PREGNANCY OUTCOMES OF KANSAS WIC PROGRAM PARTICIPANTS AGED 20 YEARS AND OLDER

by

ANITA J. CORDILL

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Approved by:

Kathleen Newell
Major Professor

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INTRODUCTION

Age of the mother is a strong indication of reproductive capabilities. The pattern of reproductive loss by age is a U shaped curve, with increased mortality rates among women who are less than 17 or more than 35 years of age (1). Age of the mother also is related to death rates and cause of death in the offspring. Women who are less than 17 or more than 35 years of age experience a high incidence of fetal loss; their babies more frequently die of congenital malformations, birth injuries, and hemolytic disease than those born to mothers in their twenties.

According to a recent vital statistics report (2) birth rates to teenagers and women aged 20 to 24 years declined steadily during the seventies. However women 20 to 24 years still retained the highest rate (56.5 per 1,000) of first births. Between 1972 and 1979 birth rates increased from 29.4 to 37.9/1,000 for women aged 25 to 29 years and from 1.8 to 2.4/1,000 for women between the ages of 35 and 39 years, representing increases of 29% and 33%, respectively. The rate of first births to women aged 40 to 44 years was 0.3 per 1,000 women. The largest increase (73%) was observed for women aged 30 to 34. Birth rates for this age group increased from 7.0 to 12.1/1,000. The incidence of low birth weight infants born to women aged 35 to 39 years was 9.8% compared to a rate of 6.9% for all women. The percentage of low birth weight infants was lowest (5.9%) for mothers aged 25 to 34 years.

Maternal nutrition is one of the most important factors affecting the health of pregnant women and their infants. Available data suggest that nutrition intervention designed to improve pregnancy outcome will be more effective the closer the intervention is to the gestation period (3). Health status of women interacts with socio-economic factors to

influence the outcome of pregnancy. Therefore, nutritional guidance and intervention should be available to women whose circumstances may lead to complications during the reproductive process.

In 1972, Public Law 92-433 (4) established the Special Supplemental Food Program for Women, Infants and Children (WIC). The purpose of the program is to prevent the occurrence of health problems and improve the nutritional status of participants through the provision of supplemental foods and nutrition education (5).

In the WIC program, nutrition intervention as food supplements is provided to pregnant, post-partum, and breast feeding women and infants and children up to four years of age, who are at nutritional risk because of inadequate nutrition, education and/or income. Eligibility requirements for the program include residency in designated geographical areas, specified income level, and certification of nutritional risk by a competent professional authority. Nutritional risk is based on one or more of the following: medical examination, dietary evaluation, anthropometric measurements and determination of hemoglobin and/or hematocrit values. Nutrition education is provided through group discussion or by one-on-one counseling throughout the food supplementation period and is designed to ensure efficient use of the foods. In addition to food supplementation and nutrition education, the WIC nutritionist may refer the client to other health and social services (6).

Four vouchers are issued per month which list quantities of specific foods for each participating family member (a partial food package). The four vouchers make up the total family food package for that month. The WIC food packages are designed for individual participant needs. Combinations of iron fortified formula, infant cereals, and high-vitamin

infant fruit juices are provided for infants. For children and women, combinations of eggs, milk, cheese and other protein sources such as legumes, lentils or peanut butter, iron fortified breakfast cereals and high vitamin fruit juices are available. The food packages are designed to increase nutrient intakes of iron, vitamin A, ascorbic acid, calcium and high quality protein. These nutrients are known to be lacking in the diets of pregnant, post-partum, and breast feeding women and their infants and children (7).

The legislation establishing the WIC Program provided for continuous collection and evaluation of data to monitor the effectiveness of the program. The results of a number of research studies (8, 9, 10) have shown a positive relationship between pregnancy outcomes and participation in the program.

The objectives of this study were:

1) to compare selected characteristics of prenatal WIC participants, aged 20 years and older, with those of non-WIC pregnant women in the same age group,
2) to investigate the effect of WIC supplemental feeding on the birth weight of infants born to prenatal WIC participants, aged 20 years and older,
3) to investigate the effect of selected maternal variables on the birth weight of infants born to WIC participants and non-WIC women, aged 20 years and older,
4) to determine if the impact of each selected maternal variable differs between the WIC and non-WIC women, aged 20 years and older.

REVIEW OF LITERATURE

The detrimental effects of poor nutrition were demonstrated in a number of studies conducted in the 1940's. Antonov (11) showed that birth weights of infants were related to the level of nutrition during pregnancy in wartime deprivation. A subsequent controlled study by Burke et al. (12) demonstrated a relationship between maternal nutrition and pregnancy outcome. Stein et al. (13) also conducted a study of the effects of famine conditions on pregnancy and the condition of the infant. Decreases were noted in maternal weight, placental weight, and the birth weights, lengths and head size of the infants. Although the methodology in those studies (11, 12, 13) has been questioned by other researchers, they demonstrated the importance of nutrition during pregnancy. As a result of these early studies dietary supplementation during pregnancy has been recommended for women who are at nutritional risk. Supplementation has been shown to be advantageous for malnourished or underweight mothers (14). Less conclusive benefits have been documented for those mothers who were well nourished prior to and during pregnancy (15).

Food Supplementation Studies in Developing Countries

Dietary supplementation in developing countries has been associated with improved maternal weight gains, higher infant birth weights and decreased incidence of prematurity and low birth weights. In India Iyenger (16) reported the effects of supplementing protein and energy intakes during the last four weeks of pregnancy on the mothers' weight gain and serum proteins, and the birth weights and serum proteins of their infants. The study included 25 pregnant women, aged 25 to 40 years, who belonged to a low socio-economic group. All the women were

hospitalized for four weeks before delivery and fed a daily diet supplying 2,100 kcal and 60 g protein, 20 g of which were animal protein. Twelve of the women received a daily supplement of 100 g of dry skim milk, which provided an additional 35 g protein and 350 kcal. The other 13 women received a 350 kcal, nonprotein supplement each day. All of the women were given an iron and vitamin supplement. Twenty-six other pregnant women of the same socio-economic group, who came to the hospital in labor, served as a comparison group.

The addition of protein and energy to the diets of the women for four weeks in late pregnancy benefited both mothers and infants. Mean maternal weight gains and infant birth weights were higher for the diet-supplemented, hospitalized women than for women who entered the hospital in labor. The birth weights of infants born to the diet-supplemented, hospitalized women were lower, however, than birth weights of infants born to well-to-do mothers.

Lechtig et al. (17) studied the effects of food supplementation during pregnancy on birthweight in four rural villages of Guatemala. Variables which might affect the relationship between maternal nutrition and birthweight were investigated. These variables included maternal ingestion of food, maternal anthropometry, obstetrical history, morbidity during pregnancy, socio-economic status, and birthweight and sex of the infant. Two types of food supplements were given; atole, a gruel containing 163 kcal and 11 g protein, and fresco, a cool drink containing 59 kcal with no protein. Both contained similar amounts of the vitamins and minerals missing in the diets of this population. Two villages received atole while the other two received fresco. Attendance at the supplementation center was voluntary, which resulted in a wide range of

supplement intake during pregnancy. A total of 671 births occurred during the four years of the study with complete data available for 405.

Results indicated a statistically significant association between caloric supplementation during pregnancy and the birth weight of the infants. Using multiple regression to control for the influence of the maternal variables, the relationship between supplementation and birth weight remained significant. There was no difference between the effect of the protein-energy supplement and that of the energy supplement on birth weight. The researchers concluded that in this population, increased energy was of more importance than additional protein. The incidence of low birth weight infants was reduced by one half the normal rate and was associated with increased energy intakes.

Moro et al. (18) studied the effect of food supplementation during the last trimester of pregnancy in Colombian women in 456 families at high risk of malnutrition. Criteria for participation was that the mother was in the first or second trimester of pregnancy and malnutrition was present in at least 50% of children under 5 years of age. The families were randomly assigned to two groups; the unsupplemented control and the supplemented sample. The supplements included dry skim milk, enriched bread, vegetable oil and a vitamin-mineral supplement in amounts considered sufficient to meet a substantial part of the recommended dietary allowances. The food was distributed weekly at specific sites and consumption was monitored by random home visits.

Weight gain of mothers pregnant with males was significantly higher for supplemented than unsupplemented women. No differences in weight gain were found between supplemented and unsupplemented mothers pregnant with females. A definite relationship was found between weight gain

during the last trimester of pregnancy and birth weight, regardless of sex. Food supplementation for women at high risk of malnutrition had a significant effect on the birth weight of males but not on females. This effect was related to the duration of supplementation and was associated with maternal weight gain.

