ANALYSIS OF WHOLE MILK VS. LOW-FAT MILK CONSUMPTION AMONG WIC CHILDREN BEFORE PROGRAMMATIC CHANGES

A Thesis

by

EMINE BAYAR

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2011

Major Subject: Agricultural Economics

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Approved by:

Co-Chairs of Committee,	Ariun Ishdorj
	Oral Capps, Jr.
Committee Members,	Peter S. Murano
	David A. Bessler
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ABSTRACT

Analysis of Whole Milk vs. Low-Fat Milk Consumption Among WIC Children Before Programmatic Changes. (May 2011)

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Co-Chairs of Advisory Committee: Dr. Ariun Ishdorj
Dr. Oral Capps, Jr.

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is one of the food assistance programs targeted at low-income women, infants and children up to age five by providing foods, nutrition education and other services. Recent updates in food packages provided by WIC include the addition of fruits, vegetables and whole wheat products as well as the removal of whole milk for women and children two years and older. This thesis concentrates on preschool children participants in the WIC program and their milk consumption habits prior to programmatic changes. Analyzing diet preferences of these children is crucial since a quarter of the population of children aged one thorough five participates in the WIC program; as well, they are not eligible to receive whole milk with WIC food packages after the implementation of revisions.

The objective is to describe the profile of preschool WIC children and their milk consumption attributes based on the National Food and Nutrition (NATFAN) questionnaire designed and conducted by the Institute for Obesity Research and Program Evaluation at Texas A&M University before the release of the revised WIC food packages. Additionally, findings of the study are compared with the National Health and Nutrition Examination Survey (NHANES) 2005-2006 dataset results. Milk consumption preferences of WIC children are analyzed nationwide and impacts of race, ethnicity, regional, and other demographic characteristics are observed. Using both NATFAN and

NHANES datasets provides a comparison of *actual* and *self-reported* participation outcomes.

Discrete choice models were used in this analysis, in particular binary logit and multinomial logit models. The results of the thesis indicate that WIC preschool children mostly drink whole milk (36.17%) and 2% fat milk (49.94%). Two year old participants, children located in the South and participants whose caregivers are younger and less educated are more likely to consume whole milk. Caucasian children are less likely to choose whole milk and more likely to choose reduced fat milk; African Americans are more likely to select whole milk. Furthermore, diet preferences and knowledge of parents/caregivers play a major role on milk consumption of children. Children whose caregivers are willing to give low-fat milk to children aged two to five are less likely to drink whole milk.

DEDICATION

To my beautiful family,

For their endless love, faith and support

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CHAPTER I

INTRODUCTION

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), aims to provide foods, nutrition education and other services to low-income women, infants, and children up to age five who are at nutritional risk. Initiated in 1972, this program is the third-largest food and nutrition assistance program following the Supplemental Nutrition Assistance Program (SNAP) and the National School Lunch Program (NSLP). The WIC program supplies grants for supplemental foods, nutrition services, and administration to 90 WIC State agencies, including all 50 States, the District of Columbia, 34 Indian Tribal Organizations, and 5 territories (Guam, the U.S. Virgin Islands, American Samoa, the Commonwealth of Puerto Rico and the Commonwealth of the Northern Mariana Islands). In 2010, 9.2 million people participated in WIC program; and roughly $ 6.7 billion was allocated to supply food packages and other services (USDA-FNS, 2010). According to the Food and Nutrition Service (FNS), about a quarter of all children aged 1 through 5 in the USA participates in the WIC Program. Children are the fastest growing group of WIC participants, with a 7% increase in fiscal year 2008 over fiscal year 2007 (Oliveira and Frazao, 2009). Almost half of the WIC participants (49.5%) were children in April 2008. The percentage of WIC children by age category is: 18.1 percent, 1 year of age; 12.7 percent, 2 years of age; 10.9 percent, 3 years of age; and 7.9 percent, 4 years of age. As age of the child increases, participation decreases (Connor et al., 2010).

The program benefits, usually in the form of checks or vouchers, allowed participants to obtain certain types of foods such as infant formula, juice, infant cereal, milk, cereal, cheese, eggs, peanut butter/dried beans, tuna (canned), and carrots. In 2000, the National Association of WIC Directors proposed some changes to the existing WIC food packages.

This thesis follows the style of *American Journal of Agricultural Economics*.

These changes included: (1) the addition of fruits and vegetables for all women and children; (2) the reduction of the amount of milk provided for children; and (3) the provision of foods for participants of different ethnic groups (National Association of WIC Directors, 2000).

Starting in October 2009, new food packages were implemented by WIC agencies. After the revisions, new food packages include fruits and vegetables as well as whole grains. The addition of these new food items brought about a cost increase to the program. In order to offset this increase in cost, the amount of dairy products provided to WIC participants was reduced. Before this revision, 24 quarts of milk (about 3 cups per day) were provided to children, but after the change, this amount reduced to 16 quarts (about 2 cups per day) (IOM, 2005) The revision not only reduced the amount of the milk provided but also eliminated whole milk from food packages for women and children aged two years and older. One cup (244 grams) of all milk types includes 8 grams of protein and 30% of the recommended dietary allowance (RDA) for calcium; however the total fat and saturated fat content amount varies by milk type. One cup of whole milk has8 grams of total fat, of which 5 grams is saturated fat, whereas same amount of 2% fat milk has 5 grams of total fat, of which 3 grams is saturated fat; 1% fat milk has only 2 grams of total fat, of which all is saturated fat, and skim milk has no fat whatsoever. Besides following the Dietary Guidelines for Americans and the American Academy of Pediatrics (AAP) recommendations, the goal of removing whole milk from WIC packages is to provide less saturated fat, cholesterol and total fat than previously.

The overall objective of this thesis is to gain knowledge about the insights of milk consumption habits of WIC children before the release of new food packages and observe who likely would be most affected by the elimination of whole milk from the food packages. Milk is chosen as the target food category of this research not only because there has been a revision related to it, but also because it is one of the most commonly consumed WIC products among children participating in the program. In addition, this research has several secondary objectives. First, we characterize the profiles of WIC children aged two through five and their milk type preferences. Second,

we analyze milk consumption of these children nationwide and observe differences by race, ethnicity, region, and other demographic characteristics. The NATFAN data set collected from 39 states separately gives us the opportunity to conduct state or region specific analysis if there is such an interest. Third, this study also uses NHANES 2005-2006 dataset and compares *actua*l and *self-reported* milk consumption behavior for WIC participants.

The WIC program is a widely studied food assistance program. Changes in the program make this research topic a noteworthy endeavor in terms of policy implications and nutrition outcomes of WIC participants. Most of the data used in the existing literature are from the large national surveys such as the NHANES (National Health and Nutrition Examination Survey), the CSFII (Continuing Survey of Food Intakes by Individuals) and the SNDA (School Nutrition Dietary Assessment). Although these data contain detailed information on individual food intakes and socio-demographic characteristics, they only provide *self-reported* program participation. In our research, we make use of the National Food Assistance and Nutrition (NATFAN) survey data, collected by the Institute for Obesity Research and Program Evaluation at Texas A&M University, which is based on the Texas Food and Nutrition Survey (TEXFAN) developed by the same research team (McKyer et al., 2010). The differentiating feature of these data rests on its collection nationwide from actual WIC participants via the agencies in which they are registered. Analyzing actual WIC participants eliminates any self-reporting bias. Besides being a nationwide analysis of WIC children, this study contributes to the existing literature by evaluating *actual* behavior of WIC children participants in milk consumption and comparing the results with the outcomes based on *self-reported* behavior.

This thesis is organized in six chapters. Chapter II is a review of literature based on studies done concerning WIC children participants. Chapter III presents the description of the discrete choice models used to analyze milk consumption behavior of WIC children. Chapter IV describes the NATFAN data used in this study. Chapter V includes the empirical results of the econometric models, binary choice and multinomial

choice models. In Chapter VI, a summary of the study is given and major conclusions are drawn.

CHAPTER II

LITERATURE REVIEW

In this chapter, we summarize previous studies concerning the impacts and effectiveness of the WIC program on targeted participating groups. There has been an enormous amount of work done on food consumption and nutrient intake of WIC participants. This thesis focuses on milk consumption of WIC children aged two through five; thus papers published related to WIC children participants are discussed in this chapter.

The major goal of WIC program is to provide nutritious foods to supplement the diets of children up to age five. There is a well established literature on WIC, eligible non-WIC and non-WIC children observing the effect of program participation on particular nutrient intakes. Analyzing nutrient intake of children is crucial since 25% of children population aged from 1 through 5 participates in the WIC program.

Rose et al. (1998) examined the effect of Food Stamp (now called Supplemental Nutrition Assistance Program) and WIC participation on nutrient intake of pre-school children by using the CSFII (Continuing Survey of Food Intakes by Individuals) data. The results indicated that WIC participation positively influences the intake of iron and zinc, but no significant relationship was evident concerning the percentage of energy from fat, saturated fat or cholesterol in the diet of pre-school children. Similarly, Oliveria and Gundersen (2000), after controlling for self-selection bias, found significant positive effects of WIC participation on children's intakes of iron, folate and vitamin B-6 using the 1994-1996 CSFII data set. Ishdorj et al. (2008) used the CSFII 1994-1996 data and examined children's intake of calcium from milk. They found that targeted WIC children participants do not have higher level of calcium intake from milk compared to targeted non-WIC children participants after accounting for the endogenous program participation. Most recently, Yen (2010) researched the effects of WIC on nutrient intake of pre-school children again using the 1994-1996 CSFII data sets and its

1998 Supplemental Children's Survey. This study found that WIC participation increases the intakes of iron, potassium and fiber of children.

Beyond the impact of WIC on intake of particular nutrients, Siega-Riz, et al. (2004), by using the 1994-1996 and 1998 CSFII data sets, investigated the effect of WIC participation on WIC pre-school children and found that prevalence of snacking among WIC children is significantly lower than non-WIC children. Hence, the WIC program has a positive impact on children's diet regarding the intake of fat, carbohydrates and added sugar from snacks, supporting healthy diet habits among pre-school children. Chandran (2003) examined the impact of WIC participation on diet quality of pre-school children by using the 1994-1996 and the 1998 CSFII data sets. Diet quality was determined by using USDA's Healthy Eating Index (HEI). The study found that WIC participation not only improved the diet of children but also reduced the consumption of added sugars.

Another reason to focus on children is the fact that the prevalence of obesity increased from 5.0% in 1976–1980 to 10.4% in 2007–2008 among children aged two through five (Ogden et al., 2010). This situation raised the question of whether or not food nutrition assistance programs work properly to reduce caloric intake on the dietary habits of children; in particular, the relationship between WIC program participation and the overweight and obesity problem among children was investigated. Cole (2001) investigated the prevalence of being overweight among WIC children using NHANES (National Health and Nutrition Examination Survey) data sets; this prevalence was high among Hispanic and Native American children, but decreased with age. Cole also found that from 1992 to 1998, white children had the largest increase in overweight prevalence. Children located in the Northeast and West regions had the highest overweight prevalence compared to other regions in 1992; children located in the Southwest had the greatest increase in overweight prevalence over the period 1992-1998.

Lin (2005) investigated the difference between WIC and non-WIC children in terms of their body weight status using NHANES data sets. Results found no difference between WIC children and income-eligible non-WIC children of ages one through four;

however WIC children were more likely to be overweight than children from higher-income families. Oliveira and Chandran (2005) using the 1994-1996 and 1998 CSFII data sets, found that WIC children consumed significantly more calories (only calories from milk, eggs, and beans/peas were used in the calculations) compared to ineligible non-participants, supporting the results of Lin's (2005) study. They also indicated that WIC participants consumed significantly more WIC-approved milk than eligible non-participants. Based on a survey conducted in 1994-1997 concerned with eating habits of two-year old children, Burstein et al. (2000) found that WIC children were significantly more likely to consume milk, cheese and juice at least once a day then non-WIC children. Ver Ploeg et al. (2009), using NHANES data sets from 1988-1994 and from 1999-2006 claimed that the WIC program was not a major cause of the childhood obesity problem. However, it was determined that Mexican-American WIC children had greater BMI (Body Mass Index) than non-Hispanic white children and non-Hispanic black children.

