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# Part I. Evaluation of aggregated food consumption patterns at the national, provincial and community level

# Using national dietary data to measure dietary changes

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## Abstract

*Objective:* To demonstrate that dietary datasets from the Continuing Survey of Food Intakes by Individuals, a US population survey, allow comparisons with national data and provide food composition datasets that can be used to generate similar dietary data.
*Design:* Two studies are described: the Lower Mississippi Delta Nutrition Intervention Research Initiative (Delta NIRI), which used a 24-hour recall, and a Department of Defense Military Nutrition Research Task, which used 3-day dietary records. Both studies used the same food composition tables.
*Setting:* Rural Lower Mississippi Delta and an Army post.
*Subjects:* Four hundred and nine residents (adults and children) from the rural Delta region of Arkansas, Louisiana and Mississippi, and 74 career soldiers from the Sergeants Major Academy, Fort Bliss, Texas.
*Results:* The Delta NIRI study found that fruit and vegetable consumption for these rural residents was lower than that found nationally. Additionally, the quality of vegetable servings is of concern since a large percentage came from french fries and potato chips. In the Sergeants Major Academy study, the national survey food composition tables allowed for easy analysis of intake data and comparisons with dietary recommendations.
*Conclusions:* Strategies similar to those used for the Delta NIRI and Military Nutrition Research Task can be used widely, allowing comparisons of 'defined populations' with nationally distributed data. Additionally, measurement of dietary change is more efficient when the same protocol is used subsequently to collect more data, a method similar to that used by the US Department of Agriculture to describe food consumption patterns from one survey to another.

**Keywords**
Dietary assessment
Measuring dietary change
National survey data

The dilemma of measuring dietary changes over time comes about as a result of several factors. Issues regarding data collection and analysis, including changes over time in both, are critical areas of investigation. Nestle and Wotecki[1] noted that the National Health and Nutrition Examination Survey (NHANES) and the National Food Consumption Survey (NFCS) reported similar intakes of total fat in grams of the population in general, but very different intakes of fat in the subset of individuals consuming diets low in fat. Several factors were identified which contributed to this difference. As an example, the NFCS reported intake of all polyunsaturated fatty acids while NHANES reported intake of only linoleic acid. When these factors were adjusted for, the magnitude of the discrepancies was reduced greatly. These factors were related to data collection methodology, the food composition databases used, and interview and coding procedures. Thus data collection and analysis issues are critical for the appropriate interpretation of changes in dietary intake or comparisons with different populations.

Contributing to the difficulty of measuring dietary change over time is the ever-increasing complexity of the food supply. Popkin *et al.*[2] point out that the availability of thousands of foods and ways in which to prepare and consume them create additional burdens in examining diet and health issues over time. The US Department of Agriculture's (USDA) US Food Supply Series indicates an increase in energy availability per capita of 15% between 1970 and 1994[3]; however, NHANES and NFCS data in virtually all surveys conducted suggest that reported energy intakes are rather low[1]. Therefore, considerable steps need to be taken to ensure that variables that may explain dietary change in relation to biological changes are considered carefully prior to interpretation.

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## Review of work

The Pennington Biomedical Research Center (PBRC), part of the Louisiana State University System, is located in Baton Rouge, LA. PBRC's mission is the promotion of healthier lives through research and education in nutrition and preventive medicine. As part of our research, we routinely assess dietary intakes of individuals involved in ongoing protocols, both in-house and as part of studies involving other entities or institutions. Some of these other involvements include the National Institutes of Health-funded DELTA (Dietary Effects on Lipoproteins and Thrombogenic Activity) and DASH (Dietary Approaches to Stop Hypertension) trials[4,5], work in the Lower Mississippi Delta[6], and several tasks devoted to Military Nutrition Research.

PBRC maintains its own nutrient database, known as MENu (Moore's Extended Nutrient Database), that evolved from the earlier mainframe database developed by Margaret C. Moore known as The Extended Table of Nutrient Values, historically cited as the database utilised for the Bogalusa Heart Study. The current MENu database contains data from the most recent releases of the USDA Survey Nutrient Database used for the Continuing Survey of Food Intakes by Individuals (CSFII) and the Nutrient Database for Standard Reference, in addition to unique regional food information.

