


Poor Appetite and Dietary Intake in Community-Dwelling Older Adults

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BACKGROUND/OBJECTIVES: Poor appetite in older adults leads to sub-optimal food intake and increases the risk of undernutrition. The impact of poor appetite on food intake in older adults is unknown. The aim of this study was to examine the differences in food intake among older community-dwelling adults with different reported appetite levels.

DESIGN: Cross-sectional analysis of data from a longitudinal prospective study.

SETTING: Health, aging, and body composition study performed in the USA.

PARTICIPANTS: 2,597 community-dwelling adults aged 70–79.

MEASUREMENTS: A semi-quantitative, interviewer-administered, 108-item food frequency questionnaire designed to estimate dietary intake. Poor appetite was defined as the report of a moderate, poor, or very poor appetite in the past month and was compared with good or very good appetite.

RESULTS: The mean age of the study sample was 74.5 ± 2.8 years; 48.2% were men, 37.7% were black, and 21.8% reported a poor appetite. After adjustment for total

energy intake and potential confounders (including biting/chewing problems), participants with a poor appetite had a significantly lower consumption of protein and dietary fiber, solid foods, protein rich foods, whole grains, fruits, and vegetables, but a higher consumption of dairy foods, fats, oils, sweets, and sodas compared to participants with very good appetite. In addition, they were less likely to report consumption of significant larger portion sizes.

CONCLUSION: Older adults reporting a poor appetite showed a different dietary intake pattern compared to those with (very) good appetite. Better understanding of the specific dietary intake pattern related to a poor appetite in older adults can be used for nutrition interventions to enhance food intake, diet variety, and diet quality. *J Am Geriatr Soc* 2017.

Key words: appetite; elderly; aged; undernutrition; food preferences

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Poor appetite is an important problem in older persons, with prevalence rates in community-dwelling older persons varying between 11% and 15%.^{1,2} A poor appetite is an important independent determinant of a reduced energy intake^{3,4} associated with a lower diet quality⁴ and less diet variety⁵ in older adults. Consequently, a poor appetite in community-dwelling older persons is a risk factor for undernutrition.^{2,6–8} As undernutrition is associated with adverse clinical outcomes and reduced quality of life and survival,^{9–11} effective strategies to increase food intake in these older persons are needed.

Common approaches to improve appetite and food intake in older adults include meal adaptations, such as reducing portion sizes or increasing meal frequency^{12–14} and the use of flavor enhancers.^{15,16} However, no consistent effects of these adaptations on food intake in older adults have been observed. A few studies in hospitals¹⁴ and nursing homes^{12,17,18} showed promising effects of feeding assistance, protected meal times, improved meal ambiance and family-style meals on food intake^{12,14,17–20}

and body weight.^{17,18} However, these measures require motivated staff and sufficient finances.²¹ A final approach is to stimulate appetite by orexigenic drugs, but these drugs may have serious side effects.²²

Novel, more feasible approaches are needed to increase the food intake of older persons with a poor appetite.²³ Research among specific groups suggests that subjects with a poor appetite have specific food preferences.^{24,25} Knowledge of those food preferences could be used to identify the risk of nutrient deficiencies, develop attractive and nutritious foods and improve dietary intake and diet quality. With poor appetite being an independent parameter of undernutrition and poor outcomes in this group, the aim of this study was to examine the differences in dietary intake among community-dwelling older adults with various levels of appetite.

METHODS

Study Sample

The health, aging, and body composition study is a prospective cohort study investigating associations among body composition, health conditions, and functional limitations in older adults. Between April 1997 and June 1998, three thousand seventy-five community-dwelling black and white men and women were enrolled. Participants were recruited from a random sample of white Medicare-eligible residents and all of the black Medicare-eligible residents in the Pittsburgh PA and Memphis TN metropolitan areas.

Subjects who were eligible reported no difficulty walking .25 of a mile, climbing up 10 steps, and performing basic activities of daily living. They also had to be free of life-threatening illness, planning to remain in the geographic area for three or more years, and not enrolled in any lifestyle intervention trials. All participants provided written informed consent. The institutional review board at each study site approved all protocols. The current study uses dietary intake data from the year two examinations and therefore has a cross-sectional approach.