CHAPTER III

METHODOLOGY

This chapter develops the conceptual framework used to profile milk consumption habits of pre-school children, aged two through five, who participated in the WIC program. First, the theoretical foundation of the binary logit model is presented. Second, the multinomial logit model is presented. Third, an explanation of the appropriateness of these models to provide the framework of milk consumption habits among children is discussed.

Discrete Choice Models

Discrete choice models, also known as qualitative response (QR) models, are used to evaluate the selection from a set of alternatives; that is the dependent variable corresponds to a choice rather than a continuous measure of some activity. In QR models, the dependent variable is an indicator of a discrete choice such as preferring whole milk to low fat milk or choosing 2% fat milk among available milk types. For these kinds of discrete choice cases, conventional regression methods are not appropriate. Qualitative models allow linking these types of outcomes with the explanatory variables by using maximum likelihood estimation methods (Greene 2008).

There are different types of discrete models that apply in different situations. All of these regression models have a response (dependent) variable which is a categorical variable with two or more categories. In this thesis, we focus on two types of discrete choice models. The first is a binary logit model, where the dependent variable can be assigned to a value of 0 or 1 to indicate if the respondent chooses a particular product or not. The second is a multinomial logit model where the values of response variable correspond to more than two choices. Binary probit and logit models tend to give

extremely similar results (Capps and Kramer, 1985). Regarding the large sample size of data used in this study only binary and multinomial logit models are used.

Binary Logit Model

Binary logit models are used to explain the impact of explanatory variables on a binary (0/1) dependent variable. According to Greene (2008), the general framework of probability models can be represented by:

(3.1) $$\Pr(Y=1|x)=F(x,\beta) \text{ and } \Pr(Y=0|x)=1-F(x,\beta)$$

where Pr is the probability of the event occurring, Y is a discrete dependent variable, x is a vector of explanatory variables, β is a vector of parameter estimates, and $F(.)$ is the cumulative distribution function (CDF).

A linear model for the probability of event occurring can be denoted by:

(3.2) $$\Pr(Y=1|x)=\beta_0+\beta_1X_1+\beta_2X_2+\ldots+\beta_kX_k+\varepsilon=X^T\beta+\varepsilon$$

where in this case the probability Pr of the event occurring is linearly related to the set of explanatory variables $X_1, X_2, \ldots, X_k$ and their associated parameter estimates. X corresponds to the data matrix, β the vector of parameter estimates, and ε is the disturbance term. A standard Ordinary Linear Squares (OLS) regression is not strictly appropriate due to the discreteness of response variable and the constraint that the predicted probabilities must be between 0 and 1. Models based on a cumulative distribution functions (CDF) are used in order to guarantee that the estimated probabilities of discrete choice models lie in the 0-1 range.

The logistic distribution can be shown as: (Gujarati, 1995)

(3.3) $$\Pr(Y=1|x)=\frac{1}{1+e^{-Z}}=\frac{e^{Z}}{1+e^{Z}}$$

where $Z=X^T\beta$.

$$\Pr(Y=1|X)=\frac{1}{1+e^{-Z}} \text{ and } 1-\Pr(Y=1|X)=\frac{e^{-Z}}{1+e^{-Z}} \tag{3.4}$$

Then the ratio of odds given by:

$$\frac{\Pr(Y=1|X)}{1-\Pr(Y=1|X)}=\frac{\frac{1}{1+e^{-z}}}{\frac{e^{-z}}{1+e^{-z}}}=\frac{1}{e^{-z}}=e^{Z}. \tag{3.5}$$

Compute the natural log of both sides of Equation 3.6:

$$\ln\left(\frac{\Pr(Y=1|X)}{1-\Pr(Y=1|X}\right)=\ln\left(e^{Z}\right)=z=X^{T}\hat{\beta}. \tag{3.6}$$

This natural log expression is termed the logit.

The marginal effects correspond to the change in probability of $Y=1$ due to changes in the explanatory variables. The expected probability of the discrete choice model is given as:

$$\mathrm{E}[y|x]=F(x'\beta) \tag{3.7}$$

Green (2008) gives the marginal effect as:

$$\frac{\partial \mathrm{E}[y|x]}{\partial x}=\Lambda(x'\beta)[1-\Lambda(x'\beta)]\beta \tag{3.8}$$

where $\Lambda(.)$ is the density function of logistic cumulative distribution function. Equation 3.8 can be used when the explanatory variable is continuous. Marginal effects are calculated at the means of explanatory variables in this thesis.

In many cases, dummy variables are right hand-side variables. The marginal effect for a binary independent variable, say d, is:

$$\text{Marginal Effect} = \Pr[Y=1|\bar{x}_{(d)},d=1]-\Pr[Y=1|\bar{x}_{(d)},d=0] \tag{3.9}$$

where $\bar{x}_{(d)}$ denotes the means of all other explanatory variables in the model.

There are various ways to measure the goodness-of-fit for qualitative response (QR) models. While R^2 is used in conventional models, McFadden's (1974) likelihood ratio index (LRI) is used to measure the goodness-of-fit. This metric is given by

$$LRI = 1 - \frac{\ln L}{\ln L_0} \tag{3.10}$$

where $\ln L$ is the value of the log-likelihood function at the maximum likelihood estimates and $\ln L_0$ is the value of the log-likelihood function when all parameter estimates are zero except for the intercept. STATA uses the McFadden's LRI to calculate Pseudo- R^2 in binary and multinomial logit models (Long and Freese, 2001).

In this thesis, tests are done for individual variables as well as for group of variables using Wald test procedures in STATA (Long and Freese, 2001). In our model, we have group of explanatory variables corresponding to age of children, education and age of caregivers, race, region and willingness to give low-fat milk to children.

Multinomial Logit Model (MNL)

There are cases where it is necessary to model the effects of explanatory variables on the choice of respondents from a set that includes more than two unordered mutually exclusive alternatives.

Green (2008) explains the unordered choice models by the use of a random utility model. The utility of choosing alternative j for individual i among J alternatives is:

$$U_{ij} = z'_{ij}\theta + \varepsilon_{ij} \tag{3.11}$$

If we assume that U_{ij} is the maximum utility level from the given alternatives, then the statistical model is driven by the probability that choice j is made, which is,

$$\Pr(U_{ij} > U_{ik}) \text{ for all other } k \neq j \tag{3.12}$$

Following Cameron and Trivedi (2009), let there are m alternatives that the dependent variable y can take. Then if y corresponds to choice j then it is the j^{th} alternative where $j=1,\ldots,. m$ Define the probability that alternative j is chosen as

(3.13) $$p_j = \Pr[y = j] \quad j=1,\ldots\ldots m.$$

Introduce m binary variables for each observation y,

(3.14) $$y_j = 1 \text{ if } y = j \text{ and } y_i = 0 \text{ if } y \neq j .$$

Thus, y_j equals one if alternative j is selected and the remaining y_k is equal to zero. Hence, for each observation on y one of $y_1, y_2, \ldots\ldots y_m$ will be nonzero.
The probability that the individual i chooses the j^{th} alternative,

(3.15) $$P_{ij} = \Pr[y_i = j] = F_j(x_i, \beta), \quad j=1,\ldots, m \text{ and } i=1,\ldots, N.$$

The functional form of F_j is that the probabilities lie between 0 and 1 and sum over j to equal one. Then,

(3.16) $$P_{ij} = \Pr[y_i = j] = \frac{\exp(\beta_j x_i)}{\sum_{j=0}^{m} \exp(\beta_j x_i)} \ , \ j = 1,\ldots, m;$$

P_{ij} is the probability for the j^{th} alternative chosen by individual i. β_j is the coefficient vector estimated by the model, and following a normalization rule, the coefficient of base category is set to zero $(\beta_{base} = 0)$.
Each observation must fall into one of the m types of the various milk categories, thus for all i, (3.17) $$\sum_{j=0}^{m} P_{ij} = 1.$$

The coefficients associated with the multinomial logit model are difficult to interpret, but it is possible to derive marginal effects. The marginal effect of a change in a regressor is more complicated than the usual impact from a binary logit model; since there is a separate marginal effect on the probability of each outcome, these marginal

effects sum to zero since the probabilities sum to one. The change in the probability of j^{th} alternative given unit change in x_i is

(3.18) $$\frac{\partial P_{ij}}{\partial x_i} = P_{ij}[\beta_j - (\sum_{j=0}^{m} \beta_j P_{ij})] \quad j = 1,\ldots, m$$

Given that $\sum_{j=0}^{m} \frac{\partial P_{ij}}{\partial x_i} = 0,$ the sign of the coefficient for any explanatory variable does not need to be same as the sign of marginal effect. Coefficient estimation needs an iterative estimation procedure since the log-likelihood function is nonlinear in parameters. (Capps et al., 1999). . In order to get the change in the probability of choosing j^{th} alternative relative to base category when there is a unit change in the explanatory variable, it is necessary to compute the relative risk ratio (RRR):

(3.19) $$\Pr[y = j \Big| y = jork] = \frac{p_j}{p_j + p_k}$$

Suppose normalization is on alternative 1, then $\beta_1 = 0$ and similar to the binary logit model the relative risk of choosing alternative j rather than alternative 1 (base category)

(3.20) $$\frac{\Pr[y_i = j]}{\Pr[y_i = 1]} = \exp(x_i' \beta_j).$$

Goodness of fit can be measured by using McFadden's LRI as in the case of binary logit models. Similarly, hypothesis tests associated with the coefficients can be done by using Wald tests or Likelihood Ratio (LR) tests.

If none of the independent variables significantly affect the choice of alternative k versus alternative j, then we can conclude that k and j are indistinguishable with respect to the variables used in the model (Anderson, 1984). Then, our null hypothesis is $H_0 : \beta_{1,k|j} = \ldots = \beta_{M,k|j} = 0$. Both Wald and LR tests are used in this thesis to check on this hypothesis.

The odds ratios in the multinomial logit model (MNL) are independent of the other alternatives; this situation is known as the independence of irrelevant alternatives (IIA) assumption. That is P_{ik} / P_{ij} is independent of remaining probabilities and adding or deleting alternatives will not affect the odds of the remaining alternatives. Hausman and McFadden (1984) introduced a Hausman-type test; McFadden, Tye and Train (1976) proposed an approximate likelihood ratio test that was modified by Small and Hsiao (1985). These tests are done for the MNL model in this thesis.

CHAPTER IV

SURVEY QUESTIONNAIRE AND DATA

This study is based on the National Food and Nutrition (NATFAN[1]) questionnaire designed to gather information about the WIC foods from participating mothers, infants, and children at WIC clinics throughout the nation. NATFAN surveys were designed and conducted by the Institute for Obesity Research and Program Evaluation at Texas A&M University. The purpose of this survey study was to meet the research requirements of the National WIC Association (NWA) Evaluation Committee, the USDA Economic Research Service (ERS) and Food and Nutrition Service (FNS).

The questionnaire targets actual WIC participants and aims to provide information about their food choice insights and the demographics of the participants. The questionnaire includes separate sections for women, infants and children, and each participant fills only the sections that are relevant for the family.

The NWA Board agreed to support the NATFAN questionnaire survey in October, 2008 and each state director was informed. Accordingly, WIC programs in thirty-nine states and thirteen ITOs, five territories, and the District of Columbia agreed to participate in this survey. The distribution of questionnaires was done from February 2009 to August 2009. About 110,000 questionnaires were mailed out. The NATFAN pre-rollout questionnaire was collected from over 80,000 WIC participants in 36 states, 11 ITOs, Washington DC, and one US Territory at WIC clinics throughout the nation between November 2008 and September 2009, prior to the implementation of the new WIC food packages. This thesis used only the questionnaires completed for children; a sample questionnaire is given in Appendix A.

[1]For information about NATFAN, contact Dr. Peter Murano, psmurano@tamu.edu at the Institute for Obesity Research and Program Evaluation.

In total 34,228 surveys for children were collected from WIC clinics from 36 states and District of Colombia (DC). Delaware, Idaho, Louisiana, Maine, Michigan, Minnesota, New York, North Dakota, Ohio, Oklahoma, Rhode Island, South Carolina, Texas and Utah are the states that did not participate in NATFAN study for various reasons. Some of the states like New York and Texas have their own survey similar to NATFAN; hence they were not part of this analysis. Table 4.1 gives the number of WIC children that participated in the program in fiscal year (FY) 2009, as well as average participation from October, 2008 to September, 2009 (USDA-FNS, 2010). The NATFAN data also are listed side by side to present the distribution of collected responses nationwide. Participation in some of the states is over estimated, while some other states, participation are under estimated.

