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Research Article

Financial Strain Is Associated with Malnutrition Risk in Community-Dwelling Older Women

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This study examined the relationship between financial strain, or difficulty acquiring necessities, and malnutrition risk in a community dwelling sample of frail and nonfrail women aged 70–79 in the Women's Health and Aging Study ($n = 679$). Malnutrition risk was measured with a modified version of the Mini-Nutritional Assessment Short Form (MNA-SF) and defined as a score <11, financial strain was measured by (1) sufficiency of money on a monthly basis and (2) adequacy of income for food, and income was measured by ordinal categories. Mean (SD) modified MNA-SF score was 12.2 (1.80), and 14.7% of women had malnutrition risk. Women who usually did not have enough money to make ends meet had more than four-fold increased odds of malnutrition risk (OR = 4.54; 95% CI: 2.26, 9.14) compared to their counterparts who had some money left over each month. This was only slightly attenuated after control for income and education, (OR = 4.08; 95% CI: 1.95, 8.52) remaining robust. These results show an association between financial strain and malnutrition risk, independent of income, in older women. Self-reported financial strain may be preferable to income as a screener for malnutrition risk in older adults in clinical and research settings.

1. Introduction

Malnutrition, which is a risk factor for disability and mortality, [1, 2] poses a burden for community dwelling older adults, particularly those of low socioeconomic status. Exact rates of this often undiagnosed condition are difficult to estimate in this population [3–5], but an estimated 9% of community dwelling older adults are malnourished and up to 45% have malnutrition risk and should have clinical diagnostic evaluation [6]. Rates are consistently higher, however, among low income compared to high income individuals [3, 7, 8]. Malnutrition is generally understood to be a deficiency of both energy and protein, combined with decreased fat-free mass [9], although older adults of low socioeconomic status can be malnourished even if consuming a high energy diet [10, 11], probably because they consume foods with lower nutrient content [10, 12]. Also, there is evidence that food insecure adults, or adults who lack regular access to food, have poorer dietary quality than food secure adults, despite similar caloric intake [11, 13–15].

Although income is associated with malnutrition, income alone may not accurately predict malnutrition in older adults, since cost of living, household size, and competing needs cause variation in the purchasing power of retirees [16]. Rising health care costs push many older adults into poverty, even if their absolute income is above the poverty line [17]. In addition, many older adults whose income is above the poverty level still lack regular access to food [14]. Also, income alone does not capture financial assets, such as wealth [17]. Therefore, socioeconomic measures in older adults should consider the inadequacy of income to obtain basic necessities, along with absolute income [18].

Self-reported financial strain, or difficulty acquiring basic necessities and meeting financial obligations [19], is related to income but also captures the balance of income to need [18]. Financial strain is associated with other health outcomes, including mortality [18], self-rated health [20], cardiac events [21, 22], depression [23], increased blood pressure [24], poorer sleep quality [25], and smoking relapse after cessation [26]. These associations remain independent of income. However, the relationship between financial strain and malnutrition is unknown. Therefore, the purpose of this study is to determine if financial strain is associated with malnutrition risk in older women and to compare the associations of financial strain with that of income for malnutrition risk.

2. Methods

2.1. Sample. Data for this study were taken from the Women's Health and Aging Study I and II (WHAS I and II), which examined the causes and progression of disability and frailty. Both samples in this study used age-stratified random sampling of community-dwelling women living in a 12 zip-code area in and around Baltimore, MD. The first cohort, WHAS I, which has been described elsewhere [27, 28], recruited 1002 women aged 65 and older, who were among the one-third most disabled of their age cohort (conducted from 1992–1995). The second cohort, WHAS II, consisted of 436 women aged 70 to 79, who were among the two-thirds least disabled (conducted from 1994–1996) and has also been described elsewhere [29]. The current study is a cross-sectional analysis of baseline data from both WHAS I and WHAS II using sampling weights, to create a representative sample of women aged 70–79. Women between these ages with complete financial strain, income, and outcome data were included in this analysis ($n = 679$). The Johns Hopkins School of Medicine Institutional Review Board approved the research protocols. Each participant provided written informed consent.

