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MALNUTRITION IN A SAMPLE OF COMMUNITY-DWELLING OLDER PENNSYLVANIANS

R.A. DiMaria-Ghalili[1], Y.L. Michael[2], A.L. Rosso[3]

Abstract: *Objectives:* Determine the prevalence of malnutrition in community-dwelling older adults with an adapted MNA and analyze the association of nutritional status with use of community-based programs. *Design:* Random digit dial telephone survey. *Participants:* Probability sample of community-dwelling adults aged 60 years and older living in Southeastern Pennsylvania (n= 3,209 adults). *Measurements:* Standardized questionnaires were administered by trained interviewers. Scores for each MNA item were derived from survey items (food intake, mobility, psychological stress and hospitalization, depression, height and weight). *Results:* Thirty-eight percent of older adults were well nourished (n = 1,168), 56.3% (n=1,740) were at-risk, and 5.9% (n = 183) were malnourished. Malnourished older adults were more likely to live alone, reside in the city, receive food stamps, have no usual source of health care, and report fair and poor self-rated health ($p < .05$). Malnourished older adults were more likely to use transportation services (Odds Ratio (OR) = 2.19 [95% Confidence Interval (CI): 1.47, 3.25]) and housing services (OR = 2.83 [95% CI: 1.80, 4.46]). *Conclusion:* This is the first study to use the MNA in a probability sample of older adults in the U.S. Our results have important health and policy implications related to providing services to malnourished older adults. In our sample, malnourished older adults were less likely to have a usual source of health care, but were more likely to use transportation and housing services. Agencies providing community-based services could incorporate nutrition screening programs to help identify the most vulnerable older adults.

Key words: Mini-Nutritional Assessment, nutritional epidemiology, older adults, malnutrition, community-based programs.

Introduction

Health, function, and quality of life (QOL) are important Healthy People 2020 goals for older Americans (1). Healthy nutrition plays a vital role in the promotion and maintenance of optimal physical functioning and QOL in older adults (2). With the rapid growth of the older U.S. population (3), the increasing trend for older adults to age in place (4-6), as well as federal policy to rebalance long-term care from nursing homes to home- and community-based services (2), understanding the individual and contextual determinants of health and social service utilization in community-dwelling older adults who are malnourished or at nutrition risk is critical for successful aging. A recent Institute of Medicine public workshop on "Nutrition and Healthy Aging in the Community" highlighted research gaps related to community-based delivery of nutrition services for older adults (7). Research gaps include well-designed nutrition screening and intervention programs to meet the needs of older adults of diverse cultures and geographic locations, and communicating best practices on nutrition to older adults and their caregivers. Health information technology (8), delivered via the Internet or with telemonitoring (9) is one way to communicate best practices. This study addresses these gaps by evaluating the association between nutrition status and use of community-based programs and the Internet in older adults in southeastern Pennsylvania.

While many nutrition screening tools are available for older adults (10), the Mini- Nutritional Assessment® (MNA) (11)is recognized as one of the most valid and reliable tools for use in older adults (12-14). The MNA, previously called the MNA short-form (MNA-SF) is the 6-item version of the original 18-item full MNA (11). The prevalence of malnutrition estimated from 53 international studies using the MNA or full MNA in primarily convenience samples of community-dwelling older adults is 4.2% (range 0-26%); 27.4% (range 0-76%) are at-risk of malnutrition (at-risk) (12, 14, 15). The prevalence of malnutrition using the MNA in a

1. Drexel University, College of Nursing and Health Professions, Doctoral Nursing Department and Nutrition Sciences Department; 2. Drexel University, School of Public Health, Epidemiology and Biostatistics; 3. University of Pittsburg, Graduate School of Public Health, Center for Aging and Population Health.

