EXPLORATORY STUDY IN DIETARY ANALYSIS OF A PEDIATRIC WIC POPULATION

by

Maureen Susan Nelson

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APPROVED:

P. A. M. Hodges, Chairman

P. A. Shifflett

J. M. Johnson

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Committee Chairman: Patricia A. M. Hodges
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(ABSTRACT)

The diets of 75 two year old children, participating in the Virginia Beach WIC Program, were evaluated twice. They were analyzed using a 24 hour dietary recall (WIC 329), and again using a computer program (Nutritionist I) for RDA. Diets were examined for the nutrients calcium, protein, vitamin A, vitamin C, and iron found in the four food groups on the WIC 329. Each food group and corresponding nutrient was identified with varying degrees of success. The protein and calcium assessment were accurate. Under the conditions of this study, several recommendations can be made. The milk group heading could state that one cup of fluid milk provides 310 IU vitamin A. The vitamin A rich foods yield 6000 IU rather than 4000-5000 IU as indicated on the WIC 329. For vitamin C, only 3/4 serving is required to satisfy the RDA rather than the stated full serving. Iron values could be documented on the WIC 329 for the meat, vitamin A, vitamin C, and bread/cereal group. Iron fortified cereals, supplying at least 45% RDA, could be a separate subgroup to reflect the higher iron content. A truncated regression formula was developed to estimate nutritional status. A ceiling of 150% RDA was used to prevent skewing of nutrients. Use of the regression formula instead of the WIC 329 resulted in a 67% improvement of estimating nutritional status.

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CHAPTER I

INTRODUCTION

Does hunger exist in America? Since the sixties and into the early seventies, this topic has been widely debated.

A key person in bringing to light America's state of poverty and hunger in certain segments of society was Martin Luther King, Jr., as leader of the Southern Leadership Conference in the early sixties. Slowly Americans responded to the problem through organizations such as the National Council on Hunger and Malnutrition in the United States. Senators Joseph Clark, George McGovern, and Robert Kennedy began inquiries at the national level. Mass media took cognizance of the problem, and it was a powerful documentary aired in 1968, Hunger in America that shocked the nation into the realization that poverty stricken, ill fed Americans could be ignored no longer (1).

In 1967 Congress required the Secretary of the Department of Health, Education, and Welfare (HEW) to undertake a survey to investigate the "incidence and location of serious hunger and malnutrition in the United States." The result of this mandate was the Ten-State Nutrition Survey, 1968-1970 (2). Thirty thousand families were identified in the selection process and out of this population, 22,000 were children less than 17 years of age. The American Academy of Pediatrics Committee Statement paper took the stand that substantial numbers of children examined in this large survey were indeed malnourished (3). The Statement paper cited as evidence retarded growth in children from low-income families, widespread prevalence of iron deficiency anemia, and the common occurrence of obesity.

In 1968 the Departments of Agriculture (USDA) and HEW recognized the high susceptibility to malnutrition of low income women and children (4). This population is at special risk with "respect to their physical and mental health by reason of inadequate nutrition or health care, or both" (5). However, it was Secretary of Agriculture Orville Freeman, pressured by the Poor Peoples Campaign, that established the first supplemental food program in May 1968 to meet the special needs of this "high risk" group (4). Senators Humphrey and Chase proposed special legislation to Congress to amend the Child Nutrition Act of 1966 to include a "Special Supplemental Food Program for Women, Infants, and Children," commonly called WIC (4).

On December 31, 1969, further support for feeding the poor came from recommendations from the White House Conference on Food, Nutrition, and Health (6). The highest priority items of the Conference were that all people in this country must be adequately fed and that people at all ages can be educated to make better food choices. The most publicized recommendations dealt with alleviating hunger and malnutrition and improving conditions for the poor. The report urged that food programs for the poor, and especially poor children, be fully funded, reformed, and expanded in order to assure adequate benefits and participation by all who needed them.

Public Law 93-32 which authorized Amendment 17 to the 1966 Act was signed by President Nixon in 1972 (4). Thus, the WIC Program was started.

In Virginia, WIC is a 100% federally funded program sponsored by USDA and administered through every local health department. WIC began in Virginia in 1975 with a pilot project in Alexandria and became statewide in 1977. As of August 1984, there were 64,000 participants in WIC, or 41% of those estimated to be eligible for its benefits (7).

The WIC Program provides food supplements and nutritional counseling to pregnant, breastfeeding, and postpartum women, infants, and children up to age five years (7). Infants receive iron fortified formula, and women and children receive, in varying amounts, milk, cheese, eggs, peanut butter, dried beans, juice, and iron fortified cereal. In order to be eligible for WIC in

Virginia, participants must meet two requirements. First, they must be at or below 167% of the poverty level, and second, they must be nutritionally at risk based on a medical screening (7).

Anthropometric measurements of height and weight and the biochemical measurements of hemoglobin and/or hematocrit are required for all participants. To determine dietary adequacy, a 24-hour dietary recall is taken. The 24-hour dietary recall normally begins with the first meal consumed on the previous day and proceeds forward for 24 hours (8). Mothers of children and infants are the ones asked about their children's dietary habits.

The Virginia WIC Program utilizes the 24-hour dietary recall method for its instrument of determining whether an individual is at nutritional risk. Due to the large numbers of participants seen on a daily basis, the recall is the most feasible technique of dietary analysis for the Virginia WIC Program. The speed in administering and the minimal burden on the respondent are indeed positive features of the 24-hour dietary recall (9).

The problem of valid and accurate assessment of an individual's diet has plagued nutritionists for decades. Countless instruments, methods, and techniques have been implemented, some more successfully than others. All methods have numerous advantages and disadvantages. By far the most common method, the 24-hour dietary recall, has been the source of professional debate since its origin.

Most researchers are in agreement about the drawbacks of this method. Variability is greater with one day intakes than with longer duration records (9, 10, 11, 12). Day to day fluctuations may be quite large. There is also the problem of under and over reporting intake. Subjects with low intakes tend to over-report, while subjects with high intakes tend to under-report their food consumption (8, 13, 14, 15). The question of group versus individual assessment is an important one. In general, a one day recall gives a better picture of the dietary status of a group than of an individual (11, 12, 14).

When assessing a pre-schooler's diet, a parent (usually the mother) normally does the actual reporting of the child's food intake instead of the child giving a self report. Preschoolers are usually not capable of giving a report of their food intake. Homemaker attitudes play a significant role in the quality of children's diets. If a woman is content with her roles of mother and homemaker, then her children will have a better score for dietary quality (16, 17). The level of nutrition knowledge of the mother also influences the quality of a child's diet. Mothers who know the least about nutrition have children with the poorest food habits and dietary quality (16, 18, 19, 20). Various studies have yielded inconclusive results regarding a mother's age, employment status, and family size as indicators of nutritional status of preschoolers (20, 21, 22).

The need exists for further study of the assessment of the diets of young children. In this paper, the research will be based on the 24-hour dietary recall as used in the Virginia WIC Program.

Statement of the Problem

The identified dietary recall form (WIC-329) has been used in screening WIC participants in Virginia for several years. To date, no study has been undertaken to determine whether this tool provides an accurate indicator of dietary assessment. This research will examine the data collected and assess the results to determine the reliability and validity of the instrument as it is currently used in assessing the diets of preschoolers.

The objectives of this study are as follows:

1. To evaluate the reliability and validity of the Bureau of Public Health Nutrition 24-hour dietary recall for the State of Virginia as it relates to the diets of preschoolers.
2. To compare the diet recall and the computer program Nutritionist I (IBM-PC) for differences and similarities

of each child's dietary assessment (24).

3. If results indicate, to devise recommendations for any change in format and/or procedure to increase accuracy in using the diet recall for the Virginia WIC Program for children aged 1-3.

Limitations

All studies have inherent limitations in design. Three limitations of this project must be cited. First, all subjects of this study reside in Virginia Beach, Virginia. The findings from this research cannot be generalized to other two year old children, regardless of whether they do or do not participate in the WIC Program and whether they reside in Virginia or any other state. However, for the purpose of examining the reliability of the form and process, this population is appropriate. Secondly, as mentioned already, the 24-hour recall is of questionable validity. However, it is the most acceptable tool to accomplish the goal of sampling dietary intake. (The nutritionist must assume, however correctly, that it is an accurate description of the child's diet and that it is a typical day's intake.) Lastly, the results of this study are limited to one computer analysis. The computer program also had a limited data base of available foods.

Definition of Terms

Certain terms and phrases will be used repeatedly throughout this paper. These will be defined here. As already stated, the 24-hour dietary recall begins with the first meal consumed on the previous day and proceeds forward for 24 hours (8). Diet recall, dietary recall, 24-hour recall, and the 24-hour dietary recall all will be used interchangeably to refer to a one day dietary intake. The WIC-329 is the standardized state form of the diet recall (5). Each time a person is screened for WIC eligibility, a completed WIC-329 must be filed in the patient's health department medical record. A common phrase to measure dietary adequacy is to use the Recommended Dietary Allowances (RDA). RDA are the levels of intake of essential nutrients considered to be adequate to meet the known nutritional needs of practically all healthy persons (23).

Additional terms are defined in Appendix A under Definitions Pertaining to Methodology. These terms are used exclusively for the treatment of data, findings, and discussion of this research project and do not reflect terminology used in other nutrition related studies.

CHAPTER II

LITERATURE REVIEW

I. The diets of preschoolers.

A. Factors affecting the nutritional status and eating habits of preschoolers.

Assessing a preschooler's diet is a complex process. Many variables must be taken into account, among them family interaction, education of parents, food preferences, and feeding practices. The family must be envisioned as an entire unit. The responses of both parents must be considered. Even if the father is absent from the home, he nevertheless may take responsibility for child care, in particular for the feeding of his children (18).

Malnourished children usually come from families with lower educational levels, greater numbers of children, a higher incidence of illnesses, and inadequate finances. A stable marital relationship is usually associated with better nutritional status for many two-parent families (18).

The family situation, faulty meal planning and poor nutrition knowledge, rather than food dislikes, might account for dietary inadequacies. A frequent complaint of parents regarding their childrens' eating habits is that they are "picky" eaters. It is worth noting that cultures concerned about having an adequate food supply do not report childrens' feeding problems, which suggests that feeding problems occur in families with access to information on feeding children and dealing with their behavior (21).

Parent-child interactions can affect a child's eating pattern. Children have been reported feeling comfortable with familiar food and not adventurous in trying new foods. More children put food in their mouths when a parent or a familiar adult was eating than when the adult was simply offering the food or coaxing the child to try a new food (17). Children often choose foods preferred by their peers or a sibling. Although children may react to positive reinforcement (praise, recognition, or approval) by eating new foods, some children will not respond or will respond for only short intervals of time. Discipline of a child influences a child's food behavior (18).

Parents can set a good example by their own eating habits. Laskarzewski, Morrison, Khoury, Kelly, Glatpelter, Larsen, and Glueck assessed potential interrelationships between nutrient intake of parents and children aged six to 19 (25). Families included at least one parent and one child. The nutrient data was collected by 24-hour recall and analyzed by correlations and analysis of covariance. Nutrients per kilogram body weight reflected commonality of dietary composition between parents and children. A positive correlation between nutrient intake of parents and children was observed for total carbohydrates, saturated fat, polyunsaturated fat, and calories. However, parents' intake of dietary cholesterol did not correlate with their childrens' intake unless analysis of covariance adjustments for sex, race, and age were applied. A serious shortcoming of this study was that 66% of the dietary data for parents and children was collected on different days (within the same week), which inevitably would increase overall variance.

Several years earlier, Sanjur and Scoma addressed a similar issue (22). Their study assessed the eating patterns of a group of 149 low-income black preschoolers in relation to their mother's social characteristics and nutrition knowledge. The 24-hour diet recall for both mother and child showed that more children than mothers had a varied diet. The food preference data indicated great differences between mother and child, with respect to agreement for two food groups (milk, fruit/vegetable), while at the same time overall high agreements and acceptance for the meat and bread/cereal group. The data suggest that not only are there differences in preference among food items within a group but among family members as well. An association existed between the child's food intake and the mother's age and employment status. Family size was not related to the dietary level in this study.

Other investigators have reported that the level of a mother's nutrition knowledge influences her child's dietary quality (16, 18, 19, 20), but few have discussed the role of nutrition education aimed directly at the preschooler. This was the focus of the next study by Harrell, Smith, and Gangever (26). The nutritive value of foods consumed at lunchtime and midmorning snack by 17 middle and upper class preschool children, aged three to five, was calculated from weighed diets over a four day period. Plate waste was determined by weighing food that remained on the plate and subtracting from the weight of the food served. Mean dietary intakes except for calories, iron, and thiamin equaled or exceeded one-third of the RDA. The proportion of the caloric and nutrient intake provided by the food groups reflected the preferences of the children for certain foods. Vegetables were not well accepted. An education program increased the mean intake of four "test" vegetables. The authors concluded that group nutrition education which provides information about foods promote acceptance of the foods by preschoolers on a short term basis.

B. Food diversity and food patterns.

Food diversity, the total number of foods consumed during a one-day period, can be an important key in determining dietary status (16). The next two studies relate to this issue (16, 19). In the study by Caliendo and Sanjur, 113 children, ranging in age from one year to four years, and their families served as the sample population (16). Dietary status was determined from a weighted quality score. The score was based on how well a child's diet in one 24-hour recall satisfied the four food groups. Diets were also assessed in terms of food diversity. Since a variety of different foods better ensures a nutritionally adequate diet, the diversity score was developed to measure the food variety of the preschoolers. The most limiting dietary factor was a dark green or deep yellow vegetable. When taking the demographic and family resource variables into account, nutrition education was the variable most significantly correlated with dietary quality and diversity. Nutrition classes for mothers improved the dietary status of the children by having an effect on the mothers' attitude. The child's birth order was negatively correlated with dietary quality.

In the second study, Yperman and Vermeersch surveyed 207 children in grades one to three and their parents

(19). The childrens' dietary complexity was based on the frequency of consuming 21 different foods. Children of mothers with higher education and more positive attitudes about the need for good nutrition had more diverse diets. The child's nutrition knowledge had a positive relationship with diet complexity scores. Children of mothers who worked full time had diets that were less diverse. Some parents were not fully aware of their childrens' food preferences. Because these children were school aged, the popularity of certain foods may have been related more to a child's social needs than to specific likes and dislikes. The researchers concluded that food preferences and dietary complexity are independent of each other and should not be used interchangeably to represent food habits.

Exactly what is a typical diet of a preschooler? Leung, Yeung, Pennell, and Hall, Martinez, Magarey, and Boulton investigated this topic (27, 28, 29). Middle class Canadian children, aged 3.5 to 4 years, were observed with respect to food and nutrient intakes (27). Eating habits and growth (height and weight) of the 189 children were assessed via home visits to each family. Dietary information was obtained once by a four-day dietary record. All children ate three regular meals and at least one in-between-meal snack each day. The energy and nutrient intakes of the preschool children were in excess of recommendations. The observed nutrient intakes ranged from 133% of the Recommended Daily Nutrient Intake (RDNI) of the 1975 Canadian Dietary Standard for iron to a high of 900% of the RDNI for vitamin C. The RDNI, except for calories, provides a margin of safety.

About two-thirds (67%) of the preschoolers were taking vitamin supplements. Since foods alone provided sufficient amounts of vitamins to satisfy the RDNI, the supplemental vitamins were not necessary. The large variety of food and nutrients consumed at mealtimes and as snacks emphasized the importance of the daily eating pattern in achieving a balanced diet. Dinner was the most important meal of the day, as it supplied the most energy, fat, phosphorus, potassium, vitamin A, and niacin. Snacks furnished the second highest amount of foods consumed daily. Snacks contained the highest levels of vitamin C and carbohydrates. A wise choice of snack foods can enhance the nutritional value of the preschool diet.

Using Canadian children again, Martinez (28) analyzed the dietary intake of 207 six and seven year olds from three socioeconomic backgrounds (high, medium, low). All children were basically well nourished. Dietary information was obtained from three day dietary diaries kept by the mothers after receiving instructions with the aid of food models. Individual nutrient intakes for all three meals plus snacks were determined utilizing computerized information based on the RDNI. Height, weight, tricep, and subscapular skinfold thickness were the anthropometric measurements taken. None of the children from the high socioeconomic group skipped breakfast whereas 7 to 10% of the other children omitted breakfast three or more times per week. Consequently, iron and thiamin intakes were lower during breakfast in the underprivileged children. Most children ingested at least two thirds of the recommended amounts of all nutrients. Mean total intakes of all nutrients did not show any differences associated with socioeconomic status except vitamin C. The higher income children consumed more oranges and fruit juices during snacks than the other children. Protein, calcium, and phosphorus intakes were slightly lower in girls than boys, possibly due to a lower consumption of dairy products by the girls. Heights of all children on the whole reflected adequate growth, however, weights tended toward higher values.

Magarey and Boulton studied the usual nutrient intake of 183 healthy Australian four year olds (29). The mothers were instructed on keeping a dietary record for three days, beginning on a Sunday. The mothers weighed all food before the children ate. Fat contributed an average of 35% of energy to both boys and girls. Protein contributed 14% of total energy for boys, and 15% for girls. For both boys and girls, carbohydrates contributed about 50% of total energy. In contrast to the Canadian children (31), the food energy intake was below the Australian as well as the American RDA. Most children consumed at least one empty calorie food on at least one day of the study. Compliance was satisfactory but involved great cooperation from the child and parent.

II. Growth.

It is widely accepted that nutrition exerts an influence on the growth and mental development of children from infancy through puberty. Many investigators have tested this hypothesis (20, 30, 31, 32, 33). The rate of change of stature, termed growth velocity, is especially sensitive to nutritional deprivation (33). In a study by Carroll, and Albanese, the highest incidence of under achievement in scholastic tests were in obese or overweight boys and girls in grades five and eight (20). The overweight children who underscored constituted 29.8% of the students. The underweight children who underscored represented 7.1% and interestingly enough, the children of normal weight who underscored constituted 18.6% of the sample population of 538 students.