The NATFAN data the data are collected from participant states separately. In order to observe regional effects, dummies variables were created for four regions following by the Centers for Disease Control and Prevention's (CDC) classification (see Appendix B). According to this classification, regions for the West, Midwest, Northeast and South were developed.

Description, means and standard deviation of the variables used in the analysis are given in Table 4.1. Since all of the explanatory variables are dummy variables, we can use mean values as percentage values. From Table 4.1the participation rate of male and female children is roughly same, children two years old comprise 40 percent of the NATFAN sample, children three years old make up 34 percent of the sample, and children four years old constitute the remaining 26 percent. White non-Hispanic children (49%) and white Hispanic children (24%) dominate this sample; caregivers mostly with a high school or less than a high school degree account for 58% of the sample observations. Those caregivers aged between 25 and 35 comprise 52% of the sample. Even though we are missing some of the notable WIC participant states, the data represent the regions almost evenly, West (29%), Midwest (25%), Northeast (18%) and South (28%). Variables "Give 2%, 1% or skim milk" variables are used to observe the impact of the perception of the caregiver's healthy diet choice on the child's

consumption habits. Since our target group is children aged between 2 and 5, caregivers, most of the times correspond to the mother of the children. Knowledge and willingness to choose healthier foods for their children likely plays a much larger role for pre-school children compared to pre-adolescents and adolescents. Answers to these questions also sheds light on the recent changes done on WIC packages by removing whole milk from food packages for children aged 2 and older. Our data set indicates that 75% of the caregivers are willing to give 2% fat milk to their children. However, for 1% and fat-free milk, their willingness decreases to 42% and 25%, respectively. Most of the caregivers prefer 2% fat milk among low-fat milk alternatives provided by WIC.

We focus on only children who receive WIC packages in last month, mostly drink cow's milk and aged between 2 and 5. Consequently, applying these restrictions and deleting the missing variables, 12,538 observations were available for use in the analysis. Figure 4.1 and Table 4.2 gives an overview concerning milk preferences of WIC children.

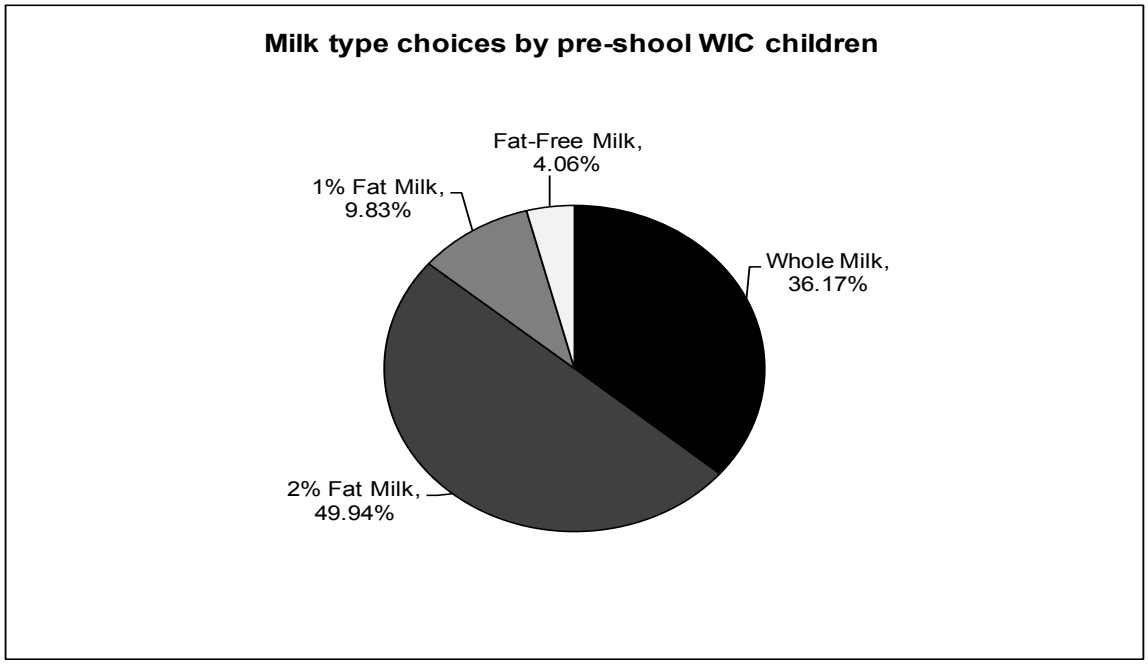

Figure 4.1: Milk type choices by pre-school WIC children

Table 4.1: Definition, Means and Standard Deviation of Explanatory Variables

Variable	Description	Mean
Gender		
Male	1 if child is male, else 0	0.51
Female (Base category)	1 if child is female, else 0	0.49
Age of Children		
Two	1 if child is 2 years old, else 0	0.40
Three	1 if child is 3 years old, else 0	0.34
Four (Base category)	1 if child is 4 years old, else 0	0.26
Race		
White Non-Hispanic	1 if caregiver is White, else 0	0.49
African American	1 if caregiver is Black, else 0	0.15
White Hispanic	1 if caregiver is White Hispanic, else 0	0.24
Other Hispanic	1 if caregiver is Other Hispanic, else 0	0.04
Other Race (Base category)	1 if caregiver's race is others, else 0	0.08
Education of Caregiver		
Less High School	1 if caregiver's education level is less than high school, else 0	0.23
High School	1 if caregiver's education level is high school, else 0	0.35
Some College	1 if caregiver's education level is college, else 0	0.35
College(Base category)	1 if caregiver's education level is university, else 0	0.07
Age of Caregiver		
Age lessthan25	1 if caregiver's age is less than 25, else 0	0.28
Age 25-34	1 if caregiver's age is btw. 25-34, else 0	0.52
Age 35-44	1 if caregiver's age is btw. 35-44, else 0	0.17
Age 45-54	1 if caregiver's age is btw. 45-54, else 0	0.03
Age 55-64(Base category)	1 if caregiver's age is btw. 55-64, else 0	0.01
Region		
West	1 if household is from West, else 0	0.29
Midwest	1 if household is from Midwest, else 0	0.25
Northeast	1 if household is from Northeast, else 0	0.18
South(Base category)	1 if household is from South, else 0	0.28
Willingness to give milk types other than whole milk		
Give 2%milk	1 if caregiver is willing to give 2% milk to child	0.75
Give1% milk	1 if caregiver is willing to give 1% milk to child	0.42
Give skim milk	1 if caregiver is willing to give skim milk to child	0.25

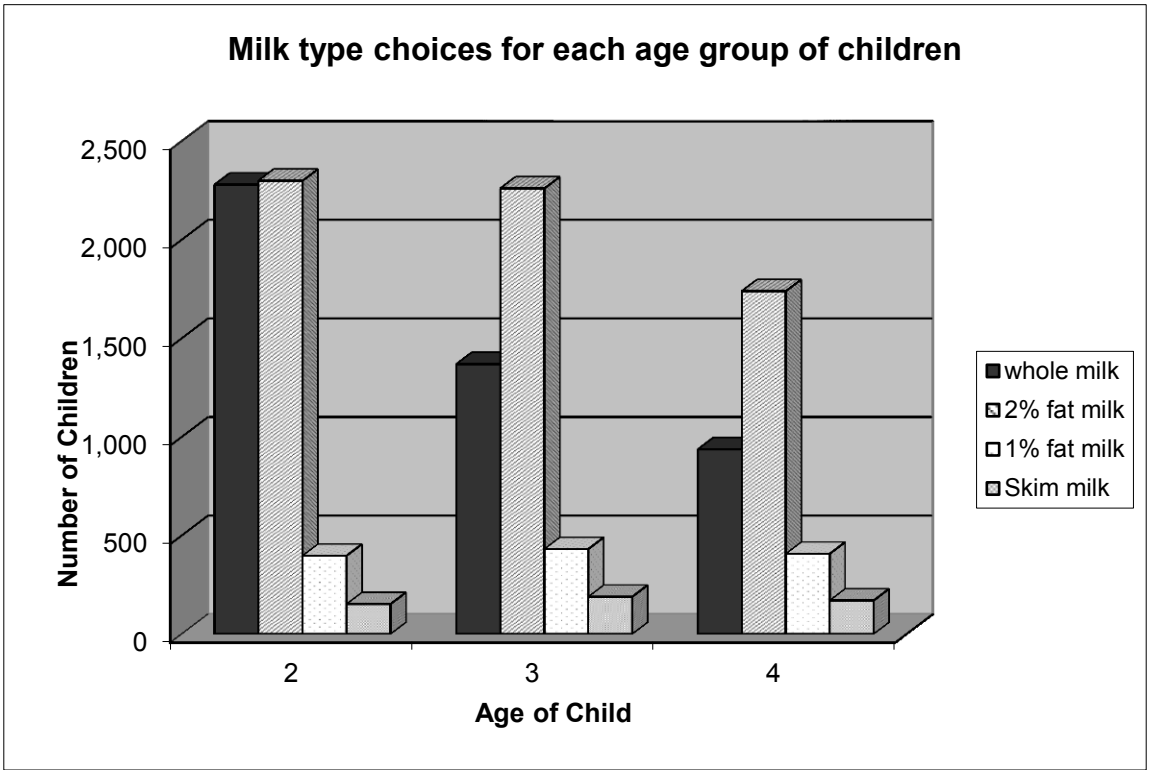

Figure 4.2: Milk type choices for each age group of children

As given in Figure 4.1, whole milk and 2% fat milk are the mostly frequently consumed milk types among pre-school WIC children. Almost half of the children drunk 2% fat milk, a good signal, especially due to the recent changes done in food packages to reduce the saturated fat intake from the WIC provided foods. Furthermore, Figure 4.2 shows that as age of child increases, the number of children who drink whole milk decreases. Given in Table 4.2, children located in the South mostly drink whole milk, whereas children from the Midwest mostly consume reduced fat milk types. Education level and knowledge of caregivers about dietary guidelines indicates some impact on children's milk consumption. Children of caregivers who have higher level of education are willing to give reduced fat milk mostly drink 2%, 1% or skim milk.

Table 4.2: Descriptive Statistics for Each Milk Type

	Whole Milk	2% Fat Milk	1% Fat Milk	Fat-Free Milk	Overall
N (%)	4,535 (36.17%)	6,261 (49.94%)	1,233 (9.83%)	509 (4.06%)	12,538 (100%)
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Gender					
Male	0.51	0.51	0.50	0.51	0.51
Female	0.49	0.49	0.50	0.49	0.49
Age of children					
Two	0.49	0.36	0.32	0.30	0.40
Three	0.30	0.36	0.35	0.37	0.34
Four	0.21	0.28	0.33	0.33	0.26
Race					
White Non-Hispanic	0.41	0.50	0.59	0.74	0.49
African American	0.21	0.12	0.07	0.06	0.15
White Hispanic	0.24	0.25	0.23	0.12	0.24
Other Hispanic	0.04	0.04	0.04	0.07	0.04
Other Race	0.10	0.09	0.07	0.01	0.08
Education of Caregiver					
Less High School	0.26	0.23	0.17	0.08	0.23
High School	0.37	0.35	0.30	0.26	0.35
Some College	0.32	0.36	0.41	0.46	0.35
College	0.06	0.06	0.12	0.20	0.07
Age of Caregiver					
Age lessthan25	0.33	0.26	0.22	0.18	0.28
Age 25-34	0.48	0.54	0.55	0.55	0.52
Age 35-44	0.16	0.17	0.20	0.21	0.17
Age 45-54	0.02	0.03	0.02	0.05	0.03
Age 55-64	0.01	0.01	0.01	0.01	0.01
Region					
West	0.28	0.31	0.27	0.20	0.29
Midwest	0.18	0.28	0.29	0.40	0.25
Northeast	0.20	0.14	0.24	0.20	0.18
South	0.34	0.27	0.20	0.20	0.28
Willingness to give milk types other than whole milk					
Give 2%milk	0.60	0.93	0.56	0.39	0.75
Give1% milk	0.28	0.43	0.88	0.50	0.42
Give skim milk	0.16	0.23	0.42	0.91	0.25

CHAPTER V

EMPIRICAL RESULTS

This chapter contains the results for the binary and multinomial logit models developed for the milk type choices of pre-school WIC children. First, binary logit models are run for each category of milk in order to observe the effect of demographics and characteristics of caregivers and other explanatory variables on choosing the particular milk type compared to all the rest. Results for each milk type categories are given and discussed separately. Second, the multinomial logit model is estimated to provide a framework for the profile of pre-school children for all milk consumption preferences. Each milk type is compared to whole milk (base category), and the results are presented and discussed. The same explanatory variables defined in the data section are used for all the models. Third, a comparison of the analysis based on the use of the NHANES data is discussed.