Dietary Intake

Trained interviewers administered a semi-quantitative block food frequency questionnaire (FFQ) at the year two follow-up visit. This FFQ contained 108-items and was used to estimate dietary intake over the previous year (thereby excluding seasonal influences on food choice). The FFQ was developed for the health, aging, and body composition study by Block Dietary Data Systems²⁶ using 24-hour recalls obtained in NHANES III from older (>65 years) non-Hispanic white and black adults in the Northeast or Southern U.S. Trained interviewers used wood blocks, food models, standard kitchen measures, and flash cards to estimate portion sizes. Interviews were periodically monitored to ensure the quality and consistency of the data collection procedures. Block Dietary Data Systems determined the intake of energy, macronutrients, food groups, and solid foods. The healthy eating index was calculated to measure compliance with U.S. dietary guidelines.²⁷ In addition, the relative consumption

of specific types of foods (processed fruits and fruit juices, white bread, and high-fat products) was determined by dividing energy from these specific types of foods by the energy consumed within the corresponding food group. For example, processed fruit + fruit juices/all fruits.

Appetite

Appetite was assessed by using the open-ended question: in the past month, would you say that your appetite or desire to eat has been...? The response options (very good, good, moderate, poor, very poor, do not know) were read by the interviewer and shown on a flash card. We excluded three subjects who responded with "do not know." Appetite was categorized into three groups: very good, good, and poor. The group with a poor appetite combined relatively small numbers of subjects reporting either a moderate, poor, or very poor appetite, all of which indicate the absence of a good appetite. This categorization was justified by preliminary analysis showing that subjects with a moderate, poor, or very poor appetite had a comparable energy and macronutrient intake. Appendix S1 reports the dietary intake for the five appetite levels.

Potential Confounders

Age, sex, self-identified racial group, study site, education, income, cognitive function, depression, number of household members, self-rated health status, smoking status, and physical activity were all considered as potential confounders of the association between appetite and dietary intake.

Age, sex, racial group, education (postgraduate, college, vocational training or some college, high school, <high school), yearly family income (\geq \$50K, \$25K to <\$50K, \$10K to <\$25K, <\$10K), cognitive function (mini mental state examination, MMSE),²⁸ depression, self-rated health status (excellent, very good, good, fair, poor), smoking (current, past, never), and physical activity were measured at year one of the health, aging, and body composition study (1997). Depression was assessed by the CES-D10 scale, a 10-item instrument designed to measure depressive symptoms experienced during the previous week.^{29,30} A score greater than 10 out of 30 was judged as symptomatic depression. Physical activity was assessed by self-report of time spent walking and exercising.³¹ Number of household members and trouble with biting/chewing foods (always, often, sometimes, seldom, never) were measured at year two examinations.

Statistical Analysis

General characteristics of the study sample were examined by general descriptive statistics. For normally distributed characteristics, differences between appetite groups were examined using univariate logistic regression with appetite (good or poor vs very good) as the dependent variable. Differences in dietary intake between appetite groups were examined by multinomial logistic regression using standardized variables (*z*-scores) of dietary intake variables as

independent variables and appetite as the dependent variable. For non-normally distributed variables, log-transformed variables were entered into the regression model.

Multivariate analyses were adjusted for confounding by adding the confounders to the regression model. Total energy intake was added to the model if the (independent) dietary intake variable was not expressed as a percentage of total energy intake. Sex and race were tested as potential modifiers of the association between dietary intake and appetite (interaction terms with $P < .10$ were regarded as significant). The cut-off level for statistical significance for differences between groups was $P < .05$. Statistical analyses were performed using SPSS Statistics version 22.0 (SPSS Inc.).

RESULTS

At year two of the health, aging, and body composition study, 3,043 persons (99%) were still alive and 2,998 participated in the follow-up visit. After excluding participants with missing values on appetite ($n = 13$) or FFQ ($n = 284$), serious errors on the FFQ ($n = 30$; e.g., many missing items or inconsistent answers), or unreasonably dietary intakes (<800 or >4000 kcal/day in men or <500 or >3500 kcal/day in women, $n = 74$),³² 2,597 participants were included for data analyses (Appendix S2).

General characteristics of the study sample are presented in Table 1. The mean age was 74.6 ± 2.8 years, 48.2% were men, and 37.7% were black. A poor appetite was reported by 21.8% of the study sample ($n = 565$). Compared to the groups with a very good or good appetite, the poor appetite group was on average older (ages: 75.0 vs 74.5, $P < .005$), had a lower BMI ($P < .005$), and more often experienced unintentional weight loss (having lost weight without trying), biting/chewing problems, and depression ($P < .001$). Furthermore, they were significantly more often female, black, current smoker, and had a lower education level, income, health status, daily energy intake, and healthy eating index ($P < .05$).

