Update on the Third National Health and Nutrition Examination Survey

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The NHANES Program

I am pleased to provide an update on National Health and Nutrition Examination Survey (NHANES) program activities. My presentation includes findings NHANES III-Phase 1 (1988-91) as well as plans for future reports and data release.

The National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) conducts periodic surveys to assess the health and nutritional status of the U.S. population. NHANES data are obtained by means of interview and examination methods. Two surveys were completed by NCHS between 1971 and 1980--NHANES I, 1971-75 and NHANES II, 1976-80. NCHS completed a special HANES of three Hispanic subgroups--Hispanic HANES between 1982-84. NHANES III is a six-year survey of the U.S. population. Data collection for this survey began in October, 1988 and will end in October, 1994. NHANES III is divided into two 3-year phases; each phase constitutes a national sample. Data for the entire six year survey may be combined to form a larger national sample.

The objectives of NHANES III are to collect national health and nutrition data to estimate the prevalences of selected diseases and risk factors, to prepare reference data for a wide range of health parameters, to examine secular trends in the prevalences of disease and health risk factors, and to collect data which are needed to study the etiology of chronic diseases. Several methodologic improvements and planning considerations were incorporated into the design of the Survey to permit tracing and longitudinal follow-up of NHANES III respondents (1,2).

The NHANES III respondent universe

The NHANES III sample is comprised of more than 40,000 persons 2 months of age and older. Of these, approximately 35,000 will complete the interview portion of the Survey, and 30,000 persons will be examined in mobile examination centers (MEC). The NHANES III sample is comprised of the civilian, noninstutionalized population of the United States. The Survey's stratified, multistage probability sample design includes an oversampling of children, older persons, African Americans, and Mexican Americans so that reliable estimates of health status indicators will be available for these population subgroups (3).

Data collection

The data collection contractor for NHANES III is Westat Inc. of Rockville, MD. The contractor completes the advance arrangements for each Survey location or "Stand". This entails setting up field offices and the MEC, hiring and training MEC and field office staff, preparing training manuals, organizing staff retraining, implementing quality control procedures, and transmitting data to NCHS.

Advance letters are mailed to prospective Sample Persons (SPs) informing them that an interviewer will visit their home. If household members are eligible and willing to participate in the Survey, family and household interview questionnaires are administered in the home. Approximately one month after the household interview, respondents complete the examination component in the MEC. Examinations are scheduled during morning, afternoon and evening hours. Examinations are conducted all days of the week. SPs are compensated for participating in the examination component.

The NHANES III Dietary Assessment Component

NHANES data are used to estimate the prevalences of nutrition-related risk factors such as overweight and poor diet, to provide data to examine the relationship between diet, nutritional status, and health, and to provide baseline data to relate long-term dietary practices to chronic diseases. Anthropometric, biochemical and hematologic, dietary, and clinical data are collected. The dietary assessment component includes 24-hr dietary recall and food frequency interviews. Information is obtained on the use of vitamin and mineral supplements, medications, alcohol, drinking water, and salt.

The food frequency questionnaire is targeted to collect more detailed information on dietary sources of calcium, caffeine, and vitamins A and C. Sample Persons (SP) 12+ years of age are eligible for the food frequency interview. SPs 17+ years of age complete the food frequency interview during the household interview; adolescents 12-16 years of age complete the food frequency interview in the MEC. A separate infant food frequency questionnaire is administered during the household interview.

All NHANES III examinees are eligible for the 24-hr dietary recall interview. Interviews are collected in the MEC by trained, bilingual dietary interviewers. Proxy respondents report for infants and young children and respondents who are unable to report for themselves. The dietary interviewer's training manual provides a detailed description of the NHANES III dietary protocol (4).