NATFAN Data Results

Binary Logit Model Results for Whole Milk

The binary logit model for whole milk describes the profile of children and their caregivers who prefer to drink whole milk among all other low fat milk types. The dependent variable of this model is equal to 1 if the child drinks whole milk, 0 otherwise. Table 5.1 provides the estimated coefficient and the accompanying marginal effects. These results show that children 2 years old are 15 basis points more likely to prefer whole milk compared to children 4 years old. White non-Hispanic and Hispanic participants are less likely to prefer whole milk compared to other races; however, African American participants are more likely to consume whole milk. Education level of caregiver plays a role on healthy diet choice. Children whose caregivers have an

education level less than high school or high school are more likely to drink whole milk. Children located in the West and Midwest regions are less likely to consume whole milk compared to children located in South. Children whose caregivers are willing to give low-fat milk (2%, 1% and skim milk) to their 2 year old and older children are less likely to drink whole milk by 27, 14 and 8 basis points, respectively.

Binary Logit Model Results for 2% Fat Milk

The binary logit model results for 2% fat milk are given in Table 5.2. The dependent variable of this model is equal to 1 if the child drinks 2% fat milk, 0 otherwise. According to these results, children who are 2 years old are less likely to consume 2% fat milk compared to 4 year old ones. As White non-Hispanics and Hispanics are more likely to consume 2% fat milk, and African American participants are less likely to drink 2% fat milk compared to other races. Children of caregivers with a college degree are less likely to drink 2% fat milk compared to children whose caregivers have less than a college degree. Children located in the West and Midwest are more likely to consume 2% fat milk, whereas children located in Northeast are less likely to consume 2% fat milk compared to children in the South. Not surprisingly, children whose caregivers are willing to give 2% milk to their children aged 2 and older are 50 basis points more likely to prefer drinking 2% fat milk.

Table 5.1: Binary Logit Coefficient Estimates and Accompanying Marginal Effects for Whole Milk Based on the NATFAN Data

Variable	Coeff.	Std. Err.	Marginal Effect[1]	Std. Err.
Gender				
Male	0.0012	0.0405	0.0003	0.0091
Age of Children				
Two	0.6501***	0.0522	0.1479***	0.0119
Three	0.1267**	0.0549	0.0287**	0.0125
Race				
White non-Hispanic	-0.3979***	0.0745	-0.0890***	0.0166
African American	0.4738***	0.0881	0.1111***	0.0213
White Hispanic	-0.2152***	0.0790	-0.0474***	0.0171
Other Hispanic	-0.0320	0.1200	-0.0072	0.0267
Less High School	0.3970***	0.0946	0.0918***	0.0224
Education of Caregiver				
High School	0.2953***	0.0897	0.0672***	0.0206
Some College	0.0406	0.0892	0.0091	0.0201
Age of caregiver				
Age lessthan25	0.3166	0.2370	0.0725	0.0552
Age 25-34	0.0472	0.2356	0.0106	0.0529
Age 35-44	-0.0086	0.2393	-0.0019	0.0537
Age 45-54	0.0391	0.2666	0.0088	0.0606
Region				
West	-0.2143***	0.0567	-0.0474***	0.0123
Midwest	-0.6299***	0.0581	-0.1333***	0.0114
Northeast	0.0227	0.0612	0.0051	0.0138
Willingness to give milk types other than whole milk				
Give 2%milk	-1.1399***	0.0467	-0.2688***	0.0110
Give1% milk	-0.6164***	0.0482	-0.1357***	0.0103
Give skim milk	-0.3473***	0.0561	-0.0757***	0.0118
Constant	0.3142	0.2631		
Number of Obs.	12,538			
Log-Likelihood	-7176.2			
McFadden's R^2	0.1254			

[1] Marginal Effects calculated at sample means.

*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.

Base Categories: Female, Four, Other Race, College, Age5564, and South respectively.

Table 5.2: Binary Logit Coefficient Estimates and Accompanying Marginal Effects for 2% Fat Milk Based on the NATFAN Data

Variable	Coeff.	Std. Err.	Marginal Effect[1]	Std. Err.
Gender				
Male	0.0139	0.0400	0.0035	0.0100
Age of Children				
Two	-0.3833***	0.0510	-0.0952***	0.0125
Three	-0.0056	0.0528	-0.0014	0.0132
Race				
White non-Hispanic	0.1320*	0.0746	0.0329*	0.0186
African American	-0.2786***	0.0893	-0.0690***	0.0218
White Hispanic	0.1966**	0.0794	0.0491**	0.0198
Other Hispanic	0.1383	0.1213	0.0346	0.0303
Education of Caregiver				
Less High School	0.2028**	0.0900	0.0507**	0.0225
High School	0.2106**	0.0846	0.0526**	0.0211
Some College	0.2820***	0.0836	0.0703***	0.0208
Age of Caregiver				
Age lessthan25	0.0009	0.2296	0.0002	0.0573
Age 25-34	0.2197	0.2280	0.0548	0.0565
Age 35-44	0.1980	0.2316	0.0495	0.0578
Age 45-54	0.3049	0.2593	0.0760	0.0642
Region				
West	0.1389**	0.0565	0.0347**	0.0141
Midwest	0.3270***	0.0562	0.0816***	0.0140
Northeast	-0.2470***	0.0621	-0.0613***	0.0152
Willingness to give milk types other than whole milk				
Give 2%milk	2.4503***	0.0586	0.5004***	0.0080
Give1% milk	-0.2584***	0.0475	-0.0643***	0.0118
Give skim milk	-0.3937***	0.0522	-0.0973***	0.0127
Constant	-2.1022	0.2573		
Number of Obs.	12,538			
Log-Likelihood	-7303.67			
McFadden's R^2	0.1596			

[1] Marginal Effects calculated at sample means.

*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.

Base Categories: Female, Four, Other Race, College, Age5564, and South respectively.

Binary Logit Model Results for 1% Fat Milk

The binary logit model results for 1% fat milk are given in Table 5.3. The dependent variable of this model is equal to 1 if the child drinks 1% fat milk, 0 otherwise. Children 2 years old are expected to be less likely to prefer 1% fat milk compared to children 4 years old. Similarly, African American participants are less likely to drink 1% fat milk. Children whose caregivers with less than high school or high school degree are less likely to drink 1% fat milk compared to children whose caregivers have a college degree. Caregivers age is significant in this model, thus children whose caregivers are less than 25 or aged between 45 and 54 are less likely to consume 1% fat milk. Children from the regions are more likely to consume 1% fat milk compared to children located in the South. Children whose caregivers are willing to give low-fat milk types to their children are more likely to consume 1% fat milk.

Binary Logit Model Results for Fat-Free (Skim) Milk

Table 5.4 gives the binary logit model results for skim fat milk. The dependent variable is equal to 1 if the child drinks skim fat milk, 0 otherwise. Regarding the results of the previous models, the sign of the coefficients for most of the explanatory variables can be guessed easily. As expected, children 2 years old, African American, white Hispanic and other Hispanic participants are less likely to prefer skim milk. Children whose caregivers younger than 25, or aged between 35 and 44, and are willing to give 2% or 1% fat milk are less likely to prefer skim milk. Children whose caregivers have a college degree are more likely to drink skim milk compared to children whose caregivers do not have a college degree. Only children from Midwest are more likely to prefer fat-free milk compared to children from other region.

Table 5.3: Binary Logit Coefficient Estimates and Accompanying Marginal Effects for 1% Fat Milk Based on the NATFAN Data

Variable	Coeff.	Std. Err.	Marginal Effect[1]	Std. Err.
Gender				
Male	-0.0242	0.0692	-0.0008	0.0024
Age of Children				
Two	-0.3574***	0.0864	-0.0119***	0.0029
Three	-0.1742**	0.0858	-0.0058**	0.0028
Race				
White non-Hispanic	0.1863	0.1290	0.0064	0.0045
African American	-0.6189***	0.1752	-0.0176***	0.0041
White Hispanic	0.0984	0.1403	0.0035	0.0051
Other Hispanic	0.0616	0.2101	0.0022	0.0076
Education of Caregiver				
Less High School	-0.4041***	0.1423	-0.0126***	0.0041
High School	-0.2997**	0.1271	-0.0099**	0.0041
Some College	-0.0753	0.1222	-0.0026	0.0041
Age of Caregiver				
Age lessthan25	-0.7334**	0.3652	-0.0221**	0.0098
Age 25-34	-0.5641	0.3607	-0.0198	0.0131
Age 35-44	-0.3991	0.3662	-0.0122	0.0099
Age4554	-0.9208**	0.4318	-0.0216***	0.0066
Region				
West	0.2020*	0.1033	0.0072*	0.0039
Midwest	0.3597***	0.1015	0.0135***	0.0042
Northeast	0.5030***	0.1059	0.0203***	0.0050
Willingness to give milk types other than whole milk				
Give 2%milk	-2.3617***	0.0873	-0.1591***	0.0094
Give1% milk	3.5186***	0.1111	0.2102***	0.0075
Give skim milk	-0.0962	0.0734	-0.0032	0.0024
Constant	-2.2288	0.4067		
Number of Obs.	12,538			
Log-Likelihood	-2890.22			
McFadden's R^2	0.2828			

[1] Marginal Effects calculated at sample means.

*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.

Base Categories: Female, Four, Other Race, College, Age5564, and South respectively.

Table 5.4: Binary Logit Coefficient Estimates and Accompanying Marginal Effects for Skim Milk Based on the NATFAN Data

Variable	Coeff.	Std. Err.	Marginal Effect[1]	Std. Err.
Gender				
Male	-0.0150	0.1129	-0.0001	0.0006
Age of Children				
Two	-0.4128***	0.1434	-0.0022***	0.0008
Three	-0.0837	0.1376	-0.0005	0.0007
Race				
White non-Hispanic	0.4747**	0.2099	0.0027**	0.0013
African American	-0.5764**	0.2908	-0.0026**	0.0011
White Hispanic	-0.4609*	0.2493	-0.0023**	0.0011
Other Hispanic	-1.1781**	0.5211	-0.0040***	0.0011
Education of Caregiver				
Less High School	-1.3778***	0.2353	-0.0057***	0.0010
High School	-0.9523***	0.1818	-0.0047***	0.0010
Some College	-0.4922***	0.1669	-0.0026***	0.0009
Age of Caregiver				
Age lessthan25	-0.9972*	0.5576	-0.0046**	0.0023
Age 25-34	-0.8722	0.5484	-0.0051	0.0035
Age 35-44	-0.8016	0.5580	-0.0035*	0.0019
Age 45-54	-0.5880	0.6141	-0.0025	0.0020
Region				
West	-0.1855	0.1744	-0.0010	0.0009
Midwest	0.3357**	0.1540	0.0020*	0.0010
Northeast	0.1797	0.1765	0.0011	0.0011
Willingness to give milk types other than whole milk				
Give 2%milk	-1.8321***	0.1241	-0.0182***	0.0026
Give1% milk	-1.4082***	0.1441	-0.0076***	0.0012
Give skim milk	4.6340***	0.1823	0.1515***	0.0109
Constant	-2.5157	0.6221		
Number of Obs.	12,538			
Log-Likelihood	-1183.23			
McFadden's R^2	0.4443			

[1] Marginal Effects calculated at sample means.
*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.
Base Categories: Female, Four, Other Race, College, Age5564, and South respectively.

To sum up, all the outcomes of binary logit models given in detail above indicates that age 2 is a transition period for children from whole milk to reduced fat milk. Caregiver's age, education level and willingness to give low-fat milk influences the child's diet choices. There are differences among different ethnic groups; black participants prefer whole milk, whereas white non-Hispanic and white Hispanics favors 2% fat milk. Regional differences are also observed; children located in the South favor whole milk and children from West and Midwest more likely to prefer low-fat milk types.