Food Supplementation Studies in the United States

Although studies in developing countries have shown the positive effect of food supplementation on pregnancy outcomes, results of studies in the United States have been less conclusive. Positive relationships between food supplementation and maternal and infant variables have been reported in some studies (8, 9, 10) and no association in others (19, 20, 21).

Non-WIC

Dieckmann et al. (19) studied the relationships between food intake and pregnancy outcome, including the condition of the infants at birth, of 602 middle income, maternity patients at the Chicago Lying In Hospital. Participants recorded their self-selected food intake for two to three weeks, and then a diet was prescribed which contained 86 g protein and other nutrients considered appropriate during pregnancy. To ensure that at least 85 g of protein were consumed, 16 varieties of high quality, canned meat supplements were made available.

No correlations were found between weight and length of the infants and the protein intakes of the mothers. Weight gains were significantly less for mothers who had high protein intakes (over 85 g) than for those on the lowest protein intakes (less than 55 g). The researchers postulated that women on high protein intakes may have found it easier

to consume fewer calories or that the more cooperative patients who kept weight gain within the recommended limits also followed the prescribed high-protein diet. A significant correlation was found between the condition of the infant at birth as assessed by a pediatrician and the average protein intake of the mother.

Rush et al. (20) conducted a controlled study of nutritional supplementation in pregnancy and its effect on infant birth weight. The sample included 814 poor, black urban women who were determined to be at high risk of delivering low birth weight infants. The women were assigned randomly to three study groups: the supplemental group received 2, 8 oz cans of beverage daily providing 40 g of animal protein and 470 calories; the complement group received 2, 8 oz cans of beverage containing a total of 6 g of animal protein and 322 calories each day, and the non-intervention or control group received no beverage supplement. All groups received a vitamin and mineral supplement.

The data indicated that the women used the beverage as instructed. There was a higher incidence of low birth weight infants and deaths of infants born prematurely among women fed the high protein supplement than among women in the other two groups. In the total population, women who had delivered low birth weight infants previously tended to deliver infants of low birth weights during the food supplementation period. Both nutritional supplements had a favorable effect on birth weights of infants born to heavy smokers.

Adams et al. (21) designed a study to investigate the effects of nutritional supplementation on the outcome of pregnancy among women in California considered to be at risk of delivering low birth weight infants. The population consisted of 227 women entering the obstetric clinic for

confirmation of pregnancy and represented a wide range of ethnic and socio-economic groups. The women were in good health but had at least one factor which indicated risk of delivering a low birth weight infant. These factors were: chronic hypertension, previous fetal loss, heart disease, heavy smoking, not married to the biological father at conception, short stature or underweight.

The women were assigned to one of three study groups: Group 1 consumed a normal diet plus 2, 8 oz cans of a high protein beverage; Group 2 consumed a normal diet plus 2, 8 oz cans of a low protein beverage; and Group 3 served as controls and consumed a normal diet plus a vitamin and mineral supplement. All women also received iron supplements. The high protein beverage provided 40 g protein (casein and soy isolate), 470 kcal, and vitamins and minerals. The low-protein beverage was similar, except that it provided only 6 g protein from the same sources and 320 kcal. Dietary assessment included a 7-day dietary record before starting the supplement and another during the 34th week of pregnancy.

Food supplementation in this study was associated with a lower incidence of low birth weight infants than was usually found in this population. No associations were found between the dietary supplements and the maternal pregravid weights and weight gains. There was a tendency toward increased birth weights with higher protein intakes. The length of treatment did not change the associations between the food supplements and the variables studied. There were no differences in infant Apgar scores in the three groups. Apgar scores are used to aid in the evaluation of the condition of an infant at birth. The infant is rated at 1 and 5 min for heart rate, respiratory effort, muscle tone, reflex irritability, and color. Each of these conditions is rated from 0 to 2 and then totaled.

Apgar scores of 7 to 10 indicate that an infant is in excellent condition.

WIC

Springer et al. (22, 23, 24) conducted a retrospective study of nutritional indexes of 198 low income, maternity patients and their infants participating in a Detroit Maternity and Infant Care Project to assess the relationships among nutritional, developmental and medical variables. Most (193) of the women in the study were black; the mean age of the study group was 20.5 years and the mean schooling was 11 years. Although most of the women were eligible for the federal food programs, Food Stamp and WIC, only slightly more than one third participated. Fourteen mothers were enrolled in both programs, 56 in WIC only and 1 in the Food Stamp program only (22). A prenatal vitamin and mineral supplement was provided for all women by the clinic.

Information relating to dietary intake, anthropometric measurements and hematologic data were obtained from the participants' files. The dietary analyses showed inadequacies in calcium, riboflavin, vitamin A, ascorbic acid, and other vitamins and minerals attributable to low intakes of milk, vegetables and fruits by the expectant mothers (23). The vitamin and mineral supplement apparently compensated in part for the dietary inadequacies, since mean hemoglobin and hematocrit values were within acceptable ranges.

The mother's age was positively correlated with the child's head circumference, and her education was correlated with her infant's birth weight (24). The relationship between the mother's weight prior to pregnancy and her infant's weight and height at birth was highly

significant. The mother's weight gain was positively related to the infant's birth weight, height, and head circumference. The mother's dietary intake was not related to any of the infant variables studied except that there was a positive relationship between the mother's protein intake and the infant's birth weight.

The United States Department of Agriculture contracted with the University of North Carolina to carry out a nationwide study under the direction of Edozien et al. (8) to determine if the WIC program produced a measurable improvement in the nutritional status of the participants. The evaluation included 9,867 pregnant or lactating women at 19 projects in 14 states. Participants were mostly urban, very low income, and with a mean age of 23.1 ± 5.7 years. Racial distribution was 24.5% white, 38.6% black, 33.8% Spanish American and 2.5% other. The data collected in the study included anthropometric and biochemical measurements; dietary intakes; maternal weight gain; medical complications during pregnancy; and vital statistics, including rates of stillbirths, low birth weights and infant mortality. Measurements were taken initially and approximately every three months until delivery.

Pregnant women who participated in the program increased their consumption of protein, calcium, phosphorus, iron, vitamin A, thiamin, riboflavin, niacin, vitamin C, and folacin but not energy. WIC program participants gained more weight during pregnancy than women in the non-WIC population. Participation in the WIC program was associated with an increase in the mean birth weights of infants. Among women who were more than 28 weeks pregnant there was a reduction in anemia after they received the food supplements. There was evidence in this study that the WIC package was used as a substitute rather than a true supplement. However,

the supplemental foods resulted in improvements in their usual diets by providing more protein, vitamins and minerals.

Wallach et al. (25) assessed the impact of the Connecticut WIC program by determining the relationship between the nutritional status of the mother and infant mortality. Infant death certificates for the period between 1975 and 1977 were examined to determine the cause of death, age at death, race and sex. The death certificates were matched with the appropriate birth certificates, when available, for complementary information such as weight at birth, mothers age at time of birth and legitimacy. WIC participation was determined by matching the mothers name to the WIC file and enrollment date in WIC to the gestation period under study. Those mothers not matched to the WIC file served as the non-WIC control group.

There was a significant difference between the infant mortality rates for WIC and non-WIC subjects for the three years of the study. The infant mortality rate was 8.4/1,000 live births for WIC mothers compared to 22.7/1,000 for the non-WIC mothers. The WIC mothers had a perinatal mortality ratio of 10.5/100 live births, while the non-WIC mothers had a 24.45/100 ratio.

Schelzel et al. (26) assessed the impact of the WIC program in 31 program sites in Pennsylvania. Obstetric and nutritional data were extracted from a random sample of client records at the time of entry into the program and after at least six months participation. Information was collected on 119 women ranging in age from 14 to 38 years with a median age of 20. The incidence of negative pregnancy outcomes, medical complications and abnormal weight gain or loss was compared with data from pregnancies prior to WIC participation and/or to subsequent pregnancies

while participating in the WIC program. There were dramatic reductions in infant deaths, premature births, and miscarriages among the participants, which continued to decrease with continued participation. Continued participation also resulted in earlier prenatal care and reductions in pregnancy complications. Because there was not a non-WIC control group, it could not be concluded that the changes were definitely attributable to WIC, but the improvements appeared to be strongly associated with WIC participation.