2.2. Study Variables

2.2.1. Outcome. The Mini Nutritional Assessment Short Form (MNA-SF) is a shortened form of the well-established Mini Nutritional Assessment [7]. The MNA-SF shows high sensitivity and specificity as a screener to identify individuals who have malnutrition risk and is able to detect malnutrition before weight loss or decreased serum albumin [6, 30]. The questionnaire assesses the following six domains that are associated with malnutrition risk: recent decreased intake, including loss of appetite or decreased intake due to difficulty chewing or swallowing; recent unintentional weight loss; diminished mobility; recent psychological distress or acute illness; neuropsychological problems (either dementia or depression); low body mass index (BMI), as assessed by height and weight measurements (See Table 5 for details). Scores for all domains are summed, ranging from 0–14; scores 11 to 14 indicate normal nutritional status and <11 indicate malnutrition risk, meaning that the individual should undergo a further clinical evaluation for malnutrition diagnosis [30]. Three domains were adapted slightly to the variables available in this dataset, as summarized in Table 5. Briefly, WHAS does not include questions specific to the past three months for the "appetite loss," "weight loss," and "psychological distress or illness" categories. Instead, these were approximated by usual appetite, weight loss in past year and/or percentage of weight lost since age 60, and psychological distress in past year or acute illness in past two weeks, respectively.

2.2.2. Main Independent Variable. Financial strain was assessed by using ordinal responses to two questions. Participants were asked "At the end of the month, do you have some money left over, just enough, or not enough." This measure has been used in prior work [18] and is taken from a longer financial strain instrument, which was shown to be correlated with job disruption, economic coping and depression [19]. The second question, chosen for theoretical relevance to malnutrition, was "How often is your income not adequate for food," with response options of "never," "once in a while," "fairly often," or "very often." These latter two response options were collapsed due to small cell counts.

2.2.3. Covariates. Participants reported demographic factors, including age, race (white or black), marital status (married, widowed, divorced/separated, and never married), years of education completed (0 to 18), and annual household income, which was collapsed to ordinal categories according to linear splines with modified MNA-SF scores: < \$6,000 (which also approximates the contemporaneous poverty threshold for older adults [31]), \$6,000–9,999, \$10,000–24,999 and ≥ \$25,000. Additional individual characteristics that may be associated with both financial strain and malnutrition risk were also considered in multivariate analysis. These included participation in the Food Stamp Program [32, 33] and diagnosis of congestive heart failure or cancer. Difficulty driving was also considered since this may limit access to nutritionally dense foods for low income adults in urban areas [34, 35].

2.3. Data Analysis. Mean and proportional differences for the demographic and financial strain characteristics were evaluated with Pearson Chi square and t-tests, as appropriate, comparing those having malnutrition risk and those not having malnutrition risk. The odds of having malnutrition risk were modeled using progressively extended logistic regression models, separately for both financial strain variables. Covariates were added in the following way: Model 1 included financial strain, Model 2 added income and education, and Model 3 added age, race, and marital status. Interaction terms were tested for financial strain with race, age and Food Stamp Program participation and retained if significant. Additional individual characteristics were included in models if they altered the relationship between financial strain and malnutrition risk. Tests were conducted for collinearity between financial strain and either income or education. Probability weights were used to account for

Table 1: Distribution of sociodemographic variables by malnutrition risk status (modified MNA-SF < 11) in WHAS I and II ($n = 679$).

Variable	Modified MNA-SF < 11, $n = 99$[b]	Modified MNA-SF 11–14, $n = 580$[b]	P value[a]
Age (SD)	74.9 (2.8)	74.0 (2.8)	0.004
Race (%)			
White	67 (68)	454 (78)	0.022
Black	32 (32)	126 (22)	
Marital status (%)			
Married	16 (16)	192 (33)	
Widowed	66 (67)	290 (50)	0.003
Separated/divorced	12 (12)	54 (9)	
Never married	5 (5)	43 (7)	
Education Years (SD)	10.2 (3.7)	11.7 (5.9)	<0.001
Income (%)			
$25,000≤	17 (17)	165 (28)	
$10,000–24,999	25 (25)	214 (37)	<0.001
$6,000–9,999	22 (22)	138 (24)	
< $6,000	35 (35)	63 (11)	
Lack income for food (%)			
Never	69 (70)	505 (87)	
Once in a while	19 (19)	56 (10)	<0.001
Fairly/very often	11 (11)	19 (3)	
Finances at month end (%)			
Some money left	45 (45)	386 (67)	
Just enough	36 (36)	166 (29)	<0.001
Not enough to make ends meet	18 (18)	28 (5)	

[a] t-test for continuous data or Pearson Chi square test of independence for categorical data.
[b] Percentages may not sum to 100 due to rounding.

age, race, and disability and account for age stratification and non-response, as has been previously described [27]. Data were analyzed using Stata 10 [36].