Corresponding Author: R. DiMaria-Ghalili, Drexel University, College of Nursing and Health Professions, Mail Stop 1030, 245 N. 15th Street, Philadelphia, PA, 19102 United States, Phone: 215-762-1221, Fax: 215-762-4080 email: rad83@drexel.edu

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probability sample of community-dwelling older Americans is not known. Since individual MNA items (e.g., food intake, mobility, disease, depression, dementia, and body mass index) are assessed either directly or indirectly in large population-based surveys, an MNA score can be calculated. Boström reports a similar methodology in which selected items and scales from the Minimum Data Set-Resident Assessment Instrument were used to score MNA items in a sample of long-term care Canadian veterans (16). The purpose of this study was to: 1) determine the prevalence of malnutrition with the MNA by adapting items from a Household Health Survey in a probability sample of community-dwelling older adults residing in southeastern Pennsylvania, and 2) analyze the distribution of nutritional status according to individual (socio-demographic factors) and contextual (use of community-based programs and the internet) determinants of health and social service utilization.

Methods

Study sample

The sample consisted of older adults (60 years and older) who responded to the 2010 Southeastern Pennsylvania Household Health Survey (HHS) (17). The Public Health Management Corporation (PHMC) conducts the survey biennially in the city of Philadelphia and surrounding suburban counties (Bucks, Chester, Delaware, and Montgomery). Respondents were recruited using random digit dialing stratified on 54 service areas in order to maintain geographic representativeness. Trained interviewers administered standardized questionnaires by telephone. For the purposes of this study we excluded respondents if data were missing on any aspect of the nutritional status measure: food intake, mobility, psychological stress or acute disease, neuropsychological problems, and body mass index (BMI). Secondary analysis of the anonymous HHS data was judged to be exempt by the Drexel University Institutional Review Board.

Study variables

The MNA score was adapted from HHS questions (MNA-A-HHS) that matched individual MNA items including food intake, mobility, psychological stress and hospitalization, depression, height and weight. The scoring rubric is presented in Table 1. Total scores for the MNA-A-HHS were categorized as normal (well-nourished) (12-14), at-risk (8-11), and malnourished (0-7). Demographic, socioeconomic, health and disability, and community-based service variables were defined according to the HHS survey (Table 2).

Data analysis

Univariate associations of nutritional status with demographic, socioeconomic, health and disability, and community-based service use were determined by ANOVA for normally distributed continuous variables. Chi-square analysis was used to detect differences between groups for categorical variables. The odds of use for each community-based service (yes/no) were analyzed separately by multinomial logistic regression models. Multinomial regression calculates a separate odds ratio for at- risk and malnourished groups with well-nourished as the reference. All models were adjusted for age, sex, race, and residence (urban/suburban). Interactions with age group (<75 years, ≥75 years) were assessed. All analyses were performed using SAS (v. 9.2 SAS Institute Inc., Cary, NC) with type I error of 0.05.

Results

In 2010, 10,006 persons were interviewed for the HHS and the overall response rate was 24.5% (18). A total of 3,209 HHS participants were aged 60 years and older and thus eligible for our analysis. We excluded 3.7% (n=118) of the older adult participants due to missing data on any nutritional status measure: food intake (n=20), mobility (n=26), psychological stress or acute disease (n=11), neuropsychological problems (n=4), and body mass index (BMI) (n=57). Thus, 96.3% (n=3,091) of older adult participants were included in our analytic sample. We observed no statistically significant differences with regard to age, race, poverty, and self-rated health between eligible participants and those who were excluded; excluded participants were more likely to be female and slightly more likely to report one or more limitation in activity of daily living.

The mean age of respondents was 71.5 $\pm$ 8.5 years, 35.3% (n=1,092) were 75 years and older, and 8.5% (n=262) were 85 years and older. Compared to the 2010 Census Data for age and region (19), individuals in these analyses were more likely to be female, black, live in Philadelphia, to be better educated, or own their own home and were less likely to be in poverty.

According to the MNA-A-HHS scores, 1,168 (37.8%) of respondents were well- nourished, 1740 (56.3%) were at-risk, and 183 (5.9%) were malnourished (see Table 1). Table 3 describes the study population by nutritional status. In general, malnourished older adults were more likely to live alone, receive food stamps, use transportation and housing services, and report fair and poor self-rated health compared to well-nourished older adults. Malnourished older adults were more likely than well-nourished older adults to live in urban setting (55% vs 38%), live below poverty level (17% vs 4%) and report difficulty with housing costs (63% vs 24%) ($P < 0.05$).

