mothers to their considerably smaller body mass rather than to their younger age or developmental immaturity. Their findings also showed that unfavorable outcomes decreased with increasing maternal age. This was consistent with the explanation that medical risks decreased with increasing prepregnancy weight.

#### PRENATAL NUTRITION AND PREGNANCY OUTCOME

Factors influencing the outcome of pregnancy were studied in 98 women aged 12-32, divided into four age groups (Ancrì et al., 1977). According to the findings in this study, there was no significant correlation between protein and caloric intake of the mother and the infant's birth weight. The absence of significant correlation was

attributed to the reasonably good nutritional status of the mother. The amount of weight gained by the mother was a function of length of gestation, but was not influenced by caloric intake. Mean caloric intakes averaged below, and mean protein intakes above, the 1974 RDA.

Nutritional status evaluated by anthropometric and biochemical measurements in 1256 adolescent mothers ranging from 12-15 years indicated that the availability of calories to the fetus (as measured by skinfold thickness which indicates the amount of caloric reserves) was less than that of older women (Frisancho et al., 1983). This supported the hypothesis that nutritional requirements of pregnancy in adolescents may be greater than those of older women.

DIETARY INTAKE IN PREGNANT ADOLESCENTS: Singleton et al., (1976) determined the nutritive value of the diet in pregnant teenager and found that it was greatly in need of improvement. Seiler and Fox (1973) evaluated nutrient content of diets of pregnant adolescent subjects. In general, their diets compared less favorably with appropriate Food and Nutrition Board recommendations, than diets of nonpregnant adolescents; however, the intakes of certain minerals and vitamins were increased appreciably by nutrient supplements.

In yet another study Kaminetsky et al., (1973) looked

into dietary histories and biochemical values in a group of teenage gravidas. These indicated gross undernutrition of many in the group. It was also reported that dietary improvement was not easily achieved despite intensive dietary counselling.

Endres et al., (1985) analyzed the energy and nutrient intake patterns of pregnant adolescents participating in the WIC program. Even though the adolescents were receiving supplemental food, their energy intakes were substantially less than the RDA. A very large percentage of these subjects had dietary intakes providing less than 100% of the RDA, for the 14 nutrients studied.

These studies recognize the pregnant adolescent as being medically and nutritionally at risk. Many schools and hospitals have established special teen parent programs in an effort to demonstrate a more favorable obstetric outcome (Alton, 1979; Dryfoos, 1985; Huyck, 1976).

#### NUTRITION INTERVENTION STUDIES

The goal of nutrient supplementation during the prenatal period is to reduce the adverse outcome of pregnancy. Several studies in developing countries have indicated that supplementation during pregnancy increased the weight gain of the mother, decreased the incidence of anemia, decreased

prematurity and improved birth weight (Lechtig et al., 1975).

Unselected prenatal patients were given nutritional counseling and, if judged necessary, dietary supplementation was provided (Rush, 1981). They were paired with controls matched for other variables. The proportion of infants of LBW born to the recipients' and controls was not significantly different; however, the recipients infants were heavier at birth than those of the controls by an average of 40g. Differences between groups in duration of gestation and maternal weight gain accounted for only a small part of these differences in birth weight.

Colombian women at risk for malnutrition were enrolled in a health care program and randomly assigned to supplementation and control groups at the beginning of the third trimester of pregnancy (Mora et al., 1979). Supplementation had a significant effect on the mean birth weight of male infants. The effect of supplementation on maternal weight gain and association of the latter with birth weight strongly suggest that improved maternal nutrition mediated the effect on birth weight.

In a randomized controlled double blind trial on the effects of nutritional supplementation of pregnant and lactating women on their offspring, McDonald et al., (1981) found that caloric supplementation does result in a small, yet statistically meaningful, increment in birth weight

within a population which is not nutritionally at risk.

The effect of dietary protein-energy supplementation was studied on 153 Asian mothers, irrespective of nutritional state (Viegas et al., 1982). The mothers put on significantly more weight and fat but the birth weights were similar between the experimental and control groups. It was concluded that dietary supplementation of all pregnant mothers did not enhance intrauterine growth.

In another study by the same group, selective supplementation of nutritionally at risk mothers showed significantly higher crude birth weight and heavier weight for gestational age (Veigas et al., 1982). This differential effect of supplementation, depending on the mother's nutritional status during the second trimester, may explain apparently conflicting results of other studies which have shown a substantial effect of supplementation and others which show only a small effect.

The fetal outcomes of 67 inner city pregnant teenagers aged 15 years or younger attending a special obstetric clinic, staffed by an interdisciplinary health team trained in adolescent and prenatal health care, were compared to fetal outcomes of 67 pregnant teenagers attending a regular obstetric clinic (Felice et al., 1981). Of the infants born to the girls attending the teen clinic, only 9% weighed below 2,500g contrasted to 21% for infants born to the pregnant

girls attending the regular clinic. The results underscored the benefits of providing specially designed prenatal care to the very young pregnant teenagers.

#### THE WIC PROGRAM AND IT'S IMPACT

WIC, the Special Supplemental Feeding Program for Women, Infants and Children is a food assistance program, authorized by Congress in 1972. It is limited to pregnant and nursing women, and children under 5 years of age, who must not only be poor, but also certified to be at nutritional risk. Administered by the State Departments of Health, the program is designed to provide access to foods rich in protein, iron, calcium and vitamin A & C (e.g., cereals, juices, eggs, infant formula, milk and cheese). Three delivery systems are available: vouchers which can be used in local stores, direct delivery to recipients' homes, and warehouses where the nutrient rich foods can be claimed.

Kennedy et al., (1982) evaluated the WIC supplemental feeding in a retrospective review of WIC and non-WIC medical and nutrition records at nine sites in four different geographical areas of Massachusetts. Among the maternal characteristics, their data indicated that gestational age exerted the greatest influence on birth weight. As participation in WIC moved from no participation to the

highest category of seven or more months there was a concurrent increase in birth weight. This increase translated into a statistically significant decrease in the incidence of LBW infants born to WIC mothers. Pregravid weight, weight gain during pregnancy and prior number of LBW infants were found to be significantly associated with birth weight.

WIC participation and pregnancy outcome were examined in yet another Massachusetts Statewide Evaluation Project (Kotelchuck et al., 1984). Teenage mothers as a group showed increased birth weight, increased gestational age, decreased LBW status and improved prenatal care. In general, their report also indicated that there was an inverse relationship between age of mother and the impact of WIC on birth outcome. The youngest mothers, age 15 and under had the largest pregnancy benefits and biggest decline in inadequate prenatal care (6.1% WIC vs 18.7% non WIC). Increased duration of participation in WIC was found to be associated with enhanced pregnancy outcomes. In particular, increased duration was significantly associated with increases in mean birth weight and gestational age and decreases in the incidence of LBW, prematurity, small for gestational age and neonatal deaths.

Kennedy and Kotelchuck (1984) used a case-control design methodology to analyze sub-populations thought to be at higher risk of adverse birth outcomes. They found a

significant increase in mean birth weight (+ 174g;  $p < 0.01$ ) of infants born to WIC adolescent mothers. WIC teenage mothers also had a 4.7% decrease in incidence of LBW infants compared to their matched non-WIC controls, though the difference was not statistically significant. Hispanic women showed similar if not stronger benefits.

Metcoff et al. (1985) selected a study group of 410 women at the Oklahoma Memorial hospital and tested the effect of WIC supplements from mid-pregnancy on birth weight. Their results showed that WIC supplementation from mid-pregnancy significantly increased mean birth weight after adjusting for gestational age, sex, prenatal visits, race, previous LBW babies and smoking. Birth weight was significantly correlated with maternal age.

Results from a study on 910 WIC and 418 non-WIC pregnant woman indicated that women who were classified as at high obstetrical risk (factors such as maternal age, number of previous pregnancies, pregravid weight, etc.) had a significantly higher incidence of LBW infants than women in the low risk group (Kennedy, 1986). The results also showed that participation in WIC lowered the incidence of LBW significantly in each of the groups. Participation in the program was also associated with an increase in infant birth weight, suggesting that WIC was able to minimize the effect of the risk factors.

### INFANT FEEDING PRACTICES

Several studies have addressed the decline in the past decade, in the frequency (Martinez & Nalenzieski, 1981) and in the mean duration of breast feeding (Cole, 1977). However, as the following studies illustrate, the trend appears to be reversing.

Sarett et al., (1983) studied the trends in infant feeding practices up to 6 months of age, in the period 1976-1980. Their results showed an increase in incidence and duration of breast feeding, and a decrease in newborn infants receiving formula.

The type of milk fed infants from birth to six months of age was ascertained by quarterly surveys of a national sample of births (Martinez & Stahle, 1982). WIC participants were identified from this sample and trend data indicated that an increased percentage of WIC mothers are choosing to breast feed their infants.

Results from survey reports conducted from 1955-1984 on milk feeding patterns in the United States were reported by Gilbert et al. (1985) with emphasis on the period from 1971-1984. These surveys traced the trend in selection of breast feeding, whole cow's milk or evaporated milk or commercially prepared formulas as infant feedings. Demographic characteristics of the mothers were examined as well. From

1971 to 1982 the incidence of breast feeding increased rapidly in the hospital and at each infant age throughout the first six months of life. Throughout the first six months of life, the use of whole cow's milk or evaporated milk had declined at every infant age from 1971 to 1982 and continued to decline through 1984. Between 1983 and 1984 the incidence of breast feeding increased. The greatest increases occurred among older women and blacks. The incidence in mothers less than 20 years of age declined. The lowest incidence of breast feeding occurred among blacks, those younger than 20 years of age, at low income levels and among the less educated.

Feeding practices for 100 infants from low income families were compared with practices for 102 infants from middle income families in Lincoln, Nebraska (Brogan & Fox, 1984). Results indicated a resurgence in the practice of breast feeding. About 50% of infants from both low and middle income families received breast milk either alone or in combination with formula. By the time the infants were 3-5 months old, 75% of the low income mothers had terminated breast feeding.

Despite increased breast feeding rates in recent years, the vast majority of women of lower socio-economic status are still bottle feeding (Winikoff et al., 1986). Data collected through direct observation conducted at a 597-bed hospital

revealed that only 16% of infants under study were breast fed and all of these had been bottle fed. The predominant assumption in the services provided to mothers was that bottle feeding was the norm.

## MATERIALS AND METHODS

This study was designed to analyze the maternal nutritional performance , pregnancy outcome, and intended method of infant feeding (breast vs bottle), of 100 pregnant teenagers who had received nutritional counseling and other benefits of the WIC program, in New Bern, North Carolina.

The Human Subjects Review Board at Virginia Tech, reviewed the research protocol and approved the collection and study of existing data from medical records of pregnant teenagers who were receiving the services of the WIC program.

### THE STUDY SITE

The WIC program in the state of North Carolina is operated under the auspices of the Nutrition and Dietary Services Branch of the Department of Human Resources. It's central office is located in Raleigh and the program implemented through local agencies and health departments. The population selected for this study was enrolled in the WIC program operating at the Craven County Health Department

in New Bern. New Bern is located in eastern North Carolina, at the confluence of the Neuse and Trent rivers, about 110 miles east of Raleigh. The Nutrition section is one of Craven County Health Department's eleven health care sections and is coordinated by a program director, and three nutritionists who serve the WIC participants. The program is assisted by a Mobile Health Van, which serves as a site for WIC voucher pick-up in the county's more outlying areas.

SUBJECTS :

WIC medical records of 100 pregnant teenagers, between the ages of 13 and 19 years, who participated in the North Carolina WIC program between July 1987 and April 1988, were reviewed. All subjects resided in Craven County, North Carolina and were determined to be 185% below the poverty line, according to WIC's Income Eligibility Guidelines and Procedures for the state of North Carolina (NC Department of Human Resources, WIC Program Manual, 1988). Subjects were also determined to be at medical/nutritional risk, based on assessments using the state's Medical/Nutritional Risk Certification Criteria (NC Department of Human Resources, WIC Program Manual, 1988).

Only those subjects who had a single fetus pregnancy, and delivered a living infant, were chosen for the study.

Mothers with significant medical or nutritional stress conditions, such as diabetes mellitus, were not selected. Also excluded were subjects who suffered from major complications of pregnancy such as toxemia, pre eclampsia or eclampsia.

DEMOGRAPHIC DATA:

(i) The racial/ethnic status of each women was retrieved from medical records and coded as 1. White, 2. Black, 3. Hispanic, 4. Asians.

(ii) The education of the mother, i.e., the number of grades of school completed prior to the birth being reported, was obtained from medical records. Mothers were classified as having completed under 9 years of school education, or over 9 years of education.

(iii) Subjects were also classified based on their employment status, during the course of the pregnancy under consideration. Subjects were grouped into whether they were attending school, employed, a combination of both, or, neither employed nor attending school.

**MATERNAL /NUTRITIONAL INDICATORS:**

Nutritional risk variables experienced by the mother at the time of enrollment were retrieved from the medical records. These included the following :-

(i) **Maternal Age:** Subjects were originally divided into two groups: Age Group I constituted teenagers of less than or equal to 15 years of age, the group considered as a prenatal indicator of high risk, (NC Department of Human Resources, WIC Program Manual, 1988); Age Group II included those individuals aged 16 to 19 years.

On preliminary examination of the population, it was observed that Group I constituted only 20% of the subjects in this study. Therefore, maternal age was classified into 3 groups, (Age Group I: 15 years or under, Age Group II: 16 to 17 years, Age Group III: 18 to 19 years) to permit a relatively even distribution of the sample, while testing for statistical association between variables.

(ii) **Parity:** The parity of the mother, defined as the number of previous children living or dead, previous fetal deaths, plus the birth being reported, was also determined from the medical records.

(iii) Maternal Preconceptual Weight: Maternal weight in pounds, prior to conception, as stated by subjects, was obtained from the medical records. Height in feet, measured during the first visit to the clinic was also obtained. Using this data, subjects were termed overweight, if their weight for height was greater than or equal to 120% of desirable level; underweight, if their weight for height was less than or equal to 85% of desirable level; or normal, if their weight for height was between 86% and 119% of desirable level (NC Department of Human Resources, WIC Program Manual, 1988).

(iv) Biochemical Risk Characteristics: Hemoglobin and hematocrit levels were used as laboratory indicators for nutritional anemia. Subjects with hemoglobin values of less than, or equal to, 11 gm/dl or hematocrit of less than, or equal to, 34%, received risk scores for the presence of anemia.

(v) Behavioral Risk Characteristics: Subjects exposed to excessive smoking (10 or more cigarettes /day), overconsumption of alcohol (the equivalent of 2 or more ounces of absolute alcohol /day), or those who had frequently used controlled drugs, were identified from risk assessment records in their medical charts and individually coded.

**EVALUATION OF NUTRITION EDUCATION SERVICES :**

The cumulative impact of nutrition education services rendered to participants was examined using the following variables:

(i) **Duration of Participation:** WIC prenatal participants can be enrolled in the program at any stage of their pregnancy. It is assumed that mothers receive dietary supplementation for a greater period of time, with early participation, and possibly more contact with the nutritionist. Duration of participation was estimated by recording the number of months, between the month of enrollment, and the month of delivery. Subjects were stratified into three groups based on absolute number of months in the WIC program. Length of participation was categorized into three groups: 1-3 months, 4-6 months, and 7+ months.

(ii) **Weeks or Trimester when prenatal care began:** To eliminate the effect of differing gestational lengths on duration of participation, subjects were grouped by the number of weeks or trimester of pregnancy when they initiated prenatal care. This was used as an index of maternal performance and pregnancy outcome.

(iii) Dietary Data: Dietary intake data, prior to receiving nutrition education, was obtained from information gathered by WIC nutritionists, at their first contact with the subjects. A typical 24 hour recall, which was most reflective of the usual eating pattern, including amounts consumed, was recorded in each subject's WIC file. WIC nutritionists confirmed the representativeness of the 24 hour recall to the individual's diet, by detailed questioning.

Typically, the WIC nutritionist calculates the number of servings consumed from each food category. A Daily Food Guide (NC Department of Human Resources, WIC Program Manual, 1988) indicating the minimum number of servings of the four basic food groups required per day, serves as a standard for evaluating daily intake. The approximate caloric intake is then calculated using an exchange list (ADA, 1981; USDA Handbook No. 456, 1975; or Pennington and Church, 1980). The adequacy of this number is assessed in relation to the subject's weight for height, and rate of weight gain. A dietary risk score (NC Department of Human Resources, WIC Program Manual, 1988) may be obtained on each mother to identify high risk mothers. Based on age, and weight status, the WIC nutritionist counsels each subject on dietary modifications required for optimal weight gain. For the purpose of this study, however, food intake data was analyzed for energy, protein, calcium and iron content.

All participants in this study received a monthly food voucher to purchase specific supplemental foods such as milk, eggs, juice and fortified cereals. In addition, iron supplements, with 65mg of elemental iron at a recommended dosage of one tablet, three times a day, were provided. For the more indigent mothers, multivitamins were supplied on a regular basis.

A repeat 24 hour recall, obtained by the WIC nutritionists during follow-up contacts, was retrieved from the subjects' files. This was analyzed for its caloric and nutrient content to evaluate the subject's progress in making appropriate dietary changes.

Intakes for energy, and three nutrients, protein, calcium and iron were computed from the 24 hour recalls, using the Evrydiet food database. This database derives its nutrient information from the computer tape of USDA, Handbook 456 (1982), and from "Food Values of Portions Commonly Used", Pennington & Church, (1980). The percentage of calories from carbohydrates, fats and protein was also calculated, using the Evrydiet program. The mean energy and nutrient intakes were compared with Recommended Dietary Allowances for pregnant adolescents, modified for age and height, from the National Research Council's RDA for non pregnant adolescents (Mahan & Rees, 1984).

(iv) Nutrition Education Contact: Subjects at high nutritional risk were eligible to receive a level of nutrition intervention, that was consistent with their degree of risk. Participants were encouraged to take part in nutrition education services provided through individual, as well as group, education. A minimum of two nutrition education contacts per certification was offered to all mothers.

Individual Contact : Nutritionists helped subjects develop strategies to overcome existing dietary irregularities, and establish plans for follow-up care. Follow-up visits were scheduled to review each subject's progress in achieving and maintaining nutritional well being. The number of individual contacts received by each subject was gathered from their files.