Kennedy et al. (9) reviewed 910 WIC and 418 non-WIC nutritional and medical records at 9 Massachusetts WIC sites over a 5 year period to study the effect of WIC participation on infant birth weights. Biological, sociodemographic and behavioral data were obtained. Potential self-selection bias of the WIC groups was avoided by selecting 2 comparison groups. The pregnant women in comparison group 1 (C_1) had either applied for WIC but were not certified because there were no openings or they were certified post partum. These women lived in the same geographical area as the WIC group and were considered to be an ideal comparison group. Comparison group 2 (C_2) consisted of pregnant women participating in non-WIC health facilities.

Gestational age, maternal weight gain, pregravid weight, the square term for pregravid weight and the number of prior low birth weight infants had a significant effect on birth weight. Maternal weight gain and gestational age had the greatest effect. There were significant differences between the birth weights of infants born to WIC women and those in the 2 comparison groups. The difference was even more pronounced if only infants of WIC participants and infants born to C_1 women were compared.

Social variables, including geographic location, agency location, income, marital status, racial/ethnic groups, family size, number of living children and number of children enrolled in WIC were not associated with birth weight. Effects of prenatal care, nutritional counseling services, and smoking on birth weight also were studied. These behavioral characteristics had no direct influence on birth weight, however total weight gains of smokers were less than those of non-smokers. Because weight gain affects birth weight, smoking indirectly reduced the birth weight of the infants.

The effect of the WIC program was evaluated by participation or non-participation and number of vouchers. Both were positively and significantly associated with increased birth weights and decreased incidence of low birth weights.

Kotelchuck et al. (10) studied the association between maternal participation in the WIC program and the outcomes of pregnancy for 1,978 births in Massachusetts. Data were derived by linking two data sets, the State Birth and Death Registry and the WIC Computer System. Birth certificates were the source of information on prenatal care, maternal characteristics and the outcome of pregnancy. The WIC system supplied the names of prenatal WIC participants and the duration and extent of participation. The linking process resulted in a WIC study group of 4,126 and a like number for a control group. The WIC subjects were individually matched to a control by maternal characteristics which included age, race, parity, years of education, marital status, and geographic location.

Compared to statewide demographics, a greater number of WIC participants were teenagers, black, unmarried, or had not graduated from high school. The incidence of low birth weight infants born to WIC mothers was

6.9% compared to 8.7% to non-WIC women. Neonatal mortality was significantly lower in the WIC population than in the control group. Length of participation was associated with increased length of gestation and infant birth weights, and decreased neonatal mortality.

Endres et al. (27) examined 24 hour dietary recalls of 115 pregnant clients enrolled in Illinois WIC programs for at least six months (WIC group) and 651 pregnant women applying for certification (non-WIC comparison group). Women in the two groups had similar socio-economic backgrounds. Dietary intakes were analyzed for energy, proteins and selected vitamins and minerals and expressed as percentages of the Recommended Dietary Allowances (RDA). The nutrient density of the diets and the frequency of use of specific WIC approved foods were determined. Energy and nutrient intakes of WIC participants were significantly higher than intakes of women in the non-WIC group. However, when kilocalories were controlled for, nutrient composition of the diets of the two groups did not differ significantly. Both WIC and non-WIC women consumed foods which are included in WIC packages, however, consumption was higher for participants than non-participants.

METHODOLOGY

The research proposal for the evaluation of Pregnancy Outcomes of Kansas WIC Program Participants Aged 20 Years and Older was submitted to and approved by the Kansas State University Subcommittee on Research Involving Human Subjects.

Data Sources

Data for the study were derived from 2 previously collected but unlinked data sets:

I. Professional Data Processing Associates (PDA), Inc.

   WIC Master File
   provided names and case numbers for all persons enrolled in the Kansas WIC Program

   WIC Voucher File
   source of data on actual dollars spent for WIC foods by each participating family including the time period in which the food dollars were spent

II. Kansas State Department of Health and Environment Vital Statistics

   Kansas Birth History Master File 1979-80
   source of data on all births in Kansas in 1979-80

The WIC Files maintained by PDA, Inc. provided documentation of the names of prenatal WIC participants along with the duration and extent of their WIC participation. The Kansas Birth History Master File was the source of data on maternal characteristics, prenatal care, and pregnancy outcome for all women giving birth during the study period.

Permission was granted by Irvin Franzen, Director, Bureau of Health and Registration Statistics, to access data on the 1979-80 Kansas Birth History Master File of the State Department of Health and Environment Vital Statistics, and by Sarah Harding, State WIC Coordinator, to access data on the WIC Master and Voucher Files.

Derivation of Sample

To derive the population of women who were enrolled in the Kansas WIC Program during pregnancy and gave birth in Kansas between July 1, 1979 and June 30, 1980, infant birth certificate numbers were hand-linked to corresponding WIC case numbers (fig 1). A birth certificate number is assigned to each infant at birth, and a WIC case number, assigned to a family at the time of enrollment, is unique to that family and identifies each participating member. The linking process was based on name, date of birth, address, and race.

The WIC Voucher File (fig 1) was accessed to determine the WIC family type (WIC number) for each woman in Data Set A (fig 1) during the woman's gestation period. The WIC number, printed on each voucher a family receives, indicates the number of women, infants' and/or children's partial food packages included on that voucher. For example the WIC number 102, where W = woman number, I = infant number, and C = child number, would indicate that 1 woman's partial food package, no infants, and 2 children's partial food packages were contained on that voucher.

Data Set A (fig 1) was classified into the following age categories: $\leq$ 19 years, 20 to 34 years, or $\geq$ 35 years at the time of delivery, and was then cross-classified according to the W number, resulting in 2 subsets for each age category: W=1 or W$\neq$1. The WIC subset of interest for each age category had W=1, indicating that the woman participated in WIC during the pregnancy under study.

The birth data remaining in the Kansas Birth History File after the linking process for women who gave birth during the study period were classified by age (fig 1, Data Set B). The women in each of these age categories served as non-WIC comparison groups as appropriate.