Intake of Macronutrients and Solid Foods

Table 2 shows the average daily macronutrient and food group intake by level of appetite and reports the results of univariate analyses. Results of multivariate analyses on differences in macronutrient and food group intakes between appetite groups, adjusted for total daily energy intake and other potential confounders, are reported in Table 3. When compared to participants with a very good appetite, participants with a poor appetite had a lower intake of (animal and vegetable) protein, higher intake of fat, and lower intake of dietary fiber (consistent for fiber from beans, grains, vegetables, fruits). They also reported a lower consumption of solid foods (but the energy density of solid foods was higher). The consumption of carbohydrates and alcohol was not significantly different between participants with a poor or a very good appetite in multivariate analyses.

When compared to participants with a very good appetite, participants with a good appetite showed a significantly lower intake of energy, total protein, animal protein, fiber from vegetables, and fruits and solid foods, and

Table 1. Characteristics of health, aging, and body composition study participants by level of self-reported appetite.

N = 2,597	Appetite		
	Very good N = 1,049	Good N = 983	Poor N = 565
Age (y)	74.5 (2.8)	74.6 (2.9)	75.0 (2.9) **
Male (%)	48.7	52.4	40.0***
White (%)	62.9	66.6	53.5***
Education level (%)			
Less than high school	22.0	21.5	25.0*
High school graduation	31.8	31.5	35.6
Postsecondary school	46.2	47.1	39.4
Income			
Less than 10,000 \$	12.6	8.6	16.0***
$\geq 10,000$ to 25,000\$	35.2	39.4	39.2
$\geq 25,000$ to 50,000\$	32.7	33.8	32.1
$\geq 50,000$ \$	19.6	18.3	12.7
Smoking status (%)			
Never	44.7	44.4	44.4***
Current	6.3	8.3	15.4
Former	49.0	47.3	40.2
Physical activity			
≤ 50 kcal/kg/wk	32.9	38.0	37.5
>50 and ≤ 75 kcal/kg/wk	20.2	21.5	20.9
>75 and ≤ 100 kcal/kg/wk	15.1	14.3	13.6
>100 kcal/kg/wk	31.8	26.1	28.0
Depression score (GES-D10)	2.6 (2.9)	2.8 (3.2)*	4.1 (4.1)***
BMI (kg/m ²)	27.6 (4.7)	27.0 (4.6)*	26.8 (5.2)**
General health status (%)			
Excellent	20.6	11.4	7.8***
Very good	36.7	32.8	22.7
Good	31.1	42.5	42.9
Fair	10.6	12.4	23.6
Poor	1.0	0.9	3.0
Biting/chewing problems – sometimes/often/always			
$>5\%$ unintentional weight loss (past 12 months; %)	4.3	5.5	14.0***
Use of breakfast/diet shakes or liquid supplements (kcal/day) ¹	9.0 (46.5)	5.5 (29.8)*	14.0 (57.2)
Healthy Eating Index (range 0–100)	70.8 (12.0)	70.3 (11.8)	67.2 (11.7)***

Mean (SD), except when stated otherwise.

Appetite was assessed by asking: “In the past month, would you say that your appetite or desire to eat has been: very good, good or moderate, poor, very poor, or don’t know?” For this study, appetite level was classified as very good, good, or poor (moderate, poor, or very poor). Subjects who responded with “don’t know” were excluded from analysis. Unintentional weight loss was defined as having lost weight without trying.

* $P < .05$; ** $P < .005$; *** $P < .001$ compared to Very good appetite (univariate multinomial logistic regression).

a higher energy density of solid foods, but the noted differences were smaller than the differences between the poor and very good appetite groups (Tables 2, 3). Sensitivity

Table 2. Average macronutrient and food group intake per day of health, aging and body composition study participants by level of self-reported appetite.