Infant feeding was addressed at the second or third visit to the clinic. Breast feeding was discussed as an option for all mothers. Depending on the mother's choice of feeding, additional information was provided on either bottle or breast feeding.

Group Contact: Group contacts were established via prenatal classes, conducted by the Maternity Clinic at the Craven County Health Department. Group sessions addressed topics such as prenatal weight gain and infant feeding practices, amongst others. Flip charts and films were used

to deliver information, and reading materials were provided to the participating women, for reference. Participation in these classes was not mandatory, and attendance by subjects in this study was found to be limited. Issues discussed in group sessions were, therefore, discussed by the nutritionist during individual contact with the subject.

**MATERNAL NUTRITIONAL PERFORMANCE CRITERIA:**

The following were used as a measure of the mother's nutritional performance:

(i) **Maternal Weight Gain:** Total maternal weight gain for the current pregnancy was calculated as the difference between the reported preconceptual weight and maternal weight recorded within two weeks of delivery. Although, weight increment in the post menarcheal years plus the typical gestational gain will yield the optimal pregnancy gain for normal weight adolescents, allowable gains may vary between 20 and 30 lbs, or more, for overweight and underweight gravidas, respectively (Worthington-Roberts, 1985). Because of this variation in the recommendation for adequate weight gain, the current recommendation of 24 lbs (11 kg) weight gain for the adult pregnant women was established as a standard, for comparison with the results from this study.

However, the comparisons were made with reference to the preconceptual weight status of the subjects.

(ii) Pattern of Weight Gain: Change in maternal weight during the course of the current pregnancy, defined as the difference between maternal weight at each prenatal visit and reported prepregnant weight, was calculated for each subject. Inappropriate weight gain, evidenced from assessments against suggested average weekly weight gain, as stated in the objectives, was recorded.

(iii) Dietary Adequacy: Differences in intake of calories, protein, calcium and iron, before and after receiving counseling services was evaluated. The overall adequacy of the diets were determined using the recommendations of the National Research Council's Committee on Dietary Allowances for adolescents (1980), adjusted for pregnancy. Since nutrient requirements were higher for those subjects who were 14 years of age, or less, dietary adequacy was also assessed by age group. Subjects were classified into two age groups for this purpose : age group I - 14 years of age, or less; and, age group II - 15 to 19 years of age.

**PREGNANCY OUTCOME:**

The outcome of pregnancy was assessed using the following two criteria:

(i) **Gestational Age:** Information on gestational age was gathered from medical records. Gestational age in completed weeks was determined based on the date of the last menstrual period and confirmed by physical examination of the infant. Infants were termed to be premature if their gestational age was less than 37 weeks.

(ii) **Infant's Birth Weight:** Birth weight of infants, in pounds was retrieved from hospital records and recalculated in grams (1 ounce = 28.35gm) for this study. Infants with birth weights of less than 2,500 gm were termed underweight. Other data included the infant's condition at birth and, complications if any, at birth.

**INTENDED METHOD OF INFANT FEEDING:**

Information on the choice of bottle or breast feeding, as elected by the mother, during her prenatal visits to the clinic was gathered from the subject's files.

### STATISTICAL ANALYSES

Descriptive statistics, including frequencies and percentages were used to describe the population. Means with standard error of mean were estimated for total weight gain, rate of weight gain, gestational age and birth weight. A General Linear Models Procedure (SAS User's Guide, 1982) was used to study the effect of demographic variables and maternal & nutritional risk indicators, on maternal nutritional performance and pregnancy outcome. If statistically significant effects were determined, t tests wherever appropriate, and Duncan Multiple Range Procedures were performed, to locate differences.

To determine the cumulative impact of WIC participation, means for total weight gain, weekly weight gain, gestational age and birth weight were calculated, by duration of participation, weeks or trimester when prenatal care was initiated, and frequency of individual counseling sessions with the nutritionist. Pearson's Correlation Coefficient Procedures and Regression Analysis Procedures were applied to examine for significant association between nutritional performance/pregnancy outcome and the components of nutrition education services, mentioned above.

An Analysis of Covariance Procedure was used to evaluate the effect of counseling services, while eliminating the

effects of confounding nutritional risk variables. The differential effect was also tested on subpopulations stratified for age and race.

Twenty four hour recalls were analyzed for the mean total caloric, protein, calcium and iron intake. Mean intakes were determined for stratified age groups. Paired t tests were performed to test for significant change in intake of the four dietary components. Means were compared with the RDA, to determine adequacy of intake before and after counseling. Pearson's Correlation Coefficient Procedure was used to assess the association between nutrient intake and nutritional counseling services.

## RESULTS AND DISCUSSION

A total of 100 prenatal teenagers, enrolled in the North Carolina WIC program from July 1987 through April 1988, were subjects for this study. These subjects were receiving the services of the WIC program, operating at the Craven County Health Department in New Bern. Demographic data, maternal and nutritional risk characteristics displayed by the women, and nutrition education services received by these mothers were all recorded and coded. Maternal nutritional performance indicators and pregnancy outcome information were analyzed, and the results and discussion follow.

### DEMOGRAPHIC DATA

(i) Race: Of the 100 teenagers studied, 35% (n=35) were white, and 65% (n=65) were of the black race. There were no subjects representing other ethnic groups such as Hispanic, American Indian or Asian/Pacific Islander. Population statistics for the state of North Carolina in 1984 reveal that about 76% of the population were white, and 24% were nonwhites, with blacks comprising greater than 90% of the

nonwhite population (US Department of Commerce, 1988). The large percentage of blacks in this study group is surprising, considering that less than 50% of all live teen births in North Carolina (1988) were to blacks. The large number of black women may be partly a reflection of the larger percentage of black residents in Craven County (30%), compared to the state as a whole. It also seems that more blacks than whites are possibly eligible for the program.

(ii) Income: Based on the preliminary estimate of poverty thresholds in 1988, a large majority of the subjects studied belong to the more indigent category of the low income population. This is perhaps in accord with a high poverty rate in the state of North Carolina, which had risen to an estimated 14.3% in 1986, compared to 13.6% for the entire country (NC Office of State and Budget Management, 1988).

(iii) Education: Ninety-two percent (n=92) of the subjects studied had completed greater than nine years of schooling. Of this group, 19.6% (n=18) had completed high school, but none had received college education. The remaining eight percent (n=8) who had under nine years of schooling, were less than or equal to 15 years of age.

(iv) Employment Status: Forty-three percent of subjects

(n=43) reported being in school, while an almost similar number (45%) were neither in school, nor employed. Twelve percent (n=12) were employed, either part-time or full time. None of the subjects in this study were employed, while attending school.

#### MATERNAL NUTRITIONAL RISK CHARACTERISTICS

(i) Age and Race Distribution: Of the population of 100 teenagers, twenty percent (n=20) were less than or equal to 15 years of age, and therefore considered to be at an increased risk for preterm delivery. Eighty percent (n=80) belonged to the 16-19 year old age group. Statistics for resident pregnancies in North Carolina, in 1988, indicated that only about half of all pregnancies in the 15-years-or-under age group, resulted in live births (NC State Center for Health Statistics, 1988). Also, live births in this age group, comprised 7.8% of all live teen births (less than or equal to 19 years). The high percentage of subjects in the 15-or-under age group in this study population, is probably indicative of improved pregnancy outcome rates among that age group, as a result of maternal and nutritional services offered via the WIC program.

Eighty percent (n=16) of subjects who were 15 years of age or under, and 61.3% (n=49) of the subjects who were

between 16 and 19 years of age, were black. North Carolina state statistics in 1988, indicated that 71.5% of all live births to the 15-or-under age group, and 45.7% of all live births to the older teens, occurred to nonwhites (NC State Center for Health Statistics, 1988). The large number of black subjects in this study is probably due, in part, to the greater percentage of nonwhite, essentially black resident population in Craven County. This, coupled with a fertility rate that is 2-6 times that of 13-19 year old white counterparts (Lee & Corpuz, 1988), may explain the over representation of black teenagers.

(ii) Parity: Sixty-nine percent (n=69) of the subjects in this study were primiparous. This compares well with North Carolina state statistics for 1987, which indicated that birth order for 73.4% of all deliveries to teen mothers, was one (NC State Center for Health Statistics, 1988). Of the multiparous mothers, 74% (n=23) were in the course of their second pregnancy, while the remaining (n=8) were in the course of their third pregnancy. With increase in parity, the percentage of blacks in each subgroup also increased, from 62% at parity one, to 87.5% at parity three.

(iii) Maternal Preconceptual Weight: The mean prepregnant weight for the entire group of 100 subjects was 60.97+13.4

kg (mean height -  $161 \pm 6.5$  cm). Although whites had a lower mean prepregnant weight compared to blacks, the difference was significant only at a p value of 0.10. No significant difference was evident, when mean prepregnant weights were analyzed by age group, although whites tended to weigh less than blacks in each group.

Maternal weight prior to conception was determined to be within the desirable range for height in 59% (n=59) of the subjects. Twenty-seven percent (n=27) and 14% (n=14) of the subjects were estimated to be overweight and underweight, respectively. The overweight group was predominantly black, with as many as twenty-one black teens (78%) exceeding 120% of desirable body weight.

(iv) Biochemical Risk Characteristics: Of this population, 42 percent (n=42) were found to have a hematocrit value of less than 34 percent, and a hemoglobin value of less than 11gm/dl, and, therefore, considered to be at high risk for pregnancy complications. About two and a half times as many black women (n=30) as white women (n=12) evidenced this reduced iron classification.

(v) Behavioral Risk Characteristics: The presence of excessive smoking (>10 cigarettes per day) was reported by 20% of the subjects, and exposure to alcohol and/or drugs was

reported by 5 percent of the subjects. Almost three times as many blacks as whites reported usage of one or more of these substances.

### NUTRITION EDUCATION SERVICES

(i) Trimester or weeks when prenatal care began: Fifty-one percent (n=51) began prenatal care during the first trimester of pregnancy (0 to 14 weeks), 39% (n=39) started receiving prenatal care during the second trimester (15 to 27 weeks) and 10% (n=10) did not initiate prenatal care until the third trimester (28 + weeks). Based on available data, North Carolina state statistics for 1987 indicated that 32%, 42.6% and 14.8% of all teens (19 years or under) initiated prenatal care during the first, second and third trimester, respectively (NC State Center for Health Statistics, 1987).

It seems that a large percentage of subjects in this study initiated prenatal care in the first trimester, and were, therefore, receiving benefits of WIC for a relatively longer period of time, compared to state averages.

(ii) Duration of participation: The mean duration of participation for subjects in this study was 5.7+1.9 months. The mean duration of participation for whites was at least

two weeks more than for blacks. However, mean duration of participation did not vary significantly between ethnic or age groups. This WIC sample was divided into three groups based on length of participation: Group I (1 to 3 months) - 10%; Group II (4 to 6 months) - 33%; and Group III (7 + months) - 57%. Mean duration of participation, as well as percentage of subjects receiving prenatal care for at least seven months, was much higher than that reported by Kennedy & Kotelchuck (1984) or Kotelchuck et al.(1984).

(iii) Nutrition Education Contact:

Individual contact: Documentation of the frequency of individual contact with the nutritionist revealed that 25% (n=25), 22% (n=22), and 20% (n=20) of the subjects received three, four, and five individual sessions respectively. The remaining 33% (n=33) had two or less contact with the nutritionist. Frequency of individual contact did not vary significantly when subjects were analyzed by age group. No significant difference was observed in number of contacts received by blacks and whites.

Group contact: This was established with only 5% of the subjects, and therefore, assumed to be ineffective in improving maternal nutritional performance of this study population. This variable was, therefore, excluded from analysis in this study.

## MATERNAL NUTRITIONAL PERFORMANCE

### (i) MATERNAL WEIGHT GAIN:

The mean weight gain for the subjects in this study was 14.16+5.04 kg (31.2 lbs). Mean weight gain in the present study was considerably higher than values cited in other reports on pregnant teenagers (Ancrì et al., 1977; Frisancho et al., 1983; Garn & Petzold, 1983 ). However, Loris et al. (1985), reported mean weight gain in subjects, aged 13 to 19 years, to be as high as 37 lbs. Although, studies in the literature recommend an average weight gain of 24 lbs during pregnancy as optimal for older age groups, it is now known that pregnancy weight gain should be higher for teens, since it must include normal weight increments seen during adolescent years, in addition to typical gestational gain (Naeye, 1981). Therefore, it is very likely that higher mean weight gain in this study includes two components - the linear growth observed in the postmenarcheal years in these subjects, as well as the normal pregnancy gain.

When the subjects were stratified into age groups, (age group I - 15 years or under; age group II - 16 to 17 years; age group III - 18 to 19 years;) a pattern of decreasing weight gain was evident with increasing maternal age, as shown in Table I. Although this was statistically insignificant, the higher weight gain in the younger teens

**Table I:** Weight gain, gestational age and infant birth weight, as a function of maternal age group<sup>1</sup>

Age Group	n	Weight Gain (kg)	Gestational Age (weeks)	Birth Weight (gm)
13-15	20	14.94 ± 1.36 <sup>a</sup>	38.55 ± 0.04 <sup>a</sup>	3299.30 ± 91.0 <sup>a</sup>
16-17	38	14.14 ± 0.83 <sup>a</sup>	39.26 ± 0.31 <sup>a</sup>	3160.29 ± 74.0 <sup>a</sup>
18-19	42	13.81 ± 0.69 <sup>a</sup>	39.23 ± 0.31 <sup>a</sup>	3203.05 ± 68.2 <sup>a</sup>

<sup>1</sup>Values represent mean ± SEM

<sup>a</sup>means within a column followed by different superscripts are significantly different (p < 0.05)

would be considered necessary to allow help the younger teens to reach this critical body mass. However, it is unlikely that this gain was sufficiently high, to provide for reserves, for producing a normal sized infant.

Weight gain based on race, education and employment is shown on Table II. Mean total weight gained by blacks was found to be significantly lower, compared to that of whites ( $p < 0.05$ ). Similar findings were reported by Kennedy et al., (1982) in their study of WIC participants, in Massachusetts. When mean weight gain was analyzed by race for each age group, significantly lower mean weight gain was observed among the older black teens (age group II and age group III). As Table II shows, no significant weight gain trend was observed, when subjects were grouped by education or employment status.

Table III shows the effect of risk variables on maternal nutritional performance. Marginally higher mean weight gain was apparent in subjects who were not anemic, and, in subjects at higher parity. However, neither of these associations reached statistical significance.

In the present study, mean weight gain in teenagers who smoked heavily (>10 cigarettes) was marginally higher than subjects who did not (Table III), but this was statistically insignificant. Metcuff et al., (1985) reported no significant reduction in mean weight gain, in their study of

**Table II:** Weight gain, gestational age and infant birth weight, as a function of maternal race, education and employment status<sup>1</sup>

Demographic Variable	n	Weight Gain (kg)	Gestational Age (weeks)	Birth Weight (gm)
<b><u>RACE</u></b>				
White	35	15.78 ± 0.68 <sup>a</sup>	38.86 ± 0.36 <sup>a</sup>	3223.83 ± 76.5 <sup>a</sup>
Black	65	13.29 ± 0.66 <sup>b</sup>	39.25 ± 0.22 <sup>a</sup>	3196.48 ± 54.0 <sup>a</sup>
<b><u>EDUCATION</u></b>				
Less than 9 yrs	8	12.30 ± 1.54 <sup>a</sup>	38.13 ± 0.88 <sup>a</sup>	3093.75 ± 157.0 <sup>a</sup>
9 years or more	92	14.32 ± 0.53 <sup>a</sup>	39.20 ± 0.19 <sup>a</sup>	3215.82 ± 45.9 <sup>a</sup>
<b><u>EMPLOYMENT</u></b>				
In School	43	14.59 ± 0.78 <sup>a</sup>	39.02 ± 0.29 <sup>a</sup>	3278.93 ± 66.2 <sup>a</sup>
Employed	12	14.08 ± 1.41 <sup>a</sup>	38.98 ± 0.45 <sup>a</sup>	3233.08 ± 103.7 <sup>a</sup>
Neither	45	13.77 ± 0.76 <sup>a</sup>	39.92 ± 0.31 <sup>a</sup>	3129.20 ± 68.5 <sup>a</sup>

<sup>1</sup>Values represent mean ± SEM

<sup>a</sup>means within a column followed by different superscripts for each variable are significantly different (p < 0.05)

**Table III:** Effect of maternal and nutritional risk variables on maternal weight gain, gestational duration and infant birth weight<sup>1</sup>

Risk Variable	n	Weight Gain (kg)	Gestational Age (weeks)	Birth Weight (gm)
<b><u>PARITY</u></b>				
One	69	14.29 ± 0.60 <sup>a*</sup>	39.29 ± 0.25 <sup>a</sup>	3197.70 ± 55.2 <sup>a</sup>
Two	28	14.44 ± 1.14 <sup>a</sup>	38.87 ± 0.35 <sup>a</sup>	3271.39 ± 86.2 <sup>a</sup>
Three	8	12.22 ± 1.34 <sup>a</sup>	38.25 ± 0.45 <sup>a</sup>	3090.25 ± 121.4 <sup>a</sup>
<b><u>WEIGHT STATUS</u></b>				
Underweight	14	14.64 ± 1.33 <sup>a</sup>	38.00 ± 0.25 <sup>a**</sup>	3109.93 ± 123.5 <sup>a</sup>
Normal	59	13.92 ± 0.58 <sup>a</sup>	39.05 ± 0.59 <sup>ab</sup>	3167.19 ± 60.2 <sup>a</sup>
Overweight	27	14.43 ± 1.22 <sup>a</sup>	39.80 ± 0.28 <sup>b</sup>	3340.81 ± 67.6 <sup>a</sup>
<b><u>ANEMIA</u></b>				
Presence	42	13.73 ± 0.84 <sup>a</sup>	39.19 ± 0.31 <sup>a</sup>	3231.24 ± 63.2 <sup>a</sup>
Absence	58	14.47 ± 0.62 <sup>a</sup>	39.05 ± 0.25 <sup>a</sup>	3187.81 ± 60.7 <sup>a</sup>
<b><u>SUBSTANCE ABUSE</u></b>				
None	75	14.29 ± 0.57 <sup>a</sup>	39.11 ± 0.57 <sup>a</sup>	3199.23 ± 50.2 <sup>a</sup>
Smoking	20	14.96 ± 1.15 <sup>a</sup>	39.20 ± 1.15 <sup>a</sup>	3290.35 ± 104.9 <sup>a</sup>
Alcohol	2	9.25 ± 3.85 <sup>a</sup>	39.50 ± 3.85 <sup>a</sup>	3189.50 ± 255.5 <sup>a</sup>
Drugs	3	8.93 ± 1.15 <sup>a</sup>	38.33 ± 1.15 <sup>a</sup>	2825.67 ± 192.3 <sup>a</sup>

<sup>1</sup>Values represent mean ± SEM

\* means within a column followed by different superscripts for each variable are significantly different (p &lt; 0.05)

\*\* p &lt; 0.01

WIC supplemented women who were smokers. Although participants in the present study reported smoking heavily at the time of enrollment, the lack of significant reduction in weight, may have been a result of a net positive effect of WIC on maternal weight gain. The mean weight gain of those subjects who reported exposure to alcohol and/or drugs, was considerably below recommended values. However, because of relatively small sample sizes, statistical significance was not evident.

