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FOOD INSECURITY AMONG OLDER EUROPEANS: EVIDENCE FROM THE SURVEY OF HEALTH, AGEING, AND RETIREMENT IN EUROPE

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Food insecurity among older Europeans: Evidence from the Survey of Health, Ageing, and Retirement in Europe

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Abstract

Using data from the fifth wave of the Survey of Health, Ageing and Retirement in Europe, this study investigates the association between food insecurity (FI) and several demographic, socioeconomic, and health-related characteristics in a sample of European residents aged 50 and over. Our initial analysis reveals that in 2013, the proportions of 50+ individuals reporting an inability to afford meat/fish/poultry or fruit/vegetables more than 3 times per week were 11.1% and 12.6%, respectively. It also indicates that not only income but also functional impairment and chronic disease are significantly associated with an increased probability of food insecurity. In a subsequent nonlinear decompositional analysis of the food unaffordability gap between European countries with high versus low FI prevalence, our rich set of covariates explains 36–39% of intercountry differences, with household income, being employed, and having functional impairment and/or chronic disease as the most important contributors.

JEL Classification Codes: D12; D63; I31

Keywords: food unaffordability; decompositional analysis; older Europeans;

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1. Introduction

Although the vast majority of undernourished people live in the developing world, over 20 million EU households are also suffering from food insecurity (Elanco, 2015), defined as the inability to afford a high-quality meal (e.g. meat, fish, poultry, or a vegetarian equivalent) every other day. Not only did the proportion of individuals unable to afford meat or its equivalent rise from 8.7% in 2009 to 10.9% in 2012 (Loopstra et al., 2015), but in 2013, the share of the household budget spent on food across Europe ranged from around 10% in the UK, 20% in Italy, and 25% in Poland to 37% in Bulgaria (Elanco, 2015). Food may be even less affordable in the wake of the recent recession, which has resulted in unemployment, debt, and housing arrears (Loopstra et al., 2015). At the same time, the European population is aging, with the proportion over 65 predicted to increase from 87.5 million in 2010 to 152.6 million in 2060 (Harper, 2014), and anecdotal evidence suggests that this older population is particularly vulnerable to the economic crisis. It has therefore become even more crucial to understand the drivers of food insecurity (FI) in Europe, especially among older citizens for whom FI statistics are scant.

Yet despite this urgency, only a small strand of research examines the association between FI and demographic and socioeconomic characteristics in individual European countries such as France, Ireland, the UK, Germany, Greece, and Portugal (Alvares and Amaral, 2014; Bocquier et al., 2015; Dowler and O'Connor, 2012; Elia and Stratton, 2005; Katsikas et al., 2014; Pfeiffer et al., 2015; Tingay et al., 2003). In our study, therefore, we extend this research by using data from the latest wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) to conduct an international comparative analysis of FI determinants for Europe's 50+ generation. Besides accounting for the standard demographic and socioeconomic FI determinants, we also examine the role of functional impairment and health problems, whose importance for altered food use (inability to use food) is highly relevant for FI among the elderly (Lee and Frongillo, 2001; Wolfe et al., 1998). We then use Fairlie's (1999) nonlinear decomposition to evaluate

the differences in FI (in our case, food unaffordability) between food-secure/food-insecure geographic groups and deepen our understanding of cross-national FI differences.

We show that in 2013, the proportions of over-50s reporting an inability to afford meat/fish/poultry or fruit/vegetables less than 3 times per week were 11.1% and 12.6%, respectively, far from a negligible number. We also confirm that being employed and married and having higher levels of education and household income are associated with a lower probability of inability to afford meat/fish/poultry or fruit/vegetables on a regular basis. Functional impairment, on the other hand, is strongly correlated with an elevated likelihood of FI. Our nonlinear decompositional results also indicate that household income and being employed/self-employed are the two main contributors to the food unaffordability gap between high FI and low FI prevalence European nations, although functional impairment and chronic disease also make a large contribution.

The remainder of this paper is structured as follows: Section 2 reviews the relevant literature, Section 3 describes the data and methods, Section 4 reports the results, and Section 5 summarizes the conclusions.

2. Prior studies

A small body of literature does examine the linkage between FI and demographic and socioeconomic determinants in Europe. For example, Elia and Stratton (2005), using data from the National Diet and Nutrition Survey of English residents 65 and over, demonstrate strong north-south inequalities (worse in the north) in the risk for protein-energy malnutrition and/or a deficiency in certain nutrients derived from fruits and vegetables. They further suggest that, although lower socioeconomic status (in terms of education, social class of household head, income, and old age pension) are important factors for nutritional status, a significant geographic gradient remains even after socioeconomic factors are accounted for. Likewise, Bocquier et al. (2015) find that, relative to French adults experiencing food security (FS), their counterparts experiencing FI are significantly younger, more frequently female, especially single women with at least one child, and more likely to have lower socioeconomic status (as measured by occupation, education, income, perceived household financial situation, and living conditions). These findings echo Alvares and Amaral's (2014) analysis of 2005/06 Portuguese National Health Survey data, which also shows that women and younger,