3. Results

Comparing participants included in this analysis to those missing data, there were no significant differences by financial strain, age, or education. However, the participants included in the sample were less likely to have a low income (14% versus 40% had < $6,000 annually, $P = 0.008$), less likely to be black (23% versus 31%, $P = 0.036$), and more likely to be widowed (52% versus 35%, $P = 0.001$). Sample characteristics are provided in Table 1. Mean modified MNA-SF scores in this sample were in the normal nutritional status range (mean = 12.2, SD = 1.80) and 14.7% of the women had malnutrition risk. There were significant differences in malnutrition risk across age, race, income, and education categories as Table 1 shows. Approximately 15% of women reported that they lacked income for food at least "once in a while," and 4% reported that this occurred "fairly" or "very often." Also, 30% of the women reported that they had just enough money to make ends meet on a monthly basis, and another 7% reported they usually did not have enough money. In this sample, only 5% received Food Stamps, and of the 115 women reporting ever lacking income for food, only 21% received Food Stamps. Income was moderately correlated with both lacking money for food and difficulty making ends meet (Spearman's $\rho = -0.40$, $P < 0.05$, for both).

Financial strain was associated with malnutrition risk, when measured either as lacking money for food or difficulty making ends meet. Women who reported fairly or very often lacking money for food had greater than four times increased odds of malnutrition risk compared with women who never lacked money for food (Table 2). This relationship remained statistically significant, but attenuated after controlling for income and education and other covariates in the model, so that individuals who often lacked money for food had approximately three times increased odds of malnutrition risk. Financial strain demonstrated a gradient of association, with a positive, though statistically nonsignificant association for those who only sometimes lacked money for food, and stronger association for individuals who often lacked money for food. However, income was significantly associated with malnutrition risk only for individuals with income below the poverty threshold, and education was not statistically significant.

Similar results were obtained for those who reported they usually did not have enough to make ends meet (Table 3). These individuals had more than four times increased odds of malnutrition risk than those who had some money left over monthly in unadjusted analysis. After controlling for

Table 2: Multivariable logistic regression analyses of the relationship between lack of income for food and malnutrition risk in women aged 70–79 ($n = 679$).

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Lack income for food			
Never (ref)	—	—	—
Once in a while	2.24 (1.23, 4.10)	1.52 (0.78, 2.96)	1.61 (0.83, 3.10)
Fairly/very often	4.31 (1.94, 9.57)	2.73 (1.14, 6.56)	2.98 (1.15, 7.73)
Education (years)		1.00 (0.94, 1.04)	0.99 (0.95, 1.04)
Income			
$25,000≤ (ref)		—	—
$10,000–24,999		0.90 (0.44, 1.86)	0.84 (0.41, 1.71)
$6,000–9,999		0.92 (0.43, 1.95)	0.72 (0.33, 1.58)
< $6,000		3.16 (1.39, 7.16)	2.77 (1.10, 6.98)
Other demographics			
Age (years)			1.11 (1.02, 1.21)
Race			
White (ref)			—
Black			0.82 (0.45, 1.52)
Marital status			
Married (ref)			—
Widowed			1.87 (0.98, 3.60)
Separated/divorced			1.55 (0.54, 4.42)
Never married			1.84 (0.57, 5.97)

income and education, the strength of the association for this financial strain question also remained robust, and, unlike income, also demonstrated a gradient of association.

Further analysis was conducted to determine which of the six domains of the modified MNA-SF were associated with financial strain (Table 4). Financial strain was correlated with decreased food intake, unintentional weight loss, and decreased mobility, neuropsychological problems, but not low BMI.