As seen in Table III, underweight subjects in this study gained more weight, compared to subjects who were classified as normal or overweight. Pearson's Correlation Coefficient procedures applied to measure the strength of an association between prepregnant weight and weight gain in underweight subjects, suggested a strong positive relationship (0.53,  $p < 0.05$ ). Data available tend to suggest that underweight women may reduce their risk of adverse pregnancy outcome, by establishing higher weight gain, compared to normal weight gravidas, during the prenatal period (Gormican et al., 1980; Naeye, 1979). The results in this study are in accord with this concept, with low weight-for-height gravidas showing higher weight gain, to perhaps reach critical body mass to support good reproductive performance.

Duration of participation and weight gain: The subject's

length of participation was used to estimate the magnitude of effect on weight gain, mediated through WIC. Table IV shows the effect of components of nutrition education on maternal performance. Though increased duration of participation resulted in higher mean weight gains, particularly in subjects who were on the program for 7 months or more, the association was not significant at an alpha of 0.05. The mean weight gain for subjects in the other two duration categories (1-3 months, and 4-6 months) was at least 2.2 kg (4.8 lbs) less. Despite the lack of statistical significance, the magnitude of difference may, in fact, be indicative of the direction of WIC impact.

As Table IV indicates, no significant trend in mean weight gain was observed when subjects were classified by the weeks or trimester when they started receiving prenatal care.

**Frequency of individual contact and weight gain:** The number of nutrition counseling sessions received by each subject, was also used to assess the effect of nutrition education services on weight gain. Table IV indicates a linear trend, that was detected in mean weight gain and the number of individual sessions, but regression analysis revealed no significance. Analysis of covariance indicated that maternal risk variables, such as race, prepregnant weight, weight status and duration of participation in WIC, did not confound

**Table IV:** Influence of components of nutrition counseling on maternal weight gain, gestational age and infant birth weight<sup>1</sup>

Index of Counseling	n	Weight Gain (kg)	Gestational Age (weeks)	Birth Weight (gm)
<b>INITIATION OF PRENATAL CARE (WEEKS)</b>				
0 - 7	2	11.90 ± 5.60 <sup>a*</sup>	40.00 ± 2.00 <sup>a</sup>	3366.50 ± 375.5 <sup>a</sup>
8 - 14	49	14.94 ± 0.68 <sup>a</sup>	39.31 ± 0.26 <sup>a</sup>	3240.18 ± 66.1 <sup>a</sup>
15 - 21	25	13.84 ± 0.99 <sup>a</sup>	38.64 ± 0.48 <sup>a</sup>	3141.24 ± 85.8 <sup>a</sup>
22 - 27	14	13.04 ± 1.73 <sup>a</sup>	38.93 ± 0.36 <sup>a</sup>	3176.71 ± 99.8 <sup>a</sup>
28 - 34	9	13.86 ± 1.34 <sup>a</sup>	39.44 ± 0.60 <sup>a</sup>	3261.89 ± 159.9 <sup>a</sup>
35+	1	6.80	39.00	2741.00
<b>INITIATION OF PRENATAL CARE (TRIMESTER)</b>				
1	51	14.82 ± 0.67 <sup>a</sup>	39.33 ± 0.26 <sup>a</sup>	3245.14 ± 64.5 <sup>a</sup>
2	39	13.56 ± 0.87 <sup>a</sup>	38.27 ± 0.36 <sup>a</sup>	3153.97 ± 64.9 <sup>a</sup>
3	10	13.15 ± 1.39 <sup>a</sup>	39.70 ± 0.23 <sup>a</sup>	3209.80 ± 152.5 <sup>a</sup>
<b>DURATION OF PARTICIPATION (MONTHS)</b>				
1 - 3	10	13.04 ± 1.65 <sup>a</sup>	38.50 ± 0.50 <sup>a**</sup>	3197.00 ± 143.4 <sup>a</sup>
4 - 6	33	12.61 ± 0.79 <sup>a</sup>	38.27 ± 0.36 <sup>a</sup>	3109.33 ± 68.2 <sup>a</sup>
≥7	57	15.26 ± 0.67 <sup>a</sup>	39.70 ± 0.23 <sup>b</sup>	3263.63 ± 60.2 <sup>a</sup>
<b>FREQUENCY OF CONTACT WITH NUTRITIONIST</b>				
1	4	11.95 ± 2.78 <sup>a</sup>	38.00 ± 0.58 <sup>a*</sup>	3301.01 ± 69.2 <sup>a</sup>
2	29	13.70 ± 0.93 <sup>a</sup>	38.17 ± 0.32 <sup>ab</sup>	3199.86 ± 76.4 <sup>a</sup>
3	25	14.09 ± 0.91 <sup>a</sup>	39.92 ± 0.33 <sup>c</sup>	3304.24 ± 80.0 <sup>a</sup>
4	22	14.62 ± 1.36 <sup>a</sup>	39.14 ± 0.44 <sup>abc</sup>	3166.18 ± 118.1 <sup>a</sup>
5	20	14.86 ± 0.93 <sup>a</sup>	39.65 ± 0.44 <sup>bc</sup>	3117.15 ± 96.7 <sup>a</sup>

<sup>1</sup>Values represent mean ± SEM

\* means within a column followed by different superscripts for each variable are significantly different (p &lt; 0.05)

\*\* p &lt; 0.001

the effect of counseling services on weight gain.

Incidence of low weight gain:

Twenty-eight percent (n=28) of the subjects in this study failed to gain at least 24 lbs or 11 kg, that is recommended for adult pregnant women, and were therefore, considered to be probably at an increased risk for poor pregnancy outcome. Twenty-six out of the twenty-eight subjects (92.8%) who had gained less than 11 kg, were blacks. When subjects who gained insufficiently were stratified into age groups, incidence of low weight gain was not found to be related to age at delivery.

Weight gain was classified into three categories, to determine it's impact on gestational age and birth weight of the infant. (Group I: less than 11 kg; Group II: 11-14.4 kg; Group III: greater than 14.4 kg). As Table V indicates, weight gain was found to be a strong predictor of birth weight of infants. Group I, the low weight gain group, delivered babies who weighed significantly lower ( $p < 0.01$ ) than those born to Group II and Group III. The mean birth weight of infants born to Group I was 222.7 gm lower than that of Group II, and 246.9 gm lower than that of Group III. However, low weight gain was also associated with lower mean gestational age ( $p < 0.05$ ). Therefore, an analysis of covariance was performed, to evaluate the effect of weight

**Table V:** Relationship of total weight gain during pregnancy to infant size, gestational age and birth weight<sup>1</sup>

Group	Pregnancy Weight Gain (kg)	n	Gestational Age (weeks)	Infant Weight (gm)
I	<11	26	38.39 ± 0.38 <sup>a*</sup>	2936.14 ± 86.8 <sup>a**</sup>
II	11 - 14.4	19	39.42 ± 0.32 <sup>b</sup>	3185.81 ± 59.2 <sup>b</sup>
III	>14.4	20	39.37 ± 0.29 <sup>b</sup>	3405.68 ± 62.8 <sup>c</sup>

<sup>1</sup>Values represent mean ± SEM

\* means within a column followed by different superscripts indicate significant difference between groups (p < 0.05)

\*\* p < 0.01

gain on birth weight, after eliminating the effects of gestational age, along with other confounding factors, such as race, prepregnant weight and weight status. The results indicated that weight gain continued to exert a significant influence on birth weight at  $p < 0.01$ ; this confirms earlier reports on this relationship (Abrams & Laros, 1986).

In an effort to study the effect of WIC program participation on the incidence of low weight gain, the relationship between maternal weight gain and the trimester when participation was initiated, was investigated. The findings reveal that, fifty percent of the subjects who started receiving benefits of the WIC program in the third trimester, failed to gain the recommended minimum of 24 lbs. This is significantly higher ( $p < 0.05$ ) than the incidence of low weight gain amongst subjects who initiated prenatal care in the first trimester (19.6%). This indirectly demonstrates the influence of differing lengths of participation on maternal weight gain during the antepartum period. The significant decline in the rate of inadequate weight gain with increasing duration of participation is possibly a function of longer term prenatal care measures, including contacts with the nutritionist, that the mother is exposed to. The incidence of low weight gain in subjects who received three or more individual sessions with the nutritionist was nearly 6% lower than in subjects who had

fewer counseling sessions.

(ii) PATTERN OF WEIGHT GAIN:

In the literature there is general agreement that the normal curve of weight gain is sigmoid in shape (Hytten & Leitch, 1971), there being little gain during the first trimester, a rapid increase during the second (0.8 to 1.0 lb/week), and some slowing in the rate of increase during the third (0.85 lb/week). It is evident that most of the weight that is gained is attributable to the products of conception. Therefore, an insufficient rate of weight gain has been associated with a higher overall incidence of prematurity, low birth weight and other complications.

Data on weekly weight gain, recorded in subjects' WIC files during the second and third trimester of pregnancy, was divided into three categories, for purpose of analysis - Trimester IIa (14th to 18th week); Trimester IIb (19th to 26th week); and Trimester III (27+ weeks).

Table VI lists mean weekly weight gain estimated on 36, 71, and 97 subjects during trimester IIa, trimester IIb, and trimester III respectively. Figure I shows comparison of values in this study to recommended standards. Mean weekly gain during trimester IIa, was higher than recommended but did not reach statistical significance. During trimester IIb and trimester III, rate of weight gain was significantly

**Table VI:** Comparison of weekly weight gain, with recommended values

Trimester (weeks)	n	Weekly Gain <sup>1</sup> (lbs)	Recommended Weekly Gain <sup>2</sup> (lbs)	PR >  T
Trimester IIa (14th - 18th week)	36	0.94 ± 0.09	0.80	0.1340
Trimester IIb (19th - 26th week)	71	1.27 ± 0.06	1.00	0.0001*
Trimester III (27+ weeks)	97	1.09 ± 0.05	0.85	0.0001*

<sup>1</sup>Values represent mean ± SEM

<sup>2</sup>From Hytten and Leitch, 1971.

\* Significant at p < 0.0001

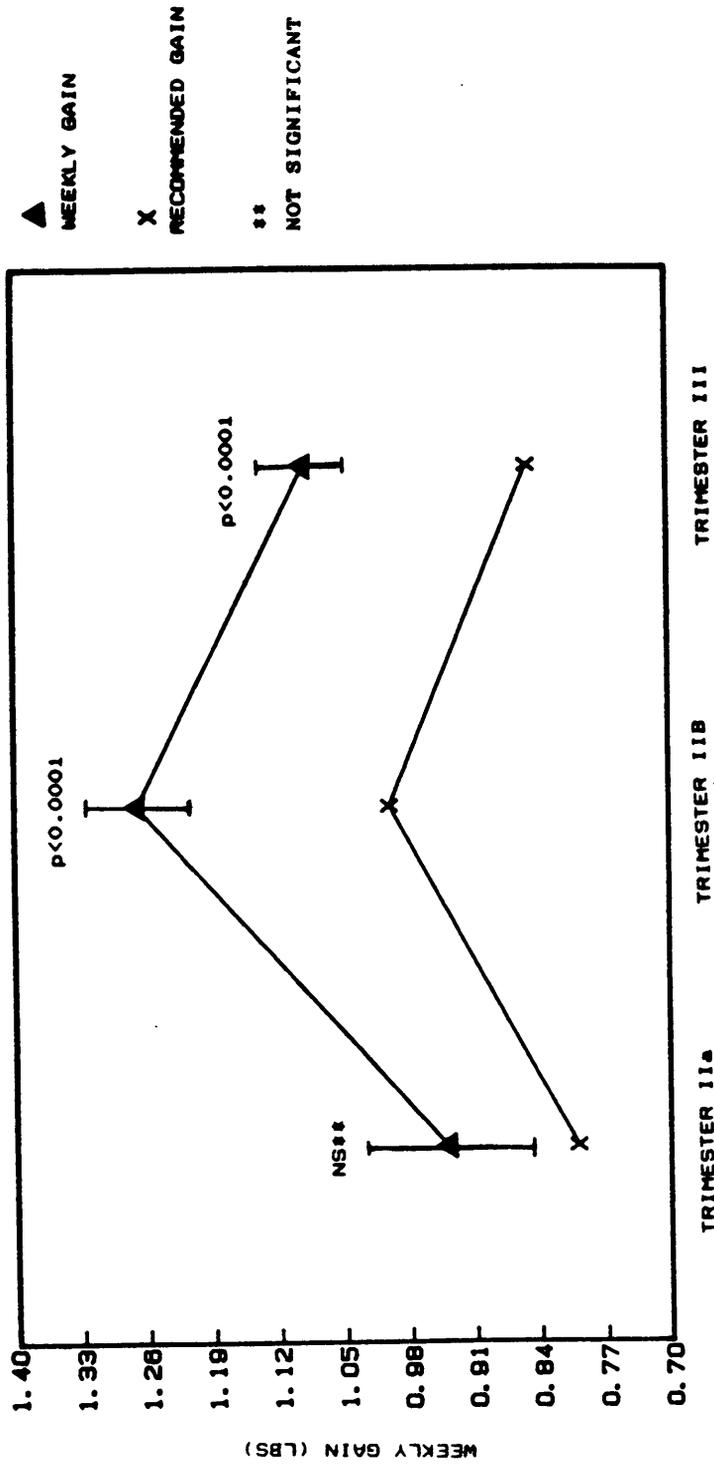


Figure I : Weekly weight gain compared with recommended weekly gain for each trimester period\*.

\* Trimester IIA: 14-18th week; IIB: 19-26th week; III: 27+ week;

higher than recommended values ( $p < 0.0001$ ). This is in accord with recommendations for additional weight increments in adolescents, to support adolescent growth, as well as a normal pregnancy.

When subjects were classified by age groups, mean weekly weight gain was observed to be higher for the younger teens, during all three trimester periods, as indicated by Table VII. However, an analysis of variance revealed significant difference, only at an alpha of 0.10, between age group I and age group III, during the late second trimester.

Table VII also gives a breakdown of maternal weekly weight gain by ethnic groups. The black women in this study had a lower mean weekly weight gain compared to the white women. However, a t test indicated that the values were not significantly different at the 5% level. It is obvious, that the small incremental difference in weekly weight gain had a cumulative impact on total weight gain, between the races, with blacks ultimately gaining significantly less weight than whites ( $p < 0.05$ ).

Table VIII lists mean weekly weight gain, by maternal risk variables. Primiparous mothers showed higher mean weekly weight gain, compared to multiparous mothers, specifically during the third trimester, but this was not statistically significant.

It is evident from Table VIII that underweight teenagers

**Table VII:** Weekly weight gain<sup>1</sup> as a function of maternal age and race

Maternal Variable	Weekly Weight Gain <sup>2</sup>					
	n	Trimester IIa (lbs)	n	Trimester IIb (lbs)	n	Trimester III (lbs)
<u>AGE GROUP</u>						
13 - 15	6	1.27 ± 0.19 <sup>a</sup>	14	1.46 ± 0.14 <sup>a</sup>	20	1.20 ± 0.12 <sup>a</sup>
16 - 17	14	0.87 ± 0.17 <sup>a</sup>	29	1.26 ± 0.09 <sup>a</sup>	36	1.07 ± 0.07 <sup>a</sup>
18 - 19	16	0.87 ± 0.11 <sup>a</sup>	28	1.18 ± 0.09 <sup>a</sup>	41	1.06 ± 0.07 <sup>a</sup>
<u>RACE</u>						
White	19	1.00 ± 0.13 <sup>a</sup>	29	1.38 ± 0.09 <sup>a</sup>	35	1.20 ± 0.07 <sup>a</sup>
Black	17	0.86 ± 0.13 <sup>a</sup>	42	1.19 ± 0.08 <sup>a</sup>	62	1.03 ± 0.06 <sup>a</sup>

<sup>1</sup>Values represent mean ± SEM

<sup>2</sup>Trimester IIa: 14th-18th week; IIb: 19th-26th week, III: 27+ weeks

<sup>a</sup>means within a column followed by different superscripts for each variable are significantly different ( $p < 0.05$ )

**Table VIII:** Effect of maternal and nutritional risk variables on weekly weight gain<sup>1</sup> during each trimester period<sup>2</sup>

Risk Variable	Weekly Weight Gain					
	n	Trimester IIa (lbs)	n	Trimester IIb (lbs)	n	Trimester III (lbs)
<b><u>PARITY</u></b>						
One	29	0.95 ± 0.11 <sup>a</sup>	54	1.29 ± 0.07 <sup>a</sup>	68	1.13 ± 0.06 <sup>a</sup>
Two	6	0.86 ± 0.13 <sup>a</sup>	13	1.14 ± 0.13 <sup>a</sup>	22	1.04 ± 0.09 <sup>a</sup>
Three	1	0.95	4	1.41 ± 0.28 <sup>a</sup>	7	0.93 ± 0.07 <sup>a</sup>
<b><u>WEIGHT STATUS</u></b>						
Underweight	21	0.97 ± 0.12 <sup>a</sup>	39	1.39 ± 0.08 <sup>a</sup>	57	1.05 ± 0.06 <sup>a</sup>
Normal	5	0.74 ± 0.17 <sup>a</sup>	10	1.23 ± 0.14 <sup>a</sup>	14	1.18 ± 0.09 <sup>a</sup>
Overweight	10	0.97 ± 0.20 <sup>a</sup>	22	1.06 ± 0.09 <sup>a</sup>	26	1.13 ± 0.10 <sup>a</sup>
<b><u>ANEMIA</u></b>						
Presence	10	1.18 ± 0.17 <sup>a</sup>	27	1.33 ± 0.09 <sup>a</sup>	41	1.08 ± 0.08 <sup>a</sup>
Absence	26	0.85 ± 0.10 <sup>a</sup>	44	1.23 ± 0.08 <sup>a</sup>	56	1.10 ± 0.05 <sup>a</sup>
<b><u>SUBSTANCE ABUSE</u></b>						
None	26	0.90 ± 0.11 <sup>a</sup>	49	1.29 ± 0.07 <sup>a</sup>	72	1.10 ± 0.06 <sup>a</sup>
Smoking	9	1.10 ± 0.16 <sup>a</sup>	18	1.25 ± 0.12 <sup>a</sup>	20	1.09 ± 0.08 <sup>a</sup>
Alcohol/Drugs	1	0.35	4	1.06 ± 0.28 <sup>a</sup>	5	1.06 ± 0.24 <sup>a</sup>

<sup>1</sup>Values represent mean ± SEM

<sup>2</sup>Trimester IIa: 14th-18th week; IIb: 19th-26th week, III: 27+ weeks

<sup>a</sup>means within a column followed by different superscripts for each variable are significantly different (p < 0.05)

in this study, appeared to gain lower amounts than recommended, during trimester IIa. However, rate of weight gain showed a substantial increase, as these women progressed into the final trimester of pregnancy. These underweight mothers seemed to make up for their initial weight deficit, and thus, reduce the risk of poor pregnancy outcome. The overweight teenagers showed higher than recommended rate of increase in weight, during the early second trimester, but the rate slowed down, during the latter half of the second trimester. Pearson's Correlation Coefficient Procedures confirmed a negative association (-0.2892) between prepregnant weight and rate of gain, during the second trimester ( $p < 0.01$ ).