NHANES III Dietary Recall Data Collection

An automated dietary interview and coding system was used to collect all NHANES III 24-hr dietary recalls. The NHANES III Dietary Data Collection (DDC) system was developed by the University of Minnesota's Nutrition Coordinating Center (NCC) with NCHS, National Heart, Lung and Blood Institute, and Food and Drug Administration funds. The features of the DDC system include the capability to conduct open-ended interviews using structured probes to ensure standardized data collection (5). Updated versions of the DDC system were installed in the field throughout NHANES III. All foods and beverages reported during Phase 1 were coded using the USDA Survey Nutrient Database (6).

Quality control monitoring of dietary data collection

Quality control monitoring for dietary interview component includes direct observations of interviews in progress by NCHS, Westat, and supervisory staff, reviews of printed recall reports, reviews of taped recall and food frequency interviews, and a ten percent cross-check of printed recall reports by a second dietary interviewer. Communication with field staff is maintained by means of telephone calls to the interviewers, field memoranda, newsletters, interviewer training manual updates, and dietary interviewer retraining activities.

NHANES III Response Data

Final interview, examination and component response data for NHANES III-Phase I (1988-91) are shown in Tables 1 and 2. A total of 20,277 persons were identified for the Phase 1 sample. Of these, 17,464 (86%) were interviewed and 15,630 (77%) were interviewed and examined. During Phase 1, a total of 15,409 examinees (99% examinees) were interviewed by a dietary interviewer.

The Phase 1 analytic sample is comprised of examinees who had complete and reliable recalls. Of the 15,409 SPs who were interviewed by the dietary interviewers, 14,801 SPs had reliable and complete

dietary recalls. The Phase 1 24-hr dietary recall component response rate was 95% (14,801/15409) and the overall analytic response rate was 73% (14,801/20,277).

Nursing infants and children were excluded from the analytic sample because NCHS did not attempt to quantify human milk intake. Individuals with incomplete (n=338) or unreliable recalls (n=100) were also excluded. NCHS did not impute missing data. A small number of recalls (n=29) were lost due to a computer problem which was unrelated to the dietary interview system. A total of 221 examinees did not complete dietary interviews for various reasons such as refusals, illness, and lack of time.

Earlier this year, NCHS produced the NHANES III-Phase 1 total nutrient intake data file. NCHS reported total mean energy and percentages of energy intake from total fat and saturated fat in the February 25th issue of the CDC Morbidity and Mortality Weekly Report (7). Highlights of this report and a paper presented by Dr. Ronette Briefel at the Nineteenth Beltsville Symposium are shown in the next series of slides (8).

Mean energy intakes for males and females by age are shown in Figure 1. Mean energy intakes were higher for males, compared to females in all ages. Energy intakes peaked during adolescence and early adulthood, and declined thereafter. The mean energy intake for males 2 years of age and older was 2518 kcal, and for females 2 years of age and older, 1751 kcal. Mean energy intakes are similar to recommended intakes based on 1989 Recommended Dietary Allowances for males through age 40 years, and for females through age 12 years (9). The Phase 1 reported energy intakes for males over 40 years of age and females in their teens and beyond fall below the recommended intakes.

Sources of food energy for males and females 20 years of age and older are shown in Figure 2. Carbohydrate provided 48% energy (%kcal) in males and 50 %kcal among females. Fat provided 34 %kcal in males and females. This figure is lower than the 36 %kcal from fat which was reported in earlier national surveys conducted in the 1970's and 1980's. Approximately fifteen percent of total energy intake was supplied by protein for males and females. Alcohol accounted for 4% total energy intake of males and 2% in females. Alcohol intakes are often under-reported in surveys, but the collection of weekend recall data, and use of a private dietary interview setting in the MEC improves alcohol information in NHANES. The only difference in the sources of energy by race/ethnicity group is that fat contributed a lower percentage of energy intake in Mexican Americans--32.8 %kcal overall versus 34 %kcal for the other race-ethnicity groups.

The variability in mean energy intakes by day of the week was examined. Differences were found between males and females (Table 3). Males had higher energy intakes on Fridays, Saturdays and Sundays, depending on the age groups. For females less than 60 years of age, mean energy intakes were highest on Friday and Saturdays. Mean energy intakes were highest on Wednesdays and Sundays for females 60 years of age and older.