Wald tests are conducted for subsets of coefficients to determine if they are jointly equal to zero for each group of explanatory variables. Results indicate all explanatory variables, except for gender are statistically important in affecting the choice of milk types. Gender has no statistically discernable impact on milk type choices among preschool WIC children.

Multinomial Logit Model (MNL) Results

A multinomial logit model is used to observe the profile of children who are more likely or less likely to choose low-fat milk types compared to whole milk. The MNL provides the probability of choosing a particular alternative among the four milk types. Therefore, the MNL is a more general model than the binary logit model.

The response variable of MNL model has four unordered categories: 1=Whole milk, 2= 2% fat milk, 3=1% and half percent fat milk and 4= Skim (Fat-free) milk. Besides the tests to determine the significance of the categories of explanatory variables, Wald tests are used to determine if we need to combine any of the dependent variable categories. Results indicate that all the categories are distinguishable from each other thus we cannot combine any of them, and whole milk is chosen to be the base category following the normalization rule. Respondents choose the milk type their children mostly consume; hence the choices are mutually exclusive. Tests done to determine the if IIA holds by using STATA10 and results of Hausman-type test suggests that

alternative 1 (whole milk) violates the IIA assumption, whereas Small-Hsiao test result shows that independence of alternatives is hold for all four alternatives in the MNL model. Previous researchers also encountered this inconsistency. Long and Freese (2001) mentioned that these tests often give inconsistent results and do not properly inform us about the violation of the IIA assumption. McFadden (1974) and Amemiya (1981) suggested that the IIA assumption implies that MNL model works well when the alternatives are dissimilar and are distinct for each decision-maker. Green (2008) suggested that the IIA assumption is convenient for the estimation of the model, but it may not be a particularly agreeable restriction to place on consumer behavior. The results of the tests for this thesis are another example of the inconsistency of tests in regard to the IIA assumption. The same explanatory variables as in the binary logit models are used. The estimated coefficients, relative risk ratio (RRR) values and marginal effects of the multinomial logit analysis are summarized in Tables 5.5- 5.7.

Dietary Guidelines for Americans (USDA, 2010) advise the consumption of fat-free or low-fat milk for children 2 years old and older rather than whole milk. Our study shows that children 2 and 3 years of age prefer whole milk to 2% fat milk. The probability of choosing any kind of low-fat milk over whole milk by children 2 years old are 0.56 times higher compared to children 4 years old. For children two years old, the probability of drinking whole milk is 14 basis points greater, whereas 12 basis points lower for 2% fat milk and negligible for 1% fat and fat-free milk.

Race of participants has an impact on their milk intake. White Hispanics and white non-Hispanics prefer less whole milk and more reduced fat milk. African Americans are 10 basis points more likely to consume whole milk and less likely to drink fat-free and reduced fat milk types. The probability of consuming skim milk relative to whole milk for White non-Hispanics is 2 times higher.

The results of our study concerning choice of milk types attributed to age and race are parallel to findings of Black et al. (2009). However, this study was done using only WIC participants from Maryland and before the implementation of new food

packages. These findings also are similar to the results of Dennison et al. (2001) concerning milk consumption habits of WIC children in New York.

Our study adds to the above mentioned studies by evaluating WIC preschool children nationwide whereas these studies analyzed behavior only from one state. Regional differences are evident respective in the choice of milk types. WIC children located in the South and in the Northeast are more likely to consume whole milk then WIC children located in the West and Midwest. Children from the West and Midwest are more likely to drink 2% compared to children from the Northeast and the South. Children located in the Midwest are 2 times more likely to prefer any kind of low-fat milk type over whole milk compared the children located in the South.

Education level and age of caregiver have impacts on milk type choice; children whose caregivers are younger and less educated less likely to drink 1% and skim milk, similar to the findings of Dennison et al. (2001). Additionally, children of caregivers who are willing to give reduced fat milk are less likely to drink whole milk which may significantly reduce their saturated fat intake. The results of this study emphasize the importance of parent's awareness about children dietary intakes and healthy food choices. High RRR values for caregiver's willingness to give low-fat milk types to their children support this contribution statistically. Children of caregivers who are willing to give skim milk to their children are 106 times more likely to consume skim milk rather than whole milk, statistically significant at 1% level. Regarding these results, the role of caregivers (mostly mothers) to introduce low-fat milk to their children is crucial in order to impose healthy eating habits in their early ages.

Table 5.5: Estimated Coefficients in Conjunction with the Multinomial Logit Model[2]
Based on the NATFAN Data

	2% Fat Milk		1% Fat Milk		Fat-Free Milk	
Variable	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Gender						
Male	0.0104	0.0431	-0.0216	0.0747	-0.0165	0.1173
Age of Children						
Two	-0.5848***	0.0557	-0.7664***	0.0939	-0.8652***	0.1492
Three	-0.0862	0.0586	-0.2576***	0.0949	-0.1916	0.1448
Race						
White non-Hispanic	0.2824***	0.0798	0.4444***	0.1384	0.6766***	0.2173
African American	-0.3980***	0.0935	-0.8359***	0.1835	-0.8225***	0.2962
White Hispanic	0.2211***	0.0841	0.2075	0.1502	-0.2835	0.2570
Other Hispanic	0.1085	0.1278	0.0933	0.2249	-1.1416***	0.5316
Education of Caregiver						
Less High School	-0.1091	0.1022	-0.7150***	0.1570	-1.5809***	0.2452
High School	-0.0537	0.0973	-0.5360***	0.1419	-1.1506***	0.1937
College	0.1326	0.0970	-0.1456	0.1377	-0.5309*	0.1799
Age of Caregiver						
Age lessthan25	-0.1946	0.2555	-0.9336**	0.3990	-1.3015**	0.5794
Age 25-34	0.0792	0.2541	-0.6132	0.3946	-1.0117*	0.5702
Age 35-44	0.1058	0.2581	-0.4200	0.4007	-0.8729	0.5803
Age 45-54	0.1190	0.2870	-0.8775*	0.4666	-0.7866	0.6409
Region						
West	0.1994***	0.0600	0.3294***	0.1103	-0.0178	0.1796
Midwest	0.5450***	0.0614	0.7830***	0.1096	0.7820***	0.1607
Northeast	-0.1608**	0.0660	0.4446***	0.1130	0.2357	0.1808
Willingness to give milk types other than whole milk						
Give 2%milk	2.1272***	0.0619	-1.7900***	0.1001	-1.7975***	0.1460

Table 5.5: Continued

Give1% milk	0.2252***	0.0536	3.7573***	0.1214	-0.3313**	0.1665
Give skim milk	-0.0847	0.0623	0.2032**	0.0869	4.6672***	0.1922
Constant	-1.4530	0.2859	-1.6689	0.4435	-1.8465	0.6454
Number of Obs.	12,538					
Log-Likelihood	-10080.138					
McFadden's R^2	0.2506					

[2] Whole Milk is chosen as the reference category following the normalization rule.

*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.

Base Categories: Female, Four, Other Race, College, Age5564, and South respectively.

Table 5.6: Relative Risk Ratios (RRR) associated with the Multinomial Logit Model[2]
Based on NATFAN data

	2% Fat Milk		1% Fat Milk		Fat-Free Milk	
Variable	RRR	Std. Err.	RRR	Std. Err.	RRR	Std. Err.
Gender						
Male	1.0104	0.0436	0.9787	0.0732	0.9836	0.1154
Age of Children						
Two	0.5572***	0.0310	0.4647***	0.0436	0.4210***	0.0628
Three	0.9174	0.0537	0.7729***	0.0733	0.8256	0.1196
Race						
White non-Hispanic	1.3263***	0.1058	1.5596***	0.2158	1.9673***	0.4275
African American	0.6717***	0.0628	0.4335***	0.0795	0.4393***	0.1301
White Hispanic	1.2475***	0.1049	1.2306	0.1849	0.7531	0.1936
Other Hispanic	1.1146	0.1425	1.0978	0.2469	0.3193**	0.1697
Education of Caregiver						
Less High School	0.8967	0.0917	0.4892***	0.0768	0.2058***	0.0505
High School	0.9477	0.0922	0.5851***	0.0830	0.3164***	0.0613
College	1.1417	0.1108	0.8645	0.1191	0.5881***	0.1058
Age of Caregiver						
Age lessthan25	0.8232	0.2103	0.3931	0.1569	0.2721**	0.1577
Age 25-34	1.0824	0.2751	0.5416	0.2137	0.3636*	0.2073
Age 35-44	1.1117	0.2869	0.6571	0.2633	0.4177	0.2424
Age 45-54	1.1264	0.3233	0.4158*	0.1940	0.4554	0.2918
Region						
West	1.2207***	0.0733	1.3901***	0.1533	0.9824	0.1765
Midwest	1.7246***	0.1058	2.1881***	0.2398	2.1857***	0.3512
Northeast	0.8514**	0.0562	1.5599***	0.1762	1.2658	0.2288
Willingness to give milk types other than whole milk						
Give 2%milk	8.3917***	0.5197	0.1670***	0.0167	0.1657***	0.0242
Give1% milk	1.2525***	0.0672	42.8337***	5.2004	0.7180**	0.1195

Table 5.6: Continued

Give skim milk	0.9188	0.0573	1.2253**	0.1065	106.3972***	20.4454
Number of Obs.	12,538					
Log-Likelihood	-10080.1					
McFadden's R^2	0.2506					

[2] Whole Milk is chosen as the reference category following the normalization rule.

*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.

Base Categories: Female, Four, Other Race, College, Age5564, and South respectively.

Table 5.7: Marginal Effects Associated with the Multinomial Logit Model[3]
Based on the NATFAN Data

	Whole Milk		**2% Fat Milk**		**1% Fat Milk**		**Fat-Free Milk**	
Variable	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.
Gender								
Male	-0.0019	0.0102	0.0031	0.0102	-0.0010	0.0027	-0.0001	0.0007
Age of Children								
Two	0.1456***	0.0131	-0.1266***	0.0131	-0.0162***	0.0032	-0.0028***	0.0008
Three	0.0239*	0.0139	-0.0154	0.0138	-0.0078**	0.0032	-0.0008	0.0008
Race								
White	-0.0718***	0.0187	0.0581***	0.0188	0.0108**	0.0051	0.0029**	0.0013
African American	0.1054***	0.0227	-0.0830***	0.0227	-0.0196***	0.0046	-0.0028**	0.0012
White Hispanic	-0.0517***	0.0194	0.0507***	0.0197	0.0032	0.0057	-0.0021*	0.0012
Other Hispanic	-0.0240	0.0297	0.0269	0.0301	0.0014	0.0084	-0.0042***	0.0011
Education of Caregiver								
Less High Sch.	0.0379	0.0246	-0.0103	0.0245	-0.0214***	0.0042	-0.0062***	0.0011
High School	0.0228	0.0231	0.0008	0.0230	-0.0180***	0.0045	-0.0056***	0.0011
College	-0.0261	0.0228	0.0375*	0.0227	-0.0081*	0.0045	-0.0032***	0.0009
Age of Caregiver								
Age lessthan25	0.0604	0.0614	-0.0278	0.0612	-0.0272**	0.0107	-0.0054**	0.0023
Age 25-34	-0.0047	0.0598	0.0366	0.0597	-0.0256*	0.0148	-0.0062*	0.0037
Age 35-44	-0.0164	0.0608	0.0363	0.0608	-0.0159	0.0107	-0.0040**	0.0019
Age 45-54	-0.0163	0.0678	0.0442	0.0679	-0.0246***	0.0073	-0.0033**	0.0017
Region								
West	-0.0496***	0.0139	0.0417***	0.0141	0.0086**	0.0044	-0.0008	0.0010
Midwest	-0.1320***	0.0134	0.1100***	0.0137	0.0193***	0.0049	0.0028**	0.0012
Northeast	0.0260*	0.0155	-0.0519***	0.0157	0.0241***	0.0057	0.0019	0.0013
Willingness to give milk types other than whole milk								
Give 2%milk	-0.2877***	0.0131	0.5186***	0.0091	-0.2017***	0.0116	-0.0292***	0.0040

Table 5.7: Continued

Give1% milk	-0.1497***	0.0115	-0.0891***	0.0124	0.2425***	0.0088	-0.0038***	0.0009
Give skim milk	-0.0539***	0.0139	-0.1113***	0.0147	0.0024	0.0030	0.1628***	0.0126

[3] Marginal Effects calculated at sample means.