Table VIII also indicates that presence of anemia did not show any significant effect on the rate of weight gain. Subjects who reported smoking excessively, or reported excessive consumption of alcohol or drugs, showed a lower rate of weight gain in the second trimester, compared to subjects who did not report exposure to behavioral risk factors. However, sample sizes were too small to reveal statistical significance. Improvements in the rate of gain was observed in mothers reporting substance abuse, as they entered their third trimester of pregnancy. As mentioned earlier, this trend may be indicative of the net positive influence of prenatal care measures, experienced by the

mothers.

Pattern of weight gain and duration of participation: Table IX shows mean maternal weight gain for differing lengths of participation. Pattern and rate of weight gain did not vary significantly, when subjects were analyzed by trimester when prenatal care began. Nor was any significant duration trend seen for mean weekly weight gain, by months of participation, although duration of seven months or more appeared to be associated with a more appropriate pattern of gain.

Pattern of weight gain and nutritional counseling: Frequency of nutritional counseling sessions was associated with difference in the rate of weight gain ( $p < 0.05$ ) during the late second trimester. Table IX indicates that during trimester IIb, subjects who had received two sessions of counseling, appeared to gain inappropriately (in excess of recommended values) higher than those who received three or more individual contacts. This trend reversed during the final trimester, and Pearson's Correlation Coefficient revealed a weak (0.2025), but positive association between rate of weight gain and individual contact with the nutritionist ( $p < 0.05$ ). It appears that the nutritionists helped establish a relatively stable pattern of weight gain, with three or more counseling sessions. A larger number of contacts may have helped nutritionists effect appropriate

**Table IX:** Influence of components of nutrition counseling on weekly weight gain<sup>1</sup> during each trimester period<sup>2</sup>

Index of Counseling	Weekly Weight Gain									
	n	Trimester IIa (lbs)		n	Trimester IIb (lbs)		n	Trimester III (lbs)		
<b>INITIATION OF PRENATAL CARE (TRIMESTER)</b>										
1	33	0.92	± 0.10 <sup>a</sup>	50	1.23	± 0.07 <sup>a</sup>	51	1.13	± 0.07 <sup>a</sup>	
2	3	1.10	± 0.21 <sup>a</sup>	21	1.37	± 0.12 <sup>a</sup>	39	1.06	± 0.08 <sup>a</sup>	
3	-	-		-	-		7	1.01	± 0.11 <sup>a</sup>	
<b>DURATION OF PARTICIPATION (MONTHS)</b>										
1 - 3	-	-		-	-		8	1.08	± 0.13 <sup>a</sup>	
4 - 6	3	1.30	± 0.52 <sup>a</sup>	17	1.34	± 0.15 <sup>a</sup>	32	0.98	± 0.47 <sup>a</sup>	
7+	33	0.90	± 0.09 <sup>a</sup>	54	1.25	± 0.06 <sup>a</sup>	57	1.16	± 0.06 <sup>a</sup>	
<b>FREQUENCY OF CONTACT WITH NUTRITIONIST</b>										
1	-	-		-	-		3	0.77	± 0.14 <sup>a</sup>	
2	8	0.96	± 0.34 <sup>a</sup>	16	1.54	± 0.15 <sup>a</sup>	29	1.03	± 0.08 <sup>a</sup>	
3	10	0.78	± 0.26 <sup>a</sup>	17	1.11	± 0.10 <sup>b</sup>	23	1.02	± 0.08 <sup>a</sup>	
4	9	1.13	± 0.41 <sup>a</sup>	19	1.25	± 0.12 <sup>ab</sup>	22	1.18	± 0.11 <sup>a</sup>	
5	9	0.89	± 0.18 <sup>a</sup>	19	1.20	± 0.08 <sup>ab</sup>	20	1.22	± 0.10 <sup>a</sup>	

<sup>1</sup>Values represent mean ± SEM<sup>2</sup>Trimester IIa: 14th-18th week; IIb: 19th-26th week, III: 27+ weeks<sup>a</sup>means within a column followed by different superscripts for each variable are significantly different (p < 0.05)

dietary changes for underweight or overweight gravidas, to encourage additional or curtail excessive weight gain as needed.

Incidence of inadequate weekly weight gain:

Available information revealed that 50% of subjects failed to gain adequately, during trimester IIa, however, the number decreased to 30% when the subjects reached the final trimester. Analysis of inadequate weekly weight gain, by race, revealed that a remarkably high proportion of blacks (73.3%) fell in this category.

Information on rate of weight gain for all three trimester periods, was available on 36 subjects. Analysis of this data revealed that 11.1% (n=4) of these subjects failed to gain at the recommended rate, during the three trimester periods. There were more blacks than whites who failed to gain at the recommended rate. As Table X indicates, the mean total weight gain in these subjects was predictably lower ( $p < 0.03$ ). No significant difference in mean gestational age was observed, however, mean birth weight of infants born to this group of subjects was significantly lower ( $p < 0.006$ ).

Seventy-one subjects, on whom information on rate of weight gain was available during the late second trimester and the third trimester (IIb, and III respectively), were

**Table X** Comparison of maternal performance and pregnancy outcome parameters, for subjects with adequate, and inadequate rate of weekly gain<sup>1</sup>, based on trimester period<sup>2</sup>

Parameter	Trimester Period IIa, IIb, III		Trimester Period IIb, III	
	Adequate (n=32)	Inadequate (n=4)	Adequate (n=60)	Inadequate (n=11)
Weight Gain (kg)	16.06 ± 0.84	10.43 ± 1.22 <sup>a</sup>	15.59 ± 0.66	10.66 ± 1.10 <sup>b</sup>
Gestational Age (weeks)	39.28 ± 0.30	38.50 ± 1.50	39.28 ± 0.24	38.55 ± 0.70
Infant Birth Weight (gm)	3325.66 ± 70.5	2709.00 ± 193.4 <sup>c</sup>	3248.20 ± 55.8	2965.64 ± 135.5 <sup>d</sup>

<sup>1</sup>Values represent mean ± SEM

<sup>2</sup>Trimester IIa: 14th-18th weeks; IIb: 19th-26th; III: 27+ weeks

<sup>a</sup>Difference between groups, for each trimester period significant at p<0.03

<sup>b</sup>p<0.006; <sup>c</sup>p<0.005; <sup>d</sup>p<0.06.

analyzed, to study their nutritional performance and fetal outcome. As many as 15.5% (n=11) of these subjects failed to gain at the recommended rate. T tests revealed significantly lower mean weight gain during the antepartum period as seen in Table X. The mean birth weight of infants born to these mothers was also significantly lower ( $p < 0.06$ ).

Since the total weight gained was found to be a function of rate of gain during the three trimester periods, the indirect effect of duration of participation, on the rate of weight gain is evident. Analysis of the other components of nutrition counseling services, in relation to inadequate rate of weight gain, indicated that weeks or trimester when prenatal care began, was not significantly associated with rate of weight gain. Although a direct association was not found, frequency of individual contact with the nutritionist may have been instrumental in effecting adequate weight gain, as a result of its association with the pattern and rate of weekly gain.

(iii) DIETARY ADEQUACY:

The effect of counseling services was evaluated by assessing intake of calories, protein, calcium and iron, before and after individual contact with the WIC nutritionist. These values were then compared with Recommended Dietary Allowances (RDA) adjusted for pregnant

adolescents (Mahan & Rees, 1984). Analysis was conducted on 71 subjects, on whom dietary intake data was available. All the subjects were receiving nutritional supplementation through WIC, for an average of 5.7 months. Forty-five percent (n=31) of these subjects were enrolled in school, and it is assumed that they were eligible to receive free school lunches. Data were also examined on a subpopulation of teenagers who were 14 years of age or under, (age group I), and who had higher caloric and protein requirements compared to teens, who were 15 years or older (age group II). In addition, the analysis also tested the effect of inadequate diet on weight gain and fetal outcome.

Table XI shows mean caloric and nutrient intake of 71 subjects, computed from 24 hour recalls, before and after counseling services were provided. Paired t tests on this data indicated highly significant changes in intakes of calories, protein, calcium and iron. The direction of this change was positive, with improvements noted in all four indicator nutrients, mentioned above.

Mean dietary intake of subjects, by age group is shown in Table XII. The mean daily intake of energy and other nutrients, for each age group, was compared with the RDA for pregnant adolescents, and the results are shown in Table XIII. Analysis of mean dietary intake by age subgroups revealed that in age group I (n=8), the intake of calories,

**Table XI:** Energy and nutrient composition of diets before and after nutrition counseling services

Nutrient	Intake <sup>1</sup>		PR >  T
	Before	After	
Energy (kcal)	1962.00 ± 73.50	2525.00 ± 60.85	0.0001*
Protein (gm)	91.17 ± 3.82	110.87 ± 3.11	0.0001*
Calcium (mg)	893.94 ± 51.98	1113.94 ± 44.54	0.0015*
Iron (mg)	13.29 ± 0.64	16.93 ± 0.73	0.0001*

<sup>1</sup>Values represent mean ± SEM

\*Significant at p < 0.002.

**Table XII:** Dietary intake of energy and nutrients, before and after counseling, for each age group<sup>2</sup>

Nutrient	Age Group I (n=8)		Age Group II (n=63)	
	Before	After	Before	After
Energy (kcal)	1999.0 ± 180.9	2541.63 ± 582.8 *	1957.0 ± 80.0	2524.0 ± 64.0**
Protein (gm)	97.75 ± 11.5	107.13 ± 9.9	90.3 ± 4.1	111.4 ± 3.3**
Calcium (mg)	1009.75 ± 169.8	899.75 ± 126.2	879.2 ± 54.7	1141.1 ± 46.8**
Iron (mg)	15.13 ± 1.8	15.63 ± 2.9	13.1 ± 0.7	17.1 ± 0.7**

<sup>1</sup>Values represent mean ± SEM

<sup>2</sup>Age group I - 14 years of age or less; Age group II - 15 - 19 years of age

\* Difference significant at p<0.07

\*\* Difference significant at p<0.0005

**Table XIII:** Comparison of daily intake of energy and nutrients with RDA<sup>1</sup>, before and after counseling, classified by age group<sup>2</sup>

Nutrient	RDA <sup>3</sup> units/cm	Comparison with RDA	
		Before	After
<b><u>AGE GROUP I (n=8)</u></b>			
Energy (kcal)	2550 (15.9/cm)	-550.3 ± 181.0 <sup>a</sup>	-8.4 ± 206.0
Protein (gm)	77 (0.48/cm)	+20.8 ± 11.5	+30.7 ± 9.9
Calcium (mg)	1600 (9.8/cm)	-590.1 ± 169.8 <sup>a</sup>	-700.3 ± 126.2 <sup>b</sup>
Iron (mg)	18 <sup>*</sup>	-2.9 ± 2.0	-2.4 ± 2.9
<b><u>AGE GROUP II (n=63)</u></b>			
Energy (kcal)	2350 (14.7/cm)	-392.8 ± 80.0 <sup>c</sup>	+173.8 ± 64.1
Protein (gm)	76 (0.47/cm)	+20.8 ± 11.5	+30.1 ± 9.9
Calcium (mg)	1600 (9.8/cm)	-720.8 ± 54.7 <sup>c</sup>	-458.9 ± 46.8 <sup>b</sup>
Iron (gm)	18 <sup>*</sup>	-4.9 ± 0.6 <sup>c</sup>	-0.9 ± 0.7

<sup>1</sup>RDA for non pregnant adolescents modified for pregnancy, age and height (Mahan and Rees, 1984)

<sup>2</sup>Age group I - 14 years of age or less; Age group II - 15 - 19 years of age

<sup>3</sup>Based on mean height of 161.1 ± 6.5 cm, for both age groups

<sup>a</sup>Significantly lower compared to RDA, p < 0.02; <sup>b</sup>p < 0.0009; <sup>c</sup>p < 0.0001

\* 30-60 mg supplemental iron recommended, in addition to dietary iron

before and after counseling showed a significant change. Mean caloric intake prior to counseling, when compared to the RDA for 11-14 year old pregnant adolescents, indicated a caloric deficit of approximately 550 kcal, and, consuming only 78% of RDA. Figure II illustrates the intake of energy, in terms of the percentage of the RDA, for both age groups. The subsequent recall dietary revealed that mean intake was comparable with the RDA (99.7%). A similar trend was noted among individuals in age group II (n=63) with caloric intake constituting only 83% of the RDA, before counseling. Mean caloric intake exceeded the RDA, by 7.5%, after counseling. The mean intake of calories in this group of subjects, after counseling, was higher than that reported in other studies on dietary intake of pregnant adolescents (Endres, 1987). However, Loris et al., (1985), and Hansen et al., (1976) have reported mean intakes to be as high as 2,600 to 2,800 kcal. The higher values in this study, may have resulted from the adolescent participation in nutrition education, in addition to receiving supplemental foods through WIC. Improved dietary intake was also reported by Farrior & Ruwe (1987), in their study on 217 pregnant WIC participants, in North Carolina, after nutrition counseling was offered to these subjects.

Protein intake was higher than the RDA, for both the age groups, before counseling as evident from Table XIII. Figure

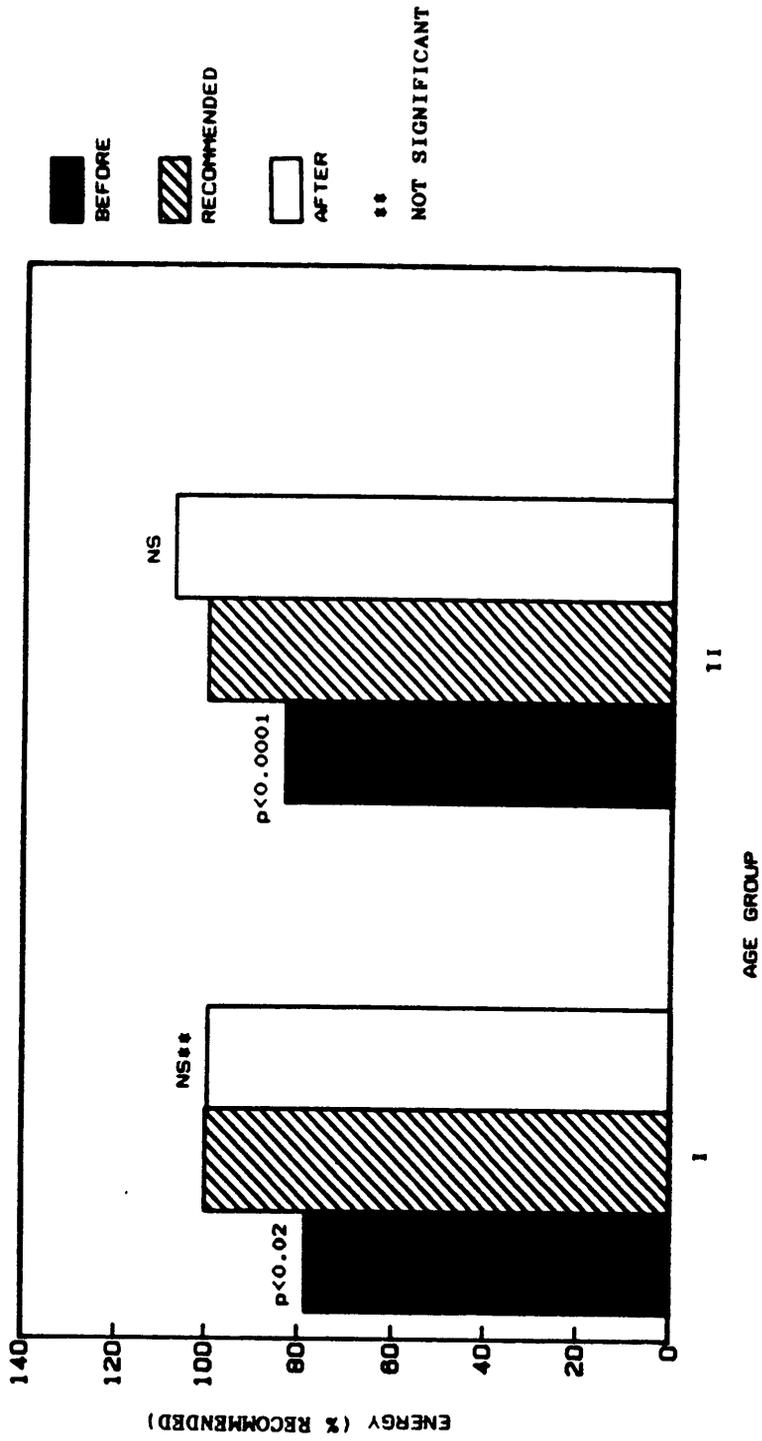


Figure II : Percent of recommended energy intake consumed by pregnant adolescents based on age group\*.