Mean energy intakes reported during NHANES II (1976-80) and NHANES III-Phase 1 were compared (Table 4). There was little change in the mean energy intakes of persons less than 12 years of age between surveys. For all age groups 12 years of age and older however, the NHANES III energy intakes were higher. Among males 12+ years of age, mean intakes were 1-13% higher; for females, mean intakes were 1-17% higher.

One objective of HANES is to look at secular trends in the U.S. population. Interpretation of trends in energy and nutrient intakes is difficult when methodologic changes occur between surveys. Many factors must be considered when interpreting changes in mean energy intake between NHANES II and NHANES

III. For example, significant improvements were made in the dietary interview methods and quality control monitoring for NHANES III to improve the completeness of the 24-hr recalls. NHANES III includes all days of the week, whereas NHANES II had few weekend days. The improved coverage on weekends probably affected alcohol estimates as well. Finally, different food coding and food composition data bases were used in these surveys.

Several studies have addressed under-reporting of total food intake in dietary studies. In a long-term study conducted by Mertz et al., reported food energy intakes were on average, 18% lower than expected, based on body weight maintenance requirements (10). Under-reporting during NHANES III was investigated using measured body weight and reported food intake data. The ratio of reported energy intake (EI) to the basal metabolic rate (BMR) was calculated using formulas published by Bingham (11). Ratio values of 1.50-1.55 are expected for sedentary populations (12).

EI/BMR ratios for adult males and females calculated by Black et al. using NHANES I and NHANES II data were compared to data for Phase 1 (13). The ratio values are higher for Phase 1 (Tables 5 and 6). The EI/BMR for males and females during NHANES III-Phase 1 are shown in Table 7. The ratio values declined with age for both sexes. Overall EI/BMR values were 1.47 for males and 1.27 for females. Within age-gender groups, the ratios did not differ by race/ethnicity group.

The EI/BMR ratios differed by overweight status. Ratios were computed for persons defined as overweight using a BMI of $\geq$ 27.8 for males and $\geq$ 27.3 for females. The EI/BMR ratios for overweight persons were significantly lower than those computed for the total population (Table 8). Overweight males had a ratio of 1.28 compared to a value of 1.47 for all males. The ratio for overweight females was even lower--1.1 in overweight females vs 1.27 in all females.

Additional research is planned to identify the characteristics of population groups which tend to under-report. For example, there may be differences in the numbers, types, and quantities of foods reported by these groups. NCHS will also compare Phase 1 energy intakes reported during Phase 1 to findings from NHANES III-Phase 2 (1991-94) which will end in October. The same data collection methods and comparable databases were used in both Phases of NHANES III.

NCHS Data Release and Reporting Activities

For the remainder of my talk I will describe reporting and data preparation activities underway at NCHS. The NHANES III laboratory methods and plan and operations manuals will be available later this year. NCHS will also release a series of NHANES III dietary reference reports this year. The first Phase 1 data files scheduled for release to data users are the Household Questionnaire and total nutrient intakes data files. The Household Questionnaire dataset includes food frequency data for persons 17 years of age and older.

In the past, HANES data were released exclusively in data tape format. Data tape formats will be available, but NCHS also plans to release Phase 1 files in CD-ROM format through the NCHS Statistical Export and Tabulation System (SETS). SETS access software is used by data users to analyze CD-ROM datasets. The NCHS Data Dissemination Branch offers technical assistance in using the SETS software and CD-ROM datasets. Data users may telephone (301)-436-8500 to obtain additional information.

CDC maintains an online computerized information system called "Wonder/pc". Currently, this system is used to download public health and census data directly to a personal computer from the CDC

mainframe computer center in Atlanta, GA. NCHS is exploring the possibility of adding NHANES datasets to the Wonder/pc database system.

Finally, let me call your attention to the NCHS Data Users Conference which will be held in Bethesda, MD from July 20-22, 1994. Representatives from NCHS and the CDC computer facility in Atlanta will attend this meeting. This meeting will provide NCHS data users with the most current information about NCHS data files and data analysis software.