In addition to using nutrient values for foods from the USDA, there are other advantages of using national survey datasets. Provided that the data collection and analyses are similar, comparisons of 'defined populations' with nationally distributed data can be made. Measurement of dietary change is also more efficient when the same protocol/data source is used subsequently to collect additional data, a method similar to that used by the USDA to describe changes in consumption patterns nationally from one survey to the next. Two specific projects at PBRC that best exemplify efforts to compare collected data with national data are the Lower Mississippi Delta Nutrition Intervention Research Initiative (Delta NIRI), initiated in 1995, and the Department of Defense Military Nutrition Research Tasks, which have been undertaken since 1989.

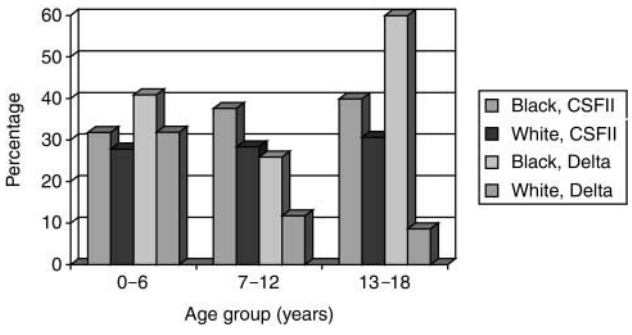


**Fig. 1** Percentage of total vegetables from french fries and potato chips by age categories: comparison between the Delta NIRI FOODS validation/pilot study (Delta) and the Continuing Survey of Food Intakes by Individuals (CSFII)

### *Delta NIRI*

The Delta NIRI's mission is to determine the nutritional status of Delta residents in Arkansas, Louisiana and Mississippi, compare these data with appropriate reference data, and plan effective nutrition intervention programmes. To this end, the Delta NIRI is collecting dietary data using the same methodology as the CSFII, has drafted a number of interventions to be piloted, and will measure dietary changes following the implementation of these interventions. Under the Delta NIRI, a cross-sectional survey to collect baseline data on the health and nutritional status of Lower Mississippi Delta's residents is planned. Data have been collected from a representative sample of 36 counties and parishes in Arkansas, Louisiana and Mississippi. In preparation for the primary study, a 'Foods of Our Delta Study (FOODS)' validation/pilot study of three counties was designed to evaluate telephone versus in-person methods of dietary intake, in order to select the appropriate method for use in the larger study[7]. The results revealed no significant difference in mean intakes of calories or protein consumed between telephone and non-telephone households by either in-person or telephone interview. To our knowledge, this was the first study to report comparisons of dietary intake between persons in households with telephones and persons in households without telephones using this methodology. This has important implications for future dietary intake studies of rural populations using telephone survey methodology.

From the validation/pilot study conducted, we further sought to compare and evaluate the quantity and quality of fruit and vegetable servings to determine whether an intervention that might be designed to increase consumption would be warranted. We computed average consumption for all age groups and, using the same dataset as CSFII 1994–96 and 1998 (which was used in the data analysis for this study), quantified fruit and vegetable servings, and compared intakes with CSFII. These data suggested that the percentage of vegetable servings from

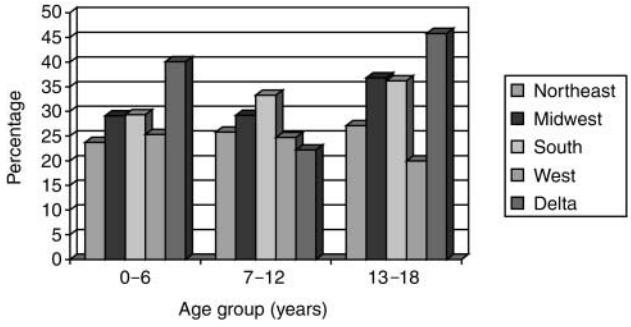


**Fig. 2** Percentage of vegetable servings from french fries and potato chips among children by region of the country

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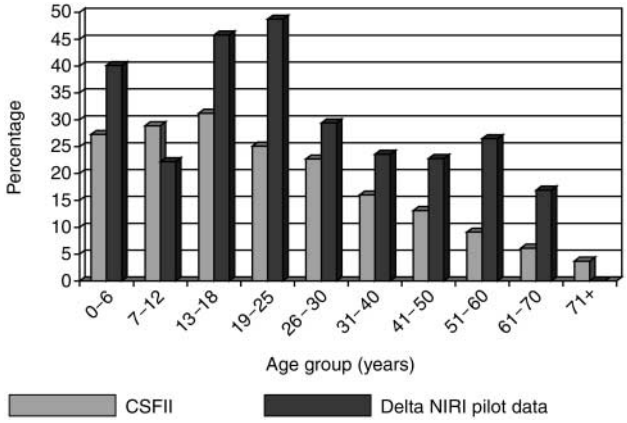


**Fig. 3** Percentage of vegetable servings from french fries and potato chips for age groups into adulthood: comparison between Delta NIRI pilot data and the Continuing Survey of Food Intakes by Individuals (CSFII)

french fries and potato chips in the three Delta counties surveyed was high relative to that consumed in the US population as a whole. These data are shown in Figs 1 to 4.