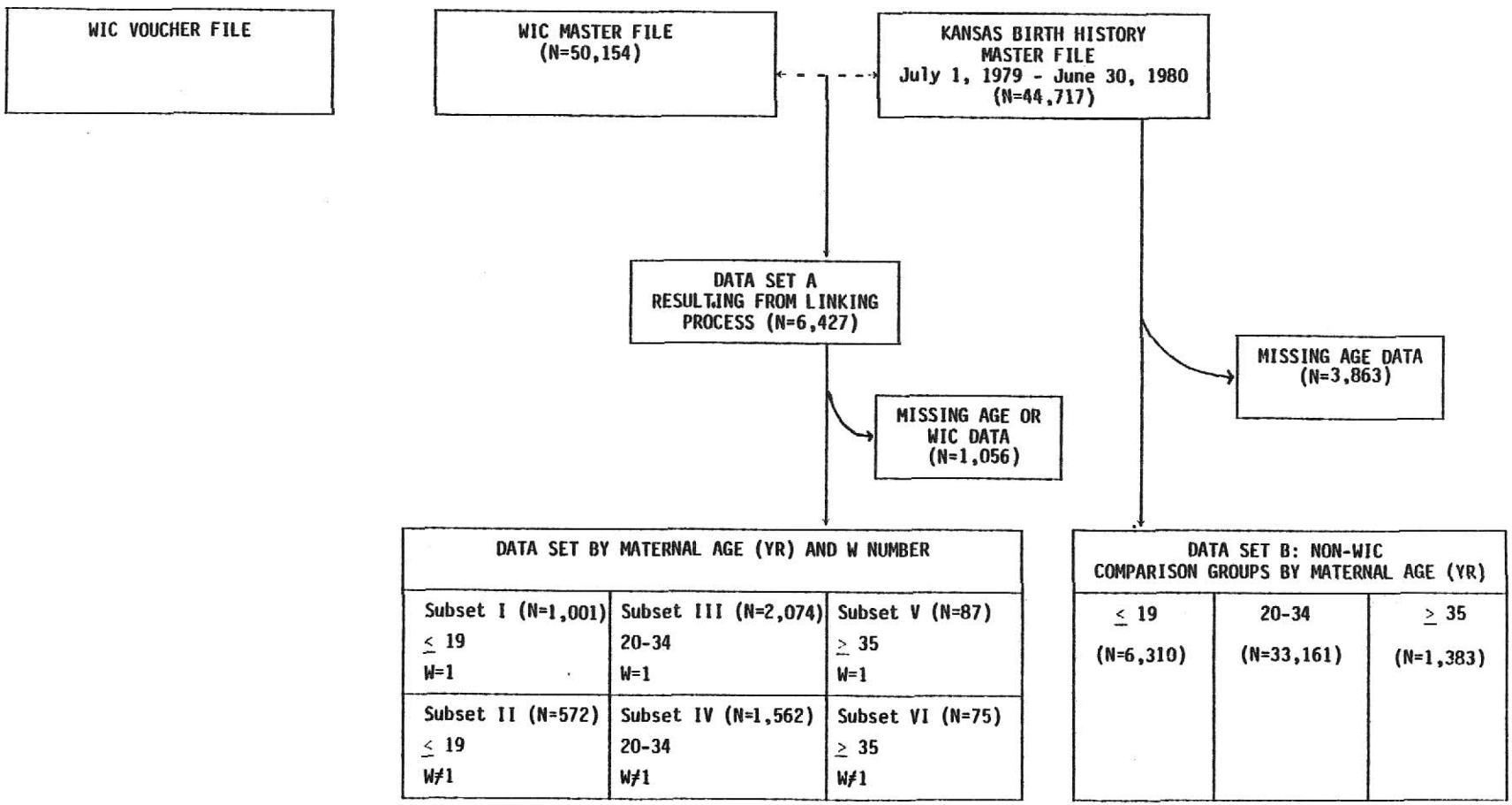


FIG. 1. Derivation of sample

In this research project, women aged 20 to 34 years and 35 years and older who participated in WIC during pregnancy (fig 1, Subsets III and V) and non-WIC women (fig 1, 20 to 34 and $\geq$ 35 years in Data Set B) were studied.

Proportional Voucher Dollar Sum for Prenatal WIC Participants

For the prenatal WIC participants, the proportional dollar value of the family food package that should be allocated to the pregnant WIC participant was estimated as follows. The dollar sum of the cashed vouchers issued during the 9 month period prior to the infant birth date was computed for each pregnant woman who was the sole participant in the family (WIC number = 100). The mean actual dollars spent by these women during pregnancy was then computed (ACT 100 = $128.14). The mean actual dollars spent during the 9 month period prior to the infant birth date by each possible combination of WIC family types for Subsets I, III, and V (fig 1) also was computed. Ratios for ACT 100 to each of the following were then calculated: ACT 110, ACT 120, ACT 130, ACT 101, ACT 111, ACT 121, ACT 102, and ACT 112. The appropriate ratio was multiplied by the value of the family's cashed vouchers during the woman's gestational period to reflect dollars spent on WIC supplemental foods for the woman during pregnancy.

Data Analysis

Frequency distributions and percentages were compiled for each variable studied (list of variables, Appendix A) for both the WIC women and the non-WIC comparison group. In addition, means, standard deviations, and coefficients of variation were computed for maternal biological variables of the women in both groups.

Analysis of covariance was used to identify factors significantly associated with birth weight in the WIC population. Variables included in the analysis were selected on the basis of availability, and were those thought to be significantly associated with birth weight (8, 9, 10). Data were analyzed for live singleton births only, deleting women with reported pregravid weights > 300 pounds. An equation was specified for the outcome variable birth weight: Birth weight = f (race, pregravid weight, maternal weight gain, proportional voucher dollar sum). Complete data for the variables studied were available for 930 WIC mothers aged 20 to 34 years and 28 aged 35 years and older. The effect of the same variables, except proportional voucher dollar sum, on the birth weight of infants born to non-WIC women was studied. Complete data for the study variables were available for 33,167 non-WIC women aged 20 to 34 years and 905 aged 35 years and older. The partial regression coefficients of these selected maternal variables were compared between the WIC and non-WIC women to determine if they differed.

RESULTS AND DISCUSSION

Description of WIC Women and Non-WIC Comparison Group

Maternal Biological Variables

The mean age of WIC women aged 20 to 34 years was 24.4 and for the 35 years and older group was 37 years (Table 1). Over half (58.6%) of the WIC women in the younger age group were 24 years or less at the time of delivery; 88% of the WIC mothers in the older age group delivered between the ages of 35 and 39 years (Table 2). The mean age of non-WIC women 20 to 34 years was 25.4 (Table 1) and 45.6% were 24 years or younger at the time of delivery (Table 2). In the 35 years and older group of non-WIC women the mean age was 37 (Table 1) and 84.7% delivered between the ages of 35 and 39 years (Table 2).

The mean pregravid weights of WIC participants in both age groups (20 to 34 years and 35 years and older) were higher than those of non-WIC women (Table 1). WIC and non-WIC women in the older age group weighed more than younger women at the time of conception. Heights of WIC and non-WIC women in both age groups were similar (Table 1).

The mean weight gains in pounds during pregnancy for WIC and non-WIC women aged 20 to 34 years were 28.88 and 28.18, respectively (Table 1). The highest percentage of WIC and non-WIC mothers in that age group gained between 21 and 30 pounds during the gestation period; about one-fourth gained less than 20 pounds (Table 2). About 14% of the WIC women in this age group gained 41 pounds or more during pregnancy compared to 10% in the non-WIC group. In the older group 35 years and older the mean weight gain in pounds for WIC women was 26.74 and 25.34 for non-WIC women (Table 1). Approximately one-third of the WIC and non-WIC women

TABLE 1
Means, standard deviations, and coefficients of variation of maternal biological variables of Kansas women

Variables	N[1]	$\bar{X}$	SD	CV
				%
20 to 34 years				
WIC				
Age (yr)	2,045	24.40	3.65	14.95
Pregravid weight (lb)	1,377	140.89	36.07	25.60
Height (in)	1,288	64.18	2.61	4.07
Weight gain (lb)	1,354	28.88	12.79	44.31
Weeks gestation	1,993	39.74	3.89	9.80
Non-WIC				
Age (yr)	33,860	25.41	3.70	14.58
Pregravid weight (lb)	24,049	136.84	29.95	21.89
Height (in)	22,784	64.60	2.61	4.04
Weight gain (lb)	23,980	28.18	10.68	37.91
Weeks gestation	33,129	39.76	3.61	9.07
35 years and older				
WIC				
Age (yr)	85	36.95	1.96	5.30
Pregravid weight (lb)	47	151.81	35.36	23.29
Height (in)	47	64.89	3.01	4.65
Weight gain (lb)	46	26.74	15.26	57.06
Weeks gestation	83	39.20	2.84	7.24
Non-WIC				
Age (yr)	1,427	37.12	2.22	5.98
Pregravid weight (lb)	960	145.48	36.00	24.75
Height (in)	911	64.58	2.75	4.25
Weight gain (lb)	948	25.34	10.67	42.10
Weeks gestation	1,393	39.26	3.05	7.76

[1]N varies because of missing data.

TABLE 2
Maternal biological variables of Kansas women

Variables	WIC		Non-WIC	
	N[1]	Percentage	N[1]	Percentage
20 to 34 years				
Age (yr)				
20-24	1,198	58.6	15,414	45.5
25-29	610	29.8	12,909	38.1
30-34	238	11.6	5,537	16.4
Pregravid weight (lb)				
< 99	55	4.0	614	2.6
100-119	294	21.3	5,633	23.4
120-139	444	32.3	9,155	38.1
140-159	259	18.8	4,575	19.0
160-179	149	10.8	2,034	8.5
180-199	89	6.5	1,011	4.2
≥ 200	87	6.3	1,027	4.2
Height (in)				
< 59	35	2.7	353	1.5
60-64	693	53.8	10,984	48.3
65-69	534	41.5	10,785	47.3
≥ 70	26	2.0	662	2.9
Weight gain (lb)				
0-10	78	5.8	889	3.7
11-20	287	21.2	4,793	20.0
21-30	480	35.4	10,085	42.1
31-40	315	23.3	5,722	23.8
41-50	113	8.3	1,774	7.4
≥ 51	81	6.0	717	3.0
Weeks gestation				
< 37	212	10.6	2,731	8.2
37-42	1,529	76.8	27,199	82.1
> 42	252	12.6	3,199	9.7

[1]N varies because of missing data.