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Table 1

24-hr dietary recall response rates

	Number	*24-hr recall*	*Survey*
Total sample persons	20,277	---	100%
Interviewed in home	17,464	---	86%
Examined in MEC	15,630	100%	77%
24-hr recall	15,409	99%	---
No 24-hr recall	221	1%	---
Reliable - complete	14,801	95%	73%

SOURCE: CDC\NCHS, NHANES III, Phase 1, 1988-91

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Table 2

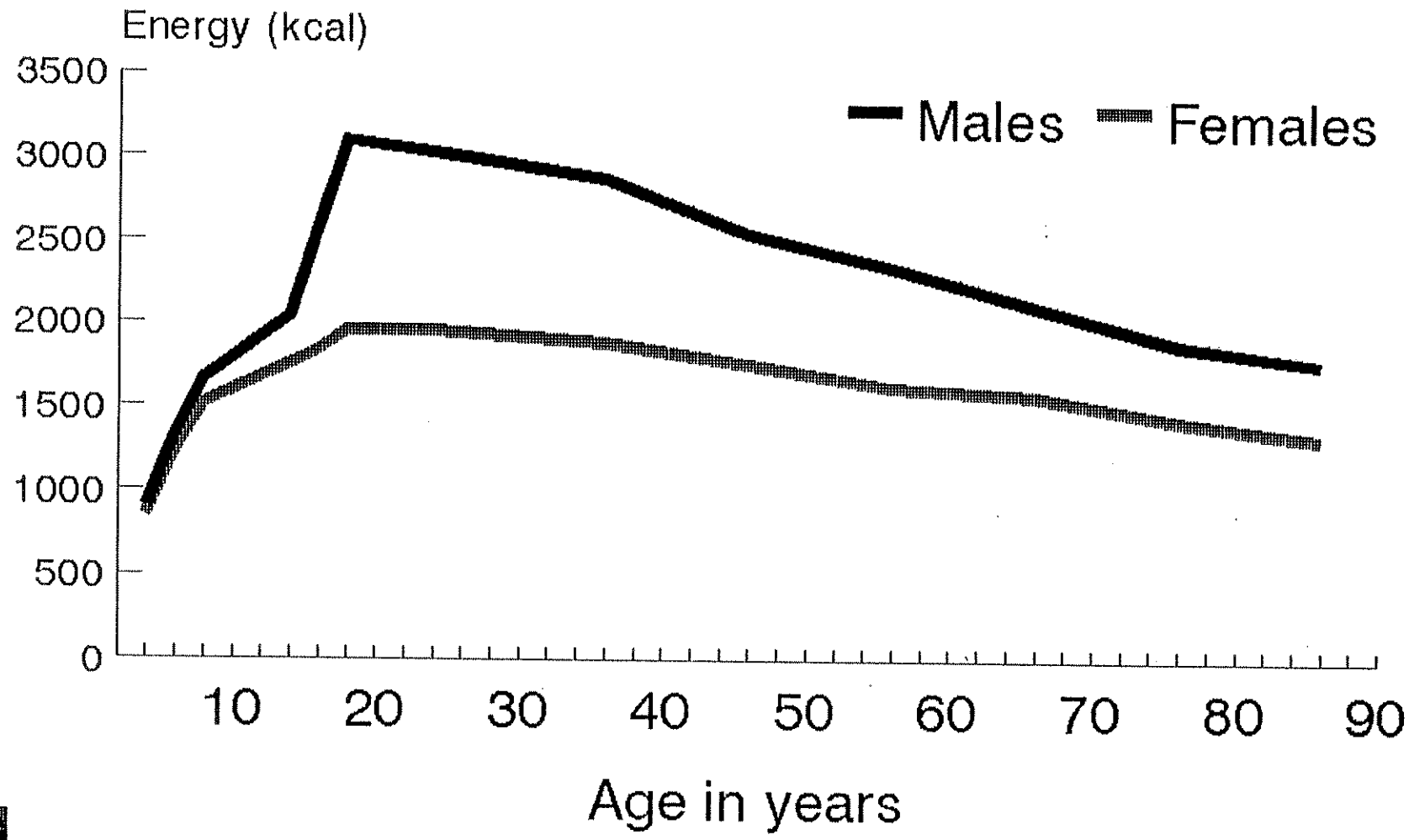
24-hr dietary recall response rates

	Number	*Percent*
Reliable 24-hr recall		
Complete	14,801	95%
Incomplete	338	2%
Nursing infant/child	141	1%
Unreliable 24-hr recall	100	< 1%
Computer malfunction	29	< 1%
No 24-hr recall interview	221	< 1%

