Published in final edited form as:

Nutr Cancer. 2014 ; 66(8): 1315–1321. doi:10.1080/01635581.2014.956249.

Reliability of Meat, Fish, Dairy, and Egg Intake Over a 33-Year Interval in Adventist Health Study 2

Pramil N. Singh, Michael Batech, and Pegah Faed

Center for Health Research, School of Public Health, Loma Linda University, Loma Linda, California, USA

Karen Jaceldo-Siegl

Center for Nutrition, Healthy Lifestyles, and Disease Prevention and Adventist Health Studies, School of Public Health, Loma Linda University, Loma Linda, California, USA

Marcia Martins

Adventist Health Studies, School of Public Health, Loma Linda University, Loma Linda, California, USA

Gary E. Fraser

Center for Nutrition, Healthy Lifestyles, and Disease Prevention and Adventist Health Studies, School of Public Health, Loma Linda University, Loma Linda, California, USA

Abstract

We studied Adventist Health Study 2 (AHS-2) cohort members to determine the reliability of long-term recall of adult dietary intake that occurred 33 years ago. Establishing the reliability of these measures supports studies of how dietary exposure across the life course affects risk of cancer and other noncommunicable disease outcomes. Among 1816 AHS-2 cohort members, we conducted a statistical comparison of long-term recall of meat, fish, dairy, and eggs at AHS-2 baseline with their report of current diet 33 years before AHS-2 baseline at an age of 30–60 years. Major findings are as follows: 1) a high correlation for frequency of red meat ($R = 0.71$), poultry ($R = 0.67$), and fish ($R = 0.60$); lower correlations for dairy ($R = 0.19$) and eggs ($R = 0.28$); 2) good concordance for dichotomous measures of red meat [sensitivity: 0.70; specificity: 0.92; positive predictive value (PPV): 0.91], poultry (sensitivity: 0.76; specificity: 0.87; PPV: 0.83), fish (sensitivity: 0.61; specificity: 0.93; PPV: 0.89), dairy (sensitivity: 0.95; specificity: 0.57; PPV: 0.99), and eggs (sensitivity: 0.95; specificity: 0.41; PPV: 0.96); negative predictive value for dairy and eggs was poor. Among older AHS-2 cohort members, we found good reliability of recall of red meat, poultry, and fish intake that occurred 33 years earlier.

INTRODUCTION

There is evidence that diet and physical activity throughout the life course contribute to the development of cancer and other noncommunicable diseases. Examples include 1) a putative

independent effect of childhood soy intake on increasing breast cancer risk in Asian women (1); 2) overweight/obesity in childhood and increased adult mortality risk (2); and 3) the possibility that overweight and obesity remain potent risk factors for mortality beyond the seventh decade of life (3,4).

The challenge of a life-course approach is that accurate long-term assessment of current exposure in a large, prospective cohort study would require multiple measures of exposure during follow-up—a protocol that is both costly and can be limited by loss to follow-up/attrition (5,6). One potential, cost-effective approach to life-course epidemiology is to use adult recall of lifetime exposure. This approach requires subjects to accurately recall lifestyle exposures over 2, 3, or even 4 decades of life. Among studies that have examined the accuracy of diet recall across the lifespan, reliability correlations (past reports of current intake vs. recall) for foods and nutrients were as high as 0.75 for recall up to 10 years in the past but tended to be lower for more than 10 years in the past (7–12).

In the present study, we assessed the reliability of recall of adult diet in a sample of 3504 cohort members of the Adventist Health Study 2 (AHS-2). AHS-2 represents the most recent prospective cohort study (97,404 enrolled during 2002–2007) of members of the Seventh-Day Adventist Church (13), who, for the past 50 yr, have been enrolled in NIH-funded prospective studies to investigate how healthy lifestyle choices (i.e., diet, low body mass index, physical activity, tobacco) contribute to lower rates of noncommunicable disease (14). The study design has been previously described (13). Because of church recommendations, the membership tend to have a very low prevalence of current smoking and alcohol use, and baseline U.S. cohort data collected over the past 50 yr indicate that about 40–50% follow a vegetarian diet pattern (13). The AHS-2 investigation of the health effects of initiating and maintaining this type of lifestyle pattern can identify many of the preventive benefits of plant-based diets.