TABLE 2
Continued

Variables	WIC		Non-WIC	
	N[1]	Percentage	N[1]	Percentage
35 years and older				
Age (yr)				
35-39	75	88.2	1,208	84.7
40-44	10	11.8	210	14.7
≥ 45	0	0	9	.6
Pregravid weight (lb)				
< 99	1	2.1	16	1.7
100-119	8	17.0	173	18.0
120-139	10	21.3	308	32.2
140-159	10	21.3	220	22.9
160-179	9	19.2	105	10.9
180-199	3	6.3	59	6.1
≥ 200	6	12.8	79	8.2
Height (in)				
< 59	2	4.3	20	2.2
60-64	17	36.1	426	46.8
65-69	24	51.1	432	47.4
≥ 70	4	8.5	33	3.6
Weight gain (lb)				
0-10	7	15.2	70	7.4
11-20	9	19.6	269	28.5
21-30	15	32.6	365	38.6
31-40	7	15.2	180	18.9
41-50	4	8.7	49	5.2
≥ 51	4	8.7	15	1.4
Weeks gestation				
< 37	10	12.0	133	9.5
37-42	67	80.8	1,179	84.7
> 42	6	7.2	81	5.8

had mean weight gains between 21 and 30 pounds; 35% gained less than 20 pounds. Over 17% of the WIC women gained 41 pounds or more compared to 6.8% in the non-WIC group (Table 2). More older than younger women, WIC and non-WIC, delivered prior to 37 weeks gestation. WIC women in both age groups had a higher percentage of early births than non-WIC women (Table 2).

Maternal Social Variables

In the WIC group, 67.5% of the women aged 20 to 34 years were white, Mexican or Puerto Rican compared to 72.9% in the 35 years or older group (Table 3). In both age groups in the non-WIC sample there was 91% of these same races. Only about 6% of the non-WIC women in both age groups were black. In the WIC groups there was a higher percentage of blacks in the younger age group (28.9%) than in the older group (18.8%). Edozien et al. (8) reported a national WIC participant distribution of 38.6% black, 24.5% white, 38.8% Spanish American, and 2.5% other. In Massachusetts Kotelchuck et al. (10) found that 23.8% of WIC births were to blacks compared to a statewide percentage of 6.2%.

There was a marked difference in marital status between WIC and non-WIC women in both age groups (Table 3). In the WIC group 27.9% women aged 20 to 34 years were unmarried compared to 7.9% of the non-WIC women. In the older group 35 years and older 22.4% of WIC women were not married compared to 5.6% of non-WIC women. Kotelchuck et al. (13) also found a higher percentage of unmarried women among WIC than non-WIC participants. Over 25% of the WIC women had some college education compared to over 40% of the non-WIC group (Table 3).

TABLE 3
Maternal social variables of Kansas women

Variables	WIC		Non-WIC	
	N[1]	Percentage	N[1]	Percentage
20 to 34 years				
Race				
White, Mexican, Puerto Rican and all other Caucasians	1,382	67.5	30,962	91.5
Black	592	28.9	2,263	6.8
Indian	37	1.8	171	0.5
Chinese	2	0.1	40	0.1
Japanese			14	0.0
Cajun or Creole	8	0.4	49	0.1
Hawaiian			8	0.0
Filipino	2	0.1	42	0.1
Other Asian or Pacific Islander	23	1.1	306	0.9
Marital status				
Married	1,475	72.1	31,181	92.1
Unmarried	571	27.9	2,673	7.9
Unclassifiable			3	0.0
Education (yr)				
1-8	77	3.8	662	2.0
9-12	1,392	68.0	18,636	55.0
13-16	545	26.6	12,861	38.0
$\geq$ 17	32	1.6	1,701	5.0
35 years and older				
Race				
White, Mexican, Puerto Rican and all other Caucasians	62	72.9	1,298	91.0
Black	16	18.8	86	6.0
Indian			2	0.1
Chinese			2	0.1
Cajun or Creole			4	0.3
Filipino			5	0.4
Other Asian or Pacific Islander	7	8.3	30	2.1

[1]N varies because of missing data.

TABLE 3
Continued

Variables	WIC		Non-WIC	
	N[1]	Percentage	N[1]	Percentage
Marital status				
Married	66	77.6	1,347	94.4
Unmarried	19	22.4	80	5.6
Education				
1-8	17	20.0	98	6.9
9-12	43	50.6	681	47.7
13-16	20	23.5	499	35.0
$\geq$ 17	5	5.9	149	10.4

Maternal Behavioral Variables

Smoking habits and utilization of prenatal care service were examined for WIC and non-WIC women of each age group. In both age groups, 4.2% of the WIC women reported smoking during pregnancy while in the non-WIC group 2.4% of the 20 to 34 year olds and 2.2% of women 35 years and older were smokers (Table 4). Over 75% of the WIC and non-WIC women in both age groups received care in the first trimester; only 1% or less received no prenatal care. In the younger and older age groups the percentages of WIC women making fewer than 9 visits for prenatal care, 28.2% and 31.3%, respectively, were slightly more than for the non-WIC women, 22.2% and 28.0%, respectively (Table 4). In a Massachusetts study Kennedy et al. (9) found that more than 40% of the WIC prenatal participants and women in the non-WIC comparison groups made 8 or fewer prenatal visits.

Pregnancy Outcome

The incidence of stillbirths was higher in the WIC group for both ages than in the non-WIC groups (Table 5). Older women in both study groups delivered about 1% more stillborn infants than younger women. Births were about evenly divided between males and females in all groups (Table 5). The highest percentage (9.2%) of twins was born to older WIC women compared to 3.8% to younger WIC women and about 2% to the non-WIC groups. Congenital malformations were reported in only about 1% of the births in all groups.

The mean birth weight of infants born to women in all groups ranged from 7.23 to 7.55 pounds. WIC and non-WIC women 35 years and older delivered more low birth weight infants (weighing 5½ lb or 2,500 g or less) than women in the 20 to 34 year old group (Table 5). Nine percent of the

TABLE 4
Maternal behavioral variables of Kansas women

Variables	WIC		Non-WIC	
	N[1]	Percentage	N[1]	Percentage
20 to 34 years				
Smoking habits				
Smoker	62	4.2	673	2.4
Non-smoker	1,431	95.8	26,831	97.6
Prenatal care				
Number of visits				
< 9	573	28.2	7,456	22.2
≥ 9	1,456	71.8	26,285	77.8
Month care began				
No care	14	0.7	132	0.4
1-3	1,527	75.3	27,986	83.7
4-6	407	20.1	4,555	13.7
7-9	80	3.9	751	2.2
35 years and older				
Smoking habits				
Smoker	2	4.2	23	2.2
Non-smoker	46	95.8	1,040	97.8
Prenatal care				
Number of visits				
< 9	26	31.3	398	28.0
≥ 9	57	68.7	1,022	72.0
Month care began				
No care	1	1.2	11	0.8
1-3	66	79.5	1,087	77.0
4-6	13	15.7	269	19.1
7-9	3	3.6	44	3.1

[1]N varies because of missing data.

TABLE 5
Pregnancy outcome of Kansas women

	WIC		Non-WIC	
	N[1]	Percentage	N[1]	Percentage
20 to 34 years				
Total births	2,074	100.0	34,110	100.0
Livebirths	2,046	98.6	33,860	99.3
Sex of infant				
Male	1,050	51.3	17,460	51.6
Female	996	48.7	16,400	48.4
Congenital malformations				
None	2,023	98.9	33,448	98.8
Malformation recorded	23	1.1	412	1.2
Birth weight (g)				
< 2,500	184	9.0	1,999	5.9
≥ 2,500	1,862	91.0	31,861	94.1
Sets of twins	39	3.8	335	2.0
Stillbirths	28	1.4	250	0.7
35 years and older				
Total births	87	100.0	1,452	100.0
Livebirths	85	97.7	1,427	98.3
Sex of infant				
Male	41	48.2	735	51.5
Female	44	51.8	692	48.5
Congenital malformations				
None	84	98.8	1,402	98.2
Malformation recorded	1	1.2	25	1.8
Birth weight (g)				
< 2,500	12	14.1	102	7.2
≥ 2,500	73	85.9	1,325	92.9
Sets of twins	4	9.2	13	2.5
Stillbirths	2	2.3	25	1.7

[1]N varies because of missing data.

infants born to WIC women 20 to 34 years had low birth weights compared to 5.9% in the non-WIC group. The percentages of low birth weight infants for WIC and non-WIC older women were 14.1 and 7.2, respectively. Our findings differ from those of Kotelchuck et al. (10) and Kennedy et al. (9), who reported a significantly lower incidence of low birth weight infants born to WIC participants than to non-WIC women. In the study by Kotelchuck et al. (10), the incidence of low birth weight infants born to WIC mothers was 6.9% compared to 8.7% for non-WIC women. Kennedy et al. (9) reported an incidence of 6.9% low birth weight infants for WIC mothers, 8.8% for non-WIC mothers and 10.1% for a comparison group (women who had applied for WIC during pregnancy but were not certified because of lack of openings or were certified post-partum).