	N = 2,597	Appetite		
		Very good N = 1,049	Good N = 983	Poor N = 565
Energy (kcal/day)		1,887 (654)	1,831 (636)	1,807 (626)*
Macronutrients				
Fats (% of kcal, alcohol excluded)		33.8 (7.6)	33.7 (7.6)	35.0 (7.5)*
Carbohydrates (% of kcal, alcohol excluded)		53.7 (8.4)	54.2 (8.1)	53.1 (8.2)
Protein (% of kcal, alcohol excluded)		15.0 (3.2)	14.7 (3.0)*	14.3 (3.0)***
Protein (g)		69.0 (27.1)	65.2 (24.1)**	62.6 (23.4)***
Protein from animal sources (g)		40.1 (21.0)	37.2 (17.6)***	36.6 (18.1)***
Protein from vegetable sources (g)		28.9 (11.5)	28.0 (11.0)	26.0 (10.2)***
Alcohol (% of kcal)		1.9 (4.1)	2.1 (4.6)	1.8 (4.3)
Dietary fiber (g)		18.7 (7.8)	17.6 (7.1)**	15.5 (6.4)***
Dietary fiber from beans (g)		2.5 (2.8)	2.3 (2.7)	2.0 (2.3)***
Dietary fiber from grains (g)		8.8 (4.4)	8.8 (4.4)	7.6 (3.8)***
Dietary fiber from vegetables & fruits (g)		7.7 (4.1)	6.8 (3.5)***	6.2 (3.4)***
Solid foods (g)		914 (360)	839 (312)***	786 (294)***
Energy density of solid foods (kcal/g)		2.2 (0.6)	2.3 (0.6)***	2.4 (0.7)***
Food groups				
Fruits & fruit juices	Servings	2.1 (1.2)	1.9 (1.1)**	1.8 (1.1)***
Vegetables	Servings	3.2 (2.0)	2.9 (1.8)***	2.6 (1.6)***
Grains	Servings	6.7 (3.1)	6.6 (2.9)	6.2 (2.9)**
Wholegrains	Servings	2.5 (2.0)	2.4 (1.8)	2.1 (1.8)***
Meat, fish, poultry, beans, egg	Servings	1.8 (1.2)	1.6 (0.9)***	1.6 (1.0)***
Milk, yogurt, cheese	Servings	1.4 (1.1)	1.4 (1.2)	1.4 (1.3)
Fats & oils, sweets, sodas	Servings	3.0 (1.8)	3.2 (1.9)	3.4 (1.9)***
Sweets, desserts	Kcal	253.1 (237.3)	264.6 (256.8)	271 (242)**
Portion size (% of foods)				
Small		11.5 (7.2)	11.9 (8.0)	12.4 (8.4)*
Medium		75.2 (9.3)	76.2 (9.1)*	76.3 (9.1)*
Large/Extra-large		13.3 (8.5)	11.9 (7.8)***	11.3 (7.3)***

Mean (SD) per day, except when stated otherwise.

* $P < .05$; ** $P < .005$; *** $P < .001$ compared to Very good appetite (univariate multinomial logistic regression).

analyses to identify the impact of excluding subjects with a moderate appetite from the poor appetite group showed larger and more significant differences in macronutrient and food group intake compared to the very good appetite group (data not shown).

Food Groups and Portion Size

After adjustment for potential confounders, participants with a poor appetite reported a significantly lower consumption of protein rich foods, fruits and vegetables, grains and whole grains, but a significantly higher consumption of dairy foods (milk, yoghurt, cheese), fats and oils, sweets, and sodas. The amount of absolute grain consumption (number of servings per day) was significantly lower only between participants with a poor appetite compared to those with a very good appetite (Tables 2, 4).

For all food groups except for dairy, grains, whole grains, sweets, and desserts, similar trends (but with smaller differences) were observed in participants with a good appetite compared to a very good appetite (Table 4). Participants with a poor and a good appetite consumed less large or extra-large portions than participants with a very good appetite (Table 4).

Intake of Specific Types of Foods

Compared to those with a very good appetite, older adults with a poor appetite showed a significant higher intake of fruit juices and processed fruits when expressed as % of the total fruit intake (poor vs very good appetite: $63.6 \pm 23.6\%$ vs $58.8 \pm 24.1\%$; OR 1.18 95% CI [1.04;1.34]). The relative amount of white bread (as % of total breads) in the poor appetite group was higher than the very good appetite group (poor vs very good appetite: $76.5 \pm 26.1\%$ vs $68.8 \pm 28.3\%$; OR 1.38, 95% CI [1.22;1.56]). Subjects with a poor appetite chose more high-fat foods, including whole milk (poor vs very good appetite: $23.2 \pm 42.3\%$ of total milk vs $12.3 \pm 32.9\%$, OR 2.41 95% CI [1.60;3.65] and high-fat meat (poor vs very good appetite: $33.2 \pm 37.0\%$ of total meat vs $28.0 \pm 34.6\%$, OR 1.18 95% CI [1.06;1.33]). In participants with a good appetite, no significant differences for specific food-types were observed compared to participants with a very good appetite (data not shown).