Pollitt, Meuller, and Leibel (30) used multiple regression analyses to determine the magnitude of IQ variance accountable by physical growth and socioeconomic variables in 91 preschool children. Growth of the children matched the fiftieth percentile of U.S. growth standards. The prevalence of malnutrition was negligible. The three growth measurements used for the correlational analysis of anthropometry and IQ were height, weight-for- height, and head circumference. The weight-for-height percentile was the only growth measure that explained a statistically significant portion of the IQ variance. However, in undernourished populations, height is normally the most potent explanatory variable of mental test score variance.

Just as family characteristics may affect the nutritional status of children, so too may they affect the growth of children. Height quotients (height age: chronologic age) were higher for children from families with parents legally married, and lower for families with a succession of father figures or with a common-law husband (18). Rona and Chinn (31) found that children in larger families were thinner and shorter than those in smaller families. Whether or not the fathers were unemployed did not affect the rate of growth over a year's time.

III. Defining nutritional risk and assessing nutritional status.

A. General assessment.

Determining if a child is at nutritional risk is a necessary step for certifying a child eligible for the WIC Program. Different investigators have used various approaches to make such a determination in individuals. Weight-for-height and height-for-age provide indices of acute and chronic malnutrition, respectively. The most recognizable and immediate response to improved nutrition is weight gain. Just as importantly, linear growth or increased midarm muscle circumference should be documented as growth in lean body mass. In children, the goal of nutrition rehabilitation is catch-up growth (32). The next research studies attempt to define nutritional status measures.

Arnold, Engel, Aguillon, and Caedo (33) devised a classification system to place preschool children in the Philippines into nutritional categories. The ability to characterize families with children at a risk of becoming malnourished may be useful to education and assistance programs such as WIC. The nutrition index used was percentage of standard weight for age (PSWT), a Philippine standard. Children were classified as normal at PSWT >91%; first degree malnutrition 76% <PSWT> 91%; second degree at

61% <PSWT< 76%, and third degree malnutrition PSWT <61%. Families were from rural, urban, or coastal geographical areas. Based on this model, Filipino children can be classified as normal or malnourished.

Dugvale (34) devised an age-independent anthropometric index of nutritional status. For children one to five years old, the weight to height ratio is independent of age but correlates with nutritional status. The index is useful in situations when the exact age of the child is unknown or undetermined as in underdeveloped countries.

Monitoring dietary intake is important in the nutritional management of a child at risk of malnutrition and in determining if the necessary intake is met, but it does not measure nutritional status (35, 36). Solomon states that the overall purpose of nutritional assessment is to determine either the total body content of a particular nutrient or the amount of the available storage pools of a nutrient (35). However, recognizable clinical signs and symptoms appear only in the advanced stages of a nutritional problem. Total reliance on blood and tissue levels of nutrients may lead to over or under diagnosis of many deficiency states. The most important functional index of nutriture in children is growth, since the growth pattern of a child is sensitive to alteration by deficiencies of many nutrients. Nutritional status is more complex than a print out sheet of laboratory values.

Guthrie used dietary and biochemical variables to assess 419 preschoolers aged two months to 72 months (36). The children were from various geographic areas, ethnic backgrounds, and socioeconomic status. A two-day food intake record was evaluated to determine if the diet contained two-thirds of the 1974 RDA. Transferrin iron saturation was the most common biochemical deficiency and iron intake the most common dietary deficiency, together identifying 74% of those at nutritional risk. The determination of one blood value and an analysis of a two-day diet record may be used as a proxy for a more complete blood and urinary analysis. The cost savings resulting from a reduced number of tests could significantly reduce the cost of a nutrition surveillance program for preschoolers.

A study broader in scope used data from the Health and Nutrition Examination Survey (HANES I). Kerr, Lee, Lam, Lorimor, Randall, Forthofer, Davis, and Magnetti compared individual 24-hour dietary intakes of five leader nutrients via the diet recall with the laboratory values of the same nutrients in blood and urine (37). In general, the mean intakes of blacks were usually below those of whites. This finding was difficult to determine in terms of nutritional risk when both intake and lab values were above the reference standard. Mean iron intakes were below standard in all population groups except young adult males. A greater prevalence of low hemoglobin values was apparent in blacks more than in whites and was not adequately explained by differences in dietary iron intakes. Despite large numbers of subjects who reported substandard dietary intakes on the day of the diet recall, most had serum or urine values above reference standards. The individuals with standard laboratory values but substandard one day intakes may represent the first stage of nutritional risk but it was also possible that they represent the substantial day-to-day variance in diets. Certain sociodemographic variables such as age, race, gender, urban/rural residence, and income above/below the poverty level explained more variation in biochemical values than the 24-hour dietary intake variable. Reference standards for nutrient intake like the RDA may be of high sensitivity but low specificity.

B. Iron deficiency anemia.

Iron deficiency anemia is a qualifying nutritional risk for certification for the WIC Program. Using data from HANES I, the prevalence of anemia in preschoolers was examined (38). Estimates of deficiency range from 17 to 44%. Children over one year old whose diets are high in cow's milk are at particular risk of iron deficiency since milk is negligible in iron content and also because it may be substituted for other higher iron food sources. The prevalence of low hemoglobin was significantly higher for black than for white persons among both sexes and all ages. Children who were younger, black, from low-income households, and from homes in which the heads of the household had fewer years of education were more likely to have low hemoglobin levels. Adequate iron intake and the absence of pica made it more likely that a child's iron status would be adequate regardless of socioeconomic situation.

The effect of supplementary foods on the iron and vitamin A intake of Colombian preschoolers was reported by Vemury (39). A similar control group did not receive any supplementary foods. The food was given bimonthly to families on a take home basis. The foods included corn flour, vegetable oil, bulgur, and instant corn soy milk. These supplemental foods provided 8.95 mg iron and 1616 IU vitamin A per child per day. The researcher did not state if the entire family consumed the food. Nutrient intake was calculated from a 24-hour dietary recall. Results indicated that 75% of the children consuming supplementary foods had increased dietary iron intake when compared to children not consuming the foods. They were able to meet their RDA requirement. In 62.5% of the cases there was a trend towards higher vitamin A intakes when children consumed the supplemental foods. This intake was not significant. Vemury concluded that supplementary foods consumed enhanced the iron and vitamin A intake of this age group.

IV. Overview of non-American preschoolers.

The nutritional status of preschool children from less developed countries than the U.S. may be affected by factors not often common in American children. One study found that 75% of 149 Mexican children had gastrointestinal parasites in their stool samples (40). Rural Indian children ate a diet that was predominantly cereal (41). Nevertheless, factors affecting diet, eating habits, and nutritional status such as family situation and income level, are universal among preschoolers, regardless of nationality.

The nutritional status of low-income Mexican children, ages two years to four years, was evaluated using anthropometric, biochemical, and dietary measures (40). No significant difference in dietary intake or nutritional status was found between children with or without parasites. Only 13.6% of children had hemoglobin levels below 11g/100ml and 16.4% with hematocrits below 34%. More deficient were the vitamins based on the Mexican RDA: only 53% of the children had acceptable levels of ascorbic acid, 64.2% had acceptable levels of vitamin A, and 52.5% had acceptable levels for riboflavin. The energy and protein intakes averaged 81% and 99%, respectively. All children infrequently consumed fruits and vegetables. Meat and poultry were eaten an average of 4.4 times per week; milk 3.3 times per week; and sodas 5.4 times per week. As indicated by anthropometric and dietary data, girls had a poorer nutritional status than boys. All children were thinner in the summer when diarrhea was most prevalent. The overall nutritional status of the children was characterized as mild to moderate malnutrition.

Aguillon, Caedo, Arnold, and Engel (41) studied 729 families in the Philippines with at least one preschool child to assess the nutritional status of the children. They were classified into four nutritional groups -- normal, first, second, and third degree malnutrition with percentage of standard weight for age as the basis of categorization (9, 11, 12, 13). As with American children in the earlier studies mothers in families of the normal group had better knowledge of nutrition and feeding practices than those in the families categorized as third degree. More children (17.4%) in the third degree group were taken care of by a family member other than the mother in comparison to the normal growth group (9.9%). If a child were breastfed as an infant, he was more likely to fall into the normal category. Predictably enough, income had a highly significant correlation with nutritional status. The educational level of the parents positively correlated with growth. In the third degree families, 79.5% of the mothers terminated their schooling in the elementary grades, while only 54% of the mothers in the normal group did so. The fathers' schooling followed a similar pattern.

Susheela and Rao (42) examined three groups of Indian children with regard to their intake of energy, cereals, fat, bulk, and energy density (kcal/ml). The subjects were children aged two years to six years from middle and lower-middle economic groups living in an urban area and the rest of the subjects were from a rural low economic group. Dietary intake was assessed by questioning the mother using a 24-hour recall method. The urban area children ate three meals along with snacks. Rural children, however, ate two meals and very few snacks. In spite of the meal pattern differences, the bulk remained the same. Differences in milk and fat intakes contributed to the differences in energy density and energy intakes between the urban and rural children. The authors postulated that the reason for the low energy intake of the rural, poor children might be the low energy density of their diets.

V. Review of methodology for dietary assessment.

A. Traditional methods.

Many researchers have addressed the issue of valid dietary analysis. Over the years, techniques have been devised to aid this process. In nutrition research, it is crucial to elicit a pattern of usual dietary intake. A brief overview will define each method.

The 24-hour dietary recall method may be administered by those with less formal nutrition training and in a short time frame. The subject must state his exact intake in the last 24 hours (9). A one day record might yield large fluctuations in variability of calories and nutrients (10). A high reliance on memory may be prone to error (43).

The seven-day recall method is an effort to achieve greater representativeness. Memories of intake may blur after the most recent day or two so that loss in accuracy may exceed gain in representativeness (9).

A seven-day record of actual intake is based on weighing, measuring, or estimation of portion sizes. This recording technique gives a reasonably accurate measurement of actual intake, and an average of seven days is more representative of intake than a single day (9). Variability of intakes is usually greater from one day dietary records than from seven day records of the same individuals over the same time frame (10). The major objection is the impracticality for clinical or epidemiologic studies since it demands a high degree of cooperation on the part of subjects. In addition, the number willing to participate may be a small and unrepresentative sample (9).

The history method includes any method which consists of a detailed interview designed to elicit the usual diet of an individual (9). The history method yields higher values than the seven day record. The diet history and diet record do not yield identical mean nutrient intake values but on the whole, the two methods do yield a similar relationship between individuals with regard to nutrient intake (9).

The food frequency questionnaire is a self-administered questionnaire that requires respondents to estimate the frequency of consumption for specified foods. Food frequency questionnaires minimize cost and a participant's burden because they do not require a personal interview (44).

Mullen, Krantzler, Grivetti, Schutz, and Meiselman tested the reliability of the food frequency questionnaire and used for their study population 31 college students living and dining in a dormitory (44). A questionnaire was mailed to each student asking them to estimate their usual intake of certain foods. Average time to complete the form was 42 minutes. Actual food consumption was determined at each meal with self-report forms along with unobtrusive plate waste observance. The forms requested participants to indicate foods chosen at that meal. The majority of the foods were accurately estimated. Foods which were major components of a meal (flesh foods, grains, starches) were estimated with greater accuracy than those foods which could be considered accessory such as seeds, nuts, fats and oils.

B. Less traditional methods.

Bird and Elwood (45) used a photographic method of diet evaluation which they compared to a weighed record in 16 adult subjects. Each subject kept a weighed intake record for four complete days. The subjects were issued a camera and asked to photograph each meal during the same four days. There was not a statistically significant difference between the mean daily intakes, standard deviation of the main nutrients, or proportion of the energy nutrients using the two methods. The photographic method was less demanding for the subjects than either the weighed record or a detailed questionnaire. The interpretation and coding of the photographs was about as time consuming for the investigator as was the weighed method. The photographic method could be used in clinical practice and research but it is crucial that a nutritionist become skillful in evaluating the photographs. (The authors never stated how to evaluate the photographs.)

Another less widely used method is a telephone-administered 24-hour dietary recall (46). The mean nutrient intake of 204 low income elderly subjects served as the data base. Estimates of food consumption and portion size were made using a two dimensional food portion visual and mailed to the respondents in advance. The mean intakes and distributions of nutrients of subjects were compared with those from HANES I. The telephone research data produced estimates of intakes very similar to those found in HANES. The telephone administered survey has the potential to lower overall costs of dietary data collection for a given sample size since it eliminates the face to face component. The telephone format also has the potential for reducing time, logistical, and personnel constraints.

VI. Limitations of the 24-hour recall.

A. Validity, assessment, and evaluation.

Three methods of collecting dietary intake were used in the Todd, Hudes, and Calloway study (47). Researchers used a written diary record of estimated portion size of foods eaten, weighed food intake recorded on tape recorders, and the 24-hour recall. The 18 subjects who were all graduate students recalled the previous day's intake for which they had measured all food consumed. For a 15 day period, there was no significant difference in the mean energy and protein intake reported by the taped intake records or written diary records. Comparing the 24-hour recall and the one-day diary record with the individual's 30-day mean illustrated that one-day records do not accurately represent the overall mean or the typical intake. The energy intakes for each day of the week were not significantly different. Weighing the food intake may be more accurate than volume or portion size estimates, but it is tedious for the subjects and costly for the researchers. The authors suggested that repeated 24-hour recalls can accurately classify the dietary intake of individuals provided enough replicate measures are taken.

Similar findings in another study gave the above recommendation validity. Houser and Bebb (15) tested the dietary intake of 127 adults who kept 3-consecutive-day diary records of their food consumption at twelve intervals for a year. The researchers concluded that the dietary recording of a day's intake results in a valid estimate of the usual intake of the individuals of this study as long as two conditions are met. The recording must include weekdays and weekend days and also must be done over a long enough time span to detect changes over a year.

As in the Todd et al. study (47), Pao, Mickle, and Burk conducted a three fold method of data collection (12). One and three day nutrient intakes from the Nationwide Food Consumption Survey Finding, Spring 1977, were compared by a one-day record (day I); one day recall and record (day II); and one-day record (day III). Mean intakes of food energy, fat, and carbohydrate per day for all individuals based on three day diets were nearly the same as those for day I. Variations were least for protein and carbohydrate and the most for fat. Intakes of one-to-two year old children were especially low in iron in comparison with their RDA. Three day median intakes for vitamin A and vitamin C were higher than those for the one day median intakes. The most variation between one and three day intakes was for vitamin A. Intakes of iron showed less association from day to day than intakes of other minerals.

Testing the 24-hour recall for reliability and validity can be accomplished by comparing the recall method with measured food intake (13), observed intake (8), or weighed food intake (14) as the next three studies indicate. Stunkard and Waxman (13) studied the accuracy of self-reports of food intake. There was a strong linear relationship (correlation coefficient 0.96) between measured food intake and the 24-hour recall of three obese and three non-obese boys, aged four to twelve years. Nutritional content was estimated by handbooks and recalls were assisted by use of plastic food models. There was not a difference between the groups in accuracy or recall. The very small sample size may limit the finding and may not be reproducible at the same correlation coefficient of 0.96. Overall, the boys tended to over-report food intake when it was low and under-report it when it was high.

The reliability and validity of the 24-hour recall was tested statistically by comparing observed and recalled intakes of protein and kilocalories (8). Data reflected observed intakes of males versus females. A large significant difference between mean recalled intakes of both calories and protein was found. As in the Stunkard and Waxman investigation (13), children with low intakes tended to over-report, while children with high intakes tended to under-report their food consumption.

The Linusson, Sanjur, and Erickson study objectives were two fold--to test the validity of the 24-hour recall and to determine whether the validity varies with the different food groups consumed (14). The researchers compared the quantity of food consumed by actual weighing with food recalled during interviews with 86 lactating women. Regression analysis between recall and actual intake indicated that sweets were the most underestimated foods while dairy products were the most overestimated foods. For the entire study, underestimation tended to be greater than overestimation. In conclusion, the 24-hour recall was reasonably accurate for qualitative estimation of average for a group but not valid for determining quality of food consumed.

Two Swedish researchers evaluated various dietary assessment techniques using the diets of infants and children (48). Short questions on food frequencies were shown to be a poor screening instrument when used to question the parents of four and eight year old children. Staple foods (cheese, bread, potatoes, fruits) were over-estimated and sucrose rich foods were under-estimated. Group mean estimations of dietary intake of the same aged children obtained by 24-hour recalls were close to those of seven-day records from the same individuals. Using 13 year old children, the group mean estimations of the dietary history method were higher than the results of the 24-hour recalls. However accurate the dietary history method may be, it is nevertheless time consuming and therefore expensive. No seasonal variation of nutrients was found with the exception that vitamin C intake was higher in winter time.

Alford and Ekvall (49) reported on the possibility of errors being introduced into the results by the dietary interview process itself. The focus was on three parts of the interview procedure--the recording and the evaluation of the 37 subjects' responses and the calculation of nutrient values. Nutrition students served as the interviewers, and they used both 24-hour recalls and food frequency questionnaires. Few significant differences of less than 10% were attributable to variability among interviewers when the mean results from large samples were examined. Significant differences were found in the calculation of calcium and vitamin D intake, estimated daily caloric output, calculated magnesium intake, and the Food Frequency Summary Score for the meat group. Repeated interviews or individual interviews of large groups of subjects gave the most valid assessment of dietary intake. Calculating each food item in a recipe obtained during an interview rather than relying on the total food item, such as beef stew, was essential.

In another study, which dealt only with food frequency questionnaires, Mullen, Krantzler, Grivetti, Schutz, and Meiselman likewise urged tabulation of individual components rather than using combination dishes as one entity (44). Alford and Edvall state that the use of only one 24-hour recall, without the use of a Food Frequency Summary Score, to evaluate a client's diet, was unreliable (49).