Table 1

Mini Nutritional Assessment tool, Public Health Management Corporation (PHMC) Household Health Survey items, and the Nutritional Status among Community Dwelling Adults in Southeastern Pennsylvania (n=3091)

Mini Nutritional Assessment Short Form Item	PHMC 2010 Household Health Survey	Total Sample n (%)
A. Has food intake declined over the past 3 months d/t loss of appetite, digestive problems, chewing or swallowing difficulties?	In the past year, has there been any time when you needed dental care but did not get it because of the cost? OR In the past 12 months, did you or other adults in your household ever cut the size of meals or skip meals because there was not enough money in the budget for food?	
0 = severe decrease in food intake		
1 = moderate decrease in food intake	1 = yes	573 (18.5)
2 = no decrease in food intake	2 = no	2518 (81.5)
B. Weight loss during the last 3 months	No question available	
0 = wt loss greater than 3 kg		
1 = does not know	1 = does not know	3091 (100)
2 = weight loss between 1 and 3 kg		
3 = no weight loss		
C. Mobility	Can you get to places out of walking distance…? Can you walk…? Can you get in and out of bed…?	
0 = bed or chair bound	0 = Unable to travel unless arrangements are made for a specialized vehicle like an ambulance AND (Completely unable to walk OR Totally dependent on someone else to lift you)	6 (0.2)
1 = able to get out of bed/chair but does not go out	1= Unable to travel unless arrangements are made for a specialized vehicle like an ambulance AND (Can walk without help except for a cane OR with some help from a person or with the use of a walker, crutches, etc. OR Can get in and out of bed without any help or aids or with some help)	44 (1.4)
2 = goes out	2 = Can get to places out of walking distance without help or with some help	3041 (98.4)
D. Has suffered psychological stress or acute disease in past 3 months	How many visits, if any, did you have to a hospital emergency room during the past twelve months that is since (date one year ago) 2009? Using a scale from 1 to 10, where 1 means "no stress" and 10 means "an extreme amount of stress", how much stress would you say you have experienced during the past year?	
0 = yes	0 = Hospital visit ≥ 1 OR Stress ≥ 8	1228 (39.7)
2 = no	2 = Hospital visit = 0 OR Stress < 8	1863 (60.3)
E. Neuropsychological problems	Geriatric Depression Scale items* a. I felt depressed b. I felt that everything I did was an effort c. My sleep was restless d. I was happy e. I felt lonely f. People were unfriendly g. I enjoyed life h. I felt sad i. I felt that people disliked me j. I could not get going	
0 = severe dementia or depression	0 = Yes to 4 or more of these symptoms OR Ever diagnosed with any mental health condition, including clinical depression, anxiety disorder or bipolar disorder?	375 (12.1))
1 = mild dementia		
2 = no psychological problems	2 = Yes to 3 or fewer symptoms OR Never diagnosed with any mental health condition, etc.	2716 (87.9)
F. BMI	BMI	
0 = BMI less than 19	0 = BMI less than 18.9	81 (2.6)
1 = 1⃣BMI 19 to less than 21	1 = BMI 19 to less than 20.9	205 (6.6)
2 = BMI 21 to less than 23	2 = BMI 21 to less than 22.9	328 (10.6)
3 = BMI 23 or greater	3 = BMI 23 or greater	2477 (80.1)
Screening Score		
0-7 malnourished		183 (5.9)
8-11 at risk of malnutrition		1740 (56.3)
12-14 normal nutritional status		1168 (37.8)

*Based on the Geriatric Depression Scale (GDS), 346 (11.2%) participants had high depressive symptoms, and 29 (0.9%) were missing GDS data but reported a history of mental health problems. No psychological problems were reported in 2716 (87.9%) of participants.

Malnourished older adults were less likely than well-nourished older adults to use the Internet (37.6% vs 61.4%). While malnourished older adults were more likely than well- nourished older adults to report no usual source of health care, they were equally likely to have prescription coverage.