In designing a long-term reliability study (current report of diet given 33 years prior to AHS-2 baseline versus recall at AHS-2 baseline) of AHS-2 dietary recall data, we hypothesized that the prominence of faith-based messaging on diet among Adventists likely contributes to enhanced recall of diet and dietary change—particularly adherence or lack thereof to church recommendations—among AHS-2 cohort members. For example, among 72 cohort members of Adventist Health Study 1 (AHS-1), Fraser et al. found that recall of meat intake over a span of 20 yr was similar to the accuracy of current intake (15).

Our aim in the present study of 1816 older cohort members of AHS-2 is to assess the reliability of adult recall of diet at ages 30, 40, 50, and 60 by comparison with the report of current diet given 33 years earlier in AHS-1.

METHODS

Adventist Health Studies

Of the 97,404 AHS-2 cohort members at baseline, 51,290 returned an interim follow-up survey with additional health and lifetime diet history items approximately 7 years after baseline. Of the 51,290 respondents, 5,649 also provided dietary data 33 yr earlier at the

baseline of the AHS-1 (1976–1979). Of these 5,649 cohort members, we selected 1,816 who reported their current diet during the following age ranges in AHS-1: 28 to 32, 38 to 42, 48 to 52, and 58 to 62 years old. Thus, in the resulting analytic sample of 1,816 subjects, we could assess the reliability of long-term recall by comparing the AHS-2 recall of past diet at age 30, 40, 50, and 60 years with the current, cross-sectional, report of diet given 33 years earlier in AHS-1 by subjects at ages 28 to 32, 38 to 42, 48 to 52, and 58 to 62.

Dietary Food Frequency Survey Items from AHS-1 and AHS-2 (13,16)

At AHS-1, cohort members completed a 55-item semi-quantitative food frequency questionnaire at enrollment (1974–1976) that has been extensively described (16). Specifically, participants were asked to report their current frequency of dietary intake as either never, less than once per month, 1–2 times per month, 1–2 times per week, 3–4 times per week, 5–6 times per week, once per day, or more than once per day. This frequency scale was used to construct composite indices for red meats (beef/steak, beef/hamburger, or other beef such as roast, chops, stew meat, etc.; and pork products such as sausage, bacon, ham, spam, etc.) and poultry (chicken or turkey). Fish and eggs were measured directly from the survey item. Frequency of dairy intake was measured slightly differently as: never or almost never, less than once per wk, several times per wk, once per day, 2–3 times per day, 4–5 times per day, or over 5 times per day. A composite dairy index then included the following: low fat (2%) milk, nonfat (skim) milk, buttermilk, whole fat milk, cheese (not including cottage cheese), and cottage cheese.

In the diet history questions administered during AHS-2 follow-up (enrollment, 2002–2007; interim follow-up survey of diet history, 2009–2011) (16), participants were asked to recall their frequency of intake of red meat, poultry, fish, dairy, and eggs as either: never or rarely, 1–3 times per mo, 1 or more times per wk. In addition, participants recalled this frequency at ages 10, 20, 30, 40, 50, 60, 70, and 80 yr (up to their present age only). The recall measures were directly based on these food/food group items and no indices were constructed based on foods within these categories.

Statistical Analysis

To assess the reliability of recalling dietary intake that occurred 33 years in the past at ages 30–70 yr, we considered the then current diet reported at ages 28 to 32, 38 to 42, 48 to 52, 58 to 62 years at AHS-1 baseline as the “gold-standard,” and the AHS-2 questionnaire recall items of diet at age 30, 40, 50, and 60 yr of age in the past as the “test” measure.