\* Age group I: 11-14 years; II: 15-19 years;

III shows that after counseling, intake increased from 127% to 139% of the RDA, in age group I, and from 119% to 146.5% of the RDA in age group II. This is consistent with findings in other studies, where protein intake in pregnant teenagers has been in excess of the RDA (Loris et al., 1985; Farrior & Ruwe, 1987).

Calcium intake for both age groups revealed serious deficits, as indicated by Table XIII even after nutrition counseling was provided to the participating subjects. Calcium intake in the younger teens dropped from 63% of the RDA before counseling, to 56% of the RDA, after contact with the nutritionist. As seen in Figure IV, a reverse trend, was observed in older teens, in that their calcium intake increased from 55% to 71% of the RDA. Previous investigators have also found inadequate intake of calcium to be common among prenataals. (Endres, 1987; Farrior & Ruwe, 1987). But the trend seen among the younger teens in this study is alarming, even though the sample size is too small to draw any definite conclusion.

Table XIII shows intakes of iron to be less than the RDA for both age groups before counseling. For age group I, however, iron intake remained at 84% of the RDA, both before and after counseling, implying no effect of counseling. However, subjects in age group II increased their iron intake from 73% to 95% of the RDA as illustrated by Figure V. Iron

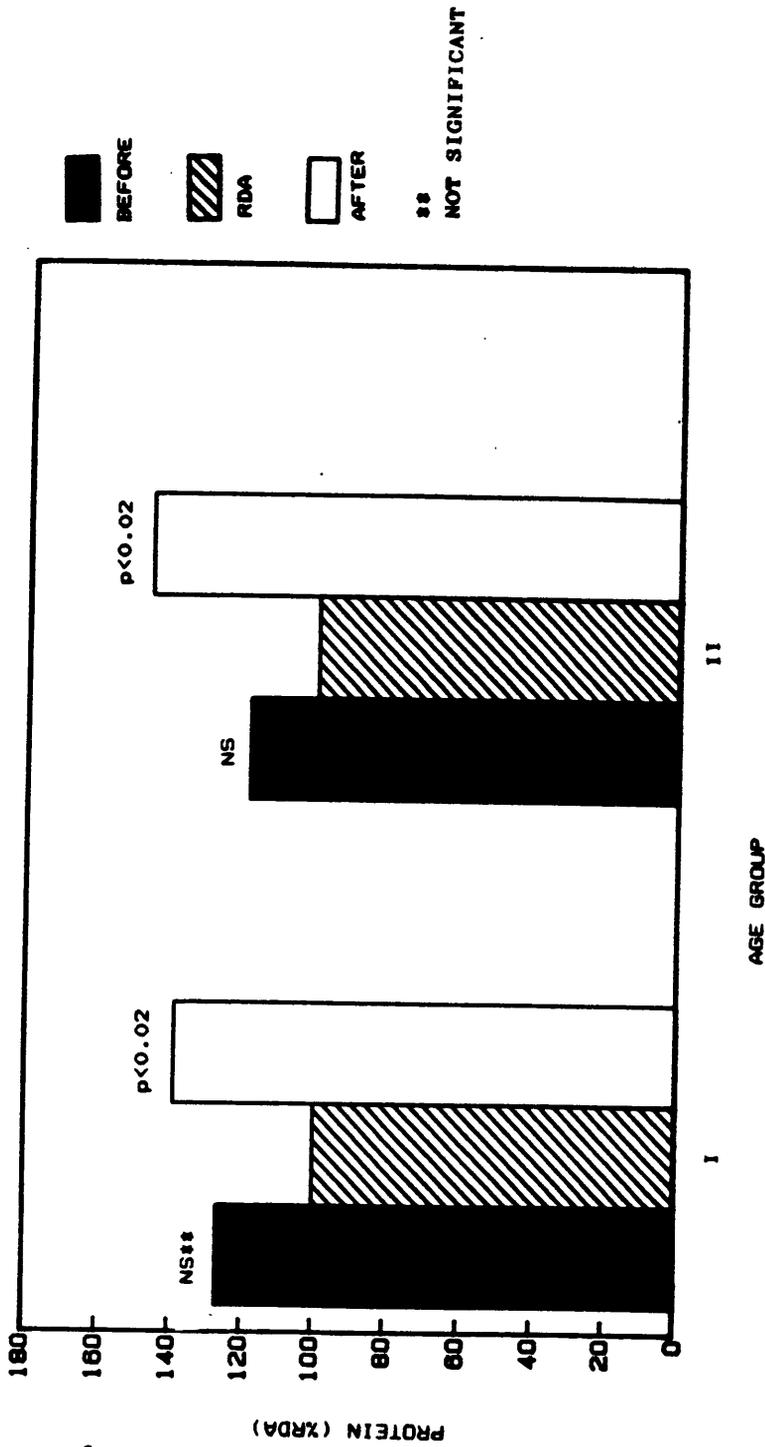


Figure III : Percent of RDA for protein consumed by pregnant adolescents based on age group\*.

\* Age group I: 11-14 years; II: 15-19 years;

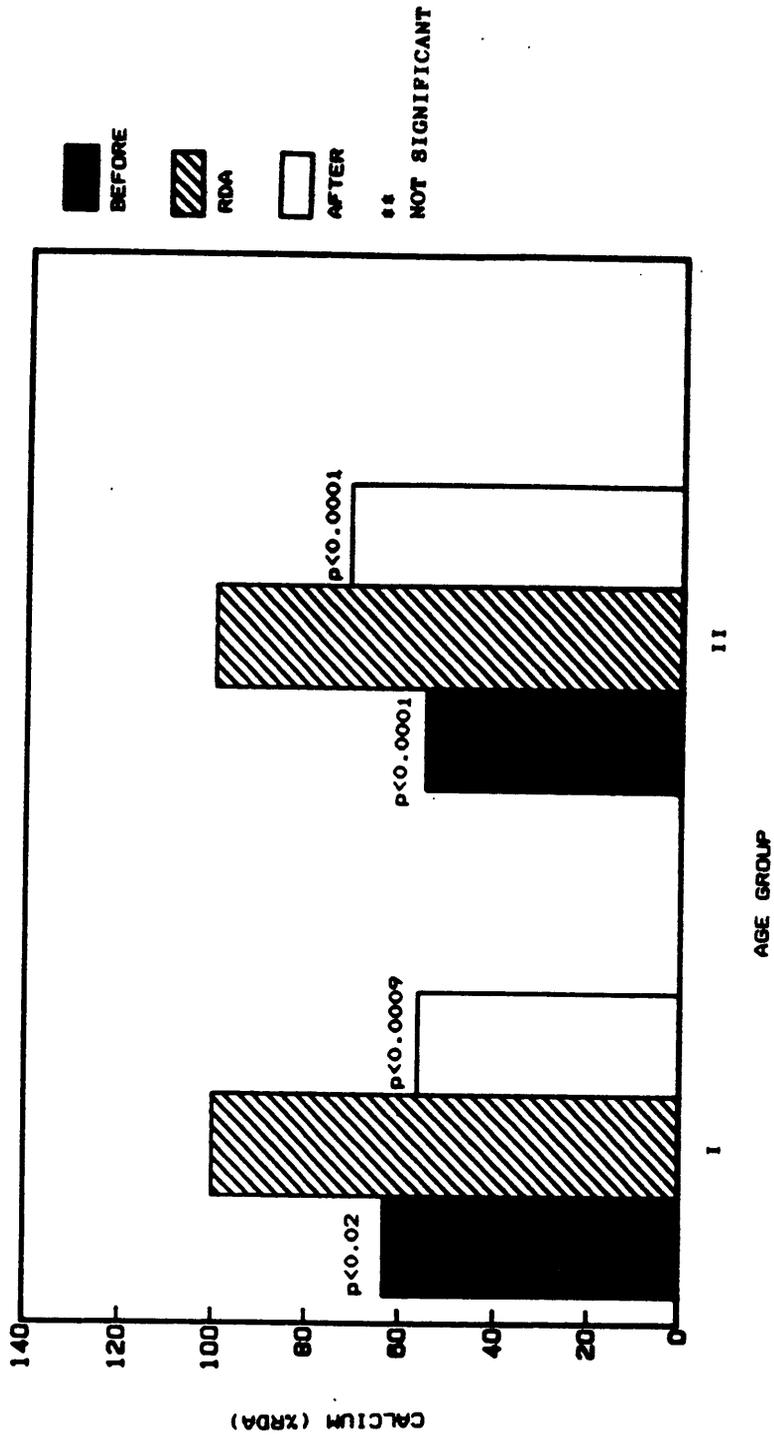


Figure IV : Percent of RDA for calcium consumed by pregnant adolescents based on age group\*.

\* Age group I: 11-14 years; II: 15-19 years;

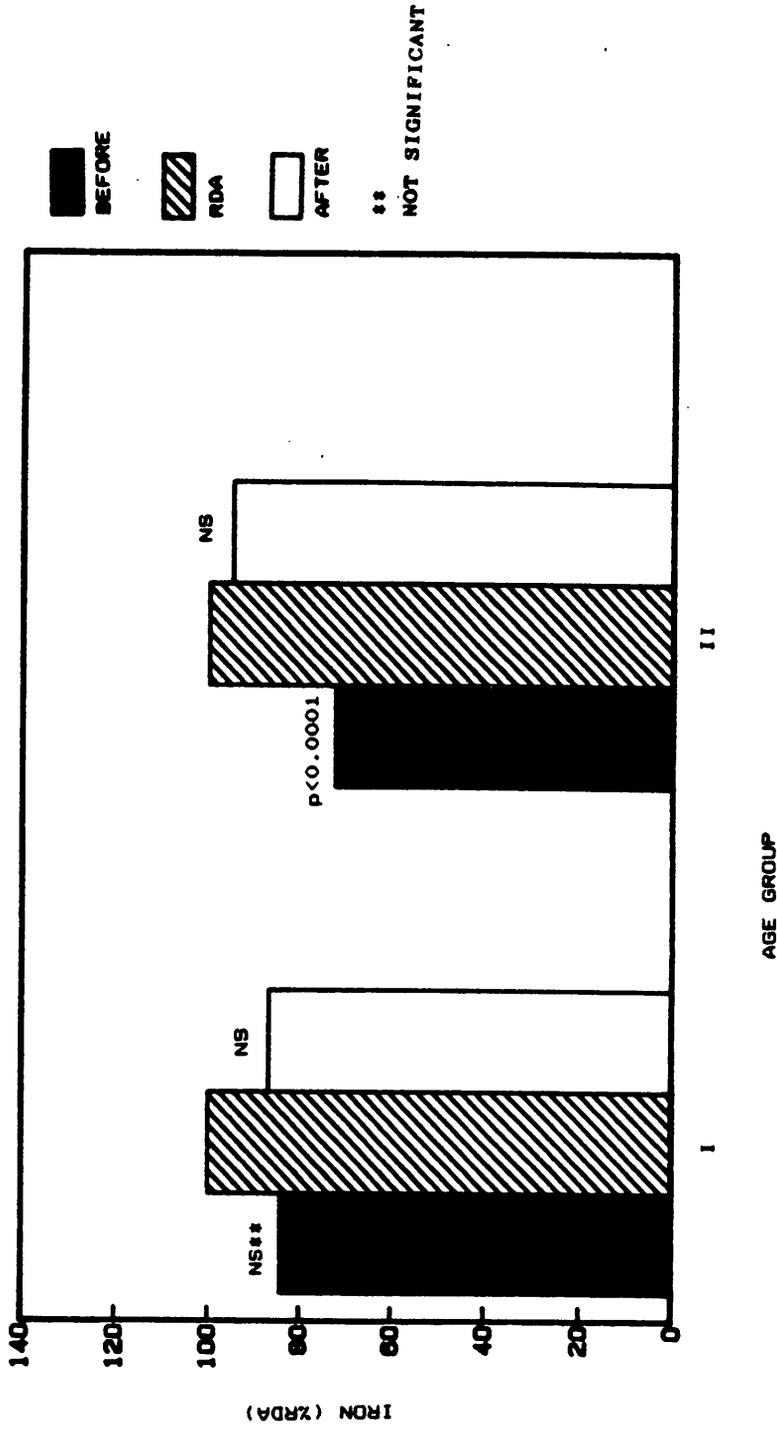


Figure V : Percent of RDA for iron consumed by pregnant adolescents based on age group\*.

\* Age group I: 11-14 years; II: 15-19 years;

intake has been found to be deficient by several investigators, and has been reported to be in the range of 55% to 92% of the RDA (Loris et al., 1985; Edozien et al., 1979). The positive change in this study, particularly among the older teens, may be viewed as a consequence of counseling. It is assumed that most subjects in this study were using 30 to 60 mg of iron supplements to provide for both the mother and fetus.

Overall, the younger teens (age group I) demonstrated more dietary deficits, compared to the perhaps more motivated, older teens (age group II). The younger teens may have been influenced by the inappropriate food related behaviors of their peers, and, therefore, were unresponsive to suggestions from the nutritionist about food choices. Alternative approaches to nutritional guidance, blending traditional principles of nutritional needs with current teenage dietary pattern, may be beneficial with this high risk age group.

The mean percentages of calories consumed from carbohydrates, protein and fat were 41.9, 19.1, and 39.0 respectively, before counseling. Mean percentage of calories consumed as carbohydrate increased significantly ( $p < 0.01$ ) to nearly 45%, while that consumed as protein decreased to 17.9%. Mean percentage of calories from fat did not show any significant change. These results concur with findings

reported by Loris et al., (1985).

Dietary intake and duration of participation: Mean intake of energy, protein, and iron did not show any significant association with duration of participation. Pearson's Correlation Coefficient procedure indicated that, duration of participation was found to be significantly related to the degree of change in calcium intake (0.2162,  $p < 0.08$ ), among the older age group. The weeks or trimester when prenatal care began, did not correlate with dietary adequacy.

Dietary adequacy and frequency of individual contact: Pearson's Correlation Coefficient procedure was performed, to test the relationship between individual contact with the WIC nutritionist, and dietary adequacy. This revealed a weak association between energy (0.2178,  $p < 0.09$ ), and protein (0.2165,  $p < 0.09$ ) intake of subjects, and frequency of counseling sessions. Calcium and iron intakes did not correlate with the number of individual sessions.

Incidence of Dietary Inadequacy:

The analysis of 24 hour recalls, obtained after counseling, showed that about 38% of the subjects in each age group, consumed less than the recommended caloric intake. The mean caloric intake was  $1910 \pm 370.2$  for age group I (78%

of RDA), and 2035+294.8 for age group II (86.8% of RDA). Nearly as many blacks, as whites, showed low energy intake. As can be seen in Table XIV, there was no significant difference in maternal weight gain in mothers, who consumed less than adequate calories, for both age groups. The lack of significance in age group I, was probably due to a relatively small sample size. Analysis of the older teens' maternal/nutritional risk characteristics, revealed that 45.8% of those who had low energy intake, were overweight. Judging by pregnancy outcome in these mothers, it seems that the low energy intake did not have a compromising effect on the birth weight of the infants. It is possible therefore, that the WIC nutritionists monitored dietary intake based on maternal prepregnant weight, and rate of weight gain, to help mothers attain optimal antepartum weight gain.

About 7% (n=5) of all subjects (both age groups included), showed less than adequate intake of protein. Mean intake of protein for this group was 60.0+9.2 gm (78% of RDA). More whites than blacks showed evidence of low protein intake. However no significant trend in weight gain or fetal outcome was observed, as seen in Table XIV, probably due to a small sample size.

Calcium intake was found to be deficient in almost 90% (n=64) of the subjects. Low calcium intake was evident in twice as many blacks, as whites. All subjects in age group

**Table XIV:** Maternal weight gain, gestational age and infant birth weight<sup>1</sup> based on adequacy of nutrient intake, for each age group

Age Group	Adequacy of Intake	n	Weight Gain (kg)	Gestational Age (weeks)	Birth Weight (gm)
<u>ENERGY</u>					
I	Inadequate	3	13.83 ± 4.07 <sup>a</sup>	38.33 ± 2.33 <sup>a</sup>	3121.00 ± 381.9 <sup>a</sup>
	Adequate	5	14.50 ± 3.52 <sup>a</sup>	38.60 ± 0.60 <sup>a</sup>	3141.00 ± 225.5 <sup>a</sup>
II	Inadequate	24	13.92 ± 1.15 <sup>a</sup>	39.08 ± 0.47 <sup>a</sup>	3147.38 ± 106.5 <sup>a</sup>
	Adequate	39	14.90 ± 0.81 <sup>a</sup>	39.31 ± 0.30 <sup>a</sup>	3167.46 ± 71.4 <sup>a</sup>
<u>PROTEIN</u>					
I	Inadequate	1	21.70	42.00	3813.00
	Adequate	7	13.19 ± 2.60 <sup>a</sup>	38.00 ± 0.79 <sup>a</sup>	3036.57 ± 180.3 <sup>a</sup>
II	Inadequate	4	14.28 ± 2.26 <sup>a</sup>	39.50 ± 1.55 <sup>a</sup>	3388.00 ± 162.3 <sup>a</sup>
	Adequate	59	14.54 ± 0.69 <sup>a</sup>	39.20 ± 0.26 <sup>a</sup>	3140.37 ± 62.3 <sup>a</sup>

<sup>1</sup>Values represent mean ± SEM

\* means within a column for each variable, followed by different superscripts are significantly different (p < 0.05)

I, and 88% of the older teens showed less than recommended intakes of calcium, after counseling. Sixty-six percent of subjects, from both age groups, showed deficits in iron intake. Nearly one and a half times as many blacks, compared to whites, showed inadequate intakes of iron. Neither of these nutrient deficiencies showed any significant effect on total weight gain, gestational age or birth weight.