unemployed, and less educated individuals are more vulnerable to FI. This observation is confirmed by Katsikas et al. (2014) for Greece and Tingay et al. (2003) for South East London. Pfeiffer et al. (2011) further observe that more Germans are being forced to rely on food banks for their regular nutritional supply and that the FI of those in poverty is heavily dependent on decisions by local entrepreneurs and volunteers. In a later study using longitudinal data from SILC/Eurostat, Pfeiffer et al. (2015) also identify delegation, denial, and stigmatization as the major societal strategies for coping with FI in Germany. In another study using EuroStat data, Loopstra et al. (2015) document an increasing FI trend between 2009 and 2012 and, although they do not empirically identify any specific socioeconomic determinants, emphasize that the FI hardship could be heterogeneous among different European countries after the recent recession.

Given our research objective, it is important to highlight three important aspects of extant studies: First, virtually no comprehensive research exists on FI among older Europeans. To our knowledge, only one UK study by Elia and Stratton (2005) identifies a significant geographic divide in nutritional status among those 65+ even after adjustment for socioeconomic factors. This lack of prior research is surprising given the susceptibility of older individuals to poverty, functional impairment, and health problems, all of which may affect FI (Lee and Frongillo, 2001; Wolfe et al., 1998). Second, although extant research does examine the association between FI and demographic and socioeconomic characteristics, no study applies a nonlinear decompositional approach to identify disaggregated contributions of individual determinants to FI differences between certain groups or geographic regions. Third, most past investigations focus only on one or two European countries, so despite substantial FI differences among European state – particularly with respect to national capacity to meet food demand (European Commission Directorate-General for Agriculture and Rural Development, 2012) – there is a dearth of research assessing such cross-national differences. Comparing different European countries, therefore, should deepen our understanding of country-specific FI heterogeneity. These three points underscore the value of our paper's contribution: not only is it the first to investigate the association between FI and a range of individual characteristics (demographic, socioeconomic, and impairment and health related) among older Europeans, it also takes a detailed look at disaggregated contributions to the FI differences between groups of European states in order to identify country-specific FI heterogeneity.

3. Data and methods

3.1 Data

The data for this analysis are taken from the Survey of Health Ageing and Retirement in Europe (SHARE), a unique European dataset on individuals aged 50 and older that includes information on health, socioeconomic status, and social and family networks (Börsch-Supan et al., 2013). This survey, which is harmonized with the U.S. Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA), has become a role model for several aging surveys worldwide (Börsch-Supan et al., 2013). Currently, the survey comprises four panel waves (2004, 2006, 2010, and 2013) covering current living conditions and retrospective life histories with several additional waves planned until 2024. One unique feature of the 2013 Wave 5 dataset is its inclusion of a specific work package of additional informative measures on respondents' material situations, including affordability (of specific expenses) and neighborhood quality. This Wave 5 dataset covers 15 countries: Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Switzerland, Belgium, Czech Republic, Luxembourg, Slovenia and Estonia, and Israel.

Our analytic sample is restricted to those aged 50 and over for whom detailed information is available on demographics, household socioeconomics, functional impairment, and health-related problems (proxied here by chronic disease). Because the data on food affordability, particularly on meat/fish/poultry and fruit/vegetable affordability, are only available in Wave 5, our final sample includes 10,181 observations for the former and 3,389 observations for the latter.

3.2 Study variables

Dependent variable

In line with Loopstra et al. (2015) and Elanco (2015), we adopt a conventional measure of household FI based on the unaffordability of meat/fish/poultry and fruit/vegetables. These two measures are based on the following question: "Would you say that you do not eat meat/fish/poultry (or fruit/vegetables) more often because…". The possible answers to this question are 1 = we cannot afford it and 2 = [of] some other reason. We thus recode the responses into a dummy variable equal to 1 if the household respondent (on behalf of other household members) reports that they do not eat meat/fish/poultry (fruit/vegetables) more often because they cannot afford to, and 0 otherwise. It should be noted that this question is only

asked of respondents who consume these food items less than 3 times per week, meaning that the dependent variables identify households that consume these commodities less often because of unaffordability.

Explanatory variables

We group the explanatory variables into four categories: (i) functional impairment and chronic disease, (ii) individual characteristics, (iii) household characteristics, and (iv) other characteristics.