SOURCE: CDC/NCHS, NHANES III, Phase 1, 1988-91, N=15,630

Figure 1

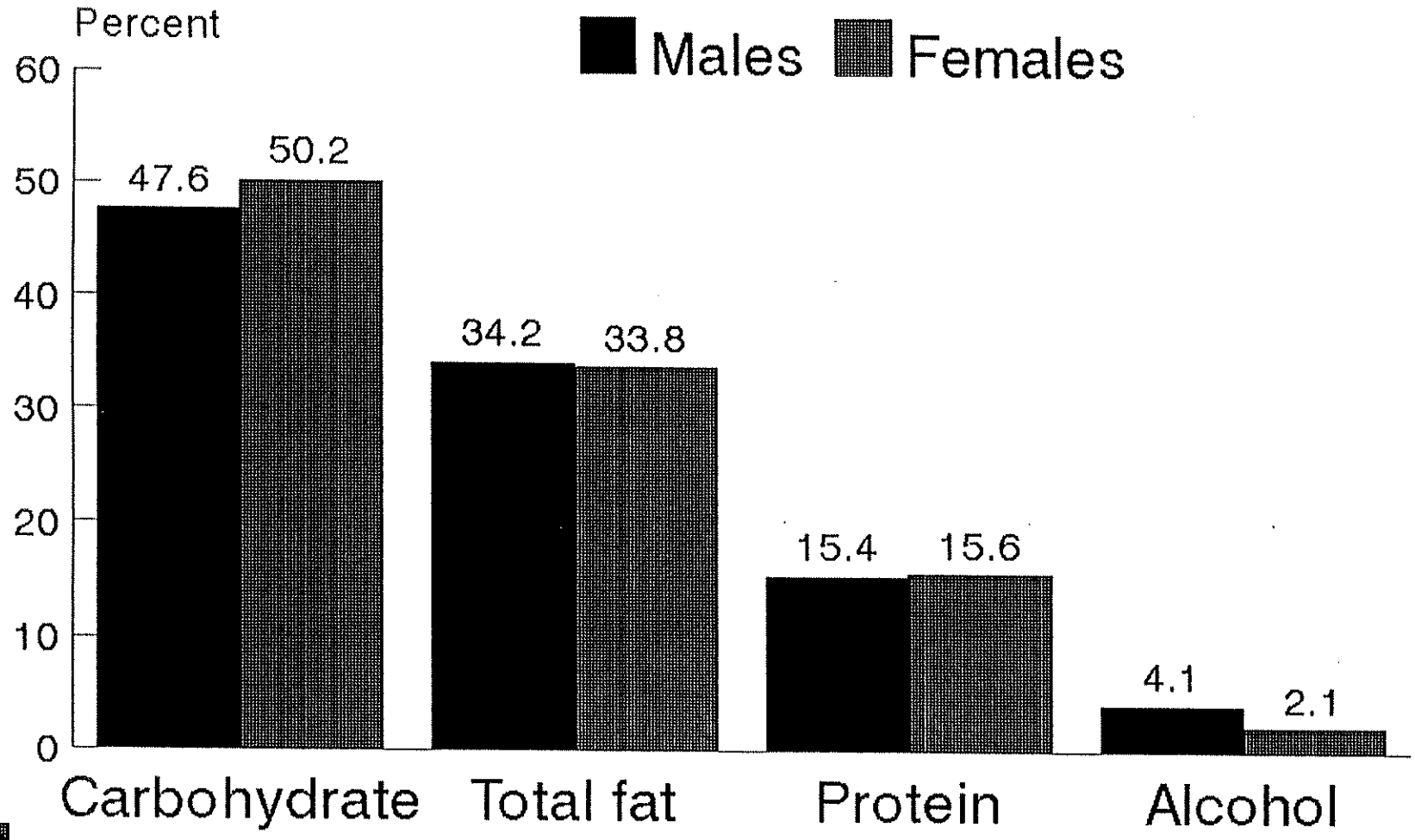
Mean energy intake



SOURCE: CDC/NCHS, NHANES III, Phase 1, 1988-91
24-hour dietary recall, 1 day, N=14,801

Figure 2

Sources of food energy: Adults



SOURCE: CDC/NCHS, NHANES III, Phase 1, 1988-91
24-hour dietary recall, 1 day, N=7931 ages 20+ years

Table 3

Day-of-the-week with highest reported mean energy intakes

Males

2 mos.-19 years	Saturday, Sunday
20-59 years	Friday, Saturday, Sunday
60+ years	Friday, Sunday

Females

2 mos.-19 years	Friday, Saturday
20-59 years	Friday, Saturday
60+ years	Wednesday, Saturday

SOURCE: CDC/NCHS, NHANES III, Phase I, 1988-91
24-hour dietary recall, 1 day, N=14,801

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Table 4

Change in mean energy intake between 1976-80 and 1988-91

Age in years	*Males*	*Females*
12-15	+ 3%	< 1%
16-19	+ 1%	+16%
20-29	+ 4%	+16%
30-39	+12%	+17%
40-49	+ 5%	+15%
50-59	+ 6%	+14%
60-69	+ 7%	+17%
70-74	+13%	+16%

CDC/NCHS, NHANES II and NHANES III, Phase 1
24-hour dietary recall, 1 day

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Table 5

Ratio of reported energy intake to basal metabolic rate in adult males

Age in years	*NHANES I** *(1971-74)*	*NHANES II** *(1976-80)*	*NHANES III* *(1988-91)*