### PREGNANCY OUTCOME

#### (i) GESTATIONAL AGE:

The mean gestational age of infants born to 100 teenagers in this study was 39.11 + 1.93 weeks. This compares well with mean gestational age of infants born to WIC supplemented mothers, investigated by Kennedy & Kotelchuck (1984), which was reported to be 39.23 weeks. Table I gives a breakdown of gestation duration by age groups. When gestational age was examined by stratified age groups, age group I (less than or equal to 15 years) had a lower mean gestational age, compared to the older age groups, but this was not statistically significant.

As evident from Table II gestational age did not differ significantly among the ethnic/racial groups, although whites tended to have a lower mean duration of gestation compared to blacks. This is in contrast to findings from Kennedy et

al's (1982) retrospective study of WIC medical records, which indicated that the black infants' mean age at birth was significantly lower than their white counterparts. Race is known to be highly correlated with biological variables, and non white women are predisposed to a greater risk of an adverse outcome, than are whites. It is possible that the results of the present study are indicative of the strong association between WIC participation and birth outcomes, particularly for the high risk, black prenatals.

When mean gestational age was analyzed by race, for each age group, blacks in each group tended to deliver infants with lower gestational age; t tests did not detect a significant difference between the races, for each age group.

Table II shows mean gestational age, by sociodemographic factors. Mean gestational age was not found to be significantly different, when subjects were classified by education or employment status.

As seen in Table III no significant trend in gestational lengths were observed in subjects who were anemic. Infants born to multiparous teenagers had a shorter period of gestation, compared to primiparous mothers, but this was not statistically significant. The number of previous deliveries has been reported to be associated with increased rates of prematurity (Jekel et al., 1975), but findings in this study may be reflective of the effect of prenatal care measures on

perinatal outcome, in the multiparous adolescent mothers.

Table III shows no reduction in duration of gestation, in subjects exposed to behavioral risks such as excessive smoking, alcohol or drug abuse. Preconceptual weight status of subjects in this study exerted a strong effect on gestational age of infants. Underweight mothers had a significantly reduced period of gestation, compared to mothers who were overweight ( $p < 0.01$ ). In addition, Pearson's Correlation Coefficient procedure revealed a significantly positive association between prepregnant weight and gestational age (0.2523,  $p < 0.011$ ). This is consistent with results reported by Garn & Petzold (1983), in the study on pregnant teenage participants from the National Collaborative Perinatal Project, where prematurity of the conceptus was attributed to the smaller body mass of the adolescents.

Duration of participation and gestational age: WIC benefits may be mediated through increased gestational age, but in turn, increased gestational age allows for increased duration in WIC. Therefore, these factors are in part, confounded. The results for duration in the WIC prenatal program, by number of months, are presented in Table IV. Increased duration in WIC was associated with enhanced pregnancy outcomes, in particular, gestational age. The findings were strongest for the 7+ month participants.

Analysis of studies on WIC participation confirmed that supplemental feeding duration did influence the extension of the gestational period, after adjusting for all other variables (Edozien et al., 1979; Kotelchuck et al., 1984).

Trimester or weeks of participation did not influence the gestational age of infants, for subjects in this study.

#### Incidence of low gestational age:

Although the underlying physiological processes have not been identified, certain medical risks are thought to cause changes in the hormonal environment and metabolic state of the uterus and cervix, that lead to premature labor. Ten percent of infants, born to subjects in this study were premature, as defined by their gestational age (duration of pregnancy <37 weeks, from the last menstrual period).

No age associated differences were observed with this unfavorable outcome of pregnancy. When these infants were stratified by ethnic group, six out of ten infants belonged to the black race. The National Center for Health Statistics (1982), indicated no major difference between races, when live births were classified according to length of gestation. The race specific prematurity in subjects in this study, may have been a result of interaction of social variables with biological processes, such as prepregnant weight, and prenatal weight gain.

Duration of gestation as a single variable, accounted for a large variability in birth weight. When subjects in this study were grouped by duration of gestation, as shown in Table XV, mean birth weight of infants was significantly lower in those in whom the gestational period was less than 37 weeks. The net weight gain during pregnancy was also significantly lower, compared to those in whom the duration of gestation exceeded 39 weeks. Pearson's Correlation Coefficient Procedure confirmed the positive association between weight gain and gestational age (0.2094,  $p < 0.04$ ).

An analysis of covariance procedure was performed to remove the influence of weight gain and prepregnant weight, while testing for the effect of gestational age on birth weight. The results revealed that gestational age continued to exert a strong influence on birth weight of the newborn ( $p < 0.01$ ). However, prenatal weight gain was found to be the strongest predictor of birth weight ( $p < 0.0001$ ). This concurs with findings by Maso et al., (1988), in that maternal nutritional status and pregnancy weight gain may mediate the birth weight outcome in adolescent pregnancy.

Analysis of risk characteristics of the low gestational age group revealed that their prepregnancy weight was significantly lower than the mean prepregnancy weight of all the subjects in this study. In addition, 60% of these subjects received two, or less, individual counseling

**Table XV:** Influence of length of gestation on maternal weight gain and infant size<sup>1</sup>

Gestational Age Group (weeks)	n	Weight Gain (kg)	Birth Weight (gm)
33-36	10	11.03 ± 1.18 <sup>a</sup>	2776.90 ± 124.75 <sup>a</sup>
37-39	44	13.81 ± 0.78 <sup>ab</sup>	3154.59 ± 60.53 <sup>b</sup>
> 40	46	15.17 ± 0.73 <sup>b</sup>	3348.57 ± 61.69 <sup>b</sup>

<sup>1</sup>Values represent mean ± SEM

<sup>a</sup>means within a column followed by different superscripts are significantly different (p < 0.05)

sessions with the WIC nutritionist. Low prepregnancy weight for stature reflected the poor nutrition experience prior to conception. Inadequate maternal weight gain during pregnancy was indicative of the poor quality of recent nutriture. These two nutritional variables, in combination with inadequate nutrition intervention, failed to promote the birth of a full-term, adequate-weight infant. The teenagers' diminished ability to attain favorable fetal outcome, with a weight gain that was apparently compatible with successful adult pregnancy outcome, was clearly evident.

(ii) BIRTH WEIGHT:

Studies, on nutrition and pregnancy outcome, support the view that nutritional assessment and services are major components of high quality prenatal care, especially for women at an elevated risk of intrauterine growth retardation (Institute of Medicine, 1985). Participation in prenatal care programs, which focus on ways to strengthen care for women at high risk, can contribute to the development of healthy infants.

The results from the present study revealed that the mean birth weight of infants, born to teenage mothers enrolled in WIC was 3206.05+439.3 gm. These infants were 47.2 gm heavier than infants born to teenagers in the state of North Carolina, for 1988 (NC Department of Environment

Health and Natural Resources, 1988). However, a one sample t test failed to detect a significant difference in this data. When the mean birth weight of infants in this study was compared to that of live borns for all ages, North Carolina state statistics (1988) indicated that the infants in the present study were 109.4 gm lighter ( $p < 0.01$ ). This difference can be attributed partly to the biologic immaturity of the teenage period, and partly, to various unfavorable sociodemographic and health care factors.

Table II gives a breakdown of birth weight of infants by racial group. No significant racial difference in birth weight was observed, with white infants weighing only 27.35 gm more than black infants. Pearson's Correlation Coefficient Procedure suggested a strong positive association between weight gain and birth weight of infants, particularly among the black teenagers (0.5545,  $p < 0.0001$ ). However, an analysis of covariance, performed to determine the effect of weight gain on birth weight, while eliminating the influence of race, indicated that weight gain still exerted a very strong effect on birth weight ( $p < 0.0001$ ). Race, by itself, did not influence birth weight of infants, when effects of weight gain and prepregnancy weight were removed.

It may be recalled that the mean total prenatal weight gain in blacks in this study was significantly lower, compared to whites. Although this showed no apparent effect

on the mean birth weight of infants born to these prenatals, a closer examination of birth weights revealed that 75% of infants born in the 2500 to 2999 gm birth weight category, were blacks.

Analysis of the higher birth weight groups indicated that 71.4% of all white infants weighed at least 3000 gm, compared to 63% of all black infants. In comparison, North Carolina state statistics for live teen births, in 1988, indicated that 74.8% of all white newborns, and, 61.6% of all black newborns, weighed 3000 gm or more (NC State Center for Health Statistics, 1988). Observations from this study may, therefore, imply that the risk differentials between white and black infants may be reduced by early, and appropriate prenatal intervention.

When age was the stratifying factor, no significant difference in mean birth weight of the newborns was apparent, as seen in Table I. However, mothers in age group I (15 years or under), delivered infants who were 139 gm and 96.25 gm heavier than age group II (16 to 17 years), and age group III (18 to 19 years), respectively. When this was further analyzed by race, a pattern of higher mean birth weight was observed in the white population, for age group I and II, but this was not statistically significant. This trend reversed in the older black prenatals, (age group III), who delivered higher birth weight babies, compared to whites. The lack of

significance of several of the birth outcome findings, was principally a function of small sample sizes, combined with large birth weight variances.

Mean birth weights are listed by sociodemographic variables in Table II. Subjects with less than nine years of education, gave birth to infants who weighed 122 gm less than those infants born to mothers who had greater than nine years of education. This was not a statistically significant finding, because of a relatively small sample size. Despite the lack of significance, this may be reflective of the risk characteristics of the younger teens (age group I), who were predominant in this group.

Subjects attending school delivered infants who were nearly 150 gm heavier than those who were neither employed, nor attending school. However, because of a large variance, a statistically significant difference was not detected. However, this result may be indicative of the positive effect of school lunch that subjects attending school probably had access to.

Table III gives a breakdown of birth weights by maternal and nutritional risk variables. No specific trend in birth weight was observed when subjects were assessed by parity. Nor was any significant difference in weight of the conceptus evident, when subjects were evaluated based on by their hemoglobin and hematocrit status.

Preconceptual weight was found to be weakly associated with birth weight of the newborns (0.1794,  $p < 0.08$ ), but did not influence birth weight by itself, when confounding factors were eliminated, using analysis of covariance procedures. Figure VI shows the variation in birth weight of infants born to varying weight status of subjects. Underweight subjects in this study delivered infants who were nearly 231gm and 57 gm lower in weight than infants born to overweight and normal weight gravidas respectively ( $p < 0.10$ ). However, the lack of a strong significant difference in birth weight may be considered to be a positive program effect, mediated through WIC on the underweight gravidas. The underweight mothers gained the same amount of weight, as did normal and overweight gravidas, but they delivered infants at a younger gestational age and of lower birth weight. Duration of gestation, prepregnancy weight, and weight gain during pregnancy are generally recognized as predominant factors influencing infant size at birth (Naeye, 1979). Birth weight has also been correlated with prepregnancy weight for height. It has been previously reported that pregnancy weight gain had a more important impact on birth weight for underweight women than women of average weight (Brown et al., 1981). Although underweight women in this study had babies with the lowest mean birth weights, maternal weight gain had a greater impact on their pregnancy, than on

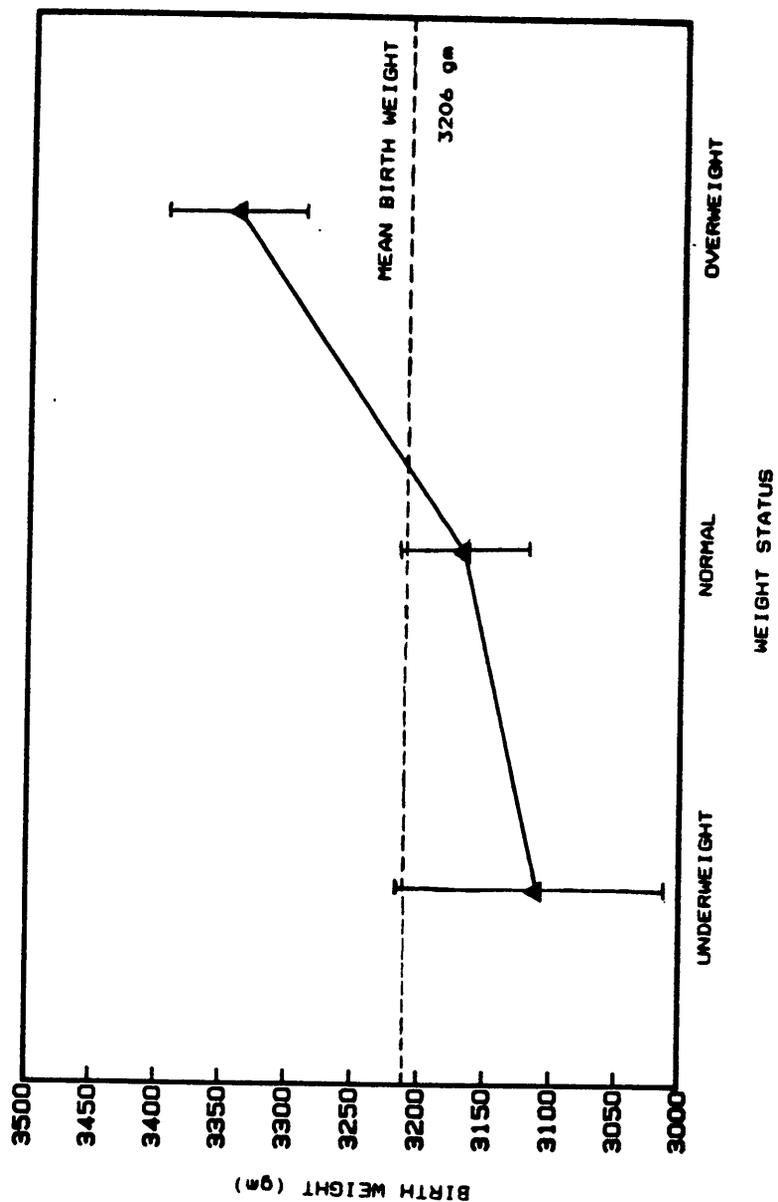


Figure VI : Influence of prepregnant weight status on infant birth weight.

normal or overweight gravidas, by increasing birth weight and bringing it into a normal range. It is apparent from the results of this study that underweight subjects need to gain a total amount that will cover their initial weight deficit and their own pubertal growth needs, in addition to the basic gain recommended for ideal weight women, in order to produce offspring of comparable size.

This study did not reveal the detrimental effect of excessive smoking on birth weight. Many studies support the view that maternal smoking retards fetal growth and that the influence is dose related. Information on whether subjects in this study continued to expose themselves to the behavioral risks, through the course of the pregnancy, was not available from the medical records. It is possible that these subjects discontinued smoking, following prenatal intervention, and, therefore, prevented a negative influence on the product of conception. The effect of alcohol and drug abuse on pregnancy outcome was difficult to assess, due to a very small sample size.

Duration of participation and birth weight: Table IV lists birth weights by different components of nutrition education. Mean birth weight of infants did not show any significant duration trend, although subjects who participated for seven months or more delivered infants who were 66.6 gm and 154.3

gm heavier than those who participated for 1-3 months and 4-6 months respectively. However, the indirect influence of increased participation on birth weight is likely, from the effect mediated through improved pattern of weight gain, and longer duration of gestation. Trimester of participation, or weeks of pregnancy when prenatal care began, was not associated with birth weight of infants.

Frequency of individual contact and birth weight: As evident from Table IV, birth weight of infants born to the WIC supplemented mothers in this study, did not show variation, based on number of individual counseling sessions with the WIC nutritionist. Although there was no direct association, the WIC nutritionist's input directed at weight gain, rate of gain, and caloric and nutrient intake, may have been instrumental in improving birth weight of infants. The results are particularly obvious for the high risk subgroups of this population, including the younger age group, black and underweight gravidas.

Birth Complications: Twenty-two percent (n=22) of the infants were delivered by cesarean section. Fetal distress was experienced in 8% (n=8) of the cases, which resulted in delivery of the infant by cesarean section. Ten percent (n=10) of the subjects experienced preterm labor leading to

premature rupture of membranes. No other major birth complications were evident from the medical records of the subjects.

Incidence of low birth weight:

Pregnant teenagers are known to be at higher risk than their older counterparts to bear low birth weight babies, contributing to a high incidence in neonatal mortality (Dott, 1979; Garn & Petzold, 1983). Very low and low birth weight rates in teenagers have been significantly higher, compared to those for mothers aged 20 years and older (Lee & Corpuz, 1988). Also, the rate of low birth weights for live births to teenage mothers has changed very little from 1950 to 1983. However, the Institute of Medicine's (1985) report on preventing low birth weight concluded that there was overwhelming evidence that incidence of low birth weight was reduced with adequate prenatal care.

For the present study incidence of birth weight, less than or equal to 2,500 gm (5lb, 8oz), was calculated for the entire study population, and by racial/ethnic group. Six percent (n=6) of infants born to subjects in this study were determined to be of low birth weight, with weights ranging between 2,254 gm and 2,495 gm. None of the infants born to the sampled subjects were of very low birth weight (1,500 gm or less). Incidence of low birth weight by racial subgroups

in the mothers sampled, showed equal distribution between blacks and whites.

North Carolina state statistics for resident live teen births, in 1987, revealed that 10.03% of these births were premature (weighing less than 5lb, 8oz)(NC State Center for Health Statistics, 1987). The results from this study indicated that low birth weight outcome of teen pregnancy can be reduced considerably by improving prenatal care status of these subjects. Participation in WIC provided a three part intervention program involving supplemental foods, nutritional counseling, and, close ties to prenatal services for the nutritionally and financially high risk teenagers in this study. This comprehensive care received by subjects demonstrated the value of nutrition to pregnancy outcome, including marginal increase in birth weight and remarkable reduction in incidence of low birth weight.