The percentage of infants with 1 and 5 min Apgar scores in each of the scoring categories were similar for WIC and non-WIC women in both age groups (Table 6). At 1 min nearly 90% of the infants in all of the study groups scored from 7 to 10, and at 5 min 98% or more scored between 7 and 10 (Table 6). Springer et al. (23) found that the majority of the 204 infants born to women participating in the Detroit Maternity and Infant Care Project had scores of 7 to 10 at birth. The mean scores of the infants were 8.0 and 9.4 at 1 and 5 min, respectively.

WIC Participation

About 44% of the younger WIC women purchased less than $100.00 worth (proportional voucher dollar sum) of supplemental foods during gestation; only 23% spent more than $175.00. In contrast only 23% of the older WIC women spent less than $100.00 during their pregnancy and 47% purchased more than $175.00 worth of supplemental foods.

TABLE 6
Apgar scores of infants born to Kansas women

Score	WIC		Non-WIC	
	N[1]	Percentage	N[1]	Percentage
20 to 34 years				
One minute				
0-3	27	1.6	581	1.9
4-6	159	9.3	2,468	8.1
7-10	1,468	89.1	26,674	90.0
Five minute				
0-3	9	0.5	177	0.6
4-6	24	1.4	406	1.3
7-10	1,614	98.1	29,056	98.1
35 years and older				
One minute				
0-3	2	3.2	25	2.0
4-6	3	4.8	111	9.0
7-10	58	92.0	1,069	89.0
Five minute				
0-3	0	0	8	0.6
4-6	0	0	18	1.5
7-10	62	100	1,177	97.9

[1]N varies because of missing data.

TABLE 7
Mean, standard deviation, and coefficient of variation of the proportional voucher dollar sum for Kansas WIC women during pregnancy

	N	$\bar{X}$	SD	CV
				%
20 to 34 years				
Proportional voucher dollar sum	1,447	131.21	95.26	72.6

	N	Percentage
Proportional voucher dollar sum		
< 24.00	80	5.5
25.00 - 49.00	172	11.9
50.00 - 74.00	182	12.6
75.00 - 99.00	198	13.7
100.00 - 124.00	131	9.7
125.00 - 149.00	190	13.2
150.00 - 174.00	132	9.8
175.00 - 199.00	101	6.9
≥ 200.00	242	16.7

	N	$\bar{X}$	SD	CV
				%
35 years and older				
Proportional voucher dollar sum	55	179.91	139.50	77.5

	N	Percentage
Proportional voucher dollar sum		
< 24.00	2	3.6
25.00 - 49.00	5	9.1
50.00 - 74.00	6	10.9
75.00 - 99.00	3	5.5
100.00 - 124.00	6	10.9
125.00 - 149.00	3	5.5
150.00 - 174.00	4	7.2
175.00 - 199.00	6	10.9
≥ 200.00	20	36.4

Factors Affecting Birth Weight

Race

The analysis of covariance for effects of selected variables on infant birth weight (Table 8) showed significant differences in the birth weight of infants among women 20 to 34 years of different races for both WIC and non-WIC groups, and a slight difference in the 35 years and older groups, WIC and non-WIC. The least square means and standard errors are listed in Table 9. Kennedy et al. (9) studied factors affecting the birth weight of infants born to Massachusetts prenatal WIC participants using multiple regression analysis. They reported that socio-demographic factors including racial/ethnic groups did not influence prenatal outcome when biological variables were held constant. The significant differences in mean birth weights among the races studied were attributed to difference in the total weight gain of the mother and in gestational age at birth in the various racial/ethnic groups.

Biological Factors

In the WIC group of women 20 to 34 years all selected variables were associated significantly and independently with birth weight (Table 8). For each additional 1 pound increase in maternal weight gain, the birth weight of infants born to WIC mothers 20 to 34 years increased by 0.0486 pound (Table 10). In the non-WIC group for this age, all maternal variables tested had a significant impact on birth weight, indicating a nonlinear relationship (Table 8). Maternal variables had no significant effect on birth weight in WIC women 35 years and older. In the non-WIC group of this age, all the variables affected birth weight significantly except the square term for maternal weight gain.

TABLE 8
General linear model analysis of covariance for effects of selected variables on infant birth weight for Kansas WIC and non-WIC women

Source of variation	WIC			Non-WIC		
	df	Mean squares	F	df	Mean squares	F
20 to 34 years						
Maternal race	6	7.35	5.46**	9	63.02	51.31***
Pregravid weight (lb)	1	21.11	15.67***	1	313.35	255.13***
Pregravid weight square	1	9.59	7.12**	1	113.21	92.18***
Maternal weight gain (lb)	1	29.02	21.54***	1	627.79	511.15***
Maternal weight gain square	1	7.61	5.65*	1	160.94	131.04***
Proportional voucher dollar sum	1	6.27	4.65*			
Error	918	1.35	14.58	23,093	1.23	281.34
R^2	0.1487			0.1367		
35 years and older						
Maternal race	2	2.26	2.35	6	5.17	3.49**
Pregravid weight (lb)	1	0.07	0.07	1	19.23	12.98***
Pregravid weight square	1	0.10	0.11	1	7.25	4.89*
Maternal weight gain (lb)	1	3.11	3.23	1	27.12	18.30***
Maternal weight gain square	1	0.64	0.66	1	5.45	3.68
Proportional voucher dollar sum	1	1.96	2.03			
Error	20	0.96	2.82	894	1.48	15.46
R^2	0.4967			0.1475		

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$

TABLE 9
Least square means and standard errors of birth weight (pounds) by race of Kansas WIC and non-WIC women from analysis of effects of selected variables

Race	Least square means and standard errors	
	WIC	Non-WIC
20 to 34 years		
White, Mexican, Puerto Rican, and all other Caucasians	7.4544 ± 0.0481	7.5909 ± 0.0076
Black	7.0423 ± 0.0665	6.9503 ± 0.0293
Indian	7.9898 ± 0.2911	7.4879 ± 0.1052
Chinese	6.8252 ± 0.8216	7.5218 ± 0.2420
Japanese		8.1201 ± 0.3343
Cajun or Creole	7.6630 ± 0.6735	8.0142 ± 0.1800
Hawaiian		7.4575 ± 0.4527
Filipino	7.5959 ± 1.1620	7.4836 ± 0.2096
Other Asian or Pacific Islander	7.7368 ± 0.3301	7.4926 ± 0.0774
35 years and older		
White, Mexican, Puerto Rican, and all other Caucasians	7.7228 ± 0.2308	7.6270 ± 0.0422
Black	6.8551 ± 0.4115	6.8427 ± 0.1922
Indian		6.6122 ± 1.2196
Chinese		8.4866 ± 1.2185
Cajun or Creole		7.6971 ± 0.7038
Filipino		8.1277 ± 0.7043
Other Asian or Pacific Islander	8.2743 ± 0.6340	8.1213 ± 0.2801

Springer et al. (24) reported that increases in maternal weight gain and pregravid weight were accompanied by increases in infant birth weight. Kennedy et al. (9) reported that maternal weight gain and gestational age exerted the greatest influence on birth weight. For each additional pound of maternal weight gain, birth weight increased by 0.02061 pound while an added week of gestation increased birth weight by 0.3699 pound. Both pregravid weight and the square term were associated significantly with birth weight indicating a curvilinear relationship to birth weight.

WIC Participation

WIC supplemental feeding, as measured by the proportional value of the cashed vouchers for women 20 to 34 years showed a significant relationship to birth weight, while there was no association in the 35 years and older group (Table 8). Data from other WIC studies (8, 9, 10) in which the effect of WIC was measured by the number of vouchers received, redeemed or the length of maternal participation have indicated a positive effect of WIC on pregnancy outcome.

Edozien et al. (8) reported an increase in mean birth weight attributable to WIC participation. Kotelchuck et al. (10) found that WIC participation was associated with a lower incidence of low birth weight infants and neonatal mortality. Kennedy et al. (9) reported that WIC participation and the number of vouchers were positively associated with birth weight.