Functional impairment and chronic disease

Following Lee and Frongillo (2001), we use limitations in (instrumental) activities of daily living (ADL, IADL) and chronic disease as proxies of functional impairment and health problems, respectively. ADL comprises 6 items: dressing, walking across a room, bathing or showering, eating, getting in and out of bed, and using the toilet (including getting up or down). IADL includes 7 items: using a map in a strange place, preparing a hot meal, shopping for groceries, making telephone calls, taking medications, doing work around the house or garden, and managing money. We then recode both ADL and IADL as dummies equal to 1 if the respondent has at least one ADL or IADL difficulty, respectively, and 0 otherwise. The chronic disease variable is a dummy equal to 1 if the respondent has at least two types of chronic disease; 0 otherwise.

Individual characteristics

The individual characteristics are age, gender, employment status, marital status, and educational level. The gender dummy equals 1 if the respondent is a male; 0 otherwise. Employment status is a dummy if the respondent is employed or self-employed; 0 otherwise. Marital status is measured on a 5-point scale of 1 = unmarried, 2 = married/living together, 3 = separated, 4 = divorced, and 5 = widowed and then recoded as a dummy with unmarried as the reference category. Education is measured by years of schooling.

Household and other (control) characteristics

In addition to using household income and size to measure household characteristics, we also include a country dummy to capture country-level polities that may influence FI in the 50+ population. Including a country dummy also facilitates intercountry comparisons, thereby

capturing the country-specific heterogeneities that account for FI hardship adjusted by other contributing factors.

3.3 Estimation procedure

3.3.1 Probit estimation

Because our food unaffordability measures are binary, we employ a probit estimation to examine their association with demographics, socioeconomic factors, and functional impairment/health problems. The specific model is as follows:

$$FIS_{ic} = \beta_0 + \beta_1 X_{ic} + \beta_2 F + \beta_3 C + \varepsilon_{ic} \quad (1)$$

where FIS_{ic} is a binary variable denoting meat/fish/poultry or fruit/vegetable unaffordability of individual i in country c, and X_i is a vector of individual i's characteristics, F is a vector of household characteristics, C is a vector of the country dummy (with Germany as the reference country), β_i denotes the coefficients of interest, and ε_{ic} is the error term. To facilitate interpretation of the estimated coefficients, we report the corresponding marginal effects, which depict the probability that the household is experiencing food unaffordability.

3.3.2 Fairlie's (1999) nonlinear decomposition

As emphasized by Fairlie (2016), the adoption of the standard Blinder-Oaxaca (BO) and a linear probability decomposition provides misleading estimates in the case of binary dependent variables, particularly when group differences are relatively large for an influential independent variable. A relatively straightforward simulation technique for nonlinear decomposition is preferable. We therefore employ a nonlinear decompositional method to qualify the contribution of demographic, socioeconomic characteristics, and functional impairment/health problems on the differences in food unaffordability between two geographic groups of European countries. Based on the country-specific prevalence of meat/fish/poultry unaffordability (see appendix Table A2), we categorize the 15 survey countries into two groups: Group 1 (higher prevalence of meat/fish/poultry unaffordability): Spain, Italy, France, Israel, Czech Republic, and Estonia; Group 2 (lower prevalence of meat/fish/poultry unaffordability): Austria, Germany, Sweden, Netherlands, Denmark, Switzerland, Belgium, Luxembourg, and Slovenia. We adopt the same strategy for fruit/vegetable unaffordability: Group 3 (higher prevalence of fruit/vegetable unaffordability): Spain, Italy, France, Slovenia, Czech Republic,

and Estonia; Group 4 (lower prevalence of fruit/vegetable unaffordability): Austria, Germany, Sweden, Netherlands, Denmark, Switzerland, Belgium, Luxembourg, and Israel.

For the analysis using meat/fish/poultry unaffordability as the binary dependent variable, the decomposition for nonlinear equation $Y = F(\mathrm{X}\hat{\beta})$ can be expressed as:

$$\bar{Y}^{G1} - \bar{Y}^{G2} = \left(\sum_{i=1}^{N^{G1}} \frac{F\left(X_i^{G1}\hat{\beta}^{G2}\right)}{N^{G1}} - \sum_{i=1}^{N^{G2}} \frac{F\left(X_i^{G2}\hat{\beta}^{G2}\right)}{N^{G2}}\right) + \left(\sum_{i=1}^{N^{G1}} \frac{F\left(X_i^{G1}\hat{\beta}^{G1}\right)}{N^{G1}} - \sum_{i=1}^{N^{G1}} \frac{F\left(X_i^{G1}\hat{\beta}^{G2}\right)}{N^{G1}}\right) \quad (2)$$

where N^j denotes the sample size of each group (j = Group 1 (G1), Group 2 (G2)). Two aspects are worth highlighting: First, in equation (2), the first (explained) term on the right indicates the contribution attributable to a difference in the distribution of the determinant of *X*, and the second (unexplained) term refers to the part resulting from a difference in the determinants' effects, meaning that it captures all the potential effects of differences in unobservables (Fairlie, 2016). Second, in keeping with the majority of previous research using decompositional analysis, we focus on the explained part and the disaggregated contribution of the individual covariates. The contribution of a variable is given by the average change in function if that variable is changed while all other variables are kept the same. We use the same approach to analyze fruit/vegetable unaffordability (i.e., the differences between Groups 3 and 4).