We assessed the concordance of dichotomous recall measures (any intake vs. no intake, weekly intake vs. less than weekly intake, monthly intake vs. less than monthly intake) using sensitivity, specificity, PPV, and negative predictive value (NPV) and computing 95% exact confidence interval limits. Next, we converted each category of the dietary variables to ordinal scores (i.e., approximate median of each category) and examined reliability across the full range of intake by computing Spearman rank-order correlation coefficients. The rationale for an ordinal score coded to the median was to preserve the natural variation of the uneven increase in food intake in the increasing frequency categories—a feature that if ignored can lead to a loss of statistical power.

Exact confidence interval limits were calculated for the validity characteristics using the conservative method attributed to Clopper-Pearson (1934), which are constructed by inverting the equal-tailed test based on the binomial distribution (17), and for the bias-adjusted Spearman rank-order correlation coefficient using Fisher's z -Transformation (18,19). All analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC).

RESULTS

In our analytic sample of 1816 subjects who reported diet in AHS-1 and AHS-2, the median time elapsed between the report of current diet in AHS-1 (1976–1979) and the report of diet history after the first seven years follow-up of AHS-2 was 33 years (interquartile range 32 to 33). Mean age of study subjects at the report of diet history during AHS-2 follow-up was 72.7 years (SD = 8.5); mean body mass index of these subjects was 26.4 (SD = 4.5) at AHS-2 baseline.

Table 1 summarizes the demographic characteristics of these 1,816 participants. These data indicate that about half (52.6%) the sample had earned a bachelor's degree. Similar to the parent AHS-2 cohort (13), participants reported a very low prevalence of smoking and alcohol use, but a somewhat higher percentage than in AHS-2 (64.6%) reported a vegetarian diet pattern.

Reliability of Semiquantitative Food Frequency Measures of Red Meat, Poultry, Fish, Dairy, and Egg Intake

In Table 2, we report Spearman rank correlation coefficients between long-term recall of diet at ages 30 to 60 by AHS-2 cohort members with their current report of diet given 33 years earlier in AHS-1. Among all subjects we found good reliability ($R > 0.60$) for red meat, poultry, and fish. Reliability was lower ($R < 0.30$) for dairy and eggs. When stratified by age, the reliability tended to decrease for 33-yr recall of diet at age 60 yr.

Reliability of Dichotomous (Any Intake/No Intake, Weekly/Less than Weekly) Food Frequency Measures of Red Meat, Poultry, Fish, Dairy, and Egg Intake

In Tables 3 and 4 we assessed the reliability of dichotomous measures of food intake over a 33-yr interval by assessing the concordance of these measures with sensitivity, specificity, PPV, and NPV. The “gold standard” for each measure was the current report of diet given 33 yr earlier during AHS-1. For the assessing foods as “any intake vs. no intake” in Table 3, we found that all measures were $>60\%$ for red meat, poultry, and fish. For dairy and egg, specificity and negative predictive value were less than 60%—suggesting a high rate of false “positives” whose long-term recall indicated abstaining from these food, but current report 33 years earlier indicated otherwise. All findings in Table 3 indicated lower levels of reliability for 33 year recall of diet at age 60 years.

For the assessing foods as “weekly vs. less than weekly” in Table 4 we found the best performance for red meat where measures ranged from 53% to 91%. For poultry and fish, positive predictive value was quite low ($<30\%$). For dairy, negative predictive value was quite low (15%), again indicating a high false positive rate. We found similar performance for a monthly vs. less than monthly index (data not shown).