Effect Modification

Race and gender modified the association of appetite with certain dietary intake variables ($P < .10$ for significant

Table 3. Multivariate analyses of macronutrients, dietary fiber, and solid foods intake (good appetite and poor appetite vs very good appetite) of health, aging and body composition study participants.

N = 2,597	Good appetite N = 983 OR [95% CI] ^a	P	Poor appetite N = 565 OR (95% CI) ^a	P
Energy ^b	0.89 [0.81;0.98]	.02	0.90 [0.80;1.02]	.10
Macronutrients				
Fats (% of kcal, alcohol excluded) ^b	0.99 [0.90;1.09]	.81	1.14 [1.01;1.28]	.03
Carbohydrates (% of kcal, alcohol excluded) ^b	1.06 [0.96;1.17]	.24	0.94 [0.84;1.06]	.32
Protein (% of kcal, alcohol excluded) ^b	0.96 [0.93;0.99]	.02	0.92 [0.89;0.96]	<.001
Protein from animal sources (g) ^c	0.84 [0.74;0.95]	<.01	0.83 [0.71;0.96]	.02
Protein from vegetable sources (g) ^c	0.93 [0.78;1.09]	.36	0.55 [0.44;0.69]	<.001
Alcohol				
% of kcal from alcohol (log-transformed) ^b	1.02 [0.92;1.13]	.74	1.10 [0.97;1.25]	.14
0–10% of kcal ^{b,d}	0.95 [0.76;1.18]	.62	1.13 [0.86;1.48]	.37
≥10% of kcal ^{b,d}	1.14 [0.76;1.73]	.52	1.47 [0.88;2.48]	.14
Dietary fiber (g) ^c	0.84 [0.74;0.96]	.01	0.50 [0.42;0.60]	<.001
Dietary fiber from beans (g) (log) ^c	1.01 [0.91;1.13]	.84	0.84 [0.74;0.96]	<.01
Dietary fiber from grains (g) ^c	1.01 [0.90;1.13]	.90	0.68 [0.58;0.79]	<.001
Dietary fiber from vegetables & fruits (g) ^c	0.80 [0.72;0.89]	<.001	0.65 [0.56;0.74]	<.001
Solid foods (g) ^c	0.70 [0.61;0.81]	<.001	0.50 [0.42;0.60]	<.001
Energy density solid foods (kcal/g) ^b	1.23 [1.11;1.37]	<.001	1.59 [1.40;1.79]	<.001

^aMultinomial logistic regression of standardized variables (reference category: very good appetite); the OR can be interpreted as the chance of having a lower (OR < 1) or a higher (OR > 1) intake than older adults with a very good appetite, with the other variables in the model held constant.

^bAdjusted for potential confounders (age, sex, race, study site, education level, income, cognitive function, depression, number of household members, self-rated health status, smoking, physical activity, biting/chewing problems).

^cAdjusted for potential confounders (age, sex, race, study site, education level, income, cognitive function, depression, number of household members, self-rated health status, smoking, physical activity, depression, biting/chewing problems, and total energy intake).

^dReference category for alcohol intake: 0% of kcal.

interaction between race or gender and dietary intake variable). In summary, gender and race modified the association between alcohol intake and appetite. Gender also modified the association between the intake of wholegrain foods and appetite. Race modified the association between the intake of dairy foods and appetite. Results for alcohol, wholegrain foods, and dairy foods stratified for race and gender are displayed in Appendix S2.

DISCUSSION

This study revealed differences in dietary intake between community-dwelling older adults with various levels of appetite. As expected, older adults with a poor appetite reported a lower intake of energy, protein, fiber, solid foods, fruits and vegetables, and large/XL portions; while consuming more fats, sweets, sodas, and dairy foods than older adults with a very good appetite. In addition, the energy density of solid foods was higher than in older adults with a very good appetite.