One potential concern with Fairlie's (1999) sequential decomposition, however, is path dependence; that is, the possibility that altering the order of the variables in the decomposition may lead to different results (Schwiebert, 2015). We therefore rule out the decompositional estimates' sensitivity to variable reordering by randomizing the variables during decomposition (Fairlie, 2016; Schwiebert, 2015). Additionally, because a large number of replications are needed to retain the summing up property while approximating the average decomposition over all possible orderings, we use the recommended minimum of 1,000 replications (see Fairlie, 2016) and also perform a robustness check using 5,000 replications.

4. Results

4.1 Descriptive statistics

As appendix Table A1 shows, the 2013 prevalence of meat/fish/poultry and fruit/vegetable unaffordability is 11.1% and 12.6%, respectively, which is slightly higher than the 2012 figure

of 10.9% obtained by Loopstra et al. (2015). The mean age in the sample is around 68, with the majority (approximately 63%) of respondents being female. Those suffering from at least one type of ADL and/or IADL difficulty make up 14.7% and 21.8%, respectively, and almost half (49.3%) are suffering from at least two types of chronic disease.

Table 1 shows the prevalence of households who report consumption of meat (fish, poultry) or fruit (vegetables) less (more) than 3 times per week and the corresponding unaffordability proportions and FI rate. On average, a mere 2% (approximately 1%) of all households suffer from meat/fish/poultry (fruit/vegetable) insecurity (columns 3 and 6, respectively), although the average FI rates vary by country, with a higher 6% (3%) rate in Estonia, followed by 4% (2%) in the Czech Republic, 4% (1%) in Italy, and 3% (1%) in Israel.

Table 1 Country-specific consumption (<3 times a week) and unaffordability of meat (fish, poultry) or fruit (vegetables)

	Meat/fish/poultry			Fruit/vegetables		
	(1)	(2)	(3)	(4)	(5)	(6)
Country	<3 times/week	Unaffordability	FI	<3 times/week	Unaffordability	FI
All	0.179	0.111	0.020	0.060	0.126	0.008
Austria	0.332	0.029	0.010	0.070	0.028	0.002
Germany	0.322	0.051	0.016	0.084	0.083	0.007
Sweden	0.077	0.032	0.002	0.086	0.016	0.001
Netherlands	0.071	0.024	0.002	0.017	0.103	0.002
Spain	0.122	0.158	0.019	0.031	0.134	0.004
Italy	0.350	0.126	0.044	0.047	0.263	0.012
France	0.069	0.137	0.009	0.025	0.185	0.005
Denmark	0.022	0.037	0.001	0.084	0.023	0.002
Switzerland	0.187	0.033	0.006	0.022	0.032	0.001
Belgium	0.077	0.086	0.007	0.036	0.072	0.003
Israel	0.251	0.107	0.027	0.068	0.086	0.006
Czech Republic	0.227	0.176	0.040	0.123	0.184	0.023
Luxembourg	0.143	0.027	0.004	0.045	0.014	0.001
Slovenia	0.261	0.062	0.016	0.027	0.135	0.004
Estonia	0.189	0.325	0.061	0.095	0.262	0.025

Note: The FI of meat/fish/poultry = (1) X (2) and that of fruit/vegetables = (4) X (5).

Before performing the nonlinear decomposition, we statistically compare meat/fish/poultry (fruit/vegetable) unaffordability in Group 1 (Group 3) versus Group 2 (Group 4). As Table 2 illustrates, a statistically significant divide exists between Groups 1 and 2 in meat/fish/poultry unaffordability, as well as in demographics, socioeconomic factors, functional impairment (ADL and IADL), and health problems (chronic disease) but not gender. As shown in Tables 2 and 3, the prevalence of meat/fish/poultry (fruit/vegetable) unaffordability is 18.1% (21.1%)

in Group 1 (Group 3) versus 4.4% (4.7%) in Group 2 (Group 4). Those in Group 1 (Group 3) are also more likely to have lower socioeconomic status (in terms of employment, education, household income) and suffer from ADL, IADL, and/or chronic disease than those in Group 2 (Group 4).