*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.

Base Categories: Female, Four, Other Race, College, Age5564, and South respectively.

Comparing NATFAN Data with NHANES Data

NATFAN questionnaires were collected from the WIC agencies just before the food package change was implemented in October, 2009. Thus, we suspect that there might be "noise" in our dataset even though the data collection was completed by September, 2009 before the new packages began to be distributed. In order to check this situation, results are compared with the NHANES dataset collected in 2005-2006. Only children aged 2-4 and receiving WIC benefits were included in the analysis as in the case of the NATFAN data. The NHANES 2007-2008 data could not be used in the analysis due to the parity of observations (N=176) that matches with the required criteria used in this thesis. However, the percent distribution of milk type consumption for these three respective data sets is given in Figure 5.1. This figure shows the milk consumption trends among pre-school WIC participants from 2005 to 2009. Even before the implementation of new food packages, whole milk consumption among children decreased noticeably. Switches were made to consume 2% fat milk, whereas choice of 1% and skim milk consumption were still relatively low.

The sample size in the NHANES 2005-2006 data set is quite small (N=396) compared to the NATFAN data set (N=12,538); however the goal is to obtain a nationally representative sample collected earlier than the changes made in the WIC program after October 2009. Figure 5.2 shows the percent distribution for whole milk, 2% fat milk and 1% fat and skim milk preferences among WIC preschool children participants in 2005-2006. Similar to the NATFAN data set, whole milk and 2% fat milk are the mostly selected milk types among preschool WIC participants. However, the whole milk percentage is higher in the NHANES dataset than the percentage in the NATFAN dataset. Table 5.8 gives the description, mean value and standard deviation of each explanatory variable used in the model based on the analysis of the data set. Because of differences in the NATFAN and the NHANES data, the explanatory variables used are not exactly the same. From Table 5.8 the participation rate of male and female children is roughly same, children two years old comprise 55 percent of the

NATFAN sample, children three years old make up 24 percent of the sample, and children four years old constitute the remaining 21 percent. Mexican American children (52%) dominate this sample; caregivers mostly with a degree less than 9th grade and less then high school degree account for 56% of the sample observations.

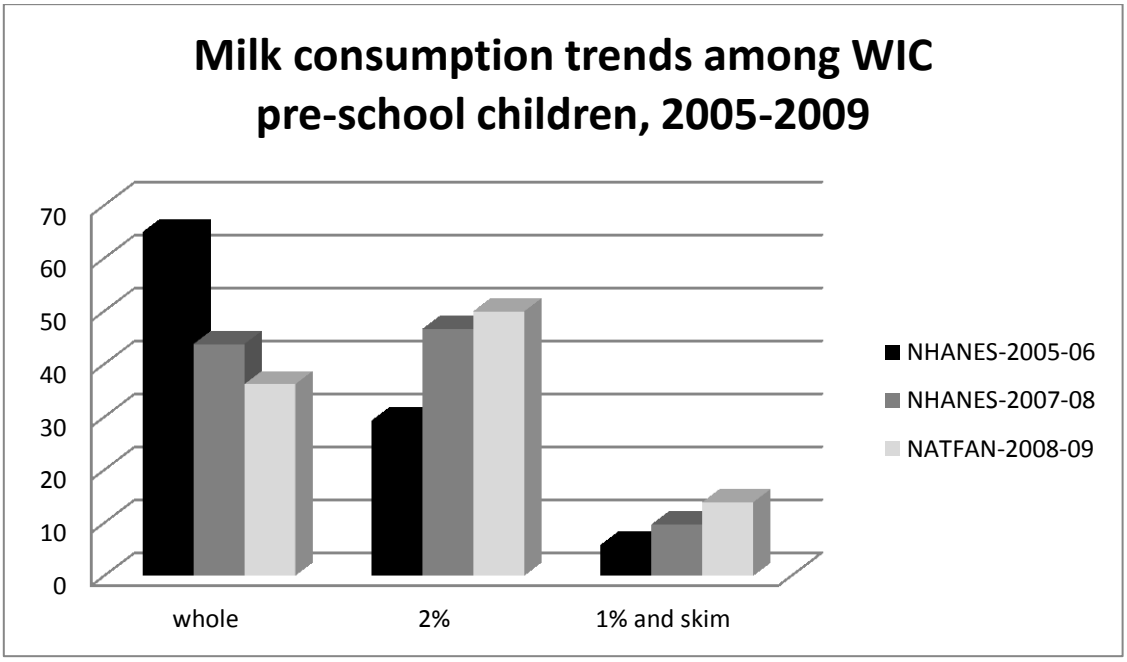

Figure 5.1: Milk consumption trends among WIC pre-school children, 2005-2009

The binomial logit results of the NHANES 2005-2006 dataset are given in Tables 5.9-5.11. Based on Wald tests, results indicate that all the subsets of coefficients corresponding to particular categories are statistically different from zero. According to the binary logit model results of the NHANES dataset, white non-Hispanic and Mexican American children are 30 basis points and 23 basis points less likely to drink whole milk, respectively. Education level of caregiver again plays a role in children's diet; children whose caregivers do not have a college degree are on average 30% more likely to consume whole milk compared to children whose caregivers have a college degree. The binary logit model for 2% fat milk indicates that children 2 years old are less likely

to consume 2% fat milk. Children whose caregivers have less than a college degree are on average 25 basis points less likely to consume 2% fat milk compared to children who have a caregiver with a college degree. Besides the education of caregiver, age also has a significant effect; as he age of the caregiver increases, children are more likely to drink 2% fat milk. Due to the few number of observations, 1% fat and skim milk drinkers are combined into a single milk type. The binary logit results show that, male children and children whose caregivers have less education than a high school education are 2 basis points less likely to prefer 1% fat or skim milk. Different from the results of 2% fat milk, as the age of the caregiver increases, children are less likely to consume 1% fat or skim milk.

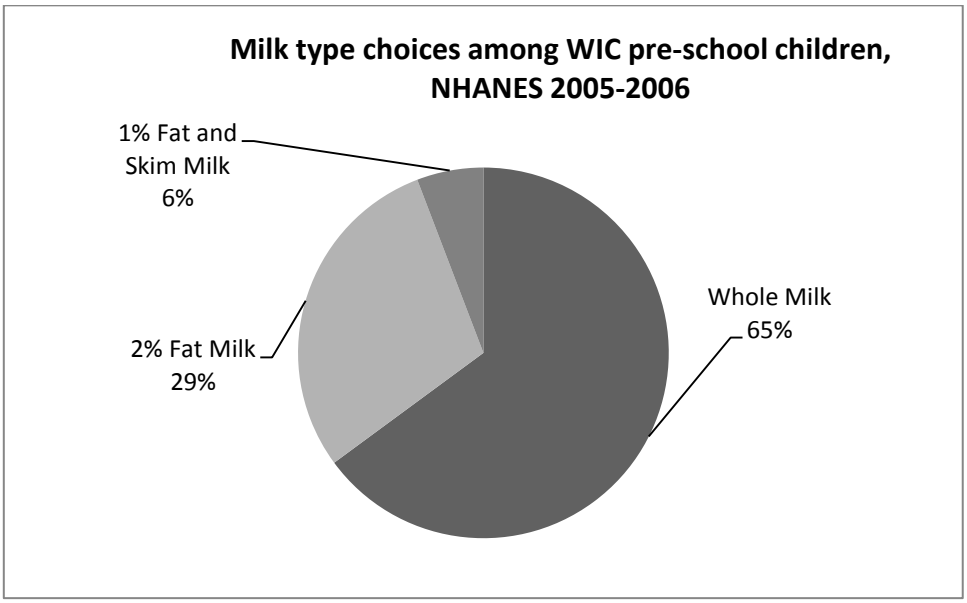

Figure 5.2: Milk type choices among WIC pre-school children, NHANES 2005-2006

Table 5.8: Definition, Means and Standard Deviation of Explanatory Variables Based on the NHANES Data

Variable	Description	Mean
Gender		
Male	1 if child is male, else 0	0.53
Female	1 if child is female, else 0	0.47
Age of Children		
Two	1 if child is 2 years old, else 0	0.55
Three	1 if child is 3 years old, else 0	0.24
Four (Base category)	1 if child is 4 years old, else 0	0.21
Race		
White non-Hispanic	1 if caregiver is White, else 0	0.16
African American	1 if caregiver is African American, else 0	0.16
Mexican American	1 if caregiver is Mexican American, else 0	0.52
Other Hispanic	1 if caregiver is Other Hispanic, else 0	0.11
Other Race (Base category)	1 if caregiver's race is others, else 0	0.05
Education of caregiver		
Less 9th grade	1 if caregiver's education level is less than 9th grade, else 0	0.24
Less High School	1 if caregiver's education level is less than high school, else 0	0.31
High School	1 if caregiver's education level is high school, else 0	0.16
Some college	1 if caregiver's education level is some college, else 0	0.23
College (Base category)	1 if caregiver's education level is college, else 0	0.24
Age of Caregiver		
Caregiver’s Age	Age of caregiver	33.19

Table 5.9: Binary Logit Coefficient Estimates and Accompanying Marginal Effects for Whole Milk Based on the NHANES data

Variable	Coeff.	Std. Err.	Marginal Effect[3]	Std. Err.
Gender				
Male	0.2690	0.2265	0.0609	0.0513
Age of Children				
Two	0.1384	0.2890	0.0313	0.0656
Three	-0.3641	0.3269	-0.0844	0.0773
Race				
White non-Hispanic	-1.2792**	0.6514	-0.3063**	0.1523
African American	-0.7768	0.6609	-0.1853	0.1614
Mexican American	-1.0319	0.6414	-0.2284*	0.1365
Other Hispanic	-0.9846	0.7077	-0.2377	0.1721
Education of Caregiver				
Less 9th grade	-0.7768***	0.5911	0.3228***	0.0854
Less High School	-0.7768***	0.5600	0.3418***	0.0894
High School	-0.7768***	0.5736	0.2747***	0.0768
Some College	-0.7768***	0.5481	0.3153***	0.0780
Age of Caregiver				
Caregiver's Age	-0.0109	0.0097	-0.0025	0.0022
Constant	-0.7768	0.7638		
Number of Obs.	396			
Log-Likelihood	-245.529			
McFadden's R^2	0.0433			

[3] Marginal Effects calculated at sample means.
*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.
Base Categories: Female, Four, Other Race and College respectively.

Table 5.10: Binary Logit Coefficient Estimates and Accompanying Marginal Effects for 2% Fat Milk Based on the NHANES Data

Variable	Coeff.	Std. Err.	Marginal Effect[3]	Std. Err.
Gender				
Male	0.1350	0.2404	0.0271	0.0482
Age of Children				
Two	-0.5546*	0.3007	-0.1127*	0.0612
Three	-0.0438	0.3374	-0.0088	0.0672
White non-Hispanic	1.1450*	0.6775	0.2592	0.1616
African American	0.6834	0.6878	0.1497	0.1601
Mexican American	1.0489	0.6729	0.2075	0.1291
Other Hispanic	0.3518	0.7747	0.0749	0.1732
Education of Caregiver				
Less 9th grade	-1.7310***	0.5881	-0.2771***	0.0725
Less High School	-1.4627***	0.5472	-0.2553***	0.0815
High School	-1.3185**	0.5627	-0.2101***	0.0681
Some College	-1.5168***	0.5338	-0.2470***	0.0685
Age of Caregiver				
Caregiver's Age	0.0274***	0.0100	0.0055***	0.0020
Constant	-1.0573	0.7772		
Number of Obs.	396			
Log-Likelihood	-224.907			
McFadden's R^2	0.0609			

[3] Marginal Effects calculated at sample means.
*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.
Base Categories: Female, Four, Other Race and College respectively.