Two extensive studies on in-depth statistical analysis of data from the National Heart Lung Blood Institute Nutrition Data System in Canada were conducted (50, 11). The analysis of sources of variance in the 24-hour recall encompassed total energy, protein, carbohydrate, fat, saturated and unsaturated fatty acids, cholesterol, and alcohol intake information (50). The study design involved 30 male and 30 female subjects, each interviewed six times, three trained interviewers and three interview days. In females but not males, there was a significant day of the week effect with Sunday intakes being higher than weekday intakes. Average nutrient intake per day among men was higher than in women, precluding pooling of data across sex. When nutrient intakes were expressed in proportion to energy intake, both the day of the week effect and sex difference disappeared. The primary variable was the total amount of food ingested (energy intake) rather than the particular combination of food (nutrient concentration per

1000 kcalories). There was not a difference among the trained interviewers.

In the investigators' follow-up research, vitamins, minerals, caffeine, and fiber were included (11). In the women, calcium, riboflavin, and caffeine all decreased on non-working days. For the overall study group, almost all of the variance of vitamin A was associated with day to day variability. The primary partitioning of variance was between interindividual variation (between subjects) and intraindividual (within subjects) which included both actual day-to-day variation in intake and methodogical variation. Except for caffeine, the interindividual variability of one-day data was larger than the interindividual variability. It was concluded from these two studies that one-day data provide inadequate estimates of usual intake of individuals (50, 11).

B. Recommendations.

If certain conditions are met, a 24 hour dietary assessment can be an accurate tool for dietary evaluation. Houser and Bebb (15) suggested that a single day's information will yield data equivalent to three consecutive days and that infrequent sampling during the year (such as bimonthly) would provide representative information. Morgan states that food intake assessment can be improved from the subjects' point of view by using digital weighing scales and a tape recorder to replace paper and pen which would decrease time spent on records (43). Some researchers have already used tape recorders (47). Alford and Ekvall state that a dietary assessment should be supported by biochemical tests, anthropometric measurements, clinical examinations, and evaluations of eating problems (49). Beaton et al. (11) conclude that there is not a perfect dietary method; however there may be preferred methods for particular purposes.

VII. Computerized dietary assessment.

Computer programs to evaluate and analyze dietary status are being used with greater popularity than ever before. Perhaps their biggest advantage is the time savings they provide (51, 52). However, their accuracy has been questioned (53).

Hunt, Luke, Murphy, Clark, and Coulson investigated nutrient intakes calculated by a dietary assessment (53). Computerized food frequency questionnaires were compared with the mean intakes of the same 50 individuals by averaging five 24-hour dietary recalls. Except for vitamin A, there was little difference in the mean 24-hour intake from the first recall through the fifth. Recalls were used during five successive weekly interviews. The average of the five interviews was a reasonable indicator of each subjects' intake since there was little difference in the reported mean intakes from the first interview through the fifth interview. The one exception was that there was wide variability in the estimated intake of vitamin A from each of the five recalls. The computerized questionnaire and the average of five 24-hour recalls produced essentially the same mean estimates of carbohydrate intake and minor differences of from 3 to 6% for the estimated mean values for calories, protein, and niacin. For all other nutrients, mean estimated intakes from computerized questionnaires ranged from 16 to 88% higher than the average of the five 24-hour recalls.

The greatest differences occurred for vitamins A and C. A high vitamin A intake reported by the food frequency questionnaire was possibly due to the exhaustive list of vitamin A rich foods. The vitamin C intake was likewise higher for the questionnaire than the average of five 24-hour recalls. This difference may be explained by the unusually large serving sizes listed on the questionnaire for foods high in vitamin C. Based on the wide confidence intervals and the relatively small correlation coefficients for most nutrients, the computerized food frequency questionnaire was not as accurate in estimating dietary intake in comparison to the averages of five 24-hour diet recalls (53).

Adelman, Dwyer, Woods, Bohn, and Otradovec compared three computerized dietary analysis systems (54). The three systems were never formally identified. Content, software, data base maintenance and cost were among the characteristics in which they differed. Ten women with a mean age of 27.6 years were recruited to compare the three systems. Each subject completed a three-day food record. Food scales were provided. Nutrient intake estimates differed according to the dietary system used. Significant differences were noted for total kilocalories, total fat, saturated fatty acids, polyunsaturated fatty acids, cholesterol and phosphorus. Differences noted in dietary studies using different computerized dietary analysis systems may be due in part not to real differences in subjects but rather to the system employed. Valid reference standards to compare nutrient value errors do not exist.

In another study comparing three computerized data bases, Taylor, Fozlowski, and Baer used 700 children, ages three to nine years as subjects (55). Each dietary record and 24-hour recall was analyzed using the three systems. As in the Adelman <u>et al</u>. study, differences in mean nutrient values were noted between the systems. Differences were not clustered among values from one data base, nor were highest or lowest mean values obtained from a particular base.

A computerized dietary assessment system was designed to provide a reliable cost-effective method of nutritional analysis that could be used with a minimum of professional hours in data entry and user training (51). The data base was derived from USDA Handbook No. 8. Sharp and Ahmed cite many of the advantages. Manual comprehensive nutrient intake reports required about three hours per one-day intake record versus ten to 15 minutes using the computerized method. Flexibility in terms of the units of measure for each food such as gram weight, volumetric measure and household units was a big plus. Data generated via each computerized analysis was used by nutritionists to develop nutritional care plans, monitor progress toward goal achievement, and in-patient education.

Smith and Lloyd-Still (52) collected three-day food records from 147 infants and children referred to gastrointestinal and cystic fibrosis clinics. The parents were given forms to record the food and liquid intake of their children at home. A microcomputer was programmed using the 1980 RDA. Recommended intakes were defined as 67% or more of the RDA for nutrients. Recommended ranges for distribution of calories were defined as 45% to 55% for carbohydrate, 9% to 16% for protein, and 30% to 40% for fat. Excessive intake for calories was defined as greater than 125% RDA. The reviewing, coding, and processing of each dietary analysis averaged 20 minutes. Hand calculation of the same analysis took six hours. A net time saving of 5.7 hours per dietary analysis showed that this program is an easy, rapid, and practical method for obtaining nutrient analysis.

Without a doubt, computerized dietary analyses have gained respect due to their flexibility, repeatability, speed, and ease of calculations (54). Care must be taken to choose a computer system that is best suited to the needs of a hospital, research team, or clinic because different systems may yield different results (54). Clearly, computerized dietary analysis is here to stay.

CHAPTER III

JOURNAL MANUSCRIPT

Introduction

In 1972, President Nixon signed Public Law 93-32 which authorized the commencement of the Special Supplemental Food Program for Women, Infants, and Children, commonly called WIC [(1)4]. The Departments of Agriculture (USDA) and Health Education and Welfare (HEW) recognized that low income women and children are at special risk to malnutrition with "respect to their physical and mental health by reason of inadequate nutrition or health care, or both" [(1,2)4,5].

To be eligible for WIC in Virginia, participants must meet two requirements. First, they must be at or below 167% of the poverty level, and second, they must be nutritionally at risk based on a medical assessment [(3)7]. The Virginia WIC Program uses a 24-hour dietary recall for its instrument of determining whether an individual is at nutritional risk [(2)5].

The diet recall has been a source of debate since its origin. Variability is greater with one day intakes than with longer duration records [(4,5,6,7)9,10,11,12]. Subjects with low intakes tend to over-report, while subjects with high intakes tend to under-report their food consumption [(8,9,10,11)8,13,14,15]. In general, a one day recall gives a better picture of the dietary status of a group than of an individual [(6,7,10)11,12,14].

When assessing a preschooler's diet, a caretaker normally does the actual reporting of the child's food intake instead of the child giving a self report. Homemaker attitudes play a significant role in the quality of children's diets. If a woman is content with her roles of mother and homemaker, then her children will have a better score for dietary quality [(12,13)16,17]. Mothers who know the least about nutrition have children with the poorest food habits and dietary quality [(12,14,15,16)16, 18,19,20].

The need exists for further study of the assessment of the diets of young children. For this study, the research will be based on the 24-hour dietary recall as used in the Virginia WIC Program.

Methodology

The researcher was a WIC Nutritionist employed by the Commonwealth of Virginia. All data was gathered at the Virginia Beach Health District between August 1984 and February 1985. The project used 75 children, aged 24 to 36 months, for subjects. They were all participants of the Virginia Beach WIC Program.

WIC 329

A standardized 24-hour dietary recall (WIC 329) used throughout the Commonwealth of Virginia was used for assessment of the two year old subjects [(2)5]. The recall is divided into four food groups--milk, meat, vegetables and fruits, and bread and cereal. Different population groups are also specified and their nutritional requirements are indicated by how many servings from the four food groups--milk, meat, vegetables and fruits, and bread and cereal each population requires on a daily basis. (see Table [(1)1]). Children aged one to three years old require two servings of milk equivalents and two half sized servings from the meat group. In the fruit and vegetable group, these children need a half serving of a vitamin A rich food, one serving of a vitamin C rich food, and two half sized servings of other fruits and vegetables Their bread and cereal requirement is four half sized servings.

Additional questions not appearing on the WIC 329 such as number of children in the family, a child's birth order and so forth were recorded at the bottom of the page for future coding. In most cases, this extra demographic information was obtained from the medical chart.

To continue receiving the supplemental foods, infants and children must be recertified (screened) for nutritional risk every six months. In order to be recertified for inadequate diet, a nutritionist must evaluate a child's diet recall. If a child was lacking more than three servings of food, in any combination the child was considered to be at nutritional risk. Caretakers were asked to report everything their children ate and drank within the past 24 hours. Measuring cups and spoons were used to assist them in determining portion sizes.

Nutritionist I

The Nutritionist I is a computer software program by N-Squared Computing which analyzes, among other features, the percentage of Recommended Dietary Allowance (RDA) consumed by various population groups, total calories ingested and grams of saturated and unsaturated fat, protein, and carbohydrates in the diet [(17,18)23,24]. The data base for the Nutritionist I is Home and Garden Bulletin No. 72 [(19)56]. Each food is identified by an item number from No. 72. This program uses the 1980 RDA [(17)23].

Once each food had been assigned an appropriate item number from No. 72, each child's diet recall was then entered into the computer and analyzed based on the Nutritionist I [(18)24]. The next step was to code WIC 329 forms by over and under servings of required amounts. Data were examined from the five nutrients (calcium, protein, vitamin A, vitamin C, and iron) found in the four food groups on the WIC 329.

Servings were standardized within each food group. This process was followed to prevent skewing of nutrients, since the nutrients are recommended at different levels and in varying units of measure. Statistical analysis was based on the SAS Institute, Inc. computer program [(20)58].

Average RDA (AVGRDA) refers to the RDA of protein, iron, calcium, vitamin A and vitamin C divided by five. The AVGRDA represents the percentage of nutrients reflected by analysis of dietary recall using the Nutritionist I. The AVGRDA was determined by a step-wise multiple regression.

Values for all nutrients were truncated at 150% of the RDA for each nutrient. This process eliminated any skewing of nutrients through excessively large amounts from any one food group.

Although the WIC 329 indicates which leader nutrients are found in each food group, not all nutrients were considered. The nutrients per food group revision for children, aged one to three are found in Table [(2)9]. All nutrient values were based on No. 72 [(19)56].

<u>Definitions Pertaining to Methodology</u>

Certain terms were developed for the analysis and interpretation of the data. The term Smilk signifies the sum of all servings of milk; the term Smeat, the sum of all servings from the meat group; and so forth. Servings total (Stotal) is the sum of all servings of milk, meat, bread, vitamin A foods, vitamin C foods, and other fruits and vegetables. Standard mg calcium (StmgCa) represents servings of milk multiplied by 288 mg per serving. Standard g protein (StgPro) represents servings of milk times 8 g plus servings of meat times 14 g and servings of bread times 2 g since protein is found in each of these food groups. Standard IU vitamin A (StIUvitA) includes servings of milk multiplied by 310 IU plus servings vitamin A fruits and vegetables times 6000 IU (a corrected value from that printed on the WIC 329) plus servings of other fruits and vegetables times 162 IU. Standard mg vitamin C (StmgvitC) refers to servings of vitamin C fruits and vegetables times 60 mg plus servings of other fruits and vegetables times 6.2 mg. Standard mg iron (StmgFe) represents servings of meat times 2.26 mg, plus servings of vitamin A fruits and vegetables times 1.11 mg, servings vitamin C fruits and vegetables times 0.76 mg and servings of bread times 1.1 mg.

The terms total servings lacking (Totlack) and total servings over (Totover) refer to all servings of foods, exclusive of food group. The standardized sum of servings (Sumst) and the standardized sum of nutrients from servings (Sumst2) were phrases devised to aid in the statistical analysis.

Results

The mean age of the 75 subjects was 28.67 ± 4 months. The majority (57.3%) received all of their health care through the Virginia Beach Health Department. More children resided in a one parent home (57.3%) than a two parent home (38.7%). The number of children in the family ranged from one child (37.3%) to seven children (4.0%) with a mean of 2.24 children per family. Almost half (48.0%) of the children were the first born. An almost equal number of subjects were male (49.3%) as female (50.7%). The population consisted of 49.3% Blacks, 45.3% whites, 2.7% Hispanics, and 2.7% Asians. The three most common nutritional risk factors were inadequate diet (58.7%), fear of regression (22.7%), and anemia (21.3%). Most of the children (73.3%) did not consume vitamin supplements. A higher percentage of families received no government assistance in the form of food stamps (68.0%) or Aid to Dependent Children (60.0%) than families that did receive these benefits. Even though Virginia Beach has a large military population, most of the children came from civilian households (82.6%). The majority of the children resided in homes at the lowest end of the income scale (64.0%). Only 4% lived in homes at the maximum qualifying income level.

Correlating demographic variables with dietary variables did not produce any significant findings. None were statistically significant at the p<.001 level.

Each food group and corresponding nutrient was identified with varying degrees of accuracy on the WIC 329. Calcium is found primarily in the milk group and none of the other food groups contribute any substantial amount. The correlation coefficient of StmgCa and Smilk is 1.00 at p<.001, signifying total unity as reflected in Table [(3)10]. All correlation coefficients used the raw weighted figures rather than truncated because the information is reported via the diet recall as raw data. The calcium RDA and StmgCa correlation coefficient is 0.73. [(Table 4)11] The RDA for children aged 1-3 is 800 mg calcium. Two thirds of this amount is 536 mg. A minimum of two servings of milk will meet 2/3 RDA. A total of 29 children (38.7%) satisfied the 2/3 RDA requirement. [Table 5)12] The mean calcium consumed was 86% of the RDA [(Table 6)13].

Protein, as indicated by the WIC 329, is a component of milk, meat and bread products. If all required servings are consumed, a child's intake will be 34 g. Two thirds of 34 g is 23 g which is also the RDA. Two thirds of the RDA is 15.4 g. All 75 children consumed 15.4 g. All but one child met the 23 g requirement and 69 (92.0%) consumed 34 g. The protein RDA and StgPro correlation coefficient is 0.78 while the Smeat and StgPro correlation coefficient is 0.80. The amount of protein consumed was 145% of the RDA.

The vitamin A RDA for children, aged one to three, is 2000 IU. Two thirds of the RDA is 1340 IU. The WIC 329 states the vitamin A value of one half serving at 2000-2500 IU. Recalculating the vitamin A value from the vitamin A fruits and vegetables yielded an average of 3000 IU per one half serving. The WIC 329 requirement, using 3000 IU as the corrected value, is 150% higher than the RDA and 224% higher than 2/3 RDA. The WIC 329 understates the vitamin A content found in these foods. A hand tally of the Nutritionist I indicated that ten (13.3%) children did not consume 2/3 RDA while the WIC 329 indicated that 46 (61.3%) did not consume the 2/3 RDA minimum. The vitamin A RDA and StIUvitA correlation coefficient is 0.69 and the SvitAfr/veg and StIUvitA correlation coefficient is 0.99. A mean of 116% of the RDA of vitamin A was consumed.

The vitamin C RDA for children, aged one to three, is

45 mg. The WIC 329 requirement is 60 mg which is 133% higher than the RDA. A hand tally of the Nutritionist I indicated that 23 (30.7%) children did not meet 2/3 RDA while the WIC 329 revealed that 28 (37.3%) did not consume the 2/3 RDA requirement. The vitamin C RDA and StmgvitC correlation coefficient is 0.84 and the SvitCfr/veg and StmgvitC correlation coefficient is 0.99. The mean vitamin C consumed was 109% of the RDA.

Seven fruits and vegetables were identified as representative of the other fruit and vegetable category. The nutrient values for these foods did not significantly affect the nutrient content of the diets of the preschoolers based on the correlation coefficients. The variables SOfr/veg and StIUvitA, and SOfr/veg and StmgvitC were not statistically significant at the $p<.001$ level. [(Table 3)10]

Although iron status is a consideration for WIC recertification, iron content is never formally evaluated on the WIC 329. When reviewing a diet recall with an anemic patient, iron rich foods are discussed. Since iron is not one of the indicator nutrients designated, the iron value of the diet is unknown. Upon calculating iron values from the four food groups, 1.1 mg iron is the average found in one bread or cereal serving. The average is skewed upward due to the inclusion of iron fortified cereal.

The total estimated averaged iron intake for a preschooler meeting the WIC 329 requirement in all food groups is 5.8 mg iron/day. This figure is computed by adding the meat, bread and vitamin A and vitamin C fruits and vegetables. [(Table 5)12] The RDA for this age group is 15 mg/day and 2/3 RDA is 10 mg/day. Consequently, the minimum required servings on the WIC 329 will not meet the daily iron recommendation. However, inadequate iron intake did not appear to be a problem. All but two children ingested the WIC 329 requirement of 5.8 mg/day. The majority (78.7%) consumed 2/3 RDA while 32 (42.7%) met the RDA. Two thirds of the iron RDA was not met since the mean RDA consumed was 56%. The mean and the range of the energy nutrients are located in Table [(5)12].

Protein comprised 16.5%, carbohydrate 48%, and fat 36% of the total caloric intake. The ideal proportion for preschoolers are 10 to 15% protein, 50 to 60% carbohydrate, and 25 to 35% fat [(21)59].