Analyses of AHS-2 Nonvegetarians

In analyses of AHS-2 nonvegetarians, we assessed the reliability of dichotomous measures of food intake (“any intake vs. no intake”) over a 33-yr interval by assessing the concordance of these measures with sensitivity, specificity, PPV, and NPV. The “gold standard” for each measure was the current report of diet given 33 yr earlier during AHS-1. We found lower negative predictive value for red meat (sensitivity, 0.84; specificity, 0.64; PPV, 0.94; NPV, 0.35), poultry (sensitivity, 0.90; specificity, 0.42; PPV, 0.87; NPV, 0.48), and fish (sensitivity, 0.73; specificity, 0.75; PPV, 0.93; NPV, 0.37) among nonvegetarians.

DISCUSSION

Among 1816 AHS-2 cohort members, we assessed the reliability of long-term recall of diet at ages 30, 40, 50, and 60 by comparing long-term recall data from AHS-2 to current reports of diet given at a corresponding age range (ages 28–32, 38–42, 48–52, 58–62) 33 years earlier in AHS-1. Our major findings are as follows: 1) good reliability for semi-quantitative measures of red meat ($R = 0.71$), poultry ($R = 0.67$), and fish ($R = 0.60$), 2) lower levels of reliability for dairy ($R = 0.19$) and egg ($R = 0.28$) that related to subjects overreporting past intake in their recall of diet 33 yr prior; 3) a lower reliability for subjects at the 9th decade recalling intake at age 60 yr; and 4) some evidence of false positives whereby nonvegetarians overestimated past intake of meat.

The poor reliability for dairy intake on the AHS-2 recall item may relate to differences in the survey items between AHS-2 and AHS-1. On AHS-1 the dairy was assessed as index of several items on dairy intake (e.g., whole milk, low-fat milk, non-fat milk, etc.) and the final index aggregates the measurement error across these variables and is missing an item of yogurt. On AHS-2, the recall of dairy is using a single age-specific item that groups all dairy-related foods into a single response.

Reliability of Long-Term Recall of Meat Intake among Seventh-Day Adventists

Overall, we found evidence that among older AHS-2 cohort members (mean age of 73 years) recall of meat and fish 33 yr in the past was very reliable. We would not expect the reliability findings from the AHS-2 cohort to be comparable to other cohort studies due to the following reasons: 1) regular exposure (i.e., through church attendance) to faith-based messages on avoiding meat consumption would likely result in a greater awareness and memory of this behavior (whether or not church recommendations were adhered to) throughout the lifespan; and 2) higher prevalence of overall health awareness and college education among Seventh-Day Adventists. Thus, our analysis primarily serves the purpose of establishing the reliability of long-term recall of meat intake on surveys of AHS-2 cohort members. Taken together with validation findings of current meat intake in AHS-2, the findings in this report support current report and recall data on meat intake in AHS-2 to construct indices of meat intake and change in meat that can be used to investigate diet–disease associations.

There is also good concordance between our findings on AHS-2 cohort members and previous studies that compared dietary data in the AHS-1 (1974–1976) and the 1960

Adventist Mortality Study. In the previous work, recall of food intake over a span of 20 years for certain foods was similar to the recall of current intake (15). Also, Kyulo et al. reported good long-term recall of weight ($r = 0.88$, $P < 0.001$) across a 26-yr interval between the baseline report in AHS-2 and the baseline report in AHS-1 (20). Vegetarians in AHS-2 tend to be leaner than nonvegetarians (21).

Epidemiologic Data on Long-Term Recall of Diet

To our knowledge, very few other studies have validated diet recall over very long (i.e., over 20 yr of follow-up). A summary of these studies is presented in Table 5. In short, there is an inconsistency in the findings of diet recall over multiple decades of lifetime. For example, in a cohort spanning more than 40 yr, time-related memory loss varied greatly based on the type of food, and systematic biases in memories of dietary intakes in the distant past were evident depending on the current diet of the participant (22). Chavarro et al. validated diet recall across 48 years and found that, although some dietary factors were reasonably recalled 3 to 6 decades later, overall adolescent diet was more validly recalled by younger adults, but not by middle-aged and older adults (23). Contrary to our findings, Eysteinsdottir et al. found that valid recall of meat and fish was low for both men and women (24)—a difference that may be explained by differences in the dietary preferences of the study populations.