Table 2 Descriptive statistics: meat/fish/poultry unaffordability, functional impairment, and health problems

Variables	Group 1	Group 2	Mean difference
Meat unaffordability	0.181	0.044	0.137***
Age	68.836	67.158	1.678***
Gender	0.361	0.360	0.001
Employed/self-employed	0.189	0.258	-0.069***
Marital status: Never married	0.068	0.087	-0.018***
Marital status: Married/partnership	0.582	0.553	0.029***
Marital status: Separated	0.016	0.022	-0.006**
Marital status: Divorced	0.104	0.148	-0.044***
Marital status: Widowed	0.230	0.191	0.040***
Years of education	10.408	10.851	-0.443***
Functional impairment: ADL	0.185	0.111	0.074***
Functional impairment: IADL	0.261	0.177	0.084***
Health problems: Chronic disease	0.536	0.451	0.084***
Log(household total income)	9.578	10.323	-0.745***
Household size	2.085	1.892	0.194***
N	4990	5191	

Note: Group 1 includes Spain, Italy, France, Israel, Czech Republic, and Estonia; Group 2 includes Austria, Germany, Sweden, Netherlands, Denmark, Switzerland, Belgium, Luxembourg, and Slovenia. For Group 1, the observations of ADL, IADL, and chronic disease are 4,987, 4,987, and 4,986, respectively; for Group 2, they are 5,189, 5,189, and 5,172, respectively. $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3 Descriptive statistics: fruit/vegetable unaffordability, functional impairment, and health problems)

Variables	Group 3	Group 4	Mean difference
Fruit unaffordability	0.212	0.047	0.164***
Age	66.951	65.733	1.218***
Gender	0.533	0.656	-0.124***
Employed/self-employed	0.194	0.291	-0.097***
Marital status: Never married	0.093	0.106	-0.013
Marital status: Married/partnership	0.583	0.560	0.023
Marital status: Separated	0.020	0.019	0.001
Marital status: Divorced	0.127	0.167	-0.040***
Marital status: Widowed	0.178	0.147	0.030**
Years of education	10.582	10.625	-0.043
Functional impairment: ADL	0.214	0.171	0.043***
Functional impairment: IADL	0.283	0.241	0.042***
Health problems: Chronic disease	0.540	0.535	0.004
Log(household total income)	9.354	10.334	-0.980***
Household size	2.108	1.882	0.226***
N	1626	1763	

Note: Group 3 includes Spain, Italy, France, Slovenia, Czech Republic, and Estonia; Group 4 includes Austria, Germany, Sweden, Netherlands, Denmark, Switzerland, Belgium, Luxembourg, and Israel. For Group 3, the observations of ADL, IADL,

and chronic disease are 1,622, 1,622 and 1,625, respectively; for Group 4, they are 1,762, 1,762, and 1,758, respectively. $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.2 Determinants of food unaffordability

As regards the association of food unaffordability with specific determinants (adjusted or unadjusted by functional impairment and health problems), Table 4 shows that when no controls are included for ADL, IADL, or chronic disease; age, being employed/self-employed, being married, and having higher levels of education and household income are linked to a lower probability of meat/fish/poultry unaffordability, and all except for education are similarly linked to fruit/vegetable unaffordability (columns 1 and 3).[1] These results are well in line with findings for Portugal (Alvares and Amaral, 2014), France (Bocquier et al., 2015), and the UK (Elia and Stratton, 2005). Once ADL, IADL, and chronic disease are controlled for, age and lower socioeconomic status are still more likely to be associated with food insecurity (columns 2 and 4). Even more interesting, 50+ individuals with ADL/IADL difficulties plus chronic disease are more vulnerable to meat/fish/poultry unaffordability, whereas those with ADL/IADL difficulties only are prone to fruit/vegetable unaffordability (with positive yet insignificant marginal effects). These observations imply that functional impairment and health problems are significantly correlated with FI among older individuals, a finding consistent with Lee and Frongillo's (2001) evidence of functional impairment's importance in predicting FI among 60+ individuals in the U.S. even when after adjustment for demographic and socioeconomic factors.

Table 4 Probit estimates for food unaffordability in 50+ individuals (marginal effects)

Variables	Meat/fish/poultry unaffordability		Fruit/vegetable unaffordability	
	(1)	(2)	(3)	(4)
Age	-0.004***	-0.005***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
Gender	0.011*	0.015**	-0.055***	-0.050***
	(0.006)	(0.006)	(0.011)	(0.011)
Employed/self-employed	-0.081***	-0.071***	-0.090***	-0.085***
	(0.009)	(0.009)	(0.016)	(0.016)
Married/partnership	-0.064***	-0.059***	-0.036*	-0.034*
	(0.011)	(0.011)	(0.019)	(0.018)
Separated	-0.008	-0.007	0.012	0.013
	(0.021)	(0.021)	(0.036)	(0.037)
Divorced	-0.008	-0.004	0.003	0.007
	(0.012)	(0.012)	(0.020)	(0.020)
Widowed	-0.039***	-0.036***	-0.021	-0.023
	(0.012)	(0.012)	(0.021)	(0.021)

[1] Interestingly, consistent with Lee and Frongillo's (2001) findings for 60- to 90-year-olds in the U.S., the younger members of the older population are significantly associated with an elevated probability of both types of unaffordability.