When percentage of live birth which resulted in low birth weight was determined by race, it was estimated that 8.57% of all births to whites, and 4.62% of all births to blacks, resulted in low birth weight outcome in this study group. North Carolina state statistics indicated that 8.77% and 7.88% of all live births, were to whites and nonwhites respectively, were classified as low birth weight infants (less than 2,500 gm), (NC State Center for Health Statistics, 1987). A substantial decrease in the incidence of low birth

weight among the high risk black teenagers in this study is probably indicative of the magnitude of impact of the supplemental WIC program.

When incidence of low birth weight was examined by age subgroups, 66.7% of the low birth weight infants were found to be born to the older teens (age group III). This is contrary to the belief that younger teens are at greater risk for low birth weight outcome, owing to their biologic immaturity. It is very likely that the unfavorable outcome associated with the older teens may have been closely related to the sociodemographic variables, than to biologic age itself.

Analysis of maternal/nutritional risk characteristics indicated that 83% of these mothers were primiparous. Most of these subjects began pregnancy with prepregnancy weights lower than average for the study group, with 33% of them being classified as underweight. Fifty percent of the subjects entered the prenatal care services, while in their second trimester of pregnancy.

Elster (1984) reported that, for primiparous women, the risk of having a small for gestational age infant was significantly related to late prenatal care. It appears from the results of this study that the effect of these factors, in combination with the additive effect of low prepregnancy weight, may have been likely variables for contributing to

the poor perinatal outcome.

Data on pregnancy weight gain were analyzed for subjects, who delivered low birth weight infants. Mean antepartum weight gain was found to be inadequate (against a recommended 24 lb) and significantly lower than in subjects who delivered higher birth weight infants ( $p < 0.001$ ). The mean gestational age of these infants was also significantly lower, but as reported earlier, weight gain was a more significant predictor of birth weight, as indicated by an analysis of covariance procedure.

Figure VII illustrates that progressive increase in maternal weight gain was accompanied by a progressive and substantial increment in mean birth weight. This study has produced strong evidence of the association of small babies with lower weight gain. Inadequate weight gain, along with the impact of maternal risk variables, and relatively late enrollment in the WIC program, may have made this group of subjects susceptible to poor fetal growth and development. Although 80% of these subjects had received at least three individual contacts with the WIC nutritionist, the effect of maternal risk factors was probably far too strong, for nutritional intervention to change the course of events and improve pregnancy outcome.

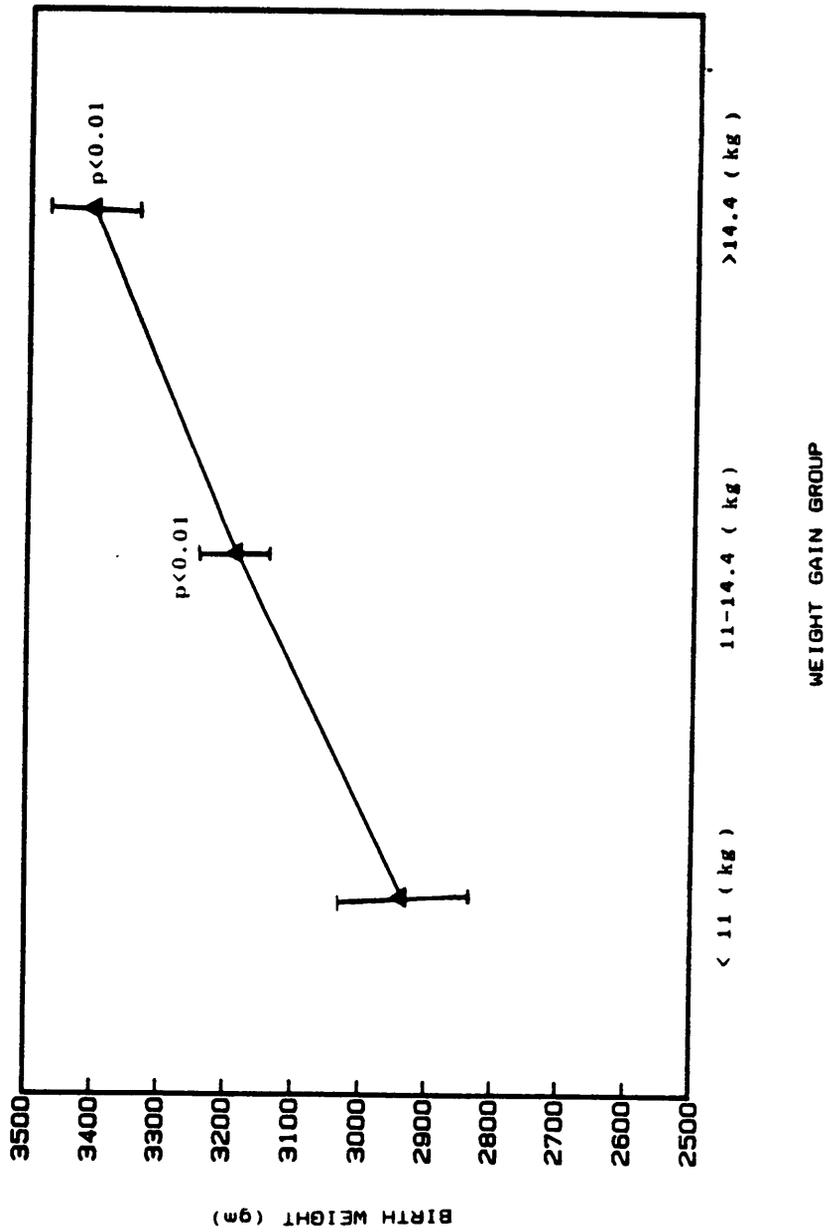


Figure VII : Influence of maternal weight gain on infant birth weight for different categories of weight gain.

### INFANT FEEDING PRACTICES

Since the 1970's, breast feeding as the preferred method of infant feeding has increased in overall popularity (Martinez et al.1981). However, certain populations, particularly poor, young, black, and less educated women have been slow to adopt this method (Winikoff et al., 1986). This part of the present study was conducted to identify factors relating to the choice of infant feeding method among the teenage WIC participants. The subjects in this study were dichotomized into bottle feeders and breast feeders, based on their response to intended method of infant feeding.

Of the total sample, only 10% said that they desired to breast feed their babies. This is considerably less than that reported by Radius & Joffe (1987), who stated that 17% of the 254 pregnant adolescents in their study reported desire to breast feed their infants. The percentage of subjects who elected to breast feed was also considerably lower than national figures reported by Martinez et al., (1983). Therefore, an analysis of maternal risk variables was done to understand the factors influencing the choice. All subjects were from low income households, satisfying WIC income guidelines.

The effect of ethnicity was strongly evident with none of the black teens electing to breast feed their infants.

It has been reported that sources of social support for breast feeding and attitude toward breast feeding vary by ethnic group (Rassin et al., 1984). These results indicate the need to consider the ethnicity of population during the development of intervention programs for improving breast feeding trends for that group.

When age subgroups were examined, a trend toward increased breast feeding with increasing maternal age was evident. Sixty percent of the subjects (n=6) were between the ages of 18 and 19 years of age, and 30% were between 16 and 17 years of age. These findings concur with those reported by Neifert et al., (1988), from their study of infant feeding practices of adolescent mothers. A study of predictors of duration of breast feeding in low income WIC participants also indicated that incidence of breast feeding was significantly lower in subjects under 20 years of age (Hawkins et al., 1987). This trend is probably related to the attitude and barriers perceived by the young adolescents toward breast feeding.

When maternal educational level was examined, all mothers who chose to breast feed had completed at least nine years of school education. Employment status was analyzed to see if it was a determinant for breast feeding. It was observed that sixty percent of the subjects who elected to breast feed were neither attending school, nor were they

employed. These results were consistent with those reported by Martinez et al., (1981) where incidence and duration of breast feeding were negatively affected by maternal employment.

More primiparous mothers than multiparous mothers expressed desire to breast feed. Intent to breast feed bore no significant association with maternal behavioral risks, particularly the smoking status; 80% of mothers who decided to breast feed were non smokers.

The results from this analysis indicated that the decision to breast feed was influenced by older maternal age, race, maternal education and employment status. A study by Radius & Joffe (1988) on adolescent mothers' feelings about breast feeding indicated that more benefits than barriers regarding breast feeding, were perceived by them. It may therefore be suggested that adolescents who are receptive to breast feeding may benefit from close follow-up and anticipatory guidance tailored to their individual needs. The decision to breast feed is a significant one and is usually made relatively early in the pregnancy. It may also be important for the nutrition professional to take a stand in support of lactation early enough in the prenatal period to influence the decision making process. In addition, identifying and working with perceived barriers, and encouraging perceived benefits, may help promote breast

feeding among young mothers.

### LIMITATIONS

Establishing the existence and magnitude of a WIC program effect, depends on the comparability of the WIC population and matched control groups. In this study it was decided that access to other similar data of a non WIC group corresponding comparably to the WIC population studied, was not attainable. Therefore, comparisons were made with available vital statistics, or recommended standards, when appropriate. Since no evaluation was performed on non recipients, it cannot be concluded through the results of this study, that the changes are solely a result of the WIC program.

This study was conducted on a select population of pregnant teenagers, who did not show any significant medical or nutritional disease conditions, during the course of their pregnancy. Therefore, fewer risk variables characterizing low birth weight outcomes, were encountered by these subjects. Generalization to other populations are, therefore, limited. In addition, subjects were selected from one county, in North Carolina, and may not be representative of all regions, within or outside the state.

Estimating the magnitude of the cumulative benefits

associated with increased duration in WIC is methodologically complicated. Analysis of subjects based on absolute duration of participation in WIC assures that these subjects have longer gestations and possibly higher birth weights. Therefore, this measure may be an overestimation of the beneficial outcomes.

Although nutritional assessments were made by competent nutritionists, and every attempt was made to collect and record information accurately, a margin of discrepancy may still exist in the reliability of the dietary recall.

Another limiting factor in this study was that data on number of monthly vouchers received or cashed during pregnancy was not included for analysis. This would have provided a quantitative estimate of WIC supplemental foods that the subjects in this study had access to. Although the WIC program is intended as a supplemental food program, increased nutrient intake observed in subjects may not have been necessarily as a result of receipt of food package.

It should also be noted that, for nutrient analysis, substitutions were necessary for those foods that were lacking in the database. It is probable that the reported intake of nutrients, specially calcium and iron, may vary from what was actually consumed.

Lastly, nutrition counseling, although directed to specific needs of individuals, supplied information on the

types and amounts of food, a pregnant woman should consume in order to meet the RDA for a pregnant teenager. This study did not assess the quality or content of education provided to subjects in this study; rather, the frequency of individual counseling sessions was used as a qualitative measure of nutrition services.

## SUMMARY AND CONCLUSIONS

The goal of this study was to examine nutritional performance, and birth outcome, in relation to selected nutritional and maternal risk variables, of a group of pregnant teenagers enrolled in the North Carolina WIC program. This research was initiated to develop a descriptive profile of this WIC population and to determine if any relationship existed between their pregnancy outcomes and nutrition counseling service. The WIC program provides support in two most needed areas : supplemental foods, and, guidance in the use of foods through nutrition counseling. It is a cost effective program that has shown to result in significant improvements in maternal nutrition, and reductions in infant mortality, low birth weight, and other complications that threaten pregnancy outcome. Since one of the most obvious effects of prenatal care has been in the area of improved maternal weight gain, and increased infant birth weight, the role of nutrition counseling in prenatal care may be assumed to be significant. Therefore, the American Dietetic Association (1989) has stressed the need for early nutrition intervention, that should continue throughout the duration of pregnancy, for the nutritionally

at risk pregnant adolescent.

The prenatal subjects in this study included 100 teenagers, receiving the benefits of the supplemental WIC Program. Demographic and nutritional risk information for all participants was collected from medical records. In addition, nutritional performance indicators and pregnancy outcome criteria for each subject, as described by maternal weight gain, pattern of weight gain, dietary intake of subjects, duration of gestation and infant birth weight, were recorded. These data were analyzed with reference to the nutrition education services provided to the subjects. Nutrition education services were evaluated using three components : Trimester or weeks when prenatal care was initiated, duration of participation in months, and frequency of individual counseling sessions received by each subject.

Demographic analysis showed that a significant portion of the subject population exhibited risk characteristics, in addition to their young age, making them increasingly vulnerable to adverse outcomes of pregnancy. A fifth of the teenagers sampled were 15 years of age or under. Almost two-thirds of the study population were of the black race. A majority displayed two or three nutritional risk variables, such as anemia, low prepregnancy weight and underweight status, and frequent conception. Behavioral risks, particularly smoking were demonstrated by 20% of the prenatal

subjects at the time of enrollment.

Fifty-seven percent of the subjects began receiving prenatal services, as early as the first trimester of pregnancy. Mean duration of participation for subjects in this study was greater than five months. Two-thirds of the subjects received at least three individual contacts with the WIC nutritionist.

The mean total weight gain for subjects in the present study was comparable with those reported by investigators studying similar populations. However, the subgroup of blacks appeared to gain significantly lower amount of weight than whites. The mean weekly weight gain was significantly higher, compared to recommended standards, which was consistent with recommendations for higher rate of gain in pregnant adolescents. Mean dietary intakes for calories, proteins, calcium and iron, before counseling was significantly lower, when compared to RDA values. However, analysis of dietary recall after counseling, showed improved intakes for all four indicator nutrients, although calcium intake continued to be significantly lower than the RDA.

Mean gestational age of infants born to subjects in this study was comparable to that of results from other similar studies. As gestational age is one of the determinants of birth weight, this was indicative of the positive effect of participation in WIC. Mean birth weight of infants born to

subjects in this study was marginally higher than that reported for the state, but lacked significance, presumably due to a large variance.

The trend observed in the intended method of infant feeding was that older, white teens with at least nine years of education, who were neither attending school, nor employed, were more likely to breast feed their infants, than others. Further investigation is required, to understand the psychosocial influence on the choice and duration of breast feeding, on the subpopulation of teenagers.

This investigation was conducted to examine five research hypothesis. The first hypothesis was that the components of nutrition education would be significantly positively correlated with total weight gain. While a direct correlation of the variables was not evident, incidence of low weight gain was significantly reduced in the group of subjects who initiated prenatal care in the first trimester, than in those who initiated care later during pregnancy. Although blacks gained significantly lower amounts of weight during pregnancy than whites, and showed greater incidence of low weight gain, this was not associated with a difference in the components of nutrition education experienced by the ethnic groups, as determined by Pearson's Correlation Coefficient procedure.

The second research hypothesis was that maternal weekly

weight gain would positively correlated with the three components of nutritional counseling. Frequency of individual counseling sessions showed a weak, but positive, association with rate of weight gain in the final trimester of pregnancy. However, rate of weight gain showed observable trends when weight status of the subjects was considered. Underweight and overweight subjects appeared to show an appropriate pattern of gain, in relation to their weight status, especially with higher frequency of counseling sessions. It is likely that nutrition intervention focused on weight-for-height proportion, to establish optimal antepartum gain, through appropriate dietary variables.

The third research hypothesis was that adequacy of dietary intake of calories, protein, calcium, and iron would be significantly positively correlated with the components of nutrition education. A very weak association was detected between frequency of individual contact and intake of calories and protein. The lack of a stronger association was also indicative of the nature of counseling, in terms of adjusting caloric and protein intakes to the preconceptual weight status, and the rate of gain, observed in subjects. Duration of participation was weakly associated with the change in intake of calcium. Iron intake did not show any trend, in relation to nutrition education services. These results indicate that nutritionists affected improvements in

dietary patterns in these pregnant adolescents, which may have helped replete nutritional reserves.

The fourth research hypothesis stated that the mean gestational duration would be significantly higher in subjects, with increased length of participation in the WIC program. The results did indicate mean gestational duration to be significantly associated with increased duration of participation. This association indicated that the WIC program may have reduced the unfavorable outcome of pregnancy, specifically, low birth weight, by extending the gestational period. Incidence of prematurity was found to be associated with decreased frequency of individual contact with the WIC nutritionist. Nutritional counseling may have influenced nutrient intake which supported optimal fetal growth, as evidenced by increased gestational length.

The final research hypothesis was that mean birth weight would be significantly higher with increased duration of participation, and would be positively correlated with the other components of nutrition education. A direct correlation was not evident between these two variables; however, the results of this study indicated that increased birth weight of newborns may have been mediated through the effects of improved pattern and rate of weight gain, and through the increased duration of gestation. The incidence of low birth weight was much lower than reported for the

state, for the same age group. Blacks in this study showed considerable decrease in unfavorable outcome of pregnancy, compared to state statistics. This was perhaps indicative of the influence of nutrition education services, in reducing risk differentials between the races.

Sociodemographic factors and maternal risk characteristics were examined, to study the influence on maternal performance and fetal outcome. Maternal weight gain was found to be the strongest predictor of birth weight of infants, although gestational age did influence birth weight to a lesser degree. Maternal weight gain was found to be highly correlated with preconceptual weight status of the subjects. Although race was associated with variable prenatal gain, WIC participation was associated with more positive fetal outcome, particularly for the high risk black teens. This was specifically evident in the reduced incidence of low birth weight outcome for the black prenatals.

Probably the most important point brought out by this study was that preconceptual weight was found to be related to total maternal weight gain, rate of gain, gestational age and birth weight of infants. Nutrition intervention by WIC nutritionists was an important modifiable variable, targeted to establish recommended weight gain based on prepregnant weight-for-height proportion. Despite being from low income,

less educated background, the socioeconomic gradient in fetal growth was apparently overcome by the prenatal care experience that the subjects in this study were exposed to.

The percentage of subjects who initiated prenatal care in the first trimester was much higher than that estimated for resident pregnant women in the state of North Carolina. The duration of participation was also found to be higher, compared to results from similar studies. It is possible that early initiation of prenatal care and nutrition services, and longer duration in the WIC program may have reduced the incidence of unfavorable outcome of pregnancy significantly among the high risk teens in this study.

The financial implication from this study is that, increasing expenditure for prenatal services may be justified, from the point of view of reducing cost of medical care for the low birth weight infants born to the teenage population. The 1990 goal set by the Surgeon General to reduce the low birth weight rate to 9% among the high risk groups may be achieved with adequate budgetary outlays on comprehensive prenatal care programs.

## REFERENCES

Abrams, B.F., Laros, R.K. (1986) Prepregnant weight, weight gain, and birth weight. *Amer J Obstet & Gynec.* 154(3): 503-509.