The percentage of vegetable servings from french fries and potato chips among children based on ethnicity is shown in Fig. 1. In both black and white children in the 0–6-year-old age group, intake tends to be somewhat higher in the Delta. For the 7–12-year-old age group, Delta children consumed less; and for the 13–18-year-old age group, almost 60% of the vegetables that were consumed by black children were chips and fries. Consumption of chips and fries among the 0–6- and 13–18-year-old age groups for all ethnic groups combined was higher in the Delta pilot study than in any region of the CSFII (Fig. 2).

The percentage of vegetable servings from french fries and potato chips for all age groups into adulthood is shown in Fig. 3. With the exception of the 7–12- and 71+-year-old age groups, there is a tendency to consume a higher percentage of vegetables as chips and fries. Figure 4

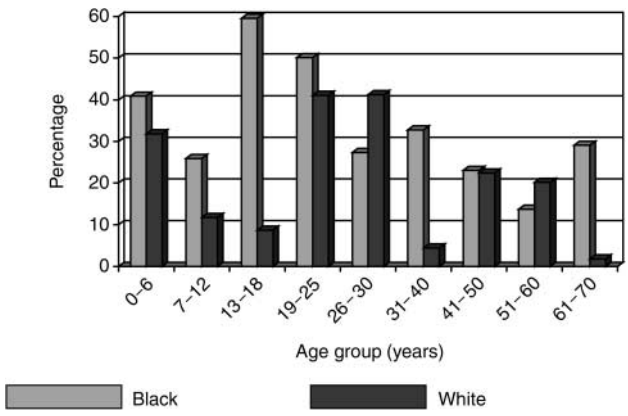


**Fig. 4** Percentage of vegetable servings from french fries and potato chips for different age/ethnic groups in the pilot Delta population

contains only the Delta pilot population sample, looking at age and ethnic differences in percentage of servings of vegetables as chips and fries. Blacks in all age groups consumed a larger percentage of vegetables as chips and fries, with the exception of the 26–30- and 51–60-year-old age groups that had a tendency towards greater consumption among whites.

From the pilot validation study, it was concluded that the overall mean consumption was 0.9 servings of fruit and 2.8 servings of vegetables in the Lower Delta population, compared with 1.5 fruit and 3.1 vegetable servings from the CSFII national data. Consumption of french fried potatoes and potato chips accounted for 30% of overall total vegetable servings in the Delta (11.5% from chips and 18.5% from fries), compared with 16.7% from CSFII (4.3% from chips and 12.4% from fries). Blacks consumed larger quantities of chips and fries, but it should be noted that the population for the pilot study was largely black.

There are several limitations of the FOODS validation/pilot dataset. The first is the similarity of the sample to the larger Delta population. The pilot data represent only three counties in the Delta, chosen primarily because they were easily accessed and the pilot study could be feasibly carried out in the time frame chosen. Second, there are sample size considerations. The pilot study consisted of only 409 individuals (adults and children) in total from a total of 268 households. This sample size may not provide adequate statistical power to address questions other than household and interview-type issues. Third, the pilot was a non-randomised probability sample comprising equal numbers of telephone and non-telephone households. In reality, the area sampled does not contain as many non-telephone households as does our sample. Therefore, the sample over-represents the non-telephone households. Finally, the pilot study represents only preliminary data. Therefore the results should be discussed carefully, and not be extrapolated to the general population or to other rural populations. The larger study may in fact show that the Delta population may not have been totally represented by the pilot.

However, we can conclude even from these preliminary data that there are implications for interventions that would increase both the quantity and quality of fruit and vegetable consumption in the Delta. Culturally appropriate nutrition education and behavioural change strategies are especially important in this diverse population group. We anticipate that the larger study of the population presently being completed will support these preliminary findings.

### *Military Nutrition Research Tasks*

The Military Nutrition Research Tasks include the collection of dietary data to justify changes needed to address the unique requirements of soldiers. Some trials are short-term, designed for specialised focus areas, e.g.