With AVGRDA as the dependent variable, several correlations were established with other predicators of nutritional status. The Sumst and AVGRDA correlation coefficient was 0.78. The standardized sum of nutrients from servings (Sumst2) and AVGRDA correlation coefficient is 0.80. The Stotal and AVGRDA relationship was 0.66. The Totover and AVGRDA correlation coefficient was 0.57. The

Totlack and AVGRDA are negatively correlated at -0.67. All values are truncated since they are more precise figures accounting for a larger degree of variance. [(Table 7)14].

Scattergrams demonstrate picturally where each subject falls with regard to nutritional status. Figure I corresponds to the correlation coefficient 0.66 of Stotal and AVGRDA while Figure 2 similarly corresponds to Totlack and AVGRDA with the value of -0.67. Using truncated values drastically reduced the incidence of false negative and positive observations on the scattergrams.

A regression formula was developed to estimate nutritional status. Truncated numerals were used again to prevent skewing of nutrient values. A ceiling of 150% RDA was used. The truncated formula is as follows:

$$46.94 + 3.67(2.87) + 2.14(6.56) + 9.39(0.33) + 6.14(0.96) + 14.98(1.47) = 103.$$

[(Table 8)15] The mean number of servings consumed from the meat, milk, vitamin A, vitamin C, and bread group are multiplied by the B values which represent the weighted value of each food group relative to the other food groups. A five variable model was used rather than a six variable model. The sixth variable, servings of other fruits and vegetables, did not affect nutrient status of the 75 diets. [(Table 8)15] Once all the variables were tabulated, the sum equaled 103. This numeral signifies the standardized RDA and summed average RDA (AVGRDA) based upon the WIC 329. The B values in the SAS program (58) for maximum R_Square improvement for the dependent variable AVGRDA provided the appropriate weighted values for each food group. The R_Square value which was derived from the maximum R_Square improvement for the AVGRDA was 0.662. This figure was the accountability of variance based on the Nutritionist I. The square of the correlation of 0.66 is 44% which was the percentage of variance accounted for based on the WIC 329. Therefore, the use of the regression formula instead of the WIC 329 can result in a 67% improvement in accuracy of estimating nutritional status for the two year olds, increasing accountability of variance from 44% to 66%. Stated another way, unaccounted variance was reduced from 56% to 34%.

Regression predictions were obtained by squaring the correlation value 0.662. The regression prediction from servings and the regression prediction from serving nutrients each had the value of 0.81 when correlated with AVGRDA. This correlation coefficient is highly significant.

If servings from all food groups are weighted properly, results of analyzing diets with the regression formula correlate 0.78 with the use of the Nutritionist I. The current system of utilizing total servings lacking on the WIC 329 correlated -0.67 with dietary analysis using the Nutritionist I. [(Table 7)14]

Discussion and Recommendations

Several relationships bear closer examination when comparing the mean servings of each food group and the standard unit of each nutrient with the mean RDA of the leader nutrients. Only 38.7% of the children ingested the minimum recommended 2/3 of the RDA for calcium. This low percentage is undesirable since 61.3% of the preschoolers did not ingest enough for a physiological margin of safety. The 1.47 mean serving of milk consumed was less than the required two servings which supports the above percentage. Both the Smilk and CaRDA and StmgCa and CaRDA correlation coefficients are statistically significant at 0.73. One would expect a higher correlation but it must be considered that while milk products undisputedly are the primary source of calcium, other foods such as leafy greens, baked products made with milk, and legumes contributed the remainder to the diet [(19)56].

A deficiency of protein was certainly not a problem since the mean protein was 145% of the RDA and all but one child consumed the RDA. Neither meat, bread, nor milk predominate as a protein indicator. Although a serving of milk contains more protein than a serving of bread, the milk correlation coefficient (0.38) was lower than the bread/cereal group (0.44) possibly because more servings of bread were eaten than milk. The Smeat and StgPro correlation coefficient is significant at 0.80. Although not the only source, the meat group can adequately fulfill the protein requirement.

The nutrients iron and calcium are so interwoven with protein intake that protein does not need to be calculated to determine protein status. In other words, if calcium and iron intake are adequate, then the protein intake will also be adequate. However, since the WIC 329 is used for both an assessment and educational instrument, protein should remain as it is already stated in each of the food groups.

The mean vitamin A fruit and vegetable serving of 0.33 consumed does not correspond to the mean of 116% of the vitamin A RDA. This discrepancy is probably due to the limited foods designated on the WIC 329 as high vitamin A sources. In this population, spaghetti (either homemade, canned, meatless, or with meat sauce) was a very popular item. A one half cup serving supplies about one fourth of the vitamin A RDA [(19)56]. More frequently, a child would consume a minimum of one cup. The WIC 329 does not state tomatoes under the vitamin A heading other than the ambiguous "one cup tomatoes". Similarly, if a child drank two glasses of milk, then he/she would fulfill nearly one third of the vitamin A requirement. Two servings of milk and one cup of spaghetti contributes 85% of the vitamin A to a child's diet [(19)56].

According to the SAS Program which analyzes values taken from the researcher's interpretation of the stated foods consumed on the WIC 329, 38.7% of the children met the 2/3 RDA minimum requirement [(20)58]. In contrast, a hand tally of all the diets analyzed by the Nutritionist I [(18)24] indicated that 86.7% of the children consumed 2/3 RDA. This difference adds further support to the inability of the WIC 329 to assess the vitamin A content of a diet. The figure of 86.7% may be more valid especially when considering the mean RDA of 116%. In defense of the WIC 329, the foods that were indicated on the form as being rich in vitamin A were truly excellent sources as evidenced by the SvitAfr/veg and StIUvitA correlation coefficient of 0.99.

The vitamin C assessment on the WIC 329 was the most accurate of the five nutrients. The mean of 0.96 servings and 109% of the RDA consumed are in agreement with one another. Both the VitCRDA and StmgVitC and VitCRDA and SVitCfr/veg correlation coefficients are 0.84. The fruits and vegetables under the heading of vitamin C rich foods were properly chosen as being representative of the nutrient vitamin C. The SVitCfr/veg and StmgVitC correlation coefficient was 0.99 further supporting the accuracy of this food group to supply vitamin C. Comparing the statistical analysis and the results of the computer printout of the Nutritionist I resulted in better agreement than the vitamin A comparison. According to the statistical analysis, 62.7% of the children met 2/3 of the vitamin C RDA which was a close fit in comparison to the 69.3% based on the Nutritionist I. It should be noted that the serving sizes stated on the WIC 329 yield 60 mg vitamin C whereas 45 mg is the RDA for children aged one to three.

As already mentioned, iron is not one of the indicator nutrients formally identified on the WIC 329. Consequently, this nutrient was poorly assessed. The meat group and bread/cereal group were the best sources of iron. Only 56% of the iron RDA was met which would indicate that the iron status for this population was marginally deficient. The FeRDA and StmgFe correlation coefficient was 0.65 which was the lowest of the five nutrients and the corresponding nutrients' RDA. No one food group was an outstanding source of iron. The StmgFe and Smeat correlation coefficient was 0.69 while the StmgFe and Sbread relationship was not statistically significant.

Interestingly enough, the Sbread and FeRDA correlation coefficient (0.51) was greater than the Smeat and FeRDA

(0.46) relationship. Both correlation coefficients were weak but not statistically significant. The servings of bread was a better indicator of percent of iron RDA consumed than meat. One plausible factor may be that about one and a half as many servings of bread were eaten than meat servings.

Those children meeting 2/3 of the iron RDA accounted for 78.7% of the population. This value does not parallel the mean of 56% RDA. When evaluating a child's diet, snack foods such as cakes, cookies, pies, and other baked goods made with iron enriched flour are not tabulated under any food category since they are presumed to be empty calories. It is possible that the small contribution of these foods add up to a substantial amount of iron. One last factor to consider is the role that iron fortified cereals play in the iron status of these children. Only cereals which contain at least 45% of the iron RDA may be purchased with WIC vouchers [(2)5]. Thus when a child has a cup of high iron WIC cereal for breakfast, he/she is ingesting a greater amount than the average of 1.1 mg per bread/cereal serving. The addition of WIC cereal in the children's diets may account for the 78.7% meeting 2/3 of their RDA. Overall, iron was not adequately represented on the WIC 329.

The energy nutrients were not in the ideal proportions. The fat and protein were too high while the carbohydrate content was too low. Excess protein can overtax the kidneys [(21)59] and lead to a negative calcium balance [(17,22)23,60]. A high fat diet may contribute to coronary heart disease [(22)60]. Many of the children had at least one meal at a fast food restaurant. These establishments are notorious for their high fat content.

The scattergrams deserve further explanation. Figure I based 70% AVGRDA as the cut off for adequate nutritional status. Below that percentage, children were at nutritional risk. Between the 100% and 70% AVGRDA a 1/3 cushion of safety exists. If less than 12.5 servings of food are consumed, a child is in danger of not meeting 70% AVGRDA. Using this model, the ten children (13.3%) in the lower left quadrant were at nutritional risk. This data positively corresponds to the correlation coefficient of 0.66 of Stotal and AVGRDA.

Figure II likewise is based on 70% AVGRDA. The children that were lacking at least 3.5 servings did not meet 70% AVGRDA. The Virginia WIC Program certifies a child eligible for WIC participation due to inadequate diet if more than three servings of any food are lacking. Thus, the three plus servings lacking requirement for inadequate diet is accurate. The nine children (12%) in the lower right quadrant fell short of the 70% AVGRDA. An inverse relationship exists between Totlack and AVGRDA at -0.67.

Since the truncated regression formula can accurately estimate nutritional status, number of servings consumed from each food group can be inserted into a programmed calculator to determine the summed average RDA or AVGRDA. If the value is below 70% AVGRDA, inadequate nutrients have been consumed. If the value is above 150% AVGRDA excess nutrients have been consumed. WIC Nutritionists could use the programmed calculator as an improved method of determining nutritional status while at the same time continuing to use the WIC 329 as an educational tool.

Overall, the WIC 329 is an acceptable means of dietary analysis. It is, however, deficient in several respects. First, as already stated earlier, any 24 hour dietary recall, regardless of instrument design, has inherent flaws. Despite these deficits, modifications of the WIC 329 can greatly improve the accuracy of nutritional assessment.

On the basis of this study, the following recommendations are offered. Vitamin A analysis should be changed. As Table 2 indicates, a serving of fluid milk yields 310 IU vitamin A. A WIC participant should be educated to the fact that fluid milk is a fair source of vitamin A. The milk group heading should state 310 IU vitamin A in addition to the 288 mg calcium and 8 g protein. The vitamin A fruit and vegetable group should include raw and canned tomatoes or tomato juice so that entrees prepared with tomatoes can be calculated as vitamin A sources. One raw tomato contains 1110 IU vitamin A; one cup of canned tomatoes including liquids contain 2170 IU and eight ounces tomato juice contain 1940 IU vitamin A [(19)56]. The vitamin A fruits and vegetables yield a higher value than 4000-5000 IU. The WIC 329 should state that these foods averaged 6000 IU. Since a half size serving provides a child 3000 IU and the RDA is 2000 IU, the WIC 329 could state that these foods are required at least every other day.

The vitamin C assessment was quite accurate. However, for this population, only 3/4 serving is needed to satisfy the 45 mg vitamin C RDA requirement. The WIC 329 could state 3/4 serving for the one to three year olds.

Iron evaluation on the WIC 329 was poor. Iron values should be indicated on the WIC 329 for the meat, vitamin A and vitamin C fruits and vegetables, and bread and cereal groups as demonstrated by Table 2. To further improve iron assessment, iron fortified cereals, supplying at least 45% RDA, should be a separate subgroup of bread and cereal items to reflect their higher iron content. The remaining bread products should be recalculated, excluding the WIC cereals, to prevent upward skewing of the nutrient. Under the iron fortified cereal subgroup, a statement could suggest that WIC cereals be consumed three to four times per week.

By incorporating the truncated regression formula into the WIC Nutritionist's diet instruction, the accuracy of estimating nutritional status can be increased. The inclusion can be accomplished through the use of a programmed calculator. To improve the regression equation, dry iron fortified cereal can be used as one of the predictors in addition to the five food groups already represented.

The study can be repeated on a larger scale. A greater number of subjects would better validate the findings. A minimum of 100 subjects, two reviewers per case, and a minimum of five recalls per child would enable a consensus on the recall number of servings to be reached.

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Table 1. **BUREAU OF PUBLIC HEALTH NUTRITION**
24-HOUR DIET RECALL
(WIC Certification—Part D)

NAME________________ RECEIVES: Food Stamps________ WIC________
AGE________ HEIGHT________ WEIGHT________ Elderly Feeding Prg.________ Meals-on-Wheels________
VITAMIN SUPPLEMENT: Yes________ No________ School Brkf.________ Lunch________

Record all food and beverages consumed in the past 24 hours, including amounts:

Evaluate above recall by counting each serving of the following groups:

FOOD GROUP	Child 1-3	Child 4-6	Pregnant Teenager	Pregnant Woman	Adult	Lactating Woman	Servings Eaten	Servings Lacking
(First food named is the standard serving size)	DAILY RECOMMENDED SERVINGS							
MILK—equivalents of 288 mg. Ca. & 8 gm. Protein 1 cup milk; 1½ cup ice cream, pudding; 2 slices cheese; 1 cup yogurt; 1¼" cube cheese; 1½ cup cottage cheese; ¾ cup custard; 1 (3¼ oz.) can sardines	2-3 (16-24) oz.	2-3	5	4	2 4 non-pregnant teen	4		
MEAT—equivalents of 14 gm protein 2 oz. meat, fish, poultry; 2 slices cheese; 1 cup dried beans, peas; 4 slices bologna; 4 T. peanut butter; ½ cup cottage cheese; 2 eggs; 6 oz. Tofu	2 ½ size serv.	3 ½ size serv.	4	3-4	2-3	2-3		
VEGETABLES & FRUIT *Vitamin A equivalents* 4000-5000 IU ½ cup greens; 1 cup broccoli; ½ cup spinach; 1 cup apricots; ½ cup carrots; 1 cup cantaloupe (¼ med.); ½ cup sweet potatoes; ½ cup mixed vegetables; 2 cups tomatoes	½ serv.	½ serv.	1	1	1	1		
Vitamin C equivalents of 60 mg. ½ cup orange juice, grapefruit juice; ½ cup fortified pineapple juice; 1 orange; 1 grapefruit; ½ cantaloupe; 2 tomatoes; 1½ cup tomato juice; ½ cup broccoli, brussel sprouts; 1 cup cabbage (raw)	1 serv.	1 serv.	2	2	1	2		
Other fruit or vegetables	2 ½ serv.	2	2	2	2	2		
BREAD & CEREAL—70 Kcal equivalents & 2 gm. Protein 1 slice bread; ½ cup cooked cereal, grits; ½ cup cooked rice; ¾-1 cup dry cereal; ½ cup cooked macaroni, spaghetti, noodles; 5 crackers; cornbread 1½" x 2" x 1½"; 4" pancake; ½ frozen waffle; 1 biscuit; ½ hot dog or hamburger bun; ½ English muffin	4 ½ size serv.	4	4	4	4	4		

If a fraction of the above amounts were eaten, count as that fraction of a serving. Total Lacking________

Alcoholic Beverages________ Non-food items eaten (paint, clay, etc.)________

If more than 3 servings are missing, and this is a typical day, diet needs improvement and meets WIC nutritional risk criteria for inadequate diet.

Evaluation of diet: (Describe any nutrient deficiencies, inappropriate patterns, etc.)________

WIC 329 (Date) (Interviewer) (Title)

Table 2. Averaged nutrients per food group per serving

FOOD GROUP	Child 1-3	nutients	per serving
(First food named is the standard serving size)			
MILK—equivalents of 288 mg. Ca. & 8 gm. Protein 1 cup milk; 1½ cup ice cream, pudding 2 slices cheese; 1 cup yogurt 1¼" cube cheese; 1½ cup cottage cheese ¾ cup custard; 1 (3¼ oz.) can sardines	2-3 (16-24) oz.	calcium protein vitamin A (fluid milk)	288 mg 8 gm 310 IU
MEAT—equivalents of 14 gm protein 2 oz. meat, fish, poultry; 2 slices cheese 1 cup dried beans, peas; 4 slices bologna 4 T. peanut butter; ½ cup cottage cheese 2 eggs; 6 oz. Tofu	2 ½ size serv.	protein iron	14 gm 2.26 mg
VEGETABLES & FRUIT *Vitamin A equivalents* 4000-5000 IU ½ cup greens; 1 cup broccoli ½ cup spinach; 1 cup apricots ½ cup carrots; 1 cup cantaloupe (¼ med.) ½ cup sweet potatoes; 2 cups tomatoes ½ cup mixed vegetables	½ serv.	vitamin A iron	6000 IU* 1.11 mg
Vitamin C equivalents of 60 mg. ½ cup orange juice, grapefruit juice ½ cup fortified pineapple juice 1 orange; 1 grapefruit ½ cantaloupe 2 tomatoes; 1½ cup tomato juice ½ cup broccoli, brussel sprouts 1 cup cabbage (raw)	1 serv.	vitamin C iron	60 mg 0.76 mg
Other fruit or vegetables	2 ½ serv.		
1/2 c mashed potatoes 10 french fries 1/2 c canned corn 1/2 c string beans 1 bananna 1 apple		vitamin C vitamin A	6.2 mg 162 IU
BREAD & CEREAL—70 Kcal equivalents & 2 gm. Protein 1 slice bread ½ cup cooked cereal, grits ½ cup cooked rice ¾-1 cup dry cereal ½ cup cooked macaroni, spaghetti, noodles 5 crackers cornbread 1½" x 2" x 1½" 4" pancake; ½ frozen waffle 1 biscuit; ½ hot dog or hamburger bun ½ English muffin	4 ½ size serv.	protein iron	2 gm 1.1 mg

* corrected average

All calculations taken from data in Home and Garden Bulletin No. 72 (56).