Only 10% (n=19) of malnourished older adults reported using meal programs compared to 7% (n=82) of well-nourished older adults. Similarly, 22% (n=40) of malnourished older adults used senior centers compared to 18% (n=215) of well-nourished older adults. However, these differences were not statistically significant.

Separate multivariable multinomial logistic regression models were used to examine the relationship between use of community-based programs for older adults (senior center, meal programs, transportation services, housing services) and use of the internet with nutritional status controlling for age, sex, race, and urban residence (Table 4, Model 1). Use of transportation and housing services were positively associated with malnutrition.

Table 2
Definition of variables according to the PMHC Household Health Survey

Variable	PMHC Household Health Survey definition
Race	Black, White, or other (Latino, Asian, Native American, Multiracial or other)
Age	Continuous variable and categorized as 60-74 or 75 years or more
County of residence	Categorized as Philadelphia or suburban counties
Poverty	Above or below 100% of the US federal poverty level which accounted for household income and size
Self-rated health status	Excellent, very good, good, fair, or poor
Activities of daily living (ADL)	A count of difficulty performing 6 ADL (eating, dressing, grooming, walking, transferring, and bathing) were categorized as 0, 1, 2 or more ADL disabilities.
Instrumental activities of daily living	A count of difficulty performing 6 IADL (using the telephone, getting to places outside of walking distance, shopping, preparing meals, taking medicine, and managing money) were categorized as 0, 1, 2 or more IADL disabilities.
Home ownership	Do you yourself rent or own your home? Categorized as yes (own home) or no (rent or other arrangement).
Difficulty with housing cost	Overall, how difficult was it for you to afford your housing costs during the past year? Categorized as yes (Very difficult, somewhat difficult) or no (not very difficult or not difficult at all)
Usual health care provider	Is there one person or place you USUALLY go to when you are sick or want advice about your health? Yes or no.
Prescription coverage	Do you CURRENTLY have any coverage for prescription medications? Yes or no.
Use of the Internet	How often do you use the Internet? Categorized as yes (several times a day, once a day, several times a week, once a week, once a month, less than once a month) or no (never)
Use of community based programs.	Categorized as yes or no for each of the following: Senior center: use of activities programs at Senior Centers or Senior Clubs in the past year. Meal programs: use of meals/food programs, such as home delivered meals, meals at Senior Centers or emergency food in the past year. Transportation services: use of transportation services or resources (medical transportation, public transit discounts) in the past year. Housing services: use of housing services such as energy assistance programs, subsidized housing or home repair programs in the past year.

Compared to well-nourished older adults, malnourished older adults were two times more likely to use transportation services and three times as likely to use housing services. Use of the Internet was negatively associated with being at-risk and malnourished. Compared to well-nourished older adults, malnourished older adults were 60% less likely to use the Internet. The association between use of senior center or meal program and nutritional status was not significant. Further adjustment for poverty status and self-reported health attenuated but did not qualitatively change the results (Table 4, Model 2) Significant trends were noted between nutritional status and use of Internet, transportation services, and housing services such that as nutritional status decreases (becomes worse), older adults were increasingly more likely to make use of transportation services, and housing services and increasing less likely to use the internet (Table 4). A significant interaction between age and nutritional status for the use of housing services indicates that the association was significant among the young-old but not the older-old: (p for interaction = 0.05; < 75 years of age: at risk OR = 1.7 (1.2, 2.4), malnourished OR = 4.0 (2.3, 6.8); > 75 years of age: at risk OR = 1.2 (0.7, 2.0); malnourished OR = 1.4 (0.6; 3.8)).

Discussion

To our knowledge this is the first study that establishes the point prevalence of malnutrition with the MNA in a large probability sample of community-dwelling older Americans. In southeastern Pennsylvania, 5.9% of older adults were malnourished and 56.3% were at-risk. Our study suggests that community-dwelling older adults who were either malnourished or at-risk were not more likely than well-nourished older adults to use meal programs or senior centers. Further, those who were either malnourished or at-risk were significantly less likely than well-nourished older adults to use the internet.