The appetite of participants was classified into very good, good, and poor. We expected that older adults with a poor appetite would have a different dietary intake than older adults with a good or very good appetite. However, our data show that participants with a good appetite also reported a slightly lower intake of protein rich foods, fruits and vegetables, and large portion sizes; and had a higher consumption of fats and oils, sweets, and sodas. Thus, there appears to be a continuous relationship between patterns of dietary intake and levels of appetite from poor to good and from good to very good.

Besides a reduced energy intake, the dietary patterns identified in this study show that a poor appetite is associated with reduced protein and fruit and vegetable intake, which could exacerbate sarcopenia³⁶ and osteoporosis.³⁷ Improvement of dietary patterns at an early stage could prevent these unfavorable health issues. In order to maintain healthy eating patterns, it would be interesting to identify predictors of a poor appetite and the associated dietary patterns. Together with offering attractive and nutritious foods and treating underlying diseases impairing appetite, this could be a cost-effective approach to prevent and treat undernutrition in older adults, thereby reducing morbidity and mortality.

The distinct food choices of older adults with a poor appetite could be explained by different food preferences in those with anorexia of aging or disease-related anorexia. So far, small studies performed in various countries, care settings and disease backgrounds published inconsistent findings on food preferences in older persons with a poor appetite. In one study, cognitively impaired elderly showed a reduced global food intake and a reduced consumption of certain food groups (meat, eggs, fish, and fruit and vegetables) and a similar consumption of milk and cereals.³⁸ Others showed a dislike to fatty and heavy food²⁵ or a preference for certain protein and non-protein foods in chronic ill elderly with anorexia.²⁴ We previously conducted computer tests, presenting pairs of photographic images of foods categorized according to a certain characteristic (e.g., high- or low-fiber) to older adults. A forced choice methodology was used for every pair by asking,

Table 4. Multivariate analyses of food groups and portion size (good appetite and poor appetite vs very good appetite) of health, aging and body composition study participants.

N = 2,597	Good appetite (n = 983) OR ^b [95% CI] ^a	P	Poor appetite (n = 565) OR [95% CI] ^a	P
Fruits & fruit juices				
Servings ^c	0.89 [0.80;0.98]	.02	0.75 [0.66;0.85]	<.001
Kcal ^c	0.91 [0.82;1.00]	.05	0.85 [0.76;0.97]	.01
% of kcal ^b	0.97 [0.88;1.07]	.49	0.89 [0.79;1.00]	.05
Vegetables				
Servings ^c	0.81 [0.72;0.90]	<.001	0.66 [0.57;0.76]	<.001
Kcal ^c	0.81 [0.73;0.90]	<.001	0.67 [0.58;0.77]	<.001
% of kcal ^b	0.84 [0.76;0.93]	<.01	0.71 [0.62;0.81]	<.001
Grains				
Servings ^c	0.98 [0.86;1.11]	.69	0.77 [0.66;0.91]	<.01
Kcal ^c	1.04 [0.92;1.17]	.55	0.85 [0.73;0.99]	.03
% of kcal ^b	1.06 [0.96;1.17]	.21	0.89 [0.79;1.00]	.05
Wholegrains				
Servings ^c	0.94 [0.85;1.05]	.26	0.67 [0.58;0.77]	<.001
Kcal ^c	0.99 [0.91;1.09]	.89	0.73 [0.64;0.83]	<.001
% of kcal ^b	1.01 [0.99;1.02]	.58	0.95 [0.92;0.97]	<.001
Meat, fish, poultry, beans, egg				
Servings ^c	0.80 [0.70;0.90]	<.001	0.74 [0.63;0.86]	<.001
Kcal ^c	0.83 [0.73;0.95]	<.01	0.80 [0.69;0.94]	<.01
% of kcal ^b	0.87 [0.79;0.97]	<.01	0.84 [0.75;0.95]	<.01
Milk, yogurt, cheese				
Servings ^c	1.00 [0.90;1.11]	.99	1.17 [1.04;1.33]	.01
Kcal ^c	1.05 [0.94;1.18]	.40	1.31 [1.15;1.49]	<.001
% of kcal ^b	1.04 [0.94;1.15]	.46	1.27 [1.13;1.42]	<.001
Fats & oils, sweets, sodas				
Servings ^c	1.19 [1.06;1.34]	<.01	1.40 [1.22;1.61]	<.001
Kcal ^c	1.02 [0.92;1.14]	.74	1.15 [1.01;1.31]	.03
% of kcal ^c	1.01 [0.91;1.11]	.86	1.15 [1.03;1.29]	.02
Sweets, desserts				
Kcal (log) ^c	1.07 [0.98;1.16]	.15	1.16 [1.05;1.27]	<.01
% of kcal (log) ^b	1.07 [0.98;1.16]	.15	1.18 [1.04;1.34]	.01
Portion size				
Small				
% of foods ^c	1.03 [0.93;1.14]	.58	1.04 [0.92;1.17]	.52
Medium				
% of foods ^c	1.12 [1.00;1.25]	.05	1.16 [1.02;1.32]	.03
Large/Extra-large				
% of foods ^c	0.82 [0.73;0.93]	<.01	0.76 [0.65;0.89]	<.001