Table 3. Correlation coefficients of standard units of nutrients with the sum of all servings from the food groups

	Stotal	AvgRDA	StmgCa	StgPro	StIUvitA	StmgvitC	StmgFe
Smilk	0.19	0.50	1.00*	-	-	-	-
Smeat	0.46	0.35	-	0.80*	-	-	0.69*
Sbread	0.76*	0.34	-	-	-	-	-
SOfr/veg	0.41	0.12	-	-	-	-	-
SvitAfr/veg	0.28	0.33	-	-	0.99*	-	-
SvitCfr/veg	0.39	0.59*	-	-	-	0.99*	-
Stotal	-	0.66*	-	-	-	-	-
StmgCa	0.19	0.50	-	-	-	-	-
StgPro	0.69*	0.64*	-	-	-	-	-
StIUvitA	0.34	0.40	-	-	-	-	-
StmgvitC	0.43	0.60*	-	-	-	-	-
StmgFe	0.85*	0.59*	-	-	-	-	-
Totlack	-0.76*	-0.67*	-	-	-	-	-
Totover	0.93*	0.54	-	-	-	-	-
Sumst	0.89*	0.78*	-	-	-	-	-
Sumst2	0.76*	0.83*	-	-	-	-	-

$p<.001$

* Statistically Significant

Table 4. Correlation coefficients of leader nutrient RDA with dietary variables

	ProRDA	FeRDA	CaRDA	VitARDA	VitCRDA
Smilk	0.38	-	0.73*	0.32	-
Smeat	0.56*	0.46	-	-	-
Sbread	0.44	0.51	-	-	-
SvitAfr/veg	-	-	-	0.69*	-
SvitCfr/veg	-	-	-	-	0.84*
ProRDA	-	0.66*	0.72*	0.39	0.46
FeRDA	0.66*	-	-	0.47	-
CaRDA	0.72*	-	-	0.40	-
VitARDA	0.39	0.47	0.40	-	0.17
VitCRDA	-	-	-	0.17	-
%cal	0.79*	0.59	0.72*	0.32	0.37
Totlack	-0.53	-0.47	-0.44	-0.41	0.41
Totover	0.63*	0.64*	0.37	0.24	0.33
Stotal	0.64*	0.64*	0.44	0.34	0.37
StgPro	0.78*	0.60*	-	-	-
StmgFe	0.66*	0.65*	-	-	-
StmgCa	-	-	0.73*	-	-
StIUvitA	-	-	-	0.73*	-
StmgvitC	-	-	-	-	0.84*
AVGRDA	0.82*	0.60*	0.69*	0.66*	0.75*

$p<.001$

* Statistically Significant

Table 5. Leader nutrients and the WIC 329 (including sodium, cholesterol, and energy nutrients)

calcium

1980 RDA = 800 mg (for children 1-3 years old)
2/3 1980 RDA = 536 mg
WIC 329 requirement for 1-3 year old children = 576 mg

WIC 329	frequency	percent
consume ≥576 mg	29	38.7
consume <576 mg	46	61.3
total	75	100.0

1980 RDA		
consume ≥800 mg	2	2.7
consume <800 mg	73	97.3
total	75	100.0

2/3 1980 RDA	
consume ≥536 mg	same frequency values as
consume <536 mg	576 mg

Table 5. (Cont.)

protein

1980 RDA = 23 g (for 1-3 year old children)
2/3 1980 RDA = 15.4 g
WIC 329 requirement for 1-3 year old children = 34 g
1980 RDA = 2/3 WIC 329 protein requirement

WIC 329 protein requirement

milk 8 g x 2 servings = 16 g
meat 14 g x 2(1/2) servings = 14 g
bread 2 g x 4(1/2) servings = 4 g

34 g total

WIC 329	frequency	percent
consume ≥34 g	69	92.0
consume <34 g	6	8.0
total	75	100.0

1980 RDA		
consume ≥23 g	74	98.7
consume <23 g	1	1.3
total	75	100.0

2/3 1980 RDA		
consume ≥15.4 g	75	100.0
consume <15.4 g	0	0.0
total	75	100.0

Table 5. (Cont.)

vitamin A

1980 RDA = 2000 IU (for children 1-3 years old)
2/3 1980 RDA = 1340 IU
WIC 329 (all sources) requirement for 1-3 year old children = 3852 IU

WIC 329

Vitamin A group serving reflected as 4000-5000 IU equivalents on form. Actual calculation resulted in the higher value of 6138 IU/serving.

all vitamin A sources from WIC 329 for children 1-3 years old

milk	310 IU x 2	servings =	620 IU
vitamin A group	6138 IU x (1/2)	servings =	3069 IU
other fruit/vegetable	163 IU x 2(1/2)	servings =	163 IU
			3852 IU total

WIC 329	frequency	percent
consume $\geq$3852 IU	20	26.7
consume <3852 IU	55	73.3
total	75	100.0

1980 RDA		
consume $\geq$2000 IU	23	30.7
consume <2000 IU	52	69.3
total	75	100.0

2/3 1980 RDA		
consume $\geq$1340 IU	29	38.7
consume <1340 IU	46	61.3
total	75	100.0

computer hand tally (based on calculations from Nutritionist I printout)		
consume $\geq$1340 IU	65	86.7
consume <1340 IU	10	13.3
total	75	100.0

Table 5. (Cont.)

vitamin C

1980 RDA = 45 mg (for children 1-3 years old)
2.3 1980 RDA = 30 mg
WIC 329 requirement for 1-3 year old children = 66.3 mg

WIC 329 vitamin C requirement

vitamin C group = 60.0 mg
other fruit/vegetable = 6.3 mg

66.3 mg

WIC 329	frequency	percent
consume ≥66.3 mg	41	54.7
consume <66.3 mg	34	45.3
total	75	100.0

1980 RDA		
consume ≥45 mg	45	60.0
consume <45 mg	30	40.0
total	75	100.0

2/3 1980 RDA		
consume ≥30 mg	47	62.7
consume <30 mg	28	37.3
total	75	100.0

computer hand tally (based on calcuations from Nutritionist I printout)		
consume ≥30 mg	52	69.3
consume <30 mg	23	30.7
total	75	100.0

Table 5. (Cont.)

iron

1980 RDA = 15 mg (for children 1-3 years old)
2/3 1980 RDA = 10 mg
WIC 329 requirement for 1-3 year old children = 5.78 mg

iron sources reflected from WIC 329

meat	2.26 mg x 2(1/2)	servings	= 2.26 mg
vitamin A group	1.11 mg x (1/2)	servings	= 0.56 mg
vitamin C group	0.76 mg x 1	serving	= 0.76 mg
bread	1.10 mg x 4(1/2)	servings	= 2.20 mg
			5.78 mg total

WIC 329	frequency	percent
consume ≥5.78 mg	78	97.3
consume <5.78 mg	2	2.7
total	75	100.0
1980 RDA		
consume ≥15 mg	32	42.7
consume <15 mg	43	57.3
total	75	100.0
2/3 RDA		
consume ≥10 mg	59	78.7
consume <10 mg	16	21.3
total	75	100.0

Table 5. (Cont.)

energy nutrients percentages in the diets

nutrient	range	mean (g)
protein	9 - 27%	16.43 ± 3.41
carbohydrate	28 - 79%	48.31 ± 8.66
fat	7 - 59%	36.25 ± 7.71

sodium and cholesterol percentages in diets

nutrient	range (mg)	mean (mg)
sodium	535 - 5031	1943.7 ± 937.25
cholesterol	475 - 8975	2663.55 ± 1972.83

Table 6. Mean RDA of the leader nutrients

Nutrient	Mean RDA (%)	Range (%)
Calcium	86	12-150
Protein	145	86-150
Vitamin A	116	20-150
Vitamin C	109	11-150
Iron	56	16-141

NOTE: The RDA was truncated at 150%. Therefore, the range would have been greater for all nutrients except iron.

Table 7. Correlations with average RDA

	Raw	Truncated
Sumst	0.78	0.78
Sumst2	0.83	0.80
Totlack	-0.61	-0.67
Totover	0.54	0.57
Stotal	0.61	0.66

$p<.001$

Table 8. Regression formula

truncated regression formula

46.94 +	3.67(2.87) +	2.14(6.56) +	9.39(0.33) +	6.14(0.96) +	14.98(1.47) =	103
intercept constant	meat group	bread group	vitamin A foods	vitamin C foods	milk group	mean RDA

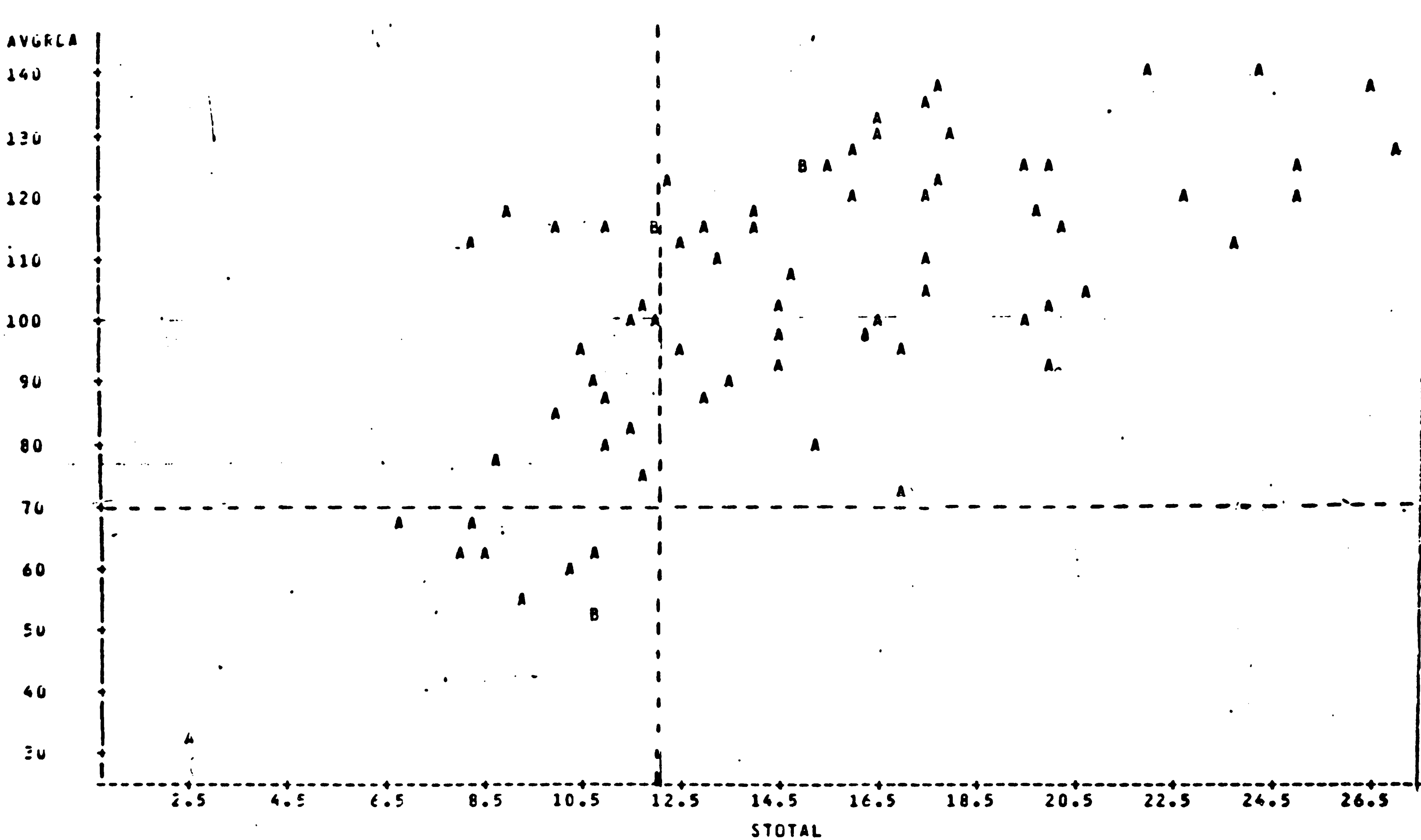
numbers outside ( ) reflect B values.

numbers inside ( ) reflect mean servings consumed.

the intercept value is the regression constant.

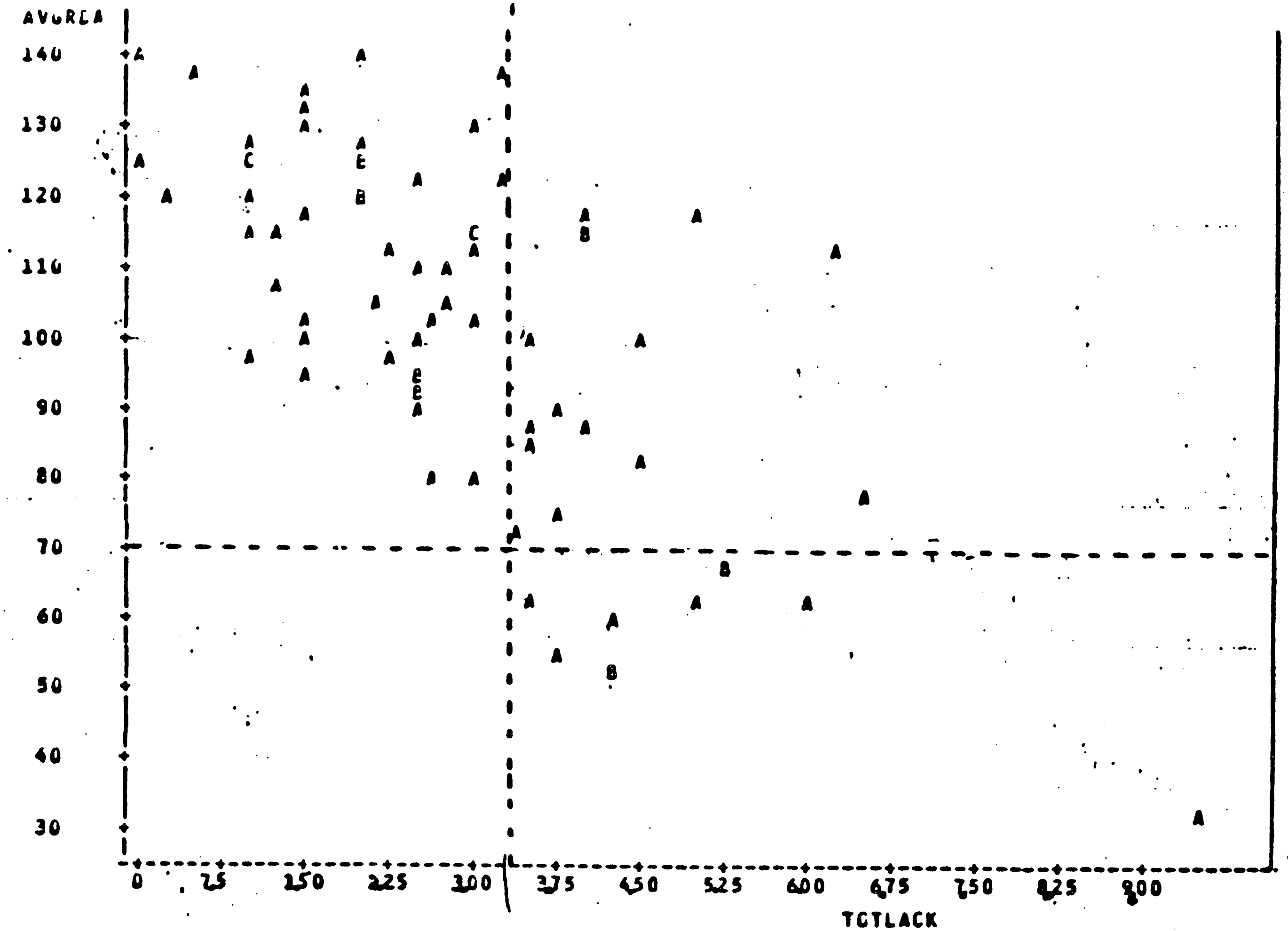
regression formula based on raw % RDA

20.03 +	10.11(2.87) +	3.33(6.56) +	28.19(0.33) +	22.11(0.96) +	28.91(1.47) =	144
intercept constant	meat group	bread group	vitamin A foods	vitamin C foods	milk group	mean RDA



A = One observation
B = Two observations

Figure 1. Average RDA and the sum of all servings



A = One observation
B = Two observations
C = Three observations

Figure 2. Average RDA and the total servings lacking

CHAPTER IV

SUMMARY

The project used 75 children, aged 24 months to 36 months, for subjects. All were participants of the Virginia Beach WIC Program. The childrens' diets were evaluated twice. First, they were evaluated using a 24 hour dietary recall (WIC 329) as a normal part of the recertification process, and again using the Nutritionist I, a computerized software program, to determine percentage of the RDA. Diets were examined from the nutrients calcium, protein, vitamin A, vitamin C, and iron found in the four food groups on the WIC 329. Servings were standardized within each food group to prevent skewing of the nutrients. Values for all nutrients were truncated at 150% of the RDA to likewise eliminate skewing of nutrients through excessively large amounts from any one food group.

Correlating demographic variables with dietary variables did not produce any significant findings. None were statistically significant at the $p<.001$ level.

Each food group and corresponding nutrient was identified with varying degrees of success. The standard mg calcium (StmgCa) and sum of all milk servings (Smilk) correlation coefficient was 1.00 and the SmgCa and calcium RDA was 0.73. A total of 29 children (38.7%) satisfied 2/3

RDA. The mean calcium consumed was 86% of the RDA.

All but one child met the protein RDA. Although protein is a component of milk, meat, and grain products, none of these foods predominate as a protein indicator. The protein RDA and standard g protein (StgPro) correlation coefficient is 0.78 while the sum of all servings of meat (Smeat) correlation coefficient is 0.80. A serving of milk contains more protein than a serving of bread; however, the milk correlation coefficient (0.38) was lower than the bread/cereal group (0.44) possibly because more servings of bread were eaten than milk.