Prior studies using the MNA in community-dwelling older Americans were conducted with convenience samples limiting generalizability and the ability to estimate participation in community-based programs by nutrition status (20-22). In inner-city community-dwelling African-Americans in St. Louis, Missouri, the prevalence of malnutrition was 1.6% and 38.6% were at-risk (22). We found a higher percent of malnutrition (11%) and at-risk (59%) in older Blacks using the MNA. In 310 seniors (78.5% female) who lived in public housing in inner-city New Haven, Connecticut, the prevalence of malnutrition was 5.4% at 38.5% were at-risk (20) . While 79% of our sample owned their own home, our estimate of malnutrition closely approximates this sample, although we found a greater proportion at-risk. The rate of malnutrition among congregant meal participants in Central Illinois was 2.9%, and 31.9% were at-risk (21) . In our study 7.3% of participants used meal programs, and among those who used meal programs we estimated that 8.3% were malnourished and 55.5% at-risk.

We acknowledge limitations of our study. The 2010 HHS survey did not include the MNA questions verbatim and we were able to compute a score for 5 of the 6 MNA items. The only question that we coded as “don’t know” was the weight loss question. While we may have an inflated rate of malnutrition by scoring everyone as “don’t know”, these individuals would be at risk and require further nutrition assessment. Despite the limitations of our modified MNA score, our findings are consistent with one of the largest population-based

Table 3

Selected Characteristics According to Nutritional Status based on Modified Mini Nutritional Assessment tool among older adults in the Southeastern Pennsylvania Household Health Survey, 2010 (n=3,091)