4. Discussion

Our findings show that financial strain may be more informative than income as an indicator of nutritional risk in older adults. These results contribute to the literature in two important ways. First, the study showed that financial strain, when measured either by lacking money for food or having difficulty making ends meet, was associated with increased odds of malnutrition risk in older adults even after control for two traditional socioeconomic measures: income and education. Also, this association showed a dose response gradient, while the association between income and malnutrition risk was only significant at the lowest income level of <$6,000 annually. Interestingly, the contemporaneous poverty threshold for older adults was $7,309 [31], indicating that the relationship between income and malnutrition risk may be explained solely by whether individuals are below or above the poverty threshold. These results indicate that income alone may not be a sufficient predictor of ability to acquire basic necessities and that financial strain may be a preferable socioeconomic measure in this sample of community-dwelling older adults. Financial strain is a more informative predictor of malnutrition risk, since it demonstrated a dose response in this sample. Also, financial strain was not strongly correlated with low BMI in this study but income was significantly associated with low BMI. Since there is growing evidence that malnutrition occurs in low socioeconomic status adults regardless of BMI [10, 11], financial strain may be preferable to income as a means of screening for nutritional risk in this population.

The reason for the dose response association between financial strain and malnutrition risk after control for income cannot be deduced from these results, but there are plausible reasons. A likely explanation is that the construct of financial strain draws upon both absolute income level and the finance-related perceived stress generated when individuals lack adequate income for their needs [41]. Financial stress has been associated with adverse health outcomes [42, 43]. General stress has a long, consistent and strong association with adverse health [44] and is thought to mediate the relationship between low socioeconomic status and poor health [45]. An alternative explanation is that income and education do not accurately reflect the adequacy of household resources, since they do not capture the balance of financial supply and demand [18, 46]. Income reflects only

Table 3: Multivariable logistic regression analyses of the relationship between difficulty making ends meet and malnutrition risk in women aged 70–79 ($n = 679$).

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Monthly finances			
Some money left (ref)	—	—	—
Just enough to make ends meet	1.80 (1.08, 3.00)	1.42 (0.83, 2.44)	1.54 (0.88, 2.68)
Not enough to make ends meet	4.55 (2.26, 9.14)	3.62 (1.75, 7.48)	4.08 (1.95, 8.52)
Education (years)		1.00 (0.95, 1.04)	1.00 (0.96, 1.03)
Income			
$25,000≤ (ref)		—	—
$10,000–24,999		0.90 (0.43, 1.86)	0.81 (0.40, 1.66)
$6,000–9,999		0.80 (0.37, 1.72)	0.60 (0.27, 1.32)
< $6,000		3.06 (1.41, 6.60)	2.54 (1.07, 5.99)
Other demographics			
Age (years)			1.12 (1.03, 1.22)
Race			
White (ref)			—
Black			0.85 (0.47, 1.54)
Marital status			
Married (ref)			—
Widowed			1.91 (0.99, 3.69)
Separated/divorced			1.74 (0.63, 4.79)
Never married			1.88 (0.57, 6.21)

Table 4: Relationship (Spearman correlation or Chi square test) between socioeconomic measures with each of the 6 domains in the modified Mini Nutritional Assessment Short Form (MNA-SF), in women aged 70–79 ($n = 679$).

	Income	Lacking money for food	Difficulty making ends meet
Recent decreased intake	$\rho = -0.21^*$	$\rho = -0.13^*$	$\rho = -0.16^*$
Recent unintentional weight loss	$\rho = -0.08^*$	$\rho = -0.10^*$	$\rho = -0.07$
Diminished mobility	$\rho = -0.17^*$	$\rho = -0.23^*$	$\rho = -0.20^*$
Recent psychological distress or acute illness	$\chi^2_3 = 6.96$	$\chi^2_2 = 2.04$	$\chi^2_2 = 1.67$
Neuropsychological problems	$\rho = -0.23^*$	$\rho = -0.20^*$	$\rho = -0.28^*$
Low body mass index	$\rho = 0.09^*$	$\rho = 0.03$	$\rho = 0.06$

$^*P < 0.05$.

the financial input into the household but financial strain also captures competing demands for financial resources. Financial strain may be a more specific indicator than income of lack of other resources, such as wealth, available to individuals and this may be particularly true for older adults [47, 48]. However, the relationship between financial strain and adverse health has also been found in younger samples [24–26, 49].