The WIC 329 states the vitamin A value of one half serving of vitamin A fruits and vegetables at 2000-2500 IU. Recalculating the vitamin A value from these foods yielded an average of 3000 IU per one half serving. Thus, the WIC 329 understates the vitamin A content found in these foods. The vitamin A RDA and standard IU vitamin A (SIUvitA) correlation coefficient is 0.69 and the sum of all servings of vitamin A fruits and vegetables (SvitAfr/veg) and StIUvitA correlation coefficient is 0.99. The mean vitamin A fruit and vegetable serving of 0.33 consumed does not correspond to the mean of 116% of the vitamin A RDA. This discrepancy is probably due to the limited foods designated on the WIC 329 as high vitamin A sources. A total of 29 (38.7%) of the children met 2/3

RDA. In contrast, a hand tally of all diets analyzed by the Nutritionist I indicated that 65 children (86.7%) consumed 2/3 RDA. The figure of 86.7% may be more valid especially when considering the mean RDA of 116%.

The vitamin C assessment on the WIC 329 was the most accurate of the five nutrients. A total of 62.7% of the children met 2/3 of the vitamin C RDA which was a close fit in comparison to the 69.3% based on a Nutritionist I hand tally. Both the vitamin C RDA and standard mg vitamin C (StmgvitC) and servings total of vitamin C fruits and vegetables (SvitCfr/veg) and vitamin C RDA correlation coefficients are 0.84. The SvitCfr/veg and StmgvitC correlation coefficient was 0.99 further supporting the accuracy of this food group to supply vitamin C. The mean of 0.96 servings and 109% of the RDA consumed are in agreement with one another.

Since iron is never formally identified on the WIC 329, it was poorly assessed. The meat group and bread/ cereal group were the best sources of iron but nonetheless no one food group was an outstanding source of iron. Only 56% of the iron RDA was met even though all but two children consumed the WIC requirement of 5.8 mg/day. The iron RDA and standard mg iron (StmgFe) correlation coefficient was 0.65 which was the lowest of the five nutrients and the corresponding nutrients' RDA. The StmgFe and sum of all bread servings (Sbread) relationship was not statistically significant. The majority (78.7%) of the children met 2/3 of the iron RDA. The high iron WIC cereals may be responsible for this high percentage.

The average RDA (AVGRDA) refers to the RDA of protein, calcium, vitamin A, vitamin C, and iron divided by five. Using AVGRDA as a dependent variable, scattergrams demonstrate picturally where each subject falls with regard to nutritional status. The cut off for adequate nutritional status was considered to be 70% AVGRDA. With Figure I, if less than 12.5 servings of food are consumed (Stotal), a child is in danger of not meeting 70% AVGRDA. Ten children (13.3%) were at nutritional risk. This data positively corresponds to the correlation coefficient of 0.66 of Stotal and AVGRDA.

In Figure II, the children that were lacking at least 3.5 servings did not meet 70% AVGRDA. The Virginia WIC Program certifies a child eligible for WIC participation due to inadequate diet if more than three servings of any food are lacking (Totlack). Thus, based on this model, the three plus servings lacking requirement for inadequate diet is accurate. Nine children (12%) fell short of the 70% AVGRDA. An inverse relationship exists between Totlack and AVGRDA at -0.67.

The truncated regression formula was developed to estimate nutritional status. The mean number of servings consumed from the meat, milk, vitamin A, vitamin C, and bread group are multiplied by the B values which represent the weighted value of each food group relative to the other food groups. Once all the variables were tabulated, the sum equaled 103. This numeral signifies the standardized RDA and summed average RDA based upon the WIC 329. Use of the regression formula instead of the WIC 329 can result in a 67% improvement of estimating nutritional status for two year olds, increasing accountability of variance from 44% to 66%.

If servings from all food groups are weighted properly, results of analyzing diets with the regression formula correlate 0.78 with the use of the Nutritionist I. In comparison, the WIC 329, which utilizes total servings lacking, correlated 0.67 with the dietary analysis using the Nutritionist I.

In summary, the WIC 329 is an acceptable means of dietary analysis. It must be kept in mind, however, that a one day assessment is more accurate for a group than for an individual. Certain modifications can increase the accuracy of the WIC 329 as a means of nutritional assessment. The protein and calcium assessment are adequate.

Based on this study, vitamin A analysis can be improved. The milk group heading should state that one cup of fluid milk yields 310 IU vitamin A. Under the vitamin A fruit and vegetable group, raw and canned tomatoes, as well as tomato juice could be calculated as vitamin A sources. The vitamin A rich foods yield a higher value than 4000-5000 IU. The WIC 329 should state the revised value of 6000 IU.

The vitamin C assessment was accurate. However, for two year old children, only 3/4 serving is needed to satisfy the 45 mg vitamin RDA requirement. Rather than stating a full serving, the WIC 329 could indicate that 3/4 serving is recommended for one to three year olds.

Iron evaluation on the WIC 329 was poor. Iron values should be indicated on the WIC 329 for the meat, vitamin A and vitamin C fruits and vegetables, and bread and cereal groups. Iron fortified cereals, supplying a minimum of 45% RDA, should be a separate subgroup of bread and cereal items to reflect their higher iron content. The remaining foods should be recalculated to exclude the WIC cereals and to prevent skewing of the nutrient.

Implications for Practitioners

Since the truncated regression formula is an accurate assessment tool, the number of servings consumed from each food group can be inserted into a programmed calculator to determine AVGRDA. The programmed calculator could be used as an improved method of determining nutritional status while at the same time, WIC Nutritionist could continue to use the WIC 329 as an educational tool. To further improve the regression equation, dry iron fortified cereal can be used as one of the predictors in addition to the milk, meat, vitamin A, vitamin C and bread group. Under the iron fortified cereal subgroup, a statement could suggest that WIC cereals be consumed three to four times per week.

A note of caution is warranted because the children in this study are not necessarily representative of all populations or even all WIC populations. Therefore, the actual figures on the truncated regression equation are applicable only to the 75 two year old children participating in the Virginia Beach WIC Program. The B values would change depending on the population studied. The mean servings consumed would pertain to each subjects individual recall.

Recommendations for Further Research

This project can be replicated on a larger scale. A greater number of subjects would better validate the findings. A minimum of 100 subjects, two nutritionist per case, and no less than five recalls per child would enable a consensus on the recall number of servings to be reached. These recommendations could be incorporated into a WIC Program's Nutrition Education Report through its local objectives. Every year, subgroups of a particular WIC Program are identified as being especially at nutritional risk. In the past, the Virginia Beach WIC Program has focused on pregnant teenagers and anemic children. Special classes or frequent nutritional counseling designed with the subgroups' unique needs are implemented. In this manner, WIC Nutritionists could choose a WIC population such as pregnant women with a risk factor of inadequate diet and utilize this group in its local objectives. Most WIC Programs have at least two WIC Nutritionists and five recalls taken over a year time span is not unrealistic. Reaching a minimum of 100 subjects should not pose a problem either.

To broaden the implications, researchers could use subjects not participating in the WIC Program. The WIC 329 can be used beyond the scope of WIC certification. Currently, the WIC 329 is used for handicapped children enrolled in the Bureau of Crippled Children. A variety of populations could be researched for future studies.

Aside from the Nutritionist I Program, many other nutrition related computer software programs exist. The Nutritionist II and the Nutritionist III, for example, have a much larger data base since they are derived from more extensive handbooks than No. 72. This study could be repeated using a more detailed software program.

APPENDIX A

METHODOLOGY

I. Introduction to methodology.

The researcher was a WIC Nutritionist employed by the Commonwealth of Virginia. All data was gathered at the Virginia Beach Health District between August 1984 and February 1985.

II. Subject selection and screening.

Subjects for this study were 75 children, aged 24 to 36 months. They were all participants of the Virginia Beach WIC Program. Two year old children served as the focus for several reasons. First, they have been eating solid table foods rather than infant or junior foods on a regular basis. Second, the vast majority are weaned from the bottle. Third, most of the children participating in the Virginia Beach WIC Program are under the age of three. The number 75 was used to validate the statistical findings.

III. Instruments used.

A. WIC 329

A standardized 24-hour dietary recall (WIC 329) used throughout the state of Virginia was used for assessment of the two-year old subjects (5). The WIC 329 has space for the nutritionist to include the patient's name, age, height, weight, and whether he or she consumes vitamin supplements. If the patient participates in feeding programs such as food stamps or school lunches, this information is indicated also. Additional questions relating to both order, number of children in family, etc. were recorded on WIC 329 at the bottom of the page. This extra information was obtained from the medical chart. The recall is divided into four food groups--milk, meat, vegetables and fruit, and bread and cereal. Columns for different WIC population groups are included on the same form and the nutritional requirements for each are indicated by how many servings from the four food groups each population requires on a daily basis. A space for servings eaten and servings lacking of each food group is used to specify the total servings lacking of all foods.

Children aged one to three years old require two servings of milk equivalents and two half sized servings from the meat group. In the fruit and vegetable group, these children need a half serving of a vitamin A rich food, one serving of a vitamin C rich food, and two half sized servings of other fruits and vegetables. Their bread and cereal requirements is four half sized servings.

The WIC 329 states which of the five leader or indicator nutrients are found in each food group.

Indicator nutrients are a set of nutrients chosen to be representative of all of the essential nutrients (57). For the purpose of the WIC 329, the five nutrients examined are protein, calcium, vitamin A, vitamin C and iron. As stated on the WIC 329, one serving of the milk group contains 288 milligrams (mg) calcium and 8 grams (g) protein. Each serving from the meat group provides 14 g protein. Vitamin A fruits and vegetables contain 4000-5000 IU per one serving. One serving from the vitamin C food group contains 60 mg of vitamin C. No foods were identified as representative of the other fruit or vegetable category. One serving from the bread and cereal group contains 2 g protein (5). (See Appendix B -- Table 1)

B. Nutritionist I.

The Nutritionist I is a computer software program by N-Squared Computing which analyzes, among other features, the percentage of RDA consumed by various population groups, total calories ingested, grams of saturated and unsaturated fat, protein, and carbohydrates in the diet, and mg of cholesterol and sodium (24). The data base for the Nutritionist I is USDA Home and Garden Bulletin No. 72 (56). Each food is identified by an item number from No. 72. This program reflects the 1980 RDA (23).

IV. Definitions pertaining to methodology.

Certain terms were developed for the analysis and interpretation of the data. The term Smilk signifies the sum of all servings of milk; the term Smeat, the sum of all servings from the meat group; and so forth. Servings total (Stotal) is the sum of all servings of milk, meat, bread, vitamin A foods, vitamin C foods, and other fruits and vegetables. Average RDA (AVGRDA) refers to the RDA of protein, calcium, vitamin A, vitamin C, and iron divided by five. Standard mg calcium (StmgCa) represents servings of milk multiplied by 288 mg per serving. Standard g protein (StgPro) represents servings of milk times 8 g plus servings of meat times 14 g and servings of bread times 2 g since protein is found in each of these food groups. Standard IU vitamin A (StIUvitA) includes servings of milk multiplied by 310 IU plus servings vitamin A fruits and vegetables times 6000 IU (a corrected value from that printed on the WIC 329) plus servings of other fruits and vegetables times 162 IU. Standard mg vitamin C (StmgvitC) refers to servings of vitamin C fruits and vegetables times 60 mg plus servings of other fruits and vegetables times 6.2 mg. Standard mg iron (StmgFe) represents servings of meat times 2.26 mg, plus servings of vitamin A fruits and vegetables times 1.11 mg, servings vitamin C fruits and vegetables times 0.76 mg and servings of bread times 1.1 mg.

The terms total servings lacking (Totlack) and total servings over (Totover) refer to all servings of foods, exclusive of food group. The standardized sum of servings (Sumst) and the standardized sum of nutrients from servings (Sumst2) were phrases devised to aid in the statistical analysis.

V. Data collection and treatment.

A. Interview to obtain diet recall.

To continue receiving the supplemental foods, infants and children must be recertified or screened for nutritional risk every six months. Only children who had been receiving WIC foods for at least one recertification period were used for this study. Two year old children who were initially enrolled or certified during this time frame were excluded. This restriction permits the inclusion of only those subjects who have been receiving the WIC foods at the time the recall was taken.

Mothers were asked to report everything their children ate and drank within the past 24 hours. Measuring cups and spoons are used to assist them in determining portion sizes.

Two WIC Nutritionists are employed in Virginia Beach.

To prevent discrepancies in interviewing technique and data collection, only the nutritionist involved in this project interviewed the mothers of two-year old children until all 75 recalls were taken. Verbal approval for this procedure was granted by the WIC supervisor.

The caretakers of the children were not informed that the diets of their children were going to be analyzed for any other reason besides that of WIC recertification. If they were told, possibly they would have given false information that they felt was the "right" answer.

In order to be recertified for inadequate diet and continue receiving WIC foods, a nutritionist must evaluate a child's diet recall. If a child is lacking more than three servings of food, in any food combination, the child is considered to be at nutritional risk. As another example, if a child is still drinking from a bottle at two years of age, the preschooler is at risk for developing nursing bottle mouth syndrome and may be recertified for inadequate diet. In another instance, a child may be at nutritional risk if lacking two servings, but the servings may be in the same food category, such as milk. Deciding if a child has an inadequate diet is based on the nutritionist's professional judgment in that the recall is to be used basically as a guideline and for documentation.

B. Nutritionist I.

After all 75 diet recalls were completed, a computer analysis determined nutrient composition of each recall. Results from this analysis were compared to the identified nutritional adequacy as reflected by the WIC-329 form. First, the recall data was coded into item numbers and quantities as published in Home and Garden Bulletin Number 72 (56). Once each food had been assigned an appropriate item number from Number 72, each child's diet recall was then entered into the computer and analyzed based on the program Nutritionist I by N-Squared Computing (24).

Certain dietary substitutions were necessary due to the limited foods listed in Home and Garden Bulletin No. 72 (56). (Appendix B - Table 2) Also, certain assumptions were made regarding the interpretation of each diet recall. Unless the caretaker specifically stated whole wheat bread or lowfat milk, the nutritionist assumed the child ate white bread and drank whole milk. An attempt was made to standardize foods for each of the 75 diets. Using bread as an example again, all sliced white bread was counted as item 342; soft-crumb type, 22 slices per loaf.

The next step was to code WIC-329 forms by over and under servings of required amounts. Following this process, data was examined from the five leader nutrients found in the four food groups on the WIC-329. The possible effect of the increase in vitamins C and A from other fruits and vegetables not listed were analyzed. It was then necessary to compare the results from nutritional analysis using computer analysis and nutrient composition of food groups on the WIC-329. The Nutritionist I analysis reflects percentage of nutrients in dietary recalls (24).

C. Code sheet for research data.

In order to statistically analyze demographic and dietary data, all variables were coded numerically. (Appendix B - Table 3) Line one on the code sheet was used for demographic variables of the population. Each subject was given an identification number to insure anonymity. Lines two and three reflected dietary information from both the WIC 329 and Nutritionist I. To standardize values, all "yes" responses were coded as a one and all "no" responses were coded as a two. When servings of food were entered on the code sheet, a negative sign by the numeral signified servings lacking according to the WIC 329. A zero indicated that the requirement was met and a positive number indicated servings over the requirement. Information not pertinent to the WIC 329 but computed on the Nutritionist I program such as sodium, cholesterol, and percentage of energy nutrients was also coded.

Total servings lacking were examined as well as total excess servings without regard to food group. For example, a child may have been deficient in one serving each of meat and milk but consumed an excess of four servings of bread.

D. Standardizing servings and revising the WIC 329.

To have a method for comparing and correlating nutrient information from the WIC 329, servings must be standardized within each food group. Standardized servings were determined through a statistical procedure to more accurately compare results. This process was followed to prevent skewing of nutrients, since the nutrients are recommended at different levels and in varying units of measure. This step was also utilized to avoid overemphasizing certain nutrients while disregarding others. All statistical analysis was based on the SAS Institute, Inc. computer program (58). These values are reflected by "ST" preceding the particular food group.

The AVGRDA represents the percentage of nutrients reflected by analysis of dietary recalls using the Nutritionist I. A step-wise multiple regression was used to determine this averaged RDA.

Values for all nutrients were truncated at 150% of the RDA for each nutrient. This process served to sharpen the use of the WIC form, eliminating any skewing of nutrients through excessively large amounts from any one food group.

For instance, several children consumed more than the recommended two to three servings from the milk group. Therefore, the mean calcium RDA would reflect a higher overall calcium status of the two year old children.

Although the WIC 329 indicates which leader nutrients are found in each food group, not all nutrients were considered. A serving from the milk group furnishes, in addition to calcium and protein, 310 IU vitamin A. One serving from the meat group provides 2.26 mg iron. (Appendix B - Table 4) Upon recalculating the vitamin A value of a serving from the vitamin A fruits and vegetables, a higher value of 6138 IU was the more accurate figure. (Appendix B - Table 5) In addition, a vitamin A rich food from this group averaged 1.11 mg iron. Not stated on the WIC 329 but necessary to consider is the 0.76 mg iron per serving provided by the vitamin C rich fruits and vegetables. The vitamin C content of the vitamin C foods was calculated and after rounding off, the 60 mg value was correct. (Appendix B - Table 6)

As stated earlier, no foods were identified as representative of the other fruits or vegetable category. A hand count of 50 of the 75 diet recalls to tally which were the most frequently consumed other fruits or vegetables resulted in an average of 6.2 mg vitamin C and 162 IU vitamin A. (Appendix B - Table 7) The vitamin A and vitamin C content was calculated from the other fruit/vegetable group. (Appendix B - Table 8)

In addition to the 2 g protein contained in each bread serving, each serving furnished 1.1 mg iron. The nutrients per food group revisions for children, aged one to three are found in Appendix B - Table 9. All nutrient values were based on No. 72 (56).