Results of non-WIC supplementation studies have been less conclusive. Those in developing countries (16, 17, 18) have shown a definite positive impact on infant birth weight, while no significant associations between supplements and birth weight were demonstrated in studies by Dieckmann et al. (19) and Adams et al. (21) in the United States.

Comparison of the Partial Regression Coefficients of Selected Maternal Variables Between WIC and Non-WIC Women

The partial regression coefficients for all maternal variables on infant birth weight (Table 10) did not differ between the WIC and non-WIC women aged 20 to 34 years. The variables were significant in both groups but the magnitude of the impact did not differ. There was a significant impact of the maternal variables on birth weight in the non-WIC women aged 35 years and older but no significance was shown in the WIC women probably due to the small sample size.

Subset IV and VI Women

Subsets IV and VI were comprised of women 20 to 34 years and 35 years and older, respectively, with W≠1 indicating that they did not participate in WIC during the pregnancy under study or that it was not possible to verify their WIC participation. Means, standard deviations, and coefficients of variation for maternal biological variables are listed in Table 11 (Appendix B). Frequency distributions and percentages for maternal biological, social, and behavioral variables, pregnancy outcome, and Apgar scores are recorded in Tables 12 to 16 (Appendix B). The analysis of covariance for the effect of selected variables on infant birth weight for both subsets and the least square means and standard errors for race are listed in Tables 17 and 18 (Appendix B). The partial regression coefficients and standard errors from the analysis are recorded in Table 19 (Appendix B).

TABLE 10
Partial regression coefficients and standard errors from analysis of the effects of infant birth weight on selected variables for Kansas WIC and non-WIC women

Variables	WIC		Non-WIC	
	$\hat{B}_i$	Std error	$\hat{B}_i$	Std error
20 to 34 years				
Pregravid weight (lb)	0.0284	0.0072	0.0272	0.0017
Pregravid weight square	-5.9145-05	2.2170-05	-5.1332-05	0.5300
Maternal weight gain (lb)	0.0486	0.0105	0.0541	0.0024
Maternal weight gain square	-0.0004	0.1495	-0.0004	0.0357
Proportional voucher dollar sum	0.0009	0.0004		
35 years and older				
Pregravid weight (lb)	0.0455	0.0993	0.0348	0.0096
Pregravid weight square	-0.0001	0.2917	-6.5226-05	2.9490-05
Maternal weight gain (lb)	-0.0007	0.1986	0.0575	0.0134
Maternal weight gain square	0.0011	0.0037	-0.0004	0.2232-04
Proportional voucher dollar sum	0.0019	0.0021		

SUMMARY

The effect of WIC supplemental feeding and selected maternal variables on the birth weight of infants born to Kansas prenatal WIC participants aged 20 years and older who gave birth between July 1, 1979 and June 30, 1980 were investigated. The influence of the same maternal variables on the birth weight of infants born to Kansas women who gave birth during the same time period but did not participate in the WIC program were examined, and the impact of each variable on birth weight was compared between the two groups.

Data for the study were extracted from two previously collected but unlinked data sets. The WIC files provided documentation of the names of prenatal WIC participants along with the extensiveness of their WIC participation. The Kansas Birth History Master File was the source of data on maternal variables and pregnancy outcome for all women giving birth during the study period. Birth certificate numbers were hand-linked to corresponding WIC case numbers to derive the WIC group. Data on women aged 20 years and older remaining in the Birth History Master File served as the non-WIC comparison group. Pregnancy outcome data were available for 2,161 WIC and 35,562 non-WIC women. For study purposes the women were divided into two age groups 20 to 34 years and 35 years and older. In the younger age groups there were 2,074 WIC and 34,110 non-WIC women; 87 WIC and 1,452 non-WIC in the older age group.

The mean age for WIC and non-WIC women in the younger group was approximately 25 years with nearly half in both groups being 24 years or less at delivery. Mean age for the older WIC and non-WIC groups was 37 years with over 85% being 34 to 39 years at delivery. About 60% of the younger women in both groups weighed 139 pounds or less prior to pregnancy

and 95% were 60 to 69 inches tall. There was more variation in weight and height between the older age groups. In both age groups a greater percentage of the WIC women were black and unmarried compared to non-WIC. More non-WIC than WIC women in both age groups had completed some college education. Over 75% of all the women in the study groups received prenatal care in the first trimester, only 1% or less received no prenatal care.

Both age groups of WIC women had a higher percentage of infants weighing less than 2,500 grams compared to non-WIC. Apgar scores for infants born to WIC and non-WIC mothers in both age groups were high. At 1 minute 90% and at 5 minutes 95% scored between 7 and 10.

The analysis of covariance for the effects of selected variables on infant birth weight indicated that there were significant differences in the birth weight of infants among women of different races in both age groups for WIC and non-WIC. Selected maternal variables were associated significantly with birth weight for both WIC and non-WIC women aged 20 to 34 years but only for non-WIC women in the older group. WIC supplemental feeding, as measured by the sum of the proportional value of the cashed vouchers, for the pregnant women during gestation, had a significant impact on birth weight of infants born to women 20 to 34 years of age.

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APPENDIXES

APPENDIX A

Data Extracted from the Kansas Birth History Master File 1979-80

Data Extracted from the Kansas Birth History
Master File 1979-80

Maternal Biological Variables

age
height
weeks gestation
weight gain
pregravid weight

Maternal Social Variables

race
marital status
education

Maternal Behavioral Variables

smoking habits
prenatal care
- number of visits
- month care began

Pregnancy Outcome

livebirths
- sex of infant
- congenital malformations
- birth weight
- twins
- Apgar scores

stillbirths

APPENDIX B

Tables for Subsets IV and VI Women

TABLE 11
Means, standard deviations, and coefficients of variation of maternal biological variables of Kansas women

Variables	N[1]	$\bar{X}$	SD	CV
				%
20 to 34 years--Subset IV				
Age (yr)	1,546	24.51	3.65	14.9
Pregravid weight (lb)	981	143.14	44.32	31.0
Height (in)	893	64.27	2.81	4.4
Weight gain (lb)	966	27.89	12.49	44.8
Weeks gestation	1,491	39.25	4.16	10.6
35 years and older--Subset VI				
Age (yr)	73	37.77	2.34	6.2
Pregravid weight (lb)	41	154.83	48.66	31.4
Height (in)	37	63.78	3.90	6.1
Weight gain (lb)	38	22.87	9.16	40.0
Weeks gestation	71	39.34	2.39	6.1

[1]N varies because of missing data.

TABLE 12
Maternal biological variables of Kansas women

Variables	N[1]	Percentage
20 to 34 years--Subset IV		
Age (yr)		
20-24	891	57.6
25-29	471	30.5
30-34	184	11.9
Pregravid weight (lb)		
< 99	37	3.8
100-119	206	21.0
120-139	327	33.3
140-159	186	19.0
160-179	81	8.2
180-199	58	5.9
≥ 200	86	8.8
Height (in)		
< 59	28	3.1
60-64	446	50.0
65-69	398	44.5
≥ 70	21	2.4
Weight gain (lb)		
0-10	15	6.2
11-20	229	23.7
21-30	287	32.8
31-40	241	25.0
41-50	81	8.4
≥ 51	38	3.9
Weeks gestation		
< 37	230	15.4
37-42	1,112	74.6
> 42	149	10.0

[1]N varies because of missing data.

TABLE 12
Continued

Variables	N[1]	Percentage
35 years and older--Subset VI		
Age (yr)		
35-39	56	76.7
40-44	16	21.9
≥ 45	1	1.4
Pregravid weight (lb)		
< 99	1	2.4
100-119	7	17.1
120-139	8	19.5
140-159	13	31.8
160-179	3	7.3
180-199	3	7.3
≥ 200	6	14.6
Height (in)		
< 59	4	10.8
60-64	16	43.3
65-69	16	43.3
≥ 70	1	2.6
Weight gain (lb)		
0-10	2	5.3
11-20	18	47.3
21-30	10	26.3
31-40	7	18.5
41-50	1	2.6
≥ 51	0	0.0
Weeks gestation		
< 37	7	9.9
37-42	62	87.3
> 42	2	2.8

TABLE 13
Maternal social variables of Kansas women

Variables	N[1]	Percentage
20 to 34 years--Subset IV		
Race		
White, Mexican, Puerto Rican, and all other Caucasians	1,064	68.7
Black	417	27.0
Indian	27	1.7
Chinese	3	0.2
Cajun or Creole	6	0.4
Hawaiian	1	0.1
Filipino	1	0.1
Other Asian or Pacific Islander	28	1.8
Marital status		
Married	1,160	75.0
Unmarried	386	25.0
Education (yr)		
1-8	89	5.8
9-12	1,086	70.2
13-16	352	22.7
≥ 17	20	1.3
35 years and older--Subset VI		
Race		
White, Mexican, Puerto Rican, and all other Caucasians	48	65.8
Black	18	24.7
Cajun or Creole	2	2.7
Other Asian or Pacific Islander	5	6.8
Marital status		
Married	56	76.7
Unmarried	17	23.3
Education (yr)		
1-8	17	23.3
9-12	39	53.4
13-16	13	17.8
≥ 17	4	5.5

[1]N varies because of missing data.