25-34	1.45	1.46	1.62
35-44	1.42	1.35	1.50
45-54	1.31	1.32	1.35
55-64	1.06	1.17	1.29

***Black et al, Eur J Clin Nutr 1991, 45:583-99**

SOURCE: CDC/NCHS, NHANES III, Phase 1, 1988-91

CDC

Ratio of reported energy intake to basal metabolic rate in adult females

Age in years	*NHANES I** *(1971-74)*	*NHANES II** *(1976-80)*	*NHANES III* *(1988-91)*
25-34	1.15	1.15	1.35
35-44	1.09	1.14	1.30
45-54	1.10	1.03	1.18
55-64	0.99	1.01	1.16

***Black et al, Eur J Clin Nutr 1991; 45:583-99**

SOURCE: CDC/NCHS, NHANES III, Phase 1, 1988-91

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Table 7

Ratio of reported energy intake to basal metabolic rate in NHANES III

Age in years	*Males*	*Females*	*Total*
20-29	1.64	1.38	1.51
30-59	1.45	1.26	1.36
60+	1.32	1.18	1.24
Total	1.47	1.27	1.37

SOURCE: CDC/NCHS, NHANES III, Phase 1, 1988-91
24-hour dietary recall, 1 day, N=7904

Table 8

Ratio of reported energy intake to basal metabolic rate in overweight* adults

Age in years	*Overweight* males*	*Overweight* females*	*Overweight* total*
20-29	1.41	1.10	1.25
30-59	1.29	1.11	1.19
60+	1.17	1.05	1.10
Total	1.28	1.10	1.18

***BMI ≥27.8 for males and ≥27.3 for females, N=2938**

SOURCE: CDC/NCHS, NHANES III, Phase 1, 1988-91

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