Table 1. **BUREAU OF PUBLIC HEALTH NUTRITION**
24-HOUR DIET RECALL
(WIC Certification—Part D)

NAME__________ RECEIVES: Food Stamps________ WIC________

AGE______ HEIGHT______ WEIGHT______ Elderly Feeding Prg.______ Meals-on-Wheels______

VITAMIN SUPPLEMENT: Yes______ No______ School Brkf.______ Lunch______

Record all food and beverages consumed in the past 24 hours, including amounts:

Evaluate above recall by counting each serving of the following groups:

FOOD GROUP	Child 1-3	Child 4-6	Pregnant Teenager	Pregnant Woman	Adult	Lactating Woman	Servings Eaten	Servings Lacking
(First food named is the standard serving size)	DAILY RECOMMENDED SERVINGS							
MILK—equivalents of 288 mg. Ca. & 8 gm. Protein 1 cup milk; 1½ cup ice cream, pudding 2 slices cheese; 1 cup yogurt 1¼" cube cheese; 1½ cup cottage cheese ¾ cup custard; 1 (3¼ oz.) can sardines	2-3 (16-24) oz.	2-3	5	4	2 4 non-pregnant teen	4		
MEAT—equivalents of 14 gm protein 2 oz. meat, fish, poultry; 2 slices cheese 1 cup dried beans, peas; 4 slices bologna 4 T. peanut butter; ½ cup cottage cheese 2 eggs; 6 oz. Tofu	2 ½ size serv.	3 ½ size serv.	4	3-4	2-3	2-3		
VEGETABLES & FRUIT *Vitamin A equivalents* 4000-5000 IU ½ cup greens; 1 cup broccoli ½ cup spinach; 1 cup apricots ½ cup carrots; 1 cup cantaloupe ½ cup sweet potatoes; (¼ med.) ½ cup mixed vegetables; 2 cups tomatoes	½ serv.	½ serv.	1	1	1	1		
Vitamin C equivalents of 60 mg. ½ cup orange juice, grapefruit juice ½ cup fortified pineapple juice 1 orange; 1 grapefruit ½ cantaloupe 2 tomatoes; 1½ cup tomato juice ½ cup broccoli, brussel sprouts 1 cup cabbage (raw)	1 serv.	1 serv.	2	2	1	2		
Other fruit or vegetables	2 ½ serv.	2	2	2	2	2		
BREAD & CEREAL—70 Kcal equivalents & 2 gm. Protein 1 slice bread ½ cup cooked cereal, grits ½ cup cooked rice ¾-1 cup dry cereal ½ cup cooked macaroni, spaghetti, noodles 5 crackers cornbread 1½" x 2" x 1½" 4" pancake; ½ frozen waffle 1 biscuit; ½ hot dog or hamburger bun ½ English muffin	4 ½ size serv.	4	4	4	4	4		

If a fraction of the above amounts were eaten, count as that fraction of a serving. Total Lacking______

Alcoholic Beverages______ Non-food items eaten (paint, clay, etc.)______

If more than 3 servings are missing, and this is a typical day, diet needs improvement and meets WIC nutritional risk criteria for inadequate diet.

Evaluation of diet: (Describe any nutrient deficiencies, inappropriate patterns, etc.)______

WIC 329 (Date) (Interviewer) (Title)

Table 2. Substitutions of actual food items on the WIC 329 for similar foods in Home and Garden Bulletin No. 72

actual food from WIC 329	substituted food from Home & Garden Bulletin No. 72	Item No. From No. 72
Kool Aid	Fruit flavored soda	694
Sausage links	Sausage patty	200
Instant vanilla pudding	Instant chocolate pudding	91
Corn chips, cheese puffs	Potato chips	654
Corn muffins	Corn bread	445
Orange juice, all forms	Frozen orange juice	278
Spaghetti	Home made spaghetti	497
Spaghetti	Canned spaghetti	498
Packaged macaroni & cheese	Home made macaroni & cheese	442
Spam	Vienna sausage	207
French fries	Frozen French fries	649
French fries	Fast food French fries	648
Green beans, all	Cut frozen green beans	572
Chicken wing, fried	3/4 chicken drumstick, fried	211 (3/4)
Hamburger Helper, Beefaroni, etc.	Canned spaghetti	498
Canned chicken vegetable soup	Canned beef vegetable soup	720
Lasagne	Home made spaghetti + 1/2 mozzarella	497+13 (1/2)
Rice, all types	White enriched, par boiled	484
Cocoa	Chocolate milk	67
2 slices French toast	2 white bread + 1/4 cup milk + 1 egg	342(2)+50(1/4)+96
Coffee, tea	No substitution possible, not found in No. 72	
Ketchup	No substitution possible, not found in No. 72	
Gravy	No substitution possible, not found in No. 72	

Table 3. Code sheet for research data

Line 1 - Demographics

Column	
1-3	Identification Number
4-5	Age in months
6	Patient status (1 = inpatient; 2 = outpatient)
7	Living arrangement (1 = single parent; 2 = two parents)
8	Number of children in family
9	Birth order
10	Race (1 = Caucasian; 2 = Black; 3 = Hispanic; 4 = Asian)
11	Sex (1 = Male; 2 = Female)
12-15	Height (measured in inches; first 2 columns precede decimal point)
16-19	Weight (measured in pounds; first 2 columns precede decimal point)
20-25	Nutritional risk factors (prioritized risk factors; maximum of three per child; two digits each to correspond to listing on nutritional risk sheet)
26	On vitamins? (1 = yes; 2 = no)
27	On food stamps? (1 = yes; 2 = no)
28	Aid to dependent children? (1 = yes; 2 = no)
29	Military? (1 = yes; 2 = no)
30	Income scale (1 = R; 2 = S; 3 = T; 4 = U)

Line 2

Column	
1-3	Protein % of RDA
4-7	Servings of milk (negative sign = servings under requirement; 0 = servings meet requirement; positive figure = servings over requirement)
8-11	Servings of mean (same as above)
12-15	Servings of bread (same as above)
17-19	Iron % hematocrit
21-23	Iron % RDA
24-27	Servings of meat (same as above)
28-31	Servings of cereal (same as above)
32-35	Servings of all fruits and vegetables (same as above)
37-39	Calcium % RDA
40-43	Servings of milk (same as above)
45-47	Vitamin A % RDA
48-51	Servings of Vitamin A fruits and vegetables (same as above)
52-55	Servings of Vitamin C fruits and vegetables (same as above)
56-59	Servings of other fruits and vegetables (same as above)
60-63	Servings of milk (same as above)
65-67	Vitamin C % RDA
68-71	Servings Vitamin C fruits and vegetables (same as above)
72-75	Servings Vitamin A fruits and vegetables (same as above)
76-79	Servings other fruits and vegetables (same as above)

Table 3. (Cont.)

Line 3

<u>Column</u>

1-2	Percentage of protein in diet
4-5	Percentage of carbohydrate in diet
7-8	Percentage of fat in diet
10-13	Mg. sodium in diet
15-17	Percentage of calories (using 1300 calories as the requirement from Home & Garden Bulletin 72)
19-21	Total servings lacking, with columns 20 and 21 reflecting decimal values
23-26	Total excess servings over requirement, with columns 25 and 26 reflecting decimal values
28-31	Mg. cholesterol in diet

Table 4. Iron values from the four food groups

meat group

item	iron mg
2 oz. meat, fish, poultry (164) ground beef	2.0
1 cup dried beans, peas (510) navy beans	5.1
4 T peanut butter (524) peanut butter	1.2
2 eggs (96) 1 raw egg	1.0
4 slices bologna (198)	2.0
	11.3

$\frac{11.3}{5}$ = 2.26 mg average iron content of one serving from the meat group

Number in ( ) signifies item number of reference food taken from No. 72 (56).

Table 4. (Cont.)

vegetables and fruits

vitamin A equivalents

item	iron mg
1/2 cup greens (610) collards	0.8
1/2 cup spinach (660) spinach	2.0
1/2 cup carrots (602) crosswise cut carrots	0.45
1/2 cup sweet potatoes (669) mashed sweet potatoes	1.0
1/2 cup mixed vegetables (680) frozen	1.2
1 cup broccoli (590) chopped frozen	0.65
1 cup apricots (229) canned in heavy syrup	0.8
1 cup cantaloupe (271) includes rind	0.65
2 cups tomatoes (672) canned, solids and liquid	2.4
	9.95

$\frac{9.95}{9}$ = 1.11 mean iron content of one serving from Vitamin A foods

Table 4. (Cont.)

item	vegetables and fruit vitamin C equivalents iron mg
1/2 cup orange juice (278) frozen	0.1
1/2 cup grapefruit juice (253) frozen	0.1
1 orange (273)	0.5
1 grapefruit (246)	0.5
1/2 cantaloupe (271) includes rind	0.65
2 tomatoes (671) whole, raw	1.2
1/2 cup tomato juice (675) canned	3.3
1/2 cup broccoli (590) chopped frozen	0.33
1/2 cup brussel sprouts (592) frozen	0.6
1 cup cabbage (593) coarsely shredded	0.3
	7.58

$\frac{7.58}{10}$ = 0.76 mg average iron content of one serving from Vitamin C foods

Table 4. (Cont.)

item	bread and cereal iron mg
1 slice bread (340) white enriched	0.6
1/2 cup cooked cereal, grits (363) enriched	0.35
1/2 cup cooked rice (484) long grain	0.9
3/4 - 1 cup dry cereal (371) plain corn flakes 1 cup	6.75
1/2 cup cooked noodles, macaroni (448) egg noodles, enriched	0.7
5 crackers (432) saltines	0.63
cornbread (447) corn muffin	0.6
pancake 4" diameter (452) homemade	0.4
1 biscuit (323) from mix	0.6
1/2 frozen waffle (501) from mix	0.5
1/2 hot dog or hamburger bun (489) 1/2 bun	0.4
1/2 English muffin [(490) substituted 1/2 plain bagel]	0.6
	13.03

$\frac{13.03}{12}$ = 1.1 mg iron in average bread/cereal serving

NOTE: Dairy products are a negligible source of iron. Therefore iron values for the milk group were not calculated.

Table 5. Corrected vitamin A values

item	foods from WIC 329	IU vitamin A
610	1/2 c greens	7,410
662	1/2 c spinach	7,695
602	1/2 c carrots	8,140
666	1/2 c sweet potatoes	4,615
680	1/2 c mixed vegetables	4,505
590	1 c broccoli	4,810
229	1 c apricots	4,490
271	1 c cantaloupe	9,240
672	2 c tomatoes	4,340
		55,245

$\frac{55,245}{9}$ = 6,138 IU average vitamin A content of one serving from the vitamin A group

Table 6. Calculated vitamin C values

item	foods from WIC 329	IU vitamin C
278	1/2 c OJ, grapefruit juice	60/48
299	1/2 c fortified pineapple juice	40
273	1 orange	66
247	1 grapefruit	44
271	1/2 cantaloupe	90
671	2 tomatoes	56
675	1 1/2 c tomatoe juice	59
590	1/2 c broccoli	53
592	1/2 c brussel spouts	68
594	1 c raw cabbage	42
		626

$\frac{626}{11}$ = 56.91 mg average vitamin C content of one serving from the vitamin C group

56.91 mg = 60 mg

Table 7. Hand tally of the most frequent "other" fruits and vegetables

(based on 50 diet recalls)

*1/2 cup mashed potatoes	- 5	18 potato servings
*10 French fries	- 10	all methods
1/2 cup boiled potatoes	- 2	of preparation
1/2 cup fried potatoes	- 1	
*1/2 cup canned corn	- 6	7 corn servings
1 corn on the cob	- 1	
*1/2 cup string beans	- 8	
1/2 cup peas	- 5	
*1 banana	- 7	
*1 apple	- 6	8 apple servings
1/2 cup applesauce	- 2	

* Ultimately used for other fruit or vegetables for Average nutrients per food group per serving (Table 9).

Table 8. Fruit and vegetable vitamin A and vitamin C values

item	foods from WIC 329	vitamin A IU	vitamin C mg
651	1/2 c mashed potatoes	20	10.5
649	10 french fries	insig	5.5
617	1/2 c canned corn	290	3.5
574	1/2 c string beans	315	2.5
235	1 bananna	230	12.0
223	1 apple	120	6.0
		975	37.5

vitamin A $\frac{975}{6}$ = 162.5 IU/other fruits/vegetables

vitamin C $\frac{37.5}{6}$ = 6 foods = 6.25 mg/other fruits/vegetables

Table 9. Averaged nutrients per food group per serving

FOOD GROUP	Child 1-3	nutrients	per serving
(First food named is the standard serving size)			
MILK—equivalents of 288 mg. Ca. & 8 gm. Protein 1 cup milk; 1½ cup ice cream, pudding 2 slices cheese; 1 cup yogurt 1¼" cube cheese; 1½ cup cottage cheese ¾ cup custard; 1 (3¼ oz.) can sardines	2-3 (16-24) oz.	calcium protein vitamin A (fluid milk)	288 mg 8 gm 310 IU
MEAT—equivalents of 14 gm protein 2 oz. meat, fish, poultry; 2 slices cheese 1 cup dried beans, peas; 4 slices bologna 4 T. peanut butter; ½ cup cottage cheese 2 eggs; 6 oz. Tofu	2 ½ size serv.	protein iron	14 gm 2.26 mg
VEGETABLES & FRUIT *Vitamin A equivalents* 4000-5000 IU ½ cup greens; 1 cup broccoli ½ cup spinach; 1 cup apricots ½ cup carrots; 1 cup cantaloupe (¼ med) ½ cup sweet potatoes ½ cup mixed vegetables; 2 cups tomatoes	½ serv.	vitamin A iron	6000 IU* 1.11 mg
Vitamin C equivalents of 60 mg. ½ cup orange juice, grapefruit juice ½ cup fortified pineapple juice 1 orange; 1 grapefruit ½ cantaloupe 2 tomatoes; 1½ cup tomato juice ½ cup broccoli, brussel sprouts 1 cup cabbage (raw)	1 serv.	vitamin C iron	60 mg 0.76 mg
Other fruit or vegetables	2 ½ serv.		
1/2 c mashed potatoes 10 french fries 1/2 c canned corn 1/2 c string beans 1 bananna 1 apple		vitamin C vitamin A	6.2 mg 162 IU
BREAD & CEREAL—70 Kcal equivalents & 2 gm. Protein 1 slice bread ½ cup cooked cereal, grits ½ cup cooked rice ¾-1 cup dry cereal ½ cup cooked macaroni, spaghetti, noodles 5 crackers cornbread 1½" x 2" x 1½" 4" pancake; ½ frozen waffle 1 biscuit; ½ hot dog or hamburger bun ½ English muffin	4 ½ size serv.	protein iron	2 gm 1.1 mg

* corrected average

All calculations taken from data in Home and Garden Bulletin No. 72 (56).

Table 10. Correlation coefficients of standard units of nutrients with the sum of all servings from the food groups

	Stotal	AvgRDA	StmgCa	StgPro	StIUvitA	StmgvitC	StmgFe
Smilk	0.19	0.50	1.00*	-	-	-	-
Smeat	0.46	0.35	-	0.80*	-	-	0.69*
Sbread	0.76*	0.34	-	-	-	-	-
SOfr/veg	0.41	0.12	-	-	-	-	-
SvitAfr/veg	0.28	0.33	-	-	0.99*	-	-
SvitCfr/veg	0.39	0.59*	-	-	-	0.99*	-
Stotal	-	0.66*	-	-	-	-	-
StmgCa	0.19	0.50	-	-	-	-	-
StgPro	0.69*	0.64*	-	-	-	-	-
StIUvitA	0.34	0.40	-	-	-	-	-
StmgvitC	0.43	0.60*	-	-	-	-	-
StmgFe	0.85*	0.59*	-	-	-	-	-
Totlack	-0.76*	-0.67*	-	-	-	-	-
Totover	0.93*	0.54	-	-	-	-	-
Sumst	0.89*	0.78*	-	-	-	-	-
Sumst2	0.76*	0.83*	-	-	-	-	-

$p<.001$

* Statistically Significant

Table 11. Correlation coefficients of leader nutrient RDA with dietary variables

	ProRDA	FeRDA	CaRDA	VitARDA	VitCRDA
Smilk	0.38	-	0.73*	0.32	-
Smeat	0.56*	0.46	-	-	-
Sbread	0.44	0.51	-	-	-
SvitAfr/veg	-	-	-	0.69*	-
SvitCfr/veg	-	-	-	-	0.84*
ProRDA	-	0.66*	0.72*	0.39	0.46
FeRDA	0.66*	-	-	0.47	-
CaRDA	0.72*	-	-	0.40	-
VitARDA	0.39	0.47	0.40	-	0.17
VitCRDA	-	-	-	0.17	-
%cal	0.79*	0.59	0.72*	0.32	0.37
Totlack	-0.53	-0.47	-0.44	-0.41	0.41
Totover	0.63*	0.64*	0.37	0.24	0.33
Stotal	0.64*	0.64*	0.44	0.34	0.37
StgPro	0.78*	0.60*	-	-	-
StmgFe	0.66*	0.65*	-	-	-
StmgCa	-	-	0.73*	-	-
StIUvitA	-	-	-	0.73*	-
StmgvitC	-	-	-	-	0.84*
AVGRDA	0.82*	0.60*	0.69*	0.66*	0.75*

$p<.001$

* Statistically Significant

Table 12. Leader nutrients and the WIC 329 (including sodium, cholesterol, and energy nutrients)

calcium

1980 RDA = 800 mg (for children 1-3 years old)
2/3 1980 RDA = 536 mg
WIC 329 requirement for 1-3 year old children = 576 mg

WIC 329	frequency	percent
consume ≥576 mg	29	38.7
consume <576 mg	46	61.3
total	75	100.0
1980 RDA		
consume ≥800 mg	2	2.7
consume <800 mg	73	97.3
total	75	100.0
2/3 1980 RDA		
consume ≥536 mg	same frequency values as	
consume <536 mg	576 mg	

Table 12. (Cont.)

protein

1980 RDA = 23 g (for 1-3 year old children)
2/3 1980 RDA = 15.4 g
WIC 329 requirement for 1-3 year old children = 34 g
1980 RDA = 2/3 WIC 329 protein requirement