Overall, the AHS-2 findings taken together with previous work on life-course measures of diet based on recall (Table 5) highlight 2 emergent themes. First, performance of the recall measures across the lifespan may be optimal in “health conscious” cohorts where some knowledge and even pre-contemplation of effective primary prevention goals is evident. Studies of those adults following faith-based health messaging, health care workers, and those actively engaged in employee wellness may present unique opportunities for valid life-course epidemiology surveys. Second, after the seventh decade of life, recall of adolescence or young adulthood is potentially inhibited by the increasing prevalence of cognitive impairment.

LIMITATIONS

Our study has the limitation that we have a subsample of cohort members who responded to the AHS-2 and AHS-1 surveys and then fall in the age ranges examined in the analysis. This could affect generalizability to the parent cohort, although the demographic characteristics depicted in Table 1 indicate similarity lifestyle trends of low rates of smoking and alcohol and a higher prevalence of vegetarianism. It is noteworthy that AHS-2 is a multiethnic cohort and AHS-1 consists of non-Hispanic whites. These analyses need testing in a multiethnic sample. As noted in previous sections, differences in the wording and design of the AHS-2 and AHS-1 survey items certainly contributed to poorer performance of some of the food items in reliability analyses.

CONCLUSIONS

Our findings from older AHS-2 cohort members indicate good reliability of recall of red meat, poultry, and fish intake that occurred 33 years earlier at ages 30–60 yr.

Acknowledgments

FUNDING This study was supported by grant #5-RO1 CA 094594 from the National Cancer Institute.

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TABLE 1Selected demographic characteristics of the analytic sample of AHS-2 cohort members ($n = 1816$)

Characteristics	<i>n</i> (%) ^a
Gender	
Female	1,136 (62.56)
Male	680 (37.44)
Vegetarian status in AHS-2	
Vegan	124 (6.90)
Lacto-ovo vegetarian	754 (41.98)
Pesco-vegetarian	154 (8.57)
Semivegetarian	128 (7.13)
Nonvegetarian	636 (35.41)
Body mass index (kg/m ²)	
Underweight	29 (1.64)
Normal weight	728 (41.22)
Overweight	675 (38.22)
Obese Class I	224 (12.68)
Obese Class II	110 (6.23)
Education	
High school or below	190 (10.46)
Trade school, some college, or associates degree	670 (36.89)
Bachelors or above	956 (52.64)
Tobacco use	
Never smoker	1,646 (91.39)
Ever smoker	155 (8.61)
Alcohol Use	
Never drinker	1,357 (75.18)
Ever drinker	448 (24.82)

AHS-2 D Adventist Health Study 2.

^aSome variables do not total to 1,816 due to missing values.

TABLE 2

Spearman rank correlation coefficients (95% exact confidence interval limits) comparing long-term recall of diet at ages 30 to 60 years by Adventist Health Study-2 cohort members with their current report of diet at the corresponding age 33 years earlier during Adventist Health Study-1 ($n = 1816$)

	Red meat	Poultry	Fish	Dairy	Eggs
All subjects	0.71 (0.68, 0.73)	0.67 (0.64, 0.69)	0.60 (0.57, 0.63)	0.19 (0.15, 0.24)	0.28 (0.24, 0.32)
Recall for age 30	0.74 (0.70, 0.78)	0.66 (0.61, 0.70)	0.62 (0.56, 0.66)	0.23 (0.16, 0.31)	0.31 (0.23, 0.38)
Recall for age 40	0.67 (0.62, 0.71)	0.66 (0.61, 0.71)	0.63 (0.58, 0.68)	0.21 (0.13, 0.29)	0.24 (0.16, 0.31)
Recall for age 50	0.71 (0.67, 0.75)	0.71 (0.67, 0.75)	0.57 (0.52, 0.63)	0.17 (0.09, 0.24)	0.31 (0.23, 0.38)
Recall for age 60	0.66 (0.38, 0.83)	0.47 (0.11, 0.72)	0.29 (0, 0.60)	0.05 (0, 0.41)	0.23 (0, 0.55)