These results are limited by specific inclusion of urban and suburban older women, and may not be generalizable to men, younger adults, or to more rural areas, which could have differences in access to supermarkets or other food resources. However, there is a rationale for focusing on women, who are particularly susceptible to malnutrition and other adverse nutritional consequences of food insecurity [15, 50], and focusing on older adults, who are susceptible to both nutritional risk and to adverse consequences of it [1, 6, 7, 51]. Another limitation was the low proportion of Food Stamp Program participation, limiting the ability to detect effect modification of the relationship between financial strain and malnutrition risk. This study was strengthened, however, by use of objectively measured BMI for malnutrition risk and use of a population-based sample.

These findings have clinical, public health, and research implications. Identification of predictors of malnutrition risk, such as financial strain, and timely identification of those factors in clinical practice may improve our ability to intervene in the aging process [52]. Also, income and

Table 5: Modifications to the Mini Nutritional Assessment Short Form (MNA-SF).

	Original MNA-SF criteria and score [30]	WHAS modifications to MNA-SF criteria and score
A	Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing, or swallowing difficulties? 0 = severe decrease in food intake 1 = moderate decrease in food intake 2 = no decrease in food intake	What is *usual* appetite? Any difficulty chewing or swallowing that limit ability to eat? 0 = appetite is usually poor or appetite is fair combined with problems chewing/swallowing that limit ability to eat 1 = fair appetite and no problems chewing/swallowing 2 = good or very good appetite
B	Weight loss during the last 3 months 0 = weight loss greater than 3 kg 1 = does not know 2 = weight loss between 1 and 3 kg 3 = no weight loss	Weight loss during the *past year* and/or *percentage of body weight lost since age 60* 0 = reports either weight loss due to illness or weight loss in past year combined with >15% of weight at age 60 is now lost 1 = weight loss unknown 2 = reports weight loss in past year combined with <15% of weight at age 60 is lost 3 = reports no weight loss in past year
C	Mobility 0 = bed or chair bound 1 = able to get out of bed/chair but does not go out 2 = goes out	No modifications 0 = By his/herself, has difficulty getting in and out of bed or chairs 1 = By his/herself, able to get in out of bed/chair, but does not leave the house in a typical week 2 = During typical week, goes outside the house and/or neighborhood
D	Has suffered psychological stress or acute disease in the past 3 months? 0 = yes 2 = no	Has suffered bereavement or seriously ill spouse in *past year* or acute disease in *past 2 weeks*? 0 = yes 2 = no
E	Neuropsychological problems 0 = severe dementia or depression 1 = mild dementia 2 = no psychological problems	No modifications 0 = Mini Mental State Examination (MMSE) score <17 [37, 38] or Geriatric Depression Scale score 11≤ [39, 40] 1 = MMSE score 17–24 and Depression score <11 2 = MMSE score 24< and Depression score <11
F	Body mass index (BMI) 0 = BMI < 19 1 = BMI 19 to <21 2 = BMI 21 to <23 3 = BMI ≥ 23	No modifications As described, according to clinically measured height at weight. If a height measurement was not available it was estimated from the mean of two measurements of knee to heel measurements, if these were obtained, with the following formula as has been recommended [30]: Estimated height = (1.83 × knee height, cm) − (0.24 × age) + 84.88

education continue to be used ubiquitously in research and policies, but this study and others [47, 48] have shown that they are not consistently associated with health outcomes in older adults. Attention to alternative socioeconomic measures, such as financial strain, may improve our ability to address nutritional risk in research, policies, and clinical practice for older adults.

This study found that a single screening question regarding financial strain may be useful in public health and primary care settings to identify individuals who have malnutrition risk and should receive formal clinical nutritional evaluation. This is important since one simple screening question on financial strain is feasible for clinical implementation and more likely to be answered by patients than questions about income. Based on these results, individuals who regularly experience financial strain are likely to be at increased malnutrition risk. In this study, individuals who reported either that they often did not have enough money to make ends meet or that they often lacked income for food had high likelihood of needing a clinical malnutrition evaluation. Timely identification of these individuals in public health and primary care settings is a critical step in effective nutritional intervention.

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