TABLE 14
Maternal behavioral variables of Kansas women

Variables	N[1]	Percentage
20 to 34 years--Subset IV		
Smoking habits		
Smoker	54	4.6
Non-smoker	1,113	95.4
Prenatal care		
Number of visits		
< 9	499	32.6
> 9	1,031	67.4
Month care began		
no care	23	1.5
1-3	1,102	72.4
4-6	326	21.4
7-9	71	4.7
35 years and older--Subset VI		
Smoking habits		
Smoker	1	1.8
Non-smoker	54	98.2
Prenatal care		
Number of visits		
< 9	28	39.4
> 9	43	60.6
Month care began		
no care		
1-3	46	64.8
4-6	13	18.3
7-9	12	16.9

[1]N varies because of missing data.

TABLE 15
Pregnancy outcome of Kansas women

	N[1]	Percentage
20 to 34 years--Subset IV		
Total births	1,562	100.0
Livebirths	1,547	99.0
Sex of infant		
Male	769	49.7
Female	778	50.3
Congenital malformations		
None	1,527	98.7
Malformation recorded	20	1.3
Birth weight (g)		
< 2,500	186	12.0
≥ 2,500	1,361	88.0
Sets of twins	31	4.0
Stillbirths	15	1.0
35 years and older--Subset VI		
Total births	75	100.0
Livebirths	73	97.3
Sex of infant		
Male	36	49.3
Female	37	50.7
Congenital malformations		
None	70	95.9
Malformation recorded	3	4.1
Birth weight (g)		
< 2,500	10	13.7
≥ 2,500	63	86.3
Sets of twins	1	2.7
Stillbirths	2	2.7

[1]N varies because of missing data.

TABLE 16
Apgar scores of infants born to Kansas women

Score	N[1]	Percentage
20 to 34 years--Subset IV		
One minute		
0-3	26	2.0
4-6	130	9.8
7-10	1,129	88.2
Five minute		
0-3	7	0.5
4-6	21	1.6
7-10	1,254	97.9
35 years and older--Subset VI		
One minute		
0-3	5	8.2
4-6	4	6.6
7-10	52	85.2
Five minute		
0-3	1	1.6
4-6	1	1.6
7-10	59	96.8

[1]N varies because of missing data.

TABLE 17
General linear model analysis of covariance for effects of selected variables on infant birth weight for Kansas women

Source of variation	df	Mean squares	F
20 to 34 years--Subset IV			
Maternal race	5	4.47	3.66
Pregravid weight (lb)	1	2.76	2.26
Pregravid weight square	1	0.15	0.13
Maternal weight gain (lb)	1	5.34	4.37
Maternal weight gain square	1	1.10	0.90
Voucher dollar sum	1	0.55	0.45
Error	489	1.22	7.06
R^2			0.1262
35 years and older--Subset VI			
Maternal race	3	0.7767	0.30
Pregravid weight (lb)	1	0.5498	0.21
Pregravid weight square	1	0.4261	0.16
Maternal weight gain (lb)	1	0.00003	0.00
Maternal weight gain square	1	0.2190	0.08
Voucher dollar sum	1	2.1233	0.81
Error	12	2.622	0.29
R^2			0.1632

TABLE 18
Least square means and standard errors of birth weight (pounds) by race of Kansas women from analysis of effects of selected variables

Race	Least square means and standard errors
20 to 34 years--Subset IV	
White, Mexican, Puerto Rican, and all other Caucasians	7.5421 ± 0.0612
Black	7.1159 ± 0.0917
Indian	7.3746 ± 0.2879
Cajun or Creole	8.3329 ± 0.7872
Hawaiian	7.1719 ± 1.1278
Other Asian or Pacific Islander	8.003 ± 0.3999
35 years and older--Subset VI	
White, Mexican, Puerto Rican, and all other Caucasians	7.7429 ± 0.4266
Black	6.8443 ± 1.0154
Cajun or Creole	8.4440 ± 1.7541
Other Asian or Pacific Islander	9.2223 ± 2.3717

TABLE 19
Partial regression coefficients and standard errors from analysis of the effects of infant birth weight on selected variables for Kansas women

Variables	$\hat{B}_i$	Std error
20 to 34 years--Subset IV		
Pregravid weight (lb)	0.0128	0.0085
Pregravid weight square	-8.7854-06	0.0002
Weight gain (lb)	0.0260	0.0124
Weight gain square	-0.0002	0.0002
Voucher dollar sum	0.0002	0.0003
35 years and older--Subset VI		
Pregravid weight (lb)	0.0455	0.0993
Pregravid weight square	-0.0001	0.0003
Weight gain (lb)	-0.0007	0.1986
Weight gain square	0.0011	0.0037
Voucher dollar sum	0.0019	0.0021

PREGNANCY OUTCOMES OF KANSAS WIC PROGRAM PARTICIPANTS AGED 20 YEARS AND OLDER

by

ANITA J. CORDILL

B.S., Fort Hays State University, 1981

AN ABSTRACT OF A MASTER'S THESIS

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Department of Foods and Nutrition

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The effect of WIC supplemental feeding and selected maternal variables on the birth weight of infants born to Kansas prenatal WIC participants aged 20 years and older who gave birth between July 1, 1979 and June 30, 1980 were investigated. The influence of the same maternal variables on the birth weight of infants born to Kansas women who gave birth during the same time period but did not participate in the WIC program were examined, and the impact of each variable on birth weight was compared between the two groups.

Data for the study were extracted from two previously collected but unlinked data sets. The WIC files provided documentation of the names of prenatal WIC participants along with the extensiveness of their WIC participation. The Kansas Birth History Master File was the source of data on maternal variables and pregnancy outcome for all women giving birth during the study period. Birth certificate numbers were hand-linked to corresponding WIC case numbers to derive the WIC group. Data on women aged 20 years and older remaining in the Birth History Master File served as the non-WIC comparison group. Pregnancy outcome data were available for 2,161 WIC and 35,562 non-WIC women. For study purposes the women were divided into two age groups 20 to 34 years and 35 years and older. In the younger age groups there were 2,074 WIC and 34,110 non-WIC women; 87 WIC and 1,452 non-WIC in the older age group.

The mean age for WIC and non-WIC women in the younger group was approximately 25 years with nearly half in both groups being 24 years or less at delivery. Mean age for the older WIC and non-WIC groups was 37 years with over 85% being 34 to 39 years at delivery. About 60% of the younger women in both groups weighed 139 pounds or less prior to pregnancy and 95% were 60 to 69 inches tall. There was more variation in weight and

height between the older age groups. In both age groups a greater percentage of the WIC women were black and unmarried compared to non-WIC. More non-WIC than WIC women in both age groups had completed some college education. Over 75% of all the women in the study groups received prenatal care in the first trimester, only 1% or less received no prenatal care.

Both age groups of WIC women had a higher percentage of infants weighing less than 2,500 grams compared to non-WIC. Apgar scores for infants born to WIC and non-WIC mothers in both age groups were high. At 1 minute 90% and at 5 minutes 95% scored between 7 and 10.

The analysis of covariance for the effects of selected variables on infant birth weight indicated that there were significant differences in the birth weight of infants among women of different races in both age groups for WIC and non-WIC. Selected maternal variables were associated significantly with birth weight for both WIC and non-WIC women aged 20 to 34 years but only for non-WIC women in the older group. WIC supplemental feeding, as measured by the sum of the proportional value of the cashed vouchers, for the pregnant women during gestation, had a significant impact on birth weight of infants born to women 20 to 34 years of age.