^aMultinomial logistic regression of standardized variables (reference category: very good appetite).

^bAdjusted for potential confounders (age, sex, race, study site, education level, income, cognitive function, depression, number of household members, self-rated health status, smoking, physical activity, biting/chewing problems).

^cAdjusted for potential confounders (age, sex, race, study site, education level, income, cognitive function, depression, number of household members, self-rated health status, smoking, physical activity, biting/chewing problems and total energy intake).

“what food do you most want to eat now?” The number of choices for foods with a certain characteristic was indicative of a certain food preference. We found that older adults with a poor appetite preferred (color) variation, non-dairy, high-fiber foods, and solid texture.³⁹

Similar to the literature,^{38,40} the current study showed that older adults with a poor appetite had a lower intake of protein-rich foods (1.6 vs 1.8 servings/day), fruits (1.8 vs 2.1 servings/day), and vegetables (2.6 vs 3.2 servings/day) than those with a very good appetite, implying that older adults with a poor appetite consume 10–20% less than the group with a very good appetite, which is clinically relevant, especially with a long-lasting poor appetite and dietary intake. Some findings are inconsistent with previous studies:^{24,38,39} older adults with a poor appetite

had a higher intake of dairy foods than subjects with a very good appetite³⁸ and a lower (instead of higher) intake of dietary fiber and solid foods.³⁹

The higher energy density of solid foods in older adults with a poor appetite suggests a preference for fatty and heavy foods. Consuming smaller portions of high density foods is a common way to provide sufficient energy, for instance in subjects with insufficient dietary intake such as hospital patients,³³ or astronauts consuming foods with an energy density of 3–4 kcal/g.³⁴ We hypothesize that choosing higher-density foods could be a natural mechanism to ingest sufficient energy and nutrients and to mitigate against weight loss. This mechanism and the effect on ingestion of other essential nutrients such as protein and vitamin D need to be investigated in humans. However,

evidence shows that increasing the energy density of meals and snacks effectively improves energy intake and body weight stabilization in older adults. This strategy is widely used in daily practice.³⁵

This is the first large-scale quantitative study investigating dietary intake in older adults with various appetite levels. The health, aging, and body composition study cohort provides data on food intake and a number of general and health characteristics that may confound the associations under study. However, the large sample size and large number of statistical tests can result in statistically significant differences that may have limited clinical meaningfulness. Moreover, it needs to be mentioned that our conclusions are based on an American sample and cannot be translated to older adults in other countries. Another limitation of this study is that it used dietary intake patterns obtained by a food frequency questionnaire as a measure of food preference. We cannot exclude that other factors, including income and household member food preferences, may have influenced intake.

The validity of the appetite question could also be questioned: appetite is a subjective entity and no gold standard to assess appetite exists. However, the different appetite levels were related to weight loss and energy intake, indicating face validity of the applied appetite question. While a person's appetite may fluctuate over time, in this study appetite was assessed at one time-point only. The use of three appetite levels resulted in an under- or over-estimation of dietary intake related to a poor appetite: sensitivity analyses showed larger and more significant differences after exclusion of subjects with a moderate appetite.

The results of this study show several differences in food consumption among community-dwelling older persons with various appetite levels. This information is an important first step in identifying specific food preferences in older adults with a poor appetite and can be used to refine nutrition interventions that aim to improve dietary intake and diet quality in older adults with a poor appetite.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Average macronutrient and food group intake per day of health, aging and body composition study participants by level of self-reported appetite.

Appendix S2. Flow chart of study population of the health ABC study.

Appendix S3. Multivariate analyses of energy, alcohol, wholegrains, milk, yogurt, cheese, sweets, and desserts intake (good appetite and poor appetite vs very good appetite) of health, aging and body composition study participants, classified for gender and race.

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