		Nutritional Status		
	Total	**Normal**	**At Risk**	**Malnourished**
Total n (%)	3091 (100)	1168 (37.8)	1740 (56.3)	183 (5.9)
Mean age (SD)*	71.5 (8.5)	71.0 (8.1)	71.8 (8.6)	71.5 (9.5)
Mean BMI (SD)++	27.4 (5.8)	28.4 (4.5)	27.1 (6.2)	25.0 (8.1)
Median Depression Score (IQR)	1 (0‐2)	0 (0‐1)	1 (0‐2)	5 (4‐6)
Gender, n (%) ++				
Female	2070 (67.0)	712 (61.0)	1218 (70.0)	140 (76.5)
Male	1021 (33.0)	456 (39.0)	522 (30.0)	43 (23.5)
*Age Group, n (%)**				
60‐74	1999 (64.7)	791 (67.7)	1089 (62.6)	119 (65.0)
75+	1092 (35.3)	377 (32.3)	651 (37.4)	64 (35.0)
Race, n (%) +				
White	2294 (75.9)	907 (79.1)	1256 (74.1)	131 (73.2)
Black	613 (20.3)	210 (18.3)	363 (21.4)	40 (22.3)
Other	115 (3.8)	30 (2.6)	7 (4.5)	8 (4.5)
County of Residence, n (%) ++				
Suburban Counties	1783 (57.7)	725 (62.1)	975 (56.0)	83 (45.4)
Philadelphia	1308 (42.3)	443 (37.9)	765 (44.0)	100 (54.6)
Education, n (%) ++				
< High School	313 (10.2)	90 (7.8)	192 (11.1)	31 (17.3)
≥ High School	2754 (89.8)	1072 (92.2)	1534 (88.9)	148 (82.7)
Poverty, n (%) ++				
Above 100%	2860 (92.5)	1124 (96.2)	1584 (91.0)	152 (83.1)
Below 100%	231 (7.5)	44 (3.8)	156 (9.0)	31 (16.9)
Lives Alone, n (%) ++				
No	1822 (59.6)	756 (65.3)	989 (57.5)	77 (42.8)
Yes	1237 (40.4)	402 (34.7)	732 (42.5)	103 (57.2)
Owns Home ++				
Yes	2421 (79.1)	989 (85.1)	1320 (76.7)	112 (62.2)
No	641 (20.9)	173 (14.9)	400 (23.3)	68 (37.8)
Difficulty with housing costs, n (%) ++				
No	1905 (64.8)	861 (76.3)	982 (59.8)	62 (36.7)
Yes	1034 (35.2)	267 (23.7)	660 (40.2)	107 (63.3)
Self‐Rated Health, n (%) ++				
Excellent	478 (15.5)	226 (19.4)	244 (14.1)	8 (4.4)
Very Good	879 (28.6)	401 (34.4)	452 (26.1)	26 (14.4)
Good	1005 (32.6)	393 (33.7)	563 (32.5)	49 (27.1)
Fair	540 (17.5)	130 (11.1)	355 (20.5)	55 (30.4)
Poor	177 (5.8)	17 (1.5)	117 (6.8)	43 (23.8)
Limitation in ADL, n (%) ++				
0	2798 (90.5)	1108 (94.9)	1554 (89.3)	136 (74.3)
1	192 (6.2)	41 (3.5)	130 (7.5)	21 (11.5)
2+	101 (3.3)	19 (1.6)	56 (3.2)	26 (14.2)
Limitation in IADL, n (%) ++				
0	2407 (77.9)	1002 (85.8)	1319 (75.8)	86 (47.0)
1	335 (10.8)	99 (8.5)	201 (11.6)	35 (19.1)
2+	349 (11.3)	67 (5.7)	220 (12.6)	62 (33.9)
Has Prescription Coverage, n (%)				
Yes	2728 (90.3)	1048 (91.1)	1523 (89.7)	157 (91.3)
No	292 (9.7)	102 (8.9)	175 (10.3)	15 (8.7)
Usual Source of Health Care, n (%) ++				
Private Source	2574 (83.8)	1012 (87.1)	1436 (83.1)	126 (69.6)
Public Source	337 (11.0)	97 (8.3)	197 (11.4)	43 (23.8)
None	160 (5.2)	53 (4.6)	95 (5.5)	12 (6.6)
Uses Senior Center, n (%)				
No	2530 (81.9)	953 (81.6)	1434 (82.4)	143 (78.1)
Yes	561 (18.2)	215 (18.4)	306 (17.6)	40 (21.9)
Uses Meal Programs, n (%)				
No	2862 (92.7)	1086 (93.0)	1612 (92.8)	164 (89.6)
Yes	227 (7.4)	82 (7.0)	126 (7.3)	19 (10.4)
Gets Food Stamps, n (%) ++				
No	2838 (93.1)	1106 (95.8)	1585 (92.5)	147 (81.7)
Yes	210 (6.9)	48 (4.2)	129 (7.5)	33 (18.3)
Uses Trans. Services, n (%) ++				
No	2633 (85.2)	1029 (88.1)	1465 (84.3)	139 (76.0)
Yes	456 (14.8)	139 (11.9)	273 (15.7)	44 (24.0)
Uses Housing Services, n (%) ++				
No	2783 (90.1)	1090 (93.3)	1545 (88.9)	148 (80.9)
Yes	306 (9.9)	78 (6.7)	193 (11.1)	35 (19.1)
Uses Internet, n (%) ++				
Yes	1622 (53.8)	700 (61.4)	838 (49.5)	68 (37.6)
No	1391 (46.2)	440 (38.6)	854 (50.5)	113 (62.4)
Wants To Live in Home, n (%) ++				
5 years or less	517 (18.6)	174 (16.3)	302 (19.4)	41 (25.9)
More than 5 years	2266 (81.4)	898 (83.7)	1256 (80.6)	117 (74.1)

ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; Trans: Transportation; *P < 0.05; + P < 0.01; ++P < 0.001

Table 4
Separate multinomial logistic regression models for the relation between use of local programs and services for older adults and use of the internet with nutritional status among older adults in the Southeastern Pennsylvania Household Health Survey, 2010 (n=3,091)