TABLE 3

Concordance (95% exact confidence interval limits) of a dichotomous measure of food intake (any intake vs. no intake) is assessed by comparing long-term recall of food intake at ages 30 to 60 by Adventist Health Study-2 (AHS-2) cohort members with their current report of the same food at the corresponding age 33 years earlier during Adventist Health Study-1 ($n = 1816$)

Food intake	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Red meat	0.70 (0.67, 0.73)	0.92 (0.90, 0.94)	0.91 (0.89, 0.93)	0.73 (0.70, 0.75)
Recall for age 30	0.75 (0.69, 0.80)	0.93 (0.89, 0.96)	0.91 (0.87, 0.95)	0.79 (0.74, 0.83)
Recall for age 40	0.71 (0.66, 0.76)	0.88 (0.83, 0.92)	0.89 (0.85, 0.93)	0.69 (0.64, 0.74)
Recall for age 50	0.64 (0.59, 0.70)	0.95 (0.92, 0.97)	0.93 (0.89, 0.96)	0.70 (0.66, 0.75)
Recall for age 60	0.60 (0.32, 0.84)	—	—	0.68 (0.43, 0.87)
Poultry	0.76 (0.73, 0.79)	0.87 (0.84, 0.89)	0.83 (0.81, 0.86)	0.81 (0.78, 0.83)
Recall for age 30	0.80 (0.74, 0.85)	0.85 (0.80, 0.88)	0.77 (0.71, 0.83)	0.86 (0.82, 0.90)
Recall for age 40	0.79 (0.74, 0.83)	0.82 (0.77, 0.87)	0.82 (0.77, 0.86)	0.79 (0.74, 0.84)
Recall for age 50	0.72 (0.66, 0.77)	0.93 (0.90, 0.96)	0.91 (0.87, 0.95)	0.77 (0.73, 0.82)
Recall for age 60	0.54 (0.25, 0.81)	0.93 (0.66, 1.00)	0.88 (0.47, 1.00)	0.68 (0.43, 0.87)
Fish	0.61 (0.58, 0.65)	0.93 (0.91, 0.94)	0.89 (0.87, 0.92)	0.71 (0.68, 0.73)
Recall for age 30	0.64 (0.57, 0.69)	0.94 (0.91, 0.96)	0.90 (0.84, 0.94)	0.76 (0.71, 0.80)
Recall for age 40	0.67 (0.62, 0.72)	0.91 (0.87, 0.94)	0.89 (0.85, 0.93)	0.71 (0.66, 0.75)
Recall for age 50	0.56 (0.50, 0.61)	0.93 (0.90, 0.96)	0.89 (0.84, 0.93)	0.67 (0.63, 0.72)
Recall for age 60	0.20 (0.04, 0.48)	0.92 (0.64, 1.00)	0.75 (0.19, 0.99)	0.50 (0.29, 0.71)
Dairy	0.95 (0.94, 0.96)	0.57 (0.34, 0.77)	0.99 (0.99, 1.00)	0.14 (0.07, 0.22)
Recall for age 30	0.97 (0.96, 0.99)	0.45 (0.17, 0.77)	0.99 (0.98, 1.00)	0.25 (0.09, 0.49)
Recall for age 40	0.96 (0.94, 0.97)	0.57 (0.18, 0.90)	0.99 (0.98, 1.00)	0.14 (0.04, 0.33)
Recall for age 50	0.94 (0.91, 0.95)	0.80 (0.28, 0.99)	1.00 (0.99, 1.00)	0.09 (0.03, 0.22)
Recall for age 60	0.83 (0.64, 0.94)	0.80 (0.28, 0.99)	—	—
Eggs	0.95 (0.94, 0.96)	0.41 (0.32, 0.51)	0.96 (0.95, 0.97)	0.32 (0.24, 0.41)
Recall for age 30	0.97 (0.95, 0.98)	0.27 (0.16, 0.42)	0.93 (0.91, 0.95)	0.44 (0.26, 0.62)
Recall for age 40	0.96 (0.94, 0.97)	0.42 (0.22, 0.63)	0.97 (0.96, 0.99)	0.29 (0.15, 0.46)
Recall for age 50	0.93 (0.91, 0.95)	0.72 (0.51, 0.88)	0.99 (0.97, 0.99)	0.31 (0.20, 0.45)
Recall for age 60	0.78 (0.58, 0.91)	—	0.91 (0.72, 0.99)	—