Table 5.11: Binary Logit Coefficient Estimates and Accompanying Marginal Effects for 1% Fat and Skim Milk Based on the NHANES Data

Variable	Coeff.	Std. Err.	Marginal Effect[3]	Std. Err.
Gender				
Male	-2.4418***	0.8336	-0.0182*	0.0110
Age of Children				
Two	1.1362	1.1644	0.0062	0.0075
Three	2.7207**	1.1891	0.0392	0.0369
Race				
White non-Hispanic	0.5922	1.3100	0.0040	0.0111
African American	-0.2679	1.4092	-0.0014	0.0065
Mexican American	1.1502	1.2814	0.0065	0.0091
Other Hispanic	1.0859	1.6649	0.0095	0.0220
Education of Caregiver				
Less 9th grade	-5.6830***	1.7655	-0.0218*	0.0123
Less High School	-4.2883***	1.5310	-0.0203*	0.0111
High School	-3.0852**	1.3029	-0.0086	0.0058
Some College	-3.3457**	1.3641	-0.0114	0.0071
Age of Caregiver				
Caregiver's Age	-0.1761***	0.0664	-0.0010*	0.0006
Constant	3.8936	2.9720		
Number of Obs.	396			
Log-Likelihood	-44.0798			
McFadden's R2	0.2719			

[3] Marginal Effects calculated at sample means.
*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.
Base Categories: Female, Four, Other Race and College respectively.

The MNL regression results associated with the NHANES 2005-2006 data set, are exhibited in Tables 5.12-5.14. Two year old children are 10 basis points less likely to consume 2% fat milk relative to whole milk relative risk ratio results indicate that two year old and three year old children are 12 and 22 times more likely to prefer 1% fat or skim milk to whole milk, respectively. The education of the caregiver is affective in choice of milk type. Caregivers who do not have a college degree are less likely to consume reduced fat milk types. As the age of caregiver increases, the likelihood of drinking whole milk by WIC children decreases. Mexican American and non-Hispanic white participants are three times more likely to be in the group of children who drink 2% fat milk rather than whole milk and follow the dietary guidelines compared to children in other race groups.

The results of the NATFAN and the NHANES data sets are very similar to each other in terms of the sign of explanatory variable in each category. Thus, even though our data set is collected just before the release of new food packages, there appears to be no noticeable differences in the empirical results. Figure 5.1 gives a good signal about the increase of reduced fat milk consumption already before the implementation of WIC packages changes. This noticeable decrease in the consumption of whole milk can be explained by the education given to WIC participants regarding their diet and the rules they need to follow for a healthy diet choice for all household members.

Table 5.12: Estimated Coefficients in Conjunction with the Multinomial Logit Model[3] Based on the NHANES Data

	2% Fat Milk		**1% Fat and Skim Milk**	
Variable	Coeff.	Std. Err.	Coeff.	Std. Err.
Gender				
Male	0.0402	0.2442	-2.3807***	0.6536
Age of Children				
Two	-0.4618	0.3032	2.5257**	1.1154
Three	0.0899	0.3426	3.1092***	1.1701
Race				
White non-Hispanic	1.2969*	0.6966	1.8673	1.2704
African American	0.7611	0.7036	0.3400	1.4021
Mexican American	1.1335*	0.6891	0.8627	1.2469
Other Hispanic	0.5249	0.7915	2.4682*	1.3329
Education of Caregiver				
Less 9th grade	-1.9354***	0.6223	-3.6313***	1.3444
Less High School	-1.7180***	0.5821	-4.8432***	1.4174
High School	-1.5448***	0.5984	-3.2883***	1.2466
Some College	-1.7333***	0.5700	-3.6128***	1.2254
Age of Caregiver				
Caregiver's Age	0.0232**	0.0101	-0.1993***	0.0608
Constant	-0.7493	0.7997	4.0003	2.6639
Number of Obs.	396			
Log-Likelihood	-280.21			
McFadden's R^2	0.1216			

[3]Whole milk is chosen as reference category of milk types.
*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.
Base Categories: Female, Four, Other Race and College respectively.

Table 5.13: Relative Risk Ratios (RRR) Associated with the Multinomial Logit Model[3] Based on the NHANES Data

	2% Fat Milk		**1% Fat and Skim Milk**	
Variable	RRR	Std. Err.	RRR	Std. Err.
Gender				
Male	1.0410	0.2542	0.0925***	0.0605
Age of Children				
Two	0.6302	0.1911	12.5002**	13.9432
Three	1.0940	0.3748	22.4041***	26.2152
Race				
White non-Hispanic	3.6579*	2.5483	6.4710	8.2210
African American	2.1406	1.5061	1.4050	1.9700
Mexican American	3.1065*	2.1407	2.3695	2.9545
Other Hispanic	1.6904	1.3380	11.8018*	15.7308
Education of Caregiver				
Less 9th grade	0.1444***	0.0898	0.0265***	0.0356
Less High School	0.1794***	0.1044	0.0079***	0.0112
High School	0.2134***	0.1277	0.0373***	0.0465
Some College	0.1767***	0.1007	0.0270***	0.0331
Age of Caregiver				
Caregiver's Age	1.0235**	0.0104	0.8193***	0.0498
Number of Obs.	396			
Log-Likelihood	-280.21			
McFadden's R^2	0.1216			

[3] Whole milk is chosen as reference category of milk types.
*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.
Base Categories: Female, Four, Other Race and College respectively.

Table 5.14: Marginal Effects Associated with the Multinomial Logit Model[3]
Based on the NHANES Data

	Whole Milk		**2% Fat Milk**		**1% Fat and Skim Milk**	
Variable	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.
Gender						
Male	0.0104	0.0512	0.0161	0.0502	-0.0266	0.0144
Age of Children						
Two	0.0782	0.0642	-0.1033*	0.0631	0.0251	0.0172
Three	-0.0717	0.0806	-0.0050	0.0707	0.0768	0.0615
Race						
White non-Hispanic	-0.3070*	0.1603	0.2887*	0.1643	0.0183	0.0282
African American	-0.1712	0.1660	0.1706	0.1668	0.0006	0.0121
Mexican American	-0.2327*	0.1343	0.2284*	0.1347	0.0042	0.0105
Other Hispanic	-0.1494	0.1773	0.0949	0.1825	0.0546	0.0724
Education of Caregiver						
Less 9th grade	0.3246***	0.0760	-0.3082***	0.0755	-0.0164*	0.0096
Less High School	0.3216***	0.0854	-0.2915***	0.0843	-0.0301**	0.0153
High School	0.2552***	0.0700	-0.2429***	0.0695	-0.0123	0.0076
Some College	0.2957***	0.0722	-0.2797***	0.0715	-0.0160*	0.0093
Age of Caregiver						
Caregiver's Age	-0.0036*	0.0022	0.0053**	0.0021	-0.0017**	0.0008

[3]Marginal Effects calculated at sample means.
*** Statistically significant at 0.01 level, ** at 0.05 level, * at 0.10 level.
Base Categories: Female, Four, Other Race and College respectively.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This final chapter presents a brief summary and the main conclusions of this thesis research. First, the motivation of the study is presented. Then, the implications of the final results concerning milk type choices of pre-school WIC children are discussed. Lastly, the limitations of this study are acknowledged and recommendations for further research are given.

Summary and Conclusions

WIC seeks to improve the nutrition and dietary intake of at-risk low-income children and pregnant/breastfeeding mothers. This program is one of the largest food assistance programs in terms of Federal expenditures; therefore the effectiveness of this program is vital. Additionally almost one quarter of all children aged 1 through 5 participates in the WIC program every month; hence it is one of the major building blocks of the food and nutrition safeguard for low-income families with children in the United States. Milk is one of the major foods in the diet for children provided by WIC packages. Analyzing milk type preferences of children is the main focus of this study.

This thesis describes the profile of preschool WIC children and their milk choices based on the NATFAN data collected before the release of the revised WIC food packages. Collected nationwide, 12,358 individual's responses are used in this analysis. Overall, the results of this study indicate that there are differences among ethnic groups and regions of the United States in terms of milk type preferences. Education level and knowledge of dietary choice of caregivers play a major role in affecting milk preferences of WIC children. Two year old children and children located in the South are more likely to drink whole milk compared to other milk types. Children whose caregivers are younger and less educated are in the whole milk drinkers group too. These children are

the group of participants that likely will be most affected by the revisions of WIC food packages wherein whole milk is eliminated.

Additionally the results of the NATFAN data collected from actual participants are compared with the NHANES 2005-2006 dataset based on the self-reported participation in the WIC program. The results show that there is a noticeable decrease in the whole milk consumption even before the implementation of the revised food packages among preschool WIC children. Econometric model results of the NHANES data set also indicate that 2 year old children, children whose caregivers are less educated and African American children are more likely to drink whole milk. These findings are in agreement with the findings based on the NATFAN data. Consequently, in regard to milk type choices, the NHANES data (self-reported participation) and the NATFAN data (actual participation) provide similar profiles.

The collection of the NATFAN data was just before the new food packages were implemented, thus our results may provide a baseline for potential outcomes of recent changes. For instance, especially pre-school children (aged between 2 and 5) who do not adapt to the taste of lower fat milks may choose to drink less milk, consequently they may substitute low-fat milk with more unhealthy drinks or they may choose to buy whole milk using their own money. Future research done after implementation of new packages is valuable in order to observe the effectiveness of WIC programmatic changes on healthier diet choices among children. Suggestions to increase the acceptance of reduced fat milk in place of whole milk among children include promoting tasting panels and providing more frequent WIC education programs to call attention to the importance of healthful eating habits of children.

Recommendation and Directions for Further Research

This thesis concentrates only on milk intake of children; further studies can be done on the intakes of whole grain products, fruits and vegetables of children before the rollout of the revised WIC packages. The NATFAN data provide information for each participant state separately; hence state or region specific studies can be done for all

participant groups. The next step to enhance the research about the effectiveness of the program and the impact of revisions includes comparing these results with the analysis done on data collected after the implementation of new packages.

Additionally, women and infant intakes for different food groups before and after the revision of WIC food packages can provide detailed insights about the success of the program on these groups of participants. Furthermore, quantifying these studies and providing detailed information about the intakes of each participant group about the targeted changes might provide more concrete insight about the effectiveness of the program and the recent changes. Results of these studies serve to enlighten policy makers and nutritionists associated with the WIC program concerning the improvement of participant's nutrition intakes through the provision of continued education.

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APPENDIX A

NATFAN QUESTIONNAIRE FOR CHILDREN

FOOD & NUTRITION QUESTIONNAIRE

WIC is changing. We want to be better for you! We need information about your eating habits so we can better meet your needs.

Completing this survey is voluntary. Refusing to fill out the questionnaire will not affect your WIC status. Your answers will be kept confidential and anonymous.

FOOD & NUTRITION QUESTIONNAIRE

NATFAN - Child
(1 Year to under 5 Years)

WIC GROWING HEALTHY FAMILIES

By filling out this questionnaire, you are giving us permission to use your answers in our study. We are glad you agreed to participate in this questionnaire.

CONSENT

Filling in the circle to the right tells us you agree. 1

Incorrect: ✓ X Correct: ●

1 2 4 8 6 2 4 8 6 2 4 8 6 2 4 8 6 2 4 8 6 2 4 8

CHILD

If you have a CHILD between the ages one and five years, please complete the next section.