Years of education	-0.005***	-0.004***	-0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)
ADL		0.031***		0.050***
		(0.009)		(0.015)
IADL		0.034***		0.027*
		(0.008)		(0.014)
Chronic disease		0.032***		0.003
		(0.006)		(0.011)
Log(total household net income)	-0.039***	-0.035***	-0.039***	-0.035***
	(0.005)	(0.005)	(0.009)	(0.009)
Household size	0.008***	0.008**	-0.013**	-0.013*
	(0.003)	(0.003)	(0.007)	(0.007)
N	10181	10158	3389	3379
Pseudo R^2	0.164	0.179	0.172	0.183

Note: The dependent variable is a dummy for whether unaffordability is the reason that the household cannot eat meat (fish, poultry) or fruits (vegetables) more often each week (1 = yes, 0 = no). For Models 1 and 3, the controls are age, gender (1 = male, 0 = female), employment status (1= employed/self-employed), marital status (measured on a five-point scale: 1 = never married, 2 = married/partnership, 3 = separated, 4 = divorced, 5 = widowed), years of education, translog total household net income, household size, and a country dummy (with Germany as the reference). Models 2 and 4 add in ADL (1 = at least 1 type of ADL, 0 = no difficulties), IADL (1 = at least 1 type of IADL, 0 = no difficulties), and chronic disease (1 = at least 1 type of chronic disease, 0 = no chronic disease). The table also reports marginal errors and robust standard errors (in parentheses). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.3 Country-specific heterogeneities in food unaffordability

As Figure 1 shows, the analysis reveals substantial country-specific heterogeneity with the Czech Republic, followed by Estonia, France, Italy, and Spain, having larger proportions of 50+ individuals unable to afford meat/fish/poultry and fruit/vegetables on a regular basis. Even with a rich set of covariates controlled for, the marginal effects are large, ranging from about 0.05 to 0.14, meaning that even after demographic, health, and economic variables are taken into account, a large degree of heterogeneity remains. This finding lends support to the notion that not only food price differences but also institutional (e.g., availability of food, public transportation, and other amenities) and social support differences (e.g. family ties and networks) may matter.