The dashed line indicates that there are too few cases observed to report finding. AHS-2 recall of past intake at a specific age with AHS-1 intake reported at that age.

TABLE 4

Concordance (95% exact confidence interval limits) of a dichotomous measure of food intake (once or more per wk vs. less than weekly) is assessed by comparing long-term recall of food intake at ages 30 to 60 by Adventist Health Study-2 (AHS-2) cohort members with their current report of the same food at the corresponding age 33 years earlier during Adventist Health Study-1 ($n = 1816$)

Food intake	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Red meat	0.53 (0.48, 0.58)	0.91 (0.90, 0.93)	0.66 (0.60, 0.71)	0.86 (0.85, 0.88)
Recall for age 30	0.63 (0.54, 0.72)	0.90 (0.87, 0.93)	0.63 (0.54, 0.71)	0.90 (0.87, 0.93)
Recall for age 40	0.54 (0.46, 0.62)	0.90 (0.87, 0.93)	0.66 (0.57, 0.74)	0.85 (0.81, 0.88)
Recall for age 50	0.44 (0.36, 0.53)	0.94 (0.91, 0.96)	0.68 (0.57, 0.78)	0.85 (0.82, 0.88)
Recall for age 60	0.40 (0.12, 0.74)	—	—	0.74 (0.52, 0.90)
Poultry	0.59 (0.50, 0.68)	0.84 (0.83, 0.86)	0.22 (0.18, 0.27)	0.97 (0.95, 0.97)
Recall for age 30	0.73 (0.52, 0.88)	0.81 (0.77, 0.84)	0.15 (0.10, 0.23)	0.98 (0.97, 0.99)
Recall for age 40	0.64 (0.48, 0.78)	0.84 (0.80, 0.87)	0.24 (0.17, 0.33)	0.97 (0.94, 0.98)
Recall for age 50	0.48 (0.33, 0.63)	0.89 (0.86, 0.91)	0.27 (0.18, 0.38)	0.95 (0.93, 0.97)
Recall for age 60	0.50 (0.07, 0.93)	0.83 (0.61, 0.95)	0.33 (0.04, 0.78)	0.90 (0.70, 0.99)
Fish	0.26 (0.18, 0.35)	0.94 (0.93, 0.95)	0.25 (0.18, 0.34)	0.95 (0.93, 0.96)
Recall for age 30	0.23 (0.10, 0.42)	0.95 (0.93, 0.97)	0.21 (0.09, 0.39)	0.96 (0.94, 0.97)
Recall for age 40	0.28 (0.16, 0.43)	0.92 (0.90, 0.94)	0.24 (0.13, 0.37)	0.94 (0.91, 0.96)
Recall for age 50	0.28 (0.15, 0.44)	0.96 (0.94, 0.97)	0.31 (0.17, 0.49)	0.95 (0.93, 0.96)
Recall for age 60	—	0.96 (0.80, 1.00)	—	0.89 (0.71, 0.98)
Dairy	0.86 (0.84, 0.88)	0.55 (0.43, 0.67)	0.98 (0.97, 0.98)	0.15 (0.11, 0.19)
Recall for age 30	0.91 (0.88, 0.93)	0.39 (0.20, 0.61)	0.97 (0.95, 0.99)	0.15 (0.07, 0.27)
Recall for age 40	0.86 (0.83, 0.89)	0.62 (0.41, 0.80)	0.98 (0.96, 0.99)	0.17 (0.10, 0.26)
Recall for age 50	0.82 (0.78, 0.85)	0.64 (0.43, 0.82)	0.98 (0.97, 0.99)	0.13 (0.08, 0.20)
Recall for age 60	0.74 (0.54, 0.89)	0.50 (0.01, 0.99)	0.95 (0.76, 1.00)	0.13 (0.00, 0.53)
Eggs	0.75 (0.72, 0.77)	0.48 (0.45, 0.52)	0.70 (0.68, 0.73)	0.54 (0.50, 0.58)
Recall for age 30	0.81 (0.76, 0.85)	0.44 (0.38, 0.51)	0.66 (0.62, 0.71)	0.63 (0.55, 0.70)
Recall for age 40	0.74 (0.69, 0.78)	0.46 (0.39, 0.53)	0.71 (0.66, 0.75)	0.50 (0.43, 0.57)
Recall for age 50	0.70 (0.66, 0.75)	0.55 (0.48, 0.62)	0.74 (0.70, 0.79)	0.50 (0.43, 0.57)
Recall for age 60	0.64 (0.35, 0.87)	0.60 (0.32, 0.84)	0.60 (0.32, 0.84)	0.64 (0.35, 0.87)