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**Table 1** Reported nutrient intakes of soldiers at the Sergeants Major Academy ($n = 74$). Values are given as mean ± standard deviation

| | MRDA | Baseline | Mid-point | Final |
|---|---|---|---|---|
| Energy (kcal) | 3200 | 2483 ± 564 | 2360 ± 728 | 2103 ± 713 |
| % Energy from fat | <30 | 32.4 ± 7.5 | 31.7 ± 7.6 | 30.3 ± 7.2 |
| % Energy from saturated fat | <10 | 10.9 ± 3.5 | 10.6 ± 2.9 | 10.2 ± 3.1 |
| Cholesterol (mg) | <300 | 315 ± 143 | 257 ± 143 | 256 ± 148 |

MRDA – Military Recommended Dietary Allowance.

**Table 2** Serum lipid levels of soldiers at the Sergeants Major Academy ($n = 74$). Values are given as mean ± standard deviation

| | Recommendation[8] | Baseline | Mid-point | Final |
|---|---|---|---|---|
| Cholesterol (mg dl$^{-1}$) | <200 | 200 ± 40 | 209 ± 41 | 210 ± 47 |
| Triglycerides (mg dl$^{-1}$) | <150 | 110 ± 88 | 103 ± 70 | 111 ± 64 |
| LDL cholesterol (mg dl$^{-1}$) | <130 | 131 ± 33 | 139 ± 40 | 136 ± 44 |

LDL – low-density lipoprotein.

cold and hot environment studies, basic training studies, etc. Other projects determine dietary intake at specific time points during military activities to help changes that may result during longer-term career training situations.

One study conducted at the Sergeants Major Academy at Fort Bliss, TX was designed to measure dietary change over the course of the Academy training to help explain changes in blood lipids. The specific objectives were to evaluate the nutritional adequacy of the diets of these career soldiers, to assess changes in diet after health promotion courses, and to assess changes in serum cholesterol that occurred. The interest in this particular study was driven by several factors. Coronary heart disease is the second leading cause of death within the US military population[8]. Previous cholesterol screenings have found elevated cholesterol levels in over 25% of soldiers[9]. Karge *et al.*[10] noted that, in particular, senior enlisted personnel display a similar trend, with more than 37% of students attending the US Sergeants Major Academy having increased cholesterol levels that rose moderately over the 9-month training period.

Hence, PBRC investigators, in conjunction with Military Nutrition researchers at the US Army Research Institute for Environmental Medicine, assessed dietary intakes at baseline, mid-point and end of training in a group of 106 soldiers enrolled in the Sergeants Major Academy, Fort Bliss, TX. Blood samples were collected at each of these time points. Nutrition education was conducted at the beginning of the academic programme.

Dietary intake data are presented in Table 1. The mean reported energy intake at baseline, mid-point and end of training was less than the Military Recommended Dietary Allowance, and tended to decrease over time. Since these individuals were in their 40 s and not highly active physically, this was not surprising. Reported fat intake as a percentage of energy exceeded the recommendation of 30% by the American Heart Association (AHA) at baseline and mid-point of the training, but met the AHA guidelines at the end of training. However, the values reported were lower than that for the US population. Dietary cholesterol intake at baseline was somewhat higher than the less than 300 mg day$^{-1}$ recommendation at 315 mg day$^{-1}$, and met the recommendation and appeared to remain constant at just over 255 mg day$^{-1}$ during the mid-point and final collections of the programme. Changes in serum lipids are shown in Table 2. Despite no significant changes in diet and a trend to decrease total dietary fat, saturated fat and cholesterol, there was a tendency for serum cholesterol and low-density lipoprotein cholesterol to increase at the mid-point of the study. At the end of the study, these measures were similar to the mid-point values. Obviously, reported average dietary intake did not appear to play a part in these changes. Further work needs to be done to account for these changes; however, if dietary intake was misreported, then this could be one explanation.

## Conclusions

The Delta NIRI and Military Nutrition Research Task projects utilise data disseminated by the USDA to capture dietary intakes of these populations, although sometimes with slight modifications to the database to account for specific foods eaten. Because of this strategy, comparisons with the US population can be made, as was shown with the Delta NIRI FOODS validation study. To measure change over time, the same USDA datasets were used at each time period and intakes were therefore analysed similarly, so that comparisons would be valid. It must be pointed out that designing and maintaining nutrient software programs that continually change to meet the needs of specific protocols and allow appropriate comparisons with previously collected data within the same population are yet another challenge.

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