	Well-nourished OR (95% CI)	At Risk OR (95% CI)	Malnourished OR (95% CI)	Test for trend p-value
Model 1¶				
Uses Senior Center	1.0 (reference)	0.89 (0.73, 1.08)	1.14 (0.77, 1.68)	0.7
Uses Meal Programs	1.0 (reference)	0.96 (0.72, 1.29)	1.45 (0.85, 2.48)	0.5
Uses Trans. Services	1.0 (reference)	1.32 (1.05, 1.66)*	2.22 (1.49, 3.31)*	<0.001
Uses Housing Services	1.0 (reference)	1.56 (1.17, 2.07)*	3.00 (1.90, 4.74)*	<0.001
Uses Internet	1.0 (reference)	0.71 (0.59, 0.84)*	0.38 (0.26, 0.55)*	<0.001
Model 2§				
Uses Senior Center	1.0 (reference)	0.90 (0.74, 1.10)	1.19 (0.79, 1.79)	0.9
Uses Meal Programs	1.0 (reference)	0.91 (0.68, 1.23)	1.22 (0.69, 2.14)	0.9
Uses Trans. Services	1.0 (reference)	1.23 (0.97, 1.56)	1.87 (1.23, 2.84)*	0.005
Uses Housing Services	1.0 (reference)	1.31 (0.98, 1.76)	1.89 (1.14, 3.11)*	0.01
Uses Internet	1.0 (reference)	0.85 (0.71, 1.03)	0.66 (0.45, 0.98)*	0.02

* $p < 0.05$; ¶All analyses, adjusted for age, sex, race and county; §Adjusted for covariates in Model 1 plus poverty status and self-rated health

samples with data on the MNA. In a study of community-dwelling older recruited from pharmacies throughout Spain (N=22,007), 66.9% were identified as either malnourished or at- risk (23). Also, the response rate for the PHMC household health survey was 24.5 for all interviews (not available by age group), which is low. However, this rate is comparable to, and in some cases exceeds, other random digit dial surveys (24). Additionally, a low response rate does not translate to selection bias; experimental comparisons find few significant differences between estimates from surveys with low and high response rates (25, 26).

Despite these limitations our study provides preliminary data for a research gap identified by the IOM workshop–tailoring nutrition screening and interventions to specific geographic regions (7). The U.S. federal government allocates substantial funding for community-based programs, but the funds are administered locally. While our findings are immediately generalizable to older southeastern Pennsylvanians, our model can be adopted in other regions.

In addition, our results have important health and policy implications—how can we locate malnourished older adults in order to implement appropriate interventions? In our sample, malnourished older adults were less likely to have a usual source of health care, but were 2 times more likely to use transportation services and almost 3 times more likely to use housing services. Agencies that provide community-based services could incorporate nutrition screening programs into their services to help identify the most vulnerable older adults. Increased efforts should be made to encourage older adults without sufficient money to purchase food to enroll in the supplemental nutrition assistance program and participate in meal programs. One of the most important findings of this study relates to outreach. While there is a sense of urgency to use telehealth and the Internet to educate (27) and monitor community-dwelling older adults (28) our findings show that even after controlling for age, sex, race, and urban residence, those who were malnourished were 60% less likely to use the Internet compared to well-nourished older adults. Older adults are less likely than younger adults to use the Internet (27), and age, education, income, race, and literacy contribute to the Internet "Have Not" disparity (29, 30). In a time of cost-constraints and shift to Internet-based education and outreach, federal, state and local agencies should continue to use traditional media (e.g. public service announcements, mailers, newspaper) to reach the frail and vulnerable older adult.

Future research should incorporate a mobility-disability index to ascertain the extent to which functional disability impacts nutrition. For example, older adults who visit senior centers (21) or shop in pharmacies (23) may be more independent, more mobile, and have less malnutrition than older adults who are aging in place with one or more functional disabilities.

In conclusion, we were able to determine the prevalence of malnutrition with an adapted version of the MNA in a population-based sample of community-dwelling older adults from southeastern Pennsylvania. Clinicians should pay particular attention to nutrition in those community-dwelling older adults who are female, less educated; who live alone, in urban areas, and below the poverty level; and those who use public sources of health care, and transportation and housing services. The challenge ahead lies in developing and expanding social and community-based services to identify these seniors so that interventions can be implemented in a timely fashion.

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