68. How many cups of milk does YOUR CHILD *usually* drink in a day? (*Choose one only*)
1 Cup = 8 oz

- 0 MY CHILD DOES NOT drink milk
- 1 Less than 1 cup
- 2 1 Cup
- 3 2 Cups
- 4 3 Cups
- 5 4 or more Cups

69. What kind of milk does YOUR CHILD drink most often? (*Choose one only*)

- 0 MY CHILD DOES NOT drink milk
- 1 Cow's milk
- 2 Lactaid or lactose free milk
- 3 Soy milk
- 4 Goat's milk
- 5 Rice milk

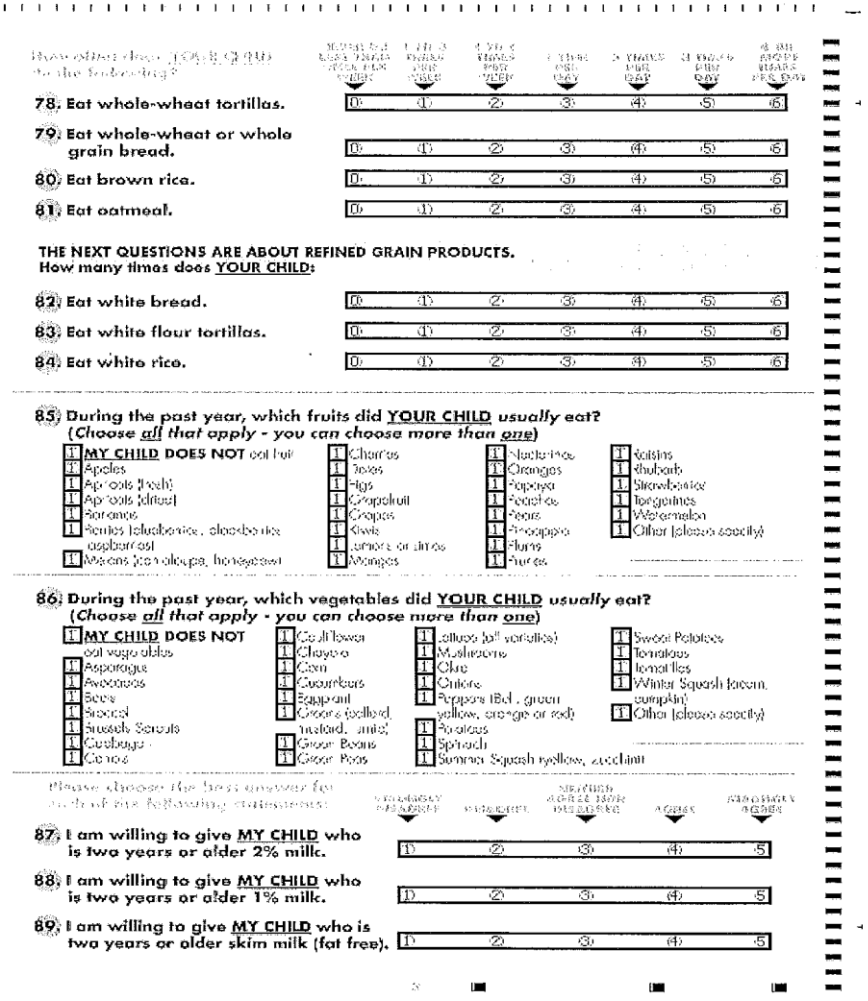
70. What type of cow's milk does YOUR CHILD drink most often? (*Choose one only*)

- 0 MY CHILD DOES NOT drink cow's milk
- 1 Whole milk
- 2 2% milk
- 3 1% milk
- 4 ½% milk
- 5 Skim (fat free) milk
- 6 I DO NOT know

How often does YOUR CHILD do the following?	(NEVER OR LESS THAN ONCE A WEEK)	1 TO 3 TIMES PER WEEK	4 TO 6 TIMES PER WEEK	1 TIME PER DAY	2 TIMES PER DAY	3 TIMES PER DAY	4 OR MORE TIMES PER DAY
71. Drink 100% juice such as apple, orange, or tomato.	0	1	2	3	4	5	6
72. Drink soy milk.	0	1	2	3	4	5	6
73. Drink artificially sweetened drinks such as diet cola, diet soda, or Crystal Light®.	0	1	2	3	4	5	6
74. Drink sugar sweetened drinks such as Kool-Aid®, soda, cola, sport drinks, or sugar sweetened tea.	0	1	2	3	4	5	6
75. Eat fruit. This DOES NOT include juice.	0	1	2	3	4	5	6
76. Eat vegetables such as salad, carrots, or sweet potatoes. This DOES NOT include potatoes, French fries, or potato chips.	0	1	2	3	4	5	6

THE NEXT QUESTIONS ARE ABOUT WHOLE GRAIN PRODUCTS.
How many times does YOUR CHILD:

77. Eat corn tortillas.	0	1	2	3	4	5	6



How often does [CHILD'S NAME] do the following?

	NEVER OR LESS THAN ONCE PER WEEK	1 TIME PER WEEK	2 TIMES PER WEEK	3 TIMES PER DAY	4 TIMES PER DAY	5 TIMES PER DAY	6 OR MORE TIMES PER DAY
78. Eat whole-wheat tortillas.	0	1	2	3	4	5	6
79. Eat whole-wheat or whole grain bread.	0	1	2	3	4	5	6
80. Eat brown rice.	0	1	2	3	4	5	6
81. Eat oatmeal.	0	1	2	3	4	5	6

THE NEXT QUESTIONS ARE ABOUT REFINED GRAIN PRODUCTS.
How many times does YOUR CHILD:

82. Eat white bread.	0	1	2	3	4	5	6
83. Eat white flour tortillas.	0	1	2	3	4	5	6
84. Eat white rice.	0	1	2	3	4	5	6

85. **During the past year, which fruits did YOUR CHILD *usually* eat?**
(Choose all that apply - you can choose more than one)

- ☐ **MY CHILD DOES NOT** eat fruit
- ☐ Apples
- ☐ Apricots (fresh)
- ☐ Apricots (dried)
- ☐ Bananas
- ☐ Berries (blueberries, strawberries, raspberries)
- ☐ Melons (cantaloupe, honeydew)
- ☐ Cherries
- ☐ Dates
- ☐ Figs
- ☐ Grapefruit
- ☐ Grapes
- ☐ Kiwis
- ☐ Lemons or limes
- ☐ Mangos
- ☐ Nectarines
- ☐ Oranges
- ☐ Papaya
- ☐ Peaches
- ☐ Pears
- ☐ Pineapple
- ☐ Plums
- ☐ Prunes
- ☐ Raisins
- ☐ Rhubarb
- ☐ Strawberries
- ☐ Tangerines
- ☐ Watermelon
- ☐ Other (please specify) _____

86. **During the past year, which vegetables did YOUR CHILD *usually* eat?**
(Choose all that apply - you can choose more than one)

- ☐ **MY CHILD DOES NOT** eat vegetables
- ☐ Asparagus
- ☐ Avocados
- ☐ Beets
- ☐ Broccoli
- ☐ Brussels Sprouts
- ☐ Cabbage
- ☐ Carrots
- ☐ Cauliflower
- ☐ Celery
- ☐ Corn
- ☐ Cucumbers
- ☐ Eggplant
- ☐ Greens (collard, mustard, turnip)
- ☐ Green Beans
- ☐ Green Peas
- ☐ Lettuce (all varieties)
- ☐ Mushrooms
- ☐ Okra
- ☐ Onions
- ☐ Peppers (Red, green, yellow, orange or hot)
- ☐ Potatoes
- ☐ Spinach
- ☐ Summer Squash (yellow, zucchini)
- ☐ Sweet Potatoes
- ☐ Tomatoes
- ☐ Tomatillos
- ☐ Winter Squash (acorn, pumpkin)
- ☐ Other (please specify) _____

Please choose the best answer for each of the following statements:

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
87. I am willing to give MY CHILD who is two years or older 2% milk.	1	2	3	4	5
88. I am willing to give MY CHILD who is two years or older 1% milk.	1	2	3	4	5
89. I am willing to give MY CHILD who is two years or older skim milk (fat free).	1	2	3	4	5

90. Do **YOU** have a **CHILD** one year or older who receives WIC foods?

1 Yes 0 No

91. If **YES**, did **YOUR CHILD** receive WIC foods in the past 30 days?

1 Yes 0 No

92. Are you the PRIMARY CAREGIVER for this **CHILD**?

1 Yes 0 No

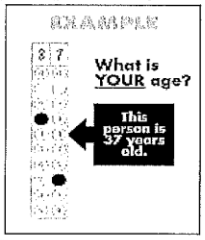
93. Is this **CHILD** a:

1 Boy 2 Girl

94. What is this **CHILD'S** age?

Years 1 2 3 4 Months 1 2 3 4 5 6 7 8 9 10 11

By using the example below, please answer the following questions:



95. What is **YOUR** age?

96. What is **YOUR** Zip code?

97. What language is spoken **MOST OFTEN** at home? (*Choose **one** only*)

1 English 2 Both Spanish and English 3 Spanish 4 Other (Please specify) _____

98. What is **YOUR** race? (*Choose **all** that apply - you can choose more than **one***)

1 White, non-Hispanic
1 White, Hispanic
1 Black, non-Hispanic
1 Black, Hispanic
1 Native American, non-Hispanic
1 Native American, Hispanic
1 Pacific Islander, non-Hispanic
1 Pacific Islander, Hispanic
1 Asian, non-Hispanic
1 Asian, Hispanic
1 Other (Please specify) _____
1 I **DO NOT** want to answer

99. What is the highest level of education **YOU** have completed?

1 1st - 8th grade
2 9th - 11th grade
3 12th grade
4 High School graduate
5 GED
6 Some College
7 Associate's degree or Technical College degree
8 Bachelor's degree or higher

YOU HAVE FINISHED THE FOOD AND NUTRITION QUESTIONNAIRE!
THANK YOU!

1 2 4 8 16 32 64 128 256 512 1024 2048 4096 8192 16384 32768 65536 131072 262144 524288

APPENDIX B

WIC CHILDREN PARTICIPATION BY STATES AND REGIONS

Table B-1: Participation of WIC Children in the WIC Program
by State and Region, 2009

	USDA[1]		NATFAN	
WEST	**Frequency**	**Percentage[2]**	**Frequency**	**Percentage[2]**
2- AK-Alaska	13,383	0.30	369	1.08
3- AZ-Arizona	92,599	2.06	824	2.41
5- CA-California	785,549	17.45	1,336	3.90
6- CO-Colorado	54,751	1.22	1,155	3.37
11-HI-Hawaii	18,734	0.42	927	2.71
12-ID-IDAHO	25,037	0.56		
26-MT-Montana	10,359	0.23	625	1.83
28-NV-Nevada	32,852	0.73	1,009	2.95
31-NM-New Mexico	35,619	0.79	1,108	3.24
37-OR-Oregon	60,854	1.35	834	2.44
44-UT-Utah	35,359	0.79		
47-WA-Washington	103,949	2.31	876	2.56
50-WY-Wyoming	6,269	0.14	616	1.80
TOTAL	1,275,314	28.33	9,679	28.28
MIDWEST				
13-IL-Illinois	149,995	3.33	691	2.02
14-IN-Indiana	83,680	1.86	901	2.63
15-IA-Iowa	40,731	0.90	1,385	4.05
16-KS-Kansas	39,283	0.87	989	2.89
22-MI-MICHIGAN	128,952	2.86		
23-MN-Minnesota	77,323	1.72		
25-MO-Missouri	71,666	1.59	927	2.71
27-NE-Nebraska	23,528	0.52	1,425	4.16
34-ND-North Dakota	7,067	0.16		
35-OH-Ohio	155,568	3.46		
41-SD-South Dakota	11,053	0.25	984	2.87
49-WI-Wisconsin	67,643	1.50	833	2.43
TOTAL	856,489	19.03	8,135	23.77
NORTHEAST				
7- CT-Connecticut	31,260	0.69	1,012	2.96
19-ME-Maine	14,740	0.33		

21-MA-Massachusetts	68,111	1.51	1,007	2.94
29-NH-New Hampshire	9,641	0.21	720	2.10
30-NJ-New Jersey	87,176	1.94	1,982	5.79
32-NY-NEWYORK	263,749	5.86		
38-PA-Pennsylvania	139,648	3.10	1,181	3.45
39-RI-Rhode Island	14,092	0.31		
45-VT-Vermont	10,655	0.24	591	1.73
TOTAL	639,072	14.20	6,493	18.97
SOUTH				
1- AL-Alabama	69,209	1.54	523	1.53
4- AR-Arkansas	43,164	0.96	880	2.57
8-DE-Delaware	12,663	0.28		
9- FL-Florida	254,433	5.65	1,275	3.73
10-GA-Georgia	120,723	2.68	825	2.41
17-KY-Kentucky	75,871	1.69	604	1.76
18-LA-Louisiana	69,650	1.55		
20-MD-Maryland	72,811	1.62	1,071	3.13
24-MS-Mississippi	54,722	1.22	770	2.25
33-NC-North Carolina	141,177	3.14	977	2.85
36-OK-Oklahoma	51,679	1.15		
40-SC-South Carolina	62,176	1.38		
42-TN- Tennessee	82,344	1.83	658	1.92
43-TX-Texas	505,258	11.22		
46-VA-Virginia	78,795	1.75	764	2.23
48- WV-West Virginia	28,032	0.62	798	2.33
51-DC-District of Colombia	7,704	0.17	776	2.27
TOTAL	1,730,411	38.44	9,921	28.99
OVERALL TOTAL	**4,501,286**	**100.00**	**34,228**	**100.00**

[1] Source: USDA-FNS, Program data for October through September of FY 2009. Data as of January 31, 2011

[2] Percentage of Overall Total.

Note: Bold font states are missing in NATFAN data

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