The dashed line indicates that there are too few cases observed to report finding. AHS-2 recall of past intake at a specific age with AHS-1 intake reported at that age.

TABLE 5

Characteristics of long-term (20 years) validation studies of diet recall

Source and year	Sample size	Age characteristics	Follow-up (yr)	Major findings
Eysteinsdottir et al., 2011 (1)	174	56–72 yr olds	18–19	Strongest correlation found for cod liver oil ($r = 0.53$, $P < 0.001$; $r = 0.56$, $P < 0.011$) for men and women respectively. For men, correlation coefficient for milk and dairy products was $r = 0.43$, $P < 0.001$. Correlation coefficients were lower for meat, fish, and potatoes for both genders ($r = 0.26$ – 0.40).
Hosking et al., 2011 (2)	52	70–90 yr olds	15–40	Showed good reproducibility in this sample with a mean polychoric correlation coefficient of 0.81 between 2 time points, and an average weighted k of 0.49 for the level of recall agreement between food groups.
Chavarro et al., 2009 (3)	72	48–70 yr olds	48	The median deattenuated correlation for foods was 0.30 (-0.53 for a beef, pork, or lamb sandwich to 0.99 for diet soda). The median deattenuated correlation for food groups was 0.31 (-0.48 for breads to 0.70 for hot beverages); for nutrient intakes, it was 0.25 (-0.08 for iron to 0.82 for vitamin B12). Some dietary factors were recalled 3–6 decades later.
Fraser et al. 1998 (4)	72	Average 74 yr olds	21	Found partially corrected correlation coefficients of greater than 0.30 for coffee, whole milk, eggs, chips, beef, fish, chicken, fruit, and legumes. Higher correlations found when the food frequencies were scored 1–9. Including portion size information was unhelpful. Data recalled from 20 yr ago have biases based on current dietary habits and should be treated with care.
Dwyer et al., 1997 (5)	91	55 yr olds	40–50	Median correlations between actual and reported consumption for all foods declined with longer time intervals and for earlier ages ($r = 0.24$ for 30 yr to 0.12 for 18 and 5–7 yr). Systematic biases in dietary intake memories of the past were apparent depending on current diet and varying between foods.