Alton, I.R. (1979) Nutrition services for pregnant adolescents within a public high school. *J Amer Diet Assoc* 74(6): 667-669.

American Academy of Pediatrics. (1979) Statement on teenage pregnancy. Committee on Adolescence. *Pediatrics.* 63(5): 795-797.

American Dietetic Association. (1981) Handbook of clinical dietetics. Yale University Press. P.O. Box 91403. Chicago, Illinois.

American Dietetic Association. (1989) Position of the ADA: Nutrition management of adolescent pregnancy and technical support paper, *J Amer Diet Assoc.* 89(1): 104-109.

Ancrì, G., Morse, E.H., Clarke, R.P. (1977) Comparison of the nutritional status of pregnant adolescents with pregnant women III: Maternal protein and caloric intake and weight gain in relation to size of infant at birth. *Amer J Clin Nutr.* 30: 568-572.

Bailey, L.B., Mahan, C.S., Dimperio, D. (1980) Folacin and iron status in low-income pregnant adolescents and mature women. *Amer J Clin Nutr.* 33(9): 1997-2001.

Beal, V.A. (1971) Nutritional studies during pregnancy. *J Amer Diet Assoc.* 58: 312-320.

Berkenfield, J., Schwartz, J.B. (1980) Nutrition intervention in the community - The WIC program. *New Eng J Med.* 302(10): 579-581.

Brogan, B.D., Fox, M.H. (1984) Infant feeding practices of low and middle income families in Nebraska. *J Amer Diet Assoc.* 84(5): 560-563.

Brown, J.E., Jacobson, H.N., Askue, L.H., Peick, M.G. (1981) Influence of pregnancy weight gain on the size of the infants born to underweight women. *Obstet & Gynec.* 57(1): 13-17.

Buchanan.R. (1975) Effects of childbearing on maternal health. *Population Reports, Series J.* (8): 125-139.

Caghan, S.B. (1975) The adolescent process and the problem of nutrition. *Amer J Nursing.* 75(10): 1728-1731.

Campbell, A.A. (1980) Trends in teenage childbearing in the United states. In *Adolescent Pregnancy and Childbearing - Findings from research*, US Department of Health and Human Services, NIH publication no 81-2077, Ch 1, pp 1-3.

Chase, H. (1970) Trends in prematurity, United States, 1950-1967, *Amer J Public Health.* 60: 1967-1983.

Cole, J.P. (1977) Breastfeeding in the Boston suburbs in relation to personal - social factors. *Clin Ped.* 16: 352-354.

Community Nutrition Institute, *Nutrition Week Report.* (1987). 17(42): 6-7.

Dott, A.B., Fort, A.T. (1976) Medical and social factors affecting teenage pregnancy, *Amer J Obstet Gynecol.* 125(4): 532-536.

Dryfoos, J. (1985) School based health clinics: A new approach to preventing adolescent pregnancy? *Fam Plan Perspt.* 17(2): 70-75.

Dwyer, J.F. (1974) Teenage pregnancy, *Amer J Obstet Gynecol.* 118: 373-375.

Eckholm, E., Newland, K. (1977) Health, the family planning factor. *Series J* (14): 253-262.

Edozein, J.C., Switzer, B.R., Bryan, R.B. (1979) Medical evaluation of the special supplemental food program for women infant and children. *Amer J clin Nutr.* 32: 677-692.

Elster, A.B. (1984) The effect of maternal age, parity, prenatal services on perinatal outcome in adolescent mothers. *Amer J Obstet Gynecol.* 149(8): 845-847.

Endres, J., Dunning, S., Poon, S., Welch, P., Duncan, H. (1987) Older pregnant women and adolescents: Nutrition data after enrollment in WIC. *J Amer Diet Assoc.* 87(8): 1011-1019.

Endres, J.M., Poell-Odenwald, K., Sawiki, M., Welch, P. (1985) Dietary assessment of pregnant adolescents participating in a supplemental food program. *J Reprod Med.* 30(7): 10-17.

Farroir, E.S., Ruwe, C.H. (1987) Women, Infants and Children Program prenatal participation and dietary intake. *Nutr Research*, 7:451-459.

Felice, M.E., Granados, J.L., Ances, I.G. (1981) The young pregnant teenager: Impact of comprehensive prenatal care. *J Adol Health Care.* 1(3): 193-197.

Frisancho, A.R., Matos, J., Flegel, P. (1983) Maternal nutritional status and adolescent pregnancy outcome. *Amer J Clin Nutr.* 38: 739-746.

Gabriel, S. (1981) Overview of incidence, risks and consequences of adolescent pregnancy and childbearing. *Birth Defects.* 17(3): 5-17.

Garn, S. M., Pesick, S.D., Petzold, A.S. (1986) The Biology of Teenage Pregnancy : The mother and the child. Ch.5, pp 77-93. In *School-age pregnancy and parenthood - Biosocial dimensions.* Ed. Jane B Lancaster & Beatrix A Hamburg. Aldine de Gruyter, New York, 1986.

Garn, S.M., Petzold, A. (1983) Characteristics of the mother and child in teenage pregnancy. *Amer J Dis Child.* 137(4): 365-368.

Gilbert, A., Martinez, G.A., Kreiger, F.W. (1985) 1984 milk feeding patterns in the US. *Pediatrics.* 76(6): 1004-1008.

Gormican, A., Valentine, J., Satter, E. (1980) Relationships of maternal weight gain, prepregnant weight and infant birth weight. *J Amer Diet Assoc.* 77:662-667.

Haider, S.Q., Wheeler, M. (1980) Dietary intake of low socioeconomic black and hispanic teenage girls. *J Amer Diet Assoc.* 77: 677-681.

Hansen, C.M., Brown, M.L., Trontell, M. (1976) Effects on pregnant adolescents of attending a special school. *J Amer Diet Assoc.* 68:538-541.

Hawkins, L.M., Nichols, F.H., Tanner, J.L. (1987) Predictors of the duration of breast feeding in low income women, *Birth.* 14(4): 204-209.

Heady, J.A., Daley, C., Morris, J.N. (1955) Social and biological factors in infant mortality II: Variations of mortality with mother's age and parity. *Lancet*, 1:395-397.

Henshaw, S.K., Van Vort, J. (1989) Teenage abortion, birth and pregnancy statistics: An Update. *Fam Plan Perspt.* 21(2):85-88.

Hollingsworth, D.R., Kotchen, J.M. (1981) Gynecological age and it's relation to neonatal outcome. *Birth defects*, 17: 91-105.

Horon, I.L., Strobino, D.M., MacDonald, H.M. (1983) Birth weights among infants born to adolescents and young adult women. *Amer J Obstet Gynecol.* 146(4): 444-449.

Huyck, N.I. (1976) Nutrition services for pregnant teenagers. *J Amer Diet Assoc.* 69(1); 60-62.

Hytten, F.E., Leitch, I. (1971) The physiology of human pregnancy. Oxford: Blackwell Scientific Publications. pp.279-280.

Institute of Medicine. (1985) Committee to study the prevention of low birth weight: Summary and recommendations. In Division of Health Promotion and Disease Prevention. National Academy Press. Washington D.C.

Jekel, J.F., Harrison, J.T., Bancroft, D.R.E. (1975) A comparison of the health index and subsequent babies born to schoolage mothers. *Amer J Public Health.* 65: 370-374.

Jelliffe, D.B. (1966) The assessment of nutritional status of the community. World Health Organization. pp.240-241.

Kaminetsky, H., Langer, A., Baker, H., Frank, O., Thomson, A.D., Munves, E.D., Opper, A., Behrle, F.C., Glista, B. (1973) The effect of nutrition in teenage gravidas on pregnancy and the status of the neonate. *Amer J Obstet Gynecol.* 115(5): 639-646.

Kennedy, E.T. (1986) A prenatal screening system for use in a community based setting. *J Amer Diet Assoc.* 86(10): 1372-1375.

Kennedy, E.T., Gershoff, S., Reed, S., Austin, J.E. (1982) Evaluation of WIC supplementary feeding on birth weights. *J Amer Diet Assoc.* 80(3): 220-227.

Kennedy, E.T., Kotelchuck, M. (1984) The effect of WIC supplemental feeding on birth weight: a case-control analysis. *Amer J Clin Nutr.* 40(3): 579-585.

Kotelchuck, M., Schwartz, J.B., Anderka, M.K., Finison, K.S. (1984) WIC participation and pregnancy outcomes: Massachusetts Statewide Evaluation Project. *Amer J Public Health.* 74: 1086-1092.

Kovar, M.G. (1968) Variables in birth weight, legitimate live births, US, 1963, Vital and Health Statistics Series No 22. National Center for Health Statistics. US GPO. Washington D.C.

Lee, K., Corpuz, M. (1988) Teenage pregnancy: Trend and impact on rates of low birth weight and fetal, maternal, neonatal mortality in the US. *Clin Perinat.* 15(4): 929-943.

Lee, K.S., Ferguson, M., Corpuz, M., Gartner, L.M. (1988) Maternal age and incidence of low birth weight at term: a population study. *Amer J Obstet Gynecol.* 158(1): 84-89.

Lechtig, A., Yarbrough, C., Delgado, H., Habicht, J.P., Martorell, R., Klein, R.E. (1975) Influence of maternal nutrition on birth weight. *Amer J Clin Nutr.* 28: 1223-1233.

Loris, P., Dewey, K.G., Poirer-Brode, K. (1985) Weight gain and dietary intake of pregnant teenagers. *J Amer Diet Assoc.* 85(10): 1296-1305.

70 Mahan L.K., Rees. J.M. (1984) Nutrition in Adolescence. Times Mirror/Mosby College Publishing, St Louis, Missouri.

Martinez, G.A., Nalenzeinski, J.P. (1981) 1980 update - Recent trend in breast feeding. *Pediatrics.* 67: 260-264.

Martinez, G.A., Stahle, D.A. (1982) The recent trend in milk feeding among WIC infants. *Amer J Public Health.* 72: 68-71.

Martinez, G., Dodd, D. (1983) 1981 milk feeding patterns in the US during the first 12 months of life. *Pediatrics.* 71:166-170.

Maso, M.J., Gong, E.J., Jacobson, M.S., Bross, D.S., Heald, F.P. (1988) Anthropometric predictors of low birth weight outcome in teenage pregnancy. *J Adol Health Care.* 9(3): 188-193.

McAnarney, E.R. (1985) Adolescent pregnancy and childbearing : New data, new challenges. *Pediatrics*. 75(5): 973-975.

McAnarney, E., Roghman, K.J., Adams, B.N. (1978) Obstetric, neonatal , psychosocial outcomes of pregnant adolescents. *Pediatrics*. 61: 199-205.

McDonald, E.C., Pollitt, E., Mueller, W., Hsueh, A.M., Sherwin, R. (1981) The Bacon - Chow study: Maternal nutritional supplements and birth weight of offspring. *Amer J Clin Nutr*. 34: 2133-2144.]

Menken, J. (1980) Health and demographic consequences of adolescent pregnancy and childbearing. In *Adolescent Pregnancy and Childbearing - Us Department of Health and Human Services, NIH publication no. 81-2077, Ch 7, pp 157-205.*

Meserole, L., et al. (1984) Prenatal weight gain and post partum weight loss patterns in adolescents. *J Adol Health Care*, 5(1): 21-27.

Metcoff, J., Costiloe, P., Crosby, W.M., Dutta, S., Sandstead, H.H., Milne, D., Bodwell, C.E., Majors, S.H. (1985) Effect of food supplementation (WIC) during pregnancy on birth weight. *Amer J Clin Nutr*. 41: 933-947.

Miller, K.A., Fields, C.S. (1984) Adolescent pregnancy: A combined obstetric and pediatric management approach. *Mayo Clinic Proc*. 59: 311-317.

Mora, J.O., de Paredes, B., Wagner, M., de Navarro, L., Suescun, J., Christiansen, N., Herrera, M.G. (1979) Nutritional supplementation and the outcome of pregnancy, I: Birth weight. *Amer J clin Nutr*. 32: 455-462.

Morrison, S.L., Heady, A, Morris, J.N. (1959) Social and biological factors in infant mortality VIII : Mortality in the post-neonatal period, *Arch Dis Child*. 34:101-113.

Naeye, R.L. (1979) Causes of fetal and neonatal mortality by race in a selected US population. *Amer J Public Health*. 69: 857-861.

Naeye, R.L. (1981) Teenaged and preteenaged pregnancies: Consequences of the fetal-maternal competition for nutrients. *Pediatrics*. 67(1): 146-150.

National Center for Health Statistics (1987). Advance report on final natality statistics, 1985. Monthly Vital Statistics Report, 36, No 4.

National Research Council. (1970) Committee on Maternal Nutrition. Maternal nutrition and the course of pregnancy. National Academy of Sciences, Washington D.C.

National Research Council. (1980) Committee on Dietary Allowances. Recommended Dietary Allowances, 9th Ed. Washington D.C.

North Carolina Department of Human Resources, WIC Program Manual. (1988) Division of Health Services, Maternal and Child Care Section, P.O. Box 2091. Raleigh, NC-27602.

North Carolina Office of State Budget and Management. (1988) NC State Data Center. Newsletter Vol 10, No 2, Raleigh, NC 27603-8005.

North Carolina Center for Health Statistics. (1987) Department of Human Resources, Division of Health Services, P.O. Box 2091, Raleigh, NC 27602.

North Carolina Center for Health Statistics. (1988) Department of Human Resources, Division of Health Services, P.O. Box 2091, Raleigh, NC 27602.

North Carolina Department of Environment, Health, and Natural Resources. (1988) Division of Statistics and Information Services, P.O. Box 27687, Raleigh, NC-27611-7687.

Neifert, M., Gray, J., Gray, N., Camp, B. (1988) Factors influencing breast feeding among adolescents. J Adol Health Care. 9: 470-473.

Olson, R.E. (1979) Maternal weight gain and the outcome of pregnancy. Nutr Rev. 37: 318-320.

Pennington J.A.T., Church, H.N. (1980) Food values of portions commonly used. 13th Edition. Harper & Row Publishers, New York.

Radius, S.M., Joffe, A. (1988) Understanding adolescent mother's feelings about breast feeding - a study of perceived benefits and barriers. J Adol Health Care. 9:156-160.

Rassin, D., Richardson, J., Baranowske, T., et al. (1984) Incidence of breast feeding in a low socioeconomic group of mothers in the US: Ethnic patterns. Pediatrics. 73: 132-137.

Rosso, P., Luke, B. (1978) Abstract. The influence of maternal weight gain on the incidence of fetal growth retardation. Amer J Public Health. 71:810-817.

Rothenberg, P.B., Varga, P.E. (1981) The relationship between age of mother and child health and development. Amer J Public Health. 71: 810-817.

Rush, O. (1981) Nutritional services during pregnancy and birth weight: A retrospective matched pair analysis. Can Med Assoc J. 125(6): 567-576.

Sarret, H.P., Bain, K.R., O'Leary, J.C. (1983) Decisions on breast feeding or formula feeding and trends in infant feeding practices. Amer J Dis Child. 137: 719-725.

SAS User's Guide. 1982 edition, SAS Institute, Cary, North Carolina.

Seiler, J., Fox, H. (1973) Adolescent pregnancy, association of dietary and obstetric factors. Home Eco Res J. 1(3): 188-194.

Select Committee on Children, Youth, and Families. (1986) Report on Teen Pregnancy: What is being done? A State by State look. 99th Congress, 1st Session, US House of Representatives, US GPO. Washington D.C.

Singleton, N., Lewis, H., Parker, J. (1976) The diet of pregnant teenagers. J Home Eco. 68(4): 43-45.

Stickle, G. (1981) Overview of incidence, risks, and consequences of adolescent childbearing. Birth Defects, 17(3): 5-17.

Task Force on Adolescent Pregnancy. (1979) Adolescent Perinatal Health. American College of Obstetricians and Gynecologists.

Tavris, D.R., Read, J. (1982) Effect of maternal weight gain on fetal, infant and childhood death, and on cognitive development. Obstet & Gynec. 69(6): 689-694.

US Department of Agriculture, Handbook No 456. (1975) Nutritive value of American foods in common units. US GPO. Washington D.C.

US Department of Agriculture, Handbook No 456. (1982) Nutritive value of American foods in common units. US GPO. Washington D.C.

US Department of Commerce. (1988) County and city data book -a statistical abstract supplement, Bureau of the Census, Washington. D.C.-20233.

Viegas, O.A.C., Scott, P.H., Cole, T.J., Mansfield, H.N., Wharton, B.A. (1982) Dietary protein energy supplementation of pregnant Asian mothers at Sorrento, Birmingham, I - Unselective during 2nd and 3rd trimesters. *Brit Med J.* 285: 589-592.

Viegas, A.O.C., Scott, P.H., Cole, T.J., Mansfield, H.N., Wharton, B.A. (1982) Dietary protein energy supplementation of pregnant Asian mothers at Sorrento, Birmingham, II - Selective during 2nd and 3rd trimester. *Brit Med J.* 285: 592-595.

Vital Statistics of the US, 1965, Vol I - Natality. (1967) US Department of Health, Education and Welfare, Public Health Service. US GPO, Washington D.C.

Weiner, G., Milton, T. (1970) Demographic correlates of low birth weight. *Amer J Epidemiol.* 96:260-272.

Winikoff, B., Lankaran, V.H., Meyers, D., Stone, R. (1986) Dynamics of infant feeding - mothers, professionals, and the institutional context. *Pediatrics.* 77(3): 357-365.

Worthington-Roberts, B.S., Vermeersch, J., Rodwell-Williams, R.S. (1985) Nutrition in Pregnancy and Lactation. Ed III. Times Mirror/Mosby, College Publishing, St Louis.

Zlatnik, F.J., Burmeister, L.F. (1977) Low gynecological age: an obstetric risk factor. *Amer J Obstet Gynecol.* 128(2): 183-186.

Zuckerman, B., Alpert, J.J., Dooling, E., Hingson, R., Kayne, H., Morelock, S. (1983) Neonatal outcome: Is adolescent pregnancy a risk factor? *Pediatrics,* 71(4): 489-493.

**The vita has been removed from  
the scanned document**