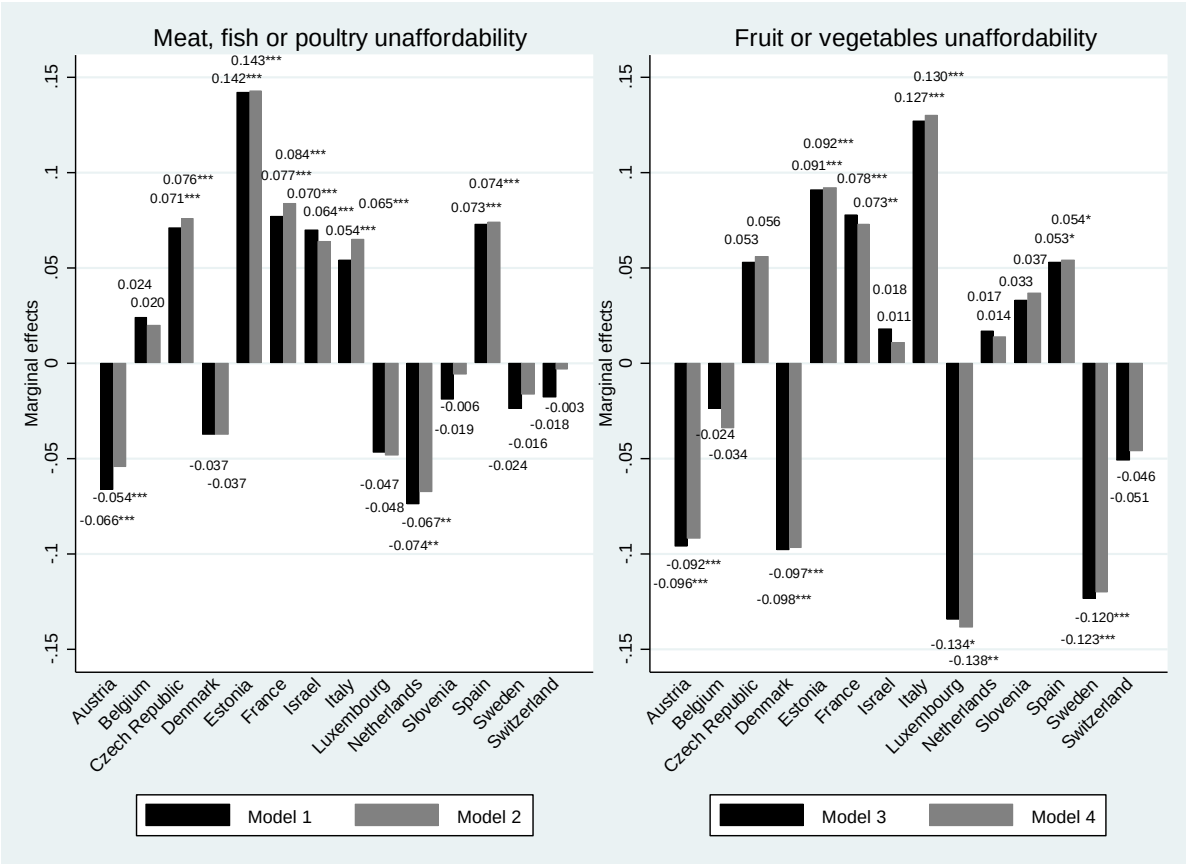

Figure 1 Meat (fish, poultry) or fruit (or vegetable) unaffordability in Europe

Note: The dependent variables are dummies for whether unaffordability is the reason that a household does not eat meat (fish, poultry) or fruit (or vegetables) more often (1 = cannot afford, 0 = cannot eat for other reasons). The controls for Models 1 and 3 are age, gender, employment status, marital status, education, total household net income, household size, and country dummy (with Germany as the reference). Models 2 and 4 add in ADL, IADL, and chronic disease. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.4 Explaining the differences in food unaffordability

To better understand the disaggregated distributions of food unaffordability differences between our geographic groups, we perform nonlinear decomposition (Fairlie, 1999) with and without controls for functional impairment and health problems in order to identify the possible mediating effects attributable to these two factors.

4.4.1 Without controls for functional impairment and health problems

The results of the nonlinear decompostion without controls for functional impairment and chronic disease are reported in Table 5, which shows the contributions of the explained part for meat/fish/poultry and fruit/vegetable unaffordability to be 36% and 39%, respectively. For the individual contribution of determinants in the explained part, household income consistently explains the largest share of the differences between Groups 1 (3) and 2 (4) in both

meat/fish/poultry and fruit/vegetable unffordability with proportions of 118% and 94%, respectively. Nevertheless, being employed/self-employed is also a relatively important contributor, accounting for 24% and 23% of the explained part for meat/fish/poultry and fruit/vegetable unaffordability, respectively.

Table 5 Nonlinear decomposition of socioeconomic differences in food unaffordability among 50+ individuals: no controls for functional impairment and health problems

	Meat/fish/poultry unaffordability	Contribution	Fruit/vegetable unaffordability	Contribution
		%		%
Group 2 (Group 4)	0.044		0.047	
Group 1 (Group 3)	0.181		0.212	
Total difference	0.137		0.165	
Explained	0.050	36	0.064	39
Unexplained	0.087	64	0.101	61
Explained part				
Age	-0.020***	-40	-0.016***	-25
	(0.002)		(0.003)	
Male	-0.000	0	0.010***	16
	(0.000)		(0.002)	
Employed/self-employed	0.012***	24	0.015***	23
	(0.002)		(0.003)	
Marital status	-0.005***	-10	-0.001	-2
	(0.001)		(0.001)	
Education	0.002***	4	0.000	0
	(0.001)		(0.000)	
Household income	0.059***	118	0.060***	94
	(0.004)		(0.009)	
Household size	0.003**	6	-0.003**	-5
	(0.001)		(0.001)	
Number of replications	1000		1000	

Note: The dependent variables are dummies for whether unaffordability is the reason that the household cannot afford meat (fish, poultry) or fruit (or vegetables) more often (1 = cannot afford to eat, 0 = do not eat for some other reason). The controls are age, gender (1 = male, 0 = female), employment status (1 = employed/self-employed), marital status (measured on a five-point scale: 1 = never married, 2 = married/partnership, 3 = separated, 4 = divorced and 5 = widowed), years of education, translog total household net income, and household size. Standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.4.2 With controls for functional impairment and health problems

We then introduce the functional impairment and chronic disease variables into the regression and re-estimate the decomposition. As Table 6 shows, household income once again uniformly makes the largest contribution to the overall explained part for both meat/fish/poultry and fruit/vegetable unaffordability, accounting for 100% and 90%, respectively. Interestingly, however, functional impairment and chronic disease also make a relatively important 34% contribution to the explained part, which is considerably larger than the 25% contribution of employment status. As regards fruit/vegetable unaffordability, in addition to household income,

employment status, male gender, and functional impairment and/or chronic disease make substantial contributions of 25%, 15%, and 13%, respectively.[2]

Table 6 Nonlinear decomposition of socioeconomic differences in food unaffordability among 50+ individuals: with controls for functional impairment and health problems