WIC 329 protein requirement

milk	8 g x 2	servings =	16 g
meat	14 g x 2(1/2)	servings =	14 g
bread	2 g x 4(1/2)	servings =	4 g
			34 g total

WIC 329	frequency	percent
consume ≥34 g	69	92.0
consume <34 g	6	8.0
total	75	100.0
1980 RDA		
consume ≥23 g	74	98.7
consume <23 g	1	1.3
total	75	100.0
2/3 1980 RDA		
consume ≥15.4 g	75	100.0
consume <15.4 g	0	0.0
total	75	100.0

Table 12. (Cont.)

vitamin A

1980 RDA = 2000 IU (for children 1-3 years old)
2/3 1980 RDA = 1340 IU
WIC 329 (all sources) requirement for 1-3 year old children = 3852 IU

WIC 329

Vitamin A group serving reflected as 4000-5000 IU equivalents on form. Actual calculation resulted in the higher value of 6138 IU/serving.

all vitamin A sources from WIC 329 for children 1-3 years old

milk	310 IU x	2	servings =	620 IU
vitamin A group	6138 IU x	(1/2)	servings =	3069 IU
other fruit/vegetable	163 IU x	2(1/2)	servings =	163 IU
				3852 IU total

WIC 329	frequency	percent
consume ≥3852 IU	20	26.7
consume <3852 IU	55	73.3
total	75	100.0

1980 RDA	frequency	percent
consume ≥2000 IU	23	30.7
consume <2000 IU	52	69.3
total	75	100.0

2/3 1980 RDA	frequency	percent
consume ≥1340 IU	29	38.7
consume <1340 IU	46	61.3
total	75	100.0

computer hand tally (based on calculations from Nutritionist I printout)	frequency	percent
consume ≥1340 IU	65	86.7
consume <1340 IU	10	13.3
total	75	100.0

Table 12. (Cont.)

vitamin C

1980 RDA = 45 mg (for children 1-3 years old)
2.3 1980 RDA = 30 mg
WIC 329 requirement for 1-3 year old children = 66.3 mg

WIC 329 vitamin C requirement

vitamin C group = 60.0 mg
other fruit/vegetable = 6.3 mg

66.3 mg

WIC 329	frequency	percent
consume ≥66.3 mg	41	54.7
consume <66.3 mg	34	45.3
total	75	100.0

1980 RDA		
consume ≥45 mg	45	60.0
consume <45 mg	30	40.0
total	75	100.0

2/3 1980 RDA		
consume ≥30 mg	47	62.7
consume <30 mg	28	37.3
total	75	100.0

computer hand tally
(based on calcuations from Nutritionist I printout)

consume ≥30 mg	52	69.3
consume <30 mg	23	30.7
total	75	100.0

Table 12. (Cont.)

iron

1980 RDA = 15 mg (for children 1-3 years old)
2/3 1980 RDA = 10 mg
WIC 329 requirement for 1-3 year old children = 5.78 mg

iron sources reflected from WIC 329

meat	2.26 mg x 2(1/2)	servings	= 2.26 mg
vitamin A group	1.11 mg x (1/2)	servings	= 0.56 mg
vitamin C group	0.76 mg x 1	serving	= 0.76 mg
bread	1.10 mg x 4(1/2)	servings	= 2.20 mg
			5.78 mg total

WIC 329	frequency	percent
consume ≥5.78 mg	78	97.3
consume <5.78 mg	2	2.7
total	75	100.0

1980 RDA		
consume ≥15 mg	32	42.7
consume <15 mg	43	57.3
total	75	100.0

2/3 RDA		
consume ≥10 mg	59	78.7
consume <10 mg	16	21.3
total	75	100.0

Table 12. (Cont.)

<u>energy nutrients percentages in the diets</u>

nutrient	range	mean (g)
protein	9 - 27%	16.43 ± 3.41
carbohydrate	28 - 79%	48.31 ± 8.66
fat	7 - 59%	36.25 ± 7.71

<u>sodium and cholesterol percentages in diets</u>

nutrient	range (mg)	mean (mg)
sodium	535 - 5031	1943.7 ± 937.25
cholesterol	475 - 8975	2663.55 ± 1972.83

Table 13. Mean RDA of the leader nutrients

Nutrient	Mean RDA (%)	Range (%)
Calcium	86	12-150
Protein	145	86-150
Vitamin A	116	20-150
Vitamin C	109	11-150
Iron	56	16-141

NOTE: The RDA was truncated at 150%. Therefore, the range would have been greater for all nutrients except iron.

Table 14. Correlations with average RDA

	Raw	Truncated
Sumst	0.78	0.78
Sumst2	0.83	0.80
Totlack	-0.61	-0.67
Totover	0.54	0.57
Stotal	0.61	0.66

p<.001

Table 15. Regression formula

truncated regression formula

46.94 +	3.67(2.87) +	2.14(6.56) +	9.39(0.33) +	6.14(0.96) +	14.98(1.47)	=	103
intercept constant	meat group	bread group	vitamin A foods	vitamin C foods	milk group		mean RDA

numbers outside ( ) reflect B values.

numbers inside ( ) reflect mean servings consumed.

the intercept value is the regression constant.

regression formula based on raw % RDA

20.03 +	10.11(2.87) +	3.33(6.56) +	28.19(0.33) +	22.11(0.96) +	28.91(1.47)	=	144
intercept constant	meat group	bread group	vitamin A foods	vitamin C foods	milk group		mean RDA

Table 16. Mean servings of the four food groups

food	mean	range
Smilk	1.47 ± 0.79	0-5
Smeat	2.87 ± 1.37	0-6
Sbread	6.56 ± 3.53	0-16
SvitAfr/veg	0.33 ± 0.59	0-2
SvitCfr/veg	0.96 ± 1.09	0-6
SOfr/veg	2.70 ± 2.32	0-12

Values were taken directly from the researcher's interpretation of the foods consumed as stated by the caretaker.

Subject characteristics

age

mean -- 28.67 $\pm$ 4 months
range -- 24 to 36 months

patient status

All children came to Virginia Beach Health Department for recertification. Some children received all their health care through the Health Department and were classified as inpatients. Others were military dependents or had private physicians and were outpatients.

patient status	frequency	percent
inpatient	43	57.3
outpatient	29	38.7
*no data	3	4.0
total	75	100.0

living arrangement

living arrangement	frequency	percent
one parent home	43	57.3
two parent home	29	38.7
*no data	3	4.0
total	75	100.0

number of children in family

number	frequency	percent
1	28	37.3
2	18	24.0
3	12	16.0
4	11	14.7
5	2	2.7
7	1	1.3
*no data	3	4.0
total	75	100.0

mean -- 2.24 $\pm$ 1.32 children in family

Subject characteristics (Cont.)

birth order of child

birth order	frequency	percent
1	36	48.0
2	11	14.6
3	7	9.3
4	5	6.7
5	1	1.3
6	1	1.3
*no data	14	18.7
total	75	100.0

mean -- 1.80 $\pm$ 1.19 children

race

race	frequency	percent
black	37	49.3
white	34	45.3
hispanic	2	2.7
asian	2	2.7
total	75	100.0

gender

gender	frequency	percent
female	38	50.7
male	37	49.3
total	75	100.0

height

mean - 35.35 $\pm$ 1.62 inches
range - 32.25 to 39.50 inches

weight

mean - 29.31 $\pm$ 3.32 pounds
range - 23.5 to 36.0 pounds

Subject characteristics (Cont.)

nutritional risk factors

Each nutritional risk factor is given a priority number. Risk factors are prioritized in the event that a health district reaches its maximum case load. For example, an anemic child is considered to be at greater nutritional risk than a child whose diet is inadequate. For the 75 children of this study, the maximum number of risk factors that any one child had on the date of recertification was three. On the code sheet, the risk factors were placed in order of their priority. Column one risk factors were higher priority than column two risk factors and column two had a higher priority than column three.

first column

risk factors	frequency	percent
inadequate diet	24	32.0
anemia	16	21.3
short stature	14	18.7
fear of regression	11	14.7
obesity	7	9.3
underweight/height	2	2.7
food allergy	1	1.3
total	75	100.0

second column

risk factors	frequency	percent
**no risk	48	64.0
inadequate diet	17	22.7
fear of regression	11	8.0
obesity	4	5.3
total	75	100.0

**These children only had one nutritional risk factor.

third column

risk factors	frequency	percent
**no risk	72	96.0
inadequate diet	3	4.0
total	75	100.0

**These children only had one or two nutritional risk factors.

Subject characteristics (Cont.)

risk factors	overall frequency	overall percent
inadequate diet	44	58.7
fear of regression	17	22.7
anemia	16	21.3
short stature	14	18.7
obesity	11	8.0
underweight/height	2	2.7
food allergy	1	1.3
total	105	133.4

Frequency and percent do not add up to 75 and 100, respectively, since these reflect total risk factors, including first, second and third columns.

vitamins

vitamins	frequency	percent
child not receiving vitamins	55	73.3
child receiving vitamins	17	22.7
*no data	3	4.0
total	75	100.0

food stamps

food stamps	frequency	percent
family not receiving food stamps	51	68.0
family receiving food stamps	20	26.7
*no data	4	5.3
total	75	100.0

Subject characteristics (Cont.)

aid to dependent children (ADC)

ADC	frequency	percent
family not receiving ADC	45	60.0
family receiving ADC	26	34.7
*no data	4	5.3
total	75	100.0

status

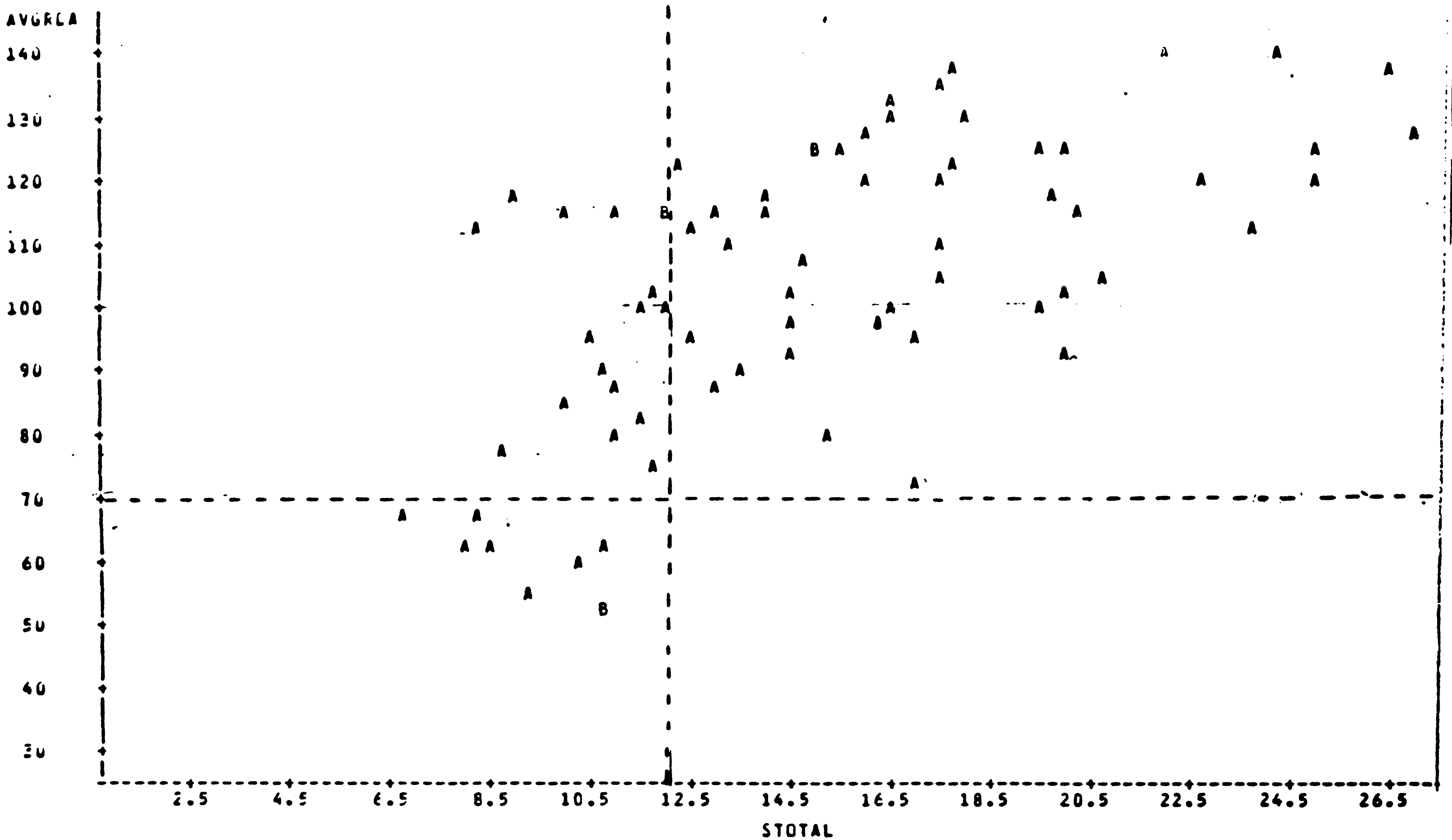
status	frequency	percent
civilian family	62	82.6
military family	11	14.7
*no data	2	2.7
total	75	100.0

income scale

Although WIC is a free program, the Virginia Health Department uses a six point income scale for determining eligibility for medical services. At one end of the scale, indigent patients are not charged for services. At the other end, patients pay 100% of the cost. To be eligible for WIC, patients must fall into one of the first four categories - i.e. - not subject to charges up to 50% of the total cost of health care provided.

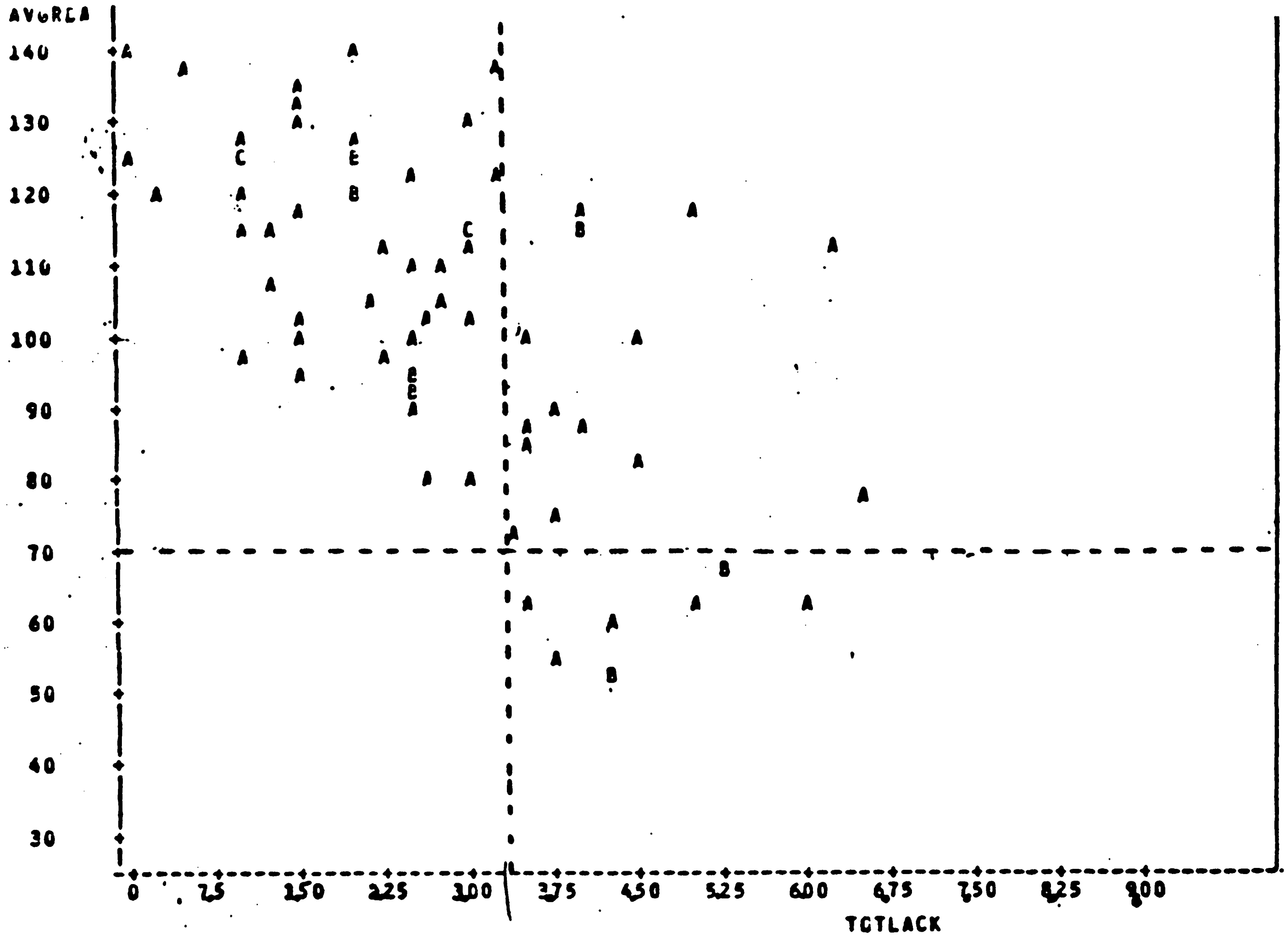
income scale	frequency	percent
no charge (R)	48	64.0
10% charge (S)	3	4.0
25% charge (T)	12	16.0
50% charge (U)	3	4.0
*no data	9	12.0
total	75	100.0

*In some instances, data was not available for all 75 subjects. Those variables which were not relevant to the child's recertification such as birth order, parents living arrangement, number of children in the family, and so on, were not initially considered during the early part of data collection. It was later necessary to refer back to the medical chart to obtain the information and to question the care taker if the child was still participating in the WIC Program at the following recertification period.



A = One observation
B = Two observations

Figure 1. Average RDA and the sum of all servings



A = One observation
B = Two observations
C = Three observations

Figure 2. Average RDA and the total servings lacking

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