Variables	Meat/fish/poultry unaffordability	Contribution	Fruit/vegetable unaffordability	Contribution
		%		%
Group 2 (Group 4)	0.044		0.047	
Group 1 (Group 3)	0.181		0.212	
Total difference	0.137		0.165	
Explained	0.053	39	0.061	37
Unexplained	0.084	61	0.104	63
Explained part				
Age	-0.031***	-58	-0.021***	-34
	(0.003)		(0.004)	
Male	-0.0002**	0	0.009***	15
	(0.000)		(0.002)	
Employed/self-employed	0.013***	25	0.015***	25
	(0.002)		(0.003)	
Marital status	-0.005***	-9	-0.002	-3
	(0.002)		(0.002)	
Education	0.003***	6	0.0002	0
	(0.001)		(0.000)	
Functional impairment and chronic disease	0.018***	34	0.008***	13
	(0.002)		(0.002)	
Household income	0.053***	100	0.055***	90
	(0.004)		(0.009)	
Household size	0.002**	4	-0.003**	-5
	(0.001)		(0.001)	
Number of replications	1000		1000	

Note: The dependent variables are dummies for whether unaffordability is the reason that the household cannot afford meat (fish, poultry) or fruit (or vegetables) more often (1 = cannot afford to eat, 0 = do not eat for some other reason). The controls are age, gender (1 = male, 0 = female), employment status (1 = employed/self-employed), marital status (measured on a five-point scale: 1 = never married, 2 = married/partnership, 3 = separated, 4 = divorced, 5 = widowed), years of education, ADL (1 = at least 1 type of ADL, 0 = no difficulties), IADL (1 = at least 1 type of IADL, 0 = no difficulties), chronic diseases (1 = at least 1 type of chronic disease, 0 = no chronic disease), translog total household net income, and household size. The functional impairment group includes ADL, IADL, and chronic disease. Standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5. Conclusions

This analysis of recent data from Wave 5 of the Survey of Health, Ageing and Retirement in Europe (SHARE) investigates the demographic and socioeconomic characteristics that account for FI among European individuals aged 50 and over. Because limited or uncertain food access may be a consequence of functional impairment and/or health problems, our models also include controls for ADL/IADL and chronic disease as proxies for these two factors. Because an additional study objective is to identify the reasons for FI differences among European

[2] To detect the possible biases from path dependence, we also randomize the variable order and re-run the estimates with 1,000 and 5,000 replications. The results, available from the authors upon request, are qualitatively similar.

countries, we categorize SHARE's participating countries into two groups based on high versus low FI prevalence. We then use Fairlie's (1999) nonlinear decomposition to determine which factors account for what share of the FI differences between these two groups.

The study yields the following major findings: First, food unaffordability among 50+ individuals in Europe is quite widespread, with approximately 11.1% of this population unable to afford meat/fish/poultry and 12.6% unable to afford fruit/vegetables more than 3 times per week. Clearly, as the Ready for Aging Alliance (2015) points out, not all baby boomers are aging successfully. Second, being employed, being married, and having higher levels of education and household income are associated with a lower probability of inability to afford meat/fish/poultry or fruit/vegetables every other day, suggesting that those 50 and over with lower socioeconomic status are more vulnerable to FI. Third, ADL, IADL, and chronic disease are strongly correlated with a higher probability of FI, which clearly supports the notion that functional impairment and health problems among older individuals affect their ability to prepare, gain access to, and even consume food. Unfortunately, however, the research to date has paid scant attention to these factors in explaining FI among the elderly. Fourth, relative to Germany, the Eastern and Southern European countries, particularly the Czech Republic, Estonia, France, Italy, and Spain, are more likely to suffer from food unaffordability, possibly because these countries are currently facing a combination of economic hardship and declining agricultural productivity (France), higher food prices relative to income than in most of the EU (Spain and Italy), or high unemployment (Spain, France, and Italy) (Elanco, 2015). Nevertheless, significant country differences remain even after we control for particular health, economic, and demographic variables, which implies that regional FI differences may be significantly affected by institutional and social support factors. The nonlinear decomposition results also provide evidence that although household income and employment status (being employed/self-employed) are the two largest contributors to the explained part of the food unaffordability differences; functional impairment and health problems also make relatively important contributions, especially in the case of meat. Our decompositional analysis further reveals, however, that even our rich set of covariates cannot explain over 50% of the differences between low and high FI prevalence countries, which suggests that the phenomenon is underlain by factors not accounted for in our models, such as differences in institutions and social support.

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Appendix:

Table A1 Descriptive statistics

Variable	Obs.	*M*	*SD*	Min.	Max.
Dependent variables					
Meat/fish/poultry unaffordability	10181	0.111	0.315	0	1
Fruit/vegetable unaffordability	3389	0.126	0.332	0	1
Independent variables					
Age	10181	67.980	10.287	50	103
Gender	10181	0.361	0.480	0	1
Employed/self-employed	10181	0.225	0.417	0	1
Marital status					
Never married	10181	0.078	0.268	0	1
Married/partnership	10181	0.567	0.495	0	1
Separated	10181	0.019	0.136	0	1
Divorced	10181	0.126	0.332	0	1
Widowed	10181	0.210	0.407	0	1
Years of education	10181	10.634	4.472	1	25
ADL	10176	0.147	0.354	0	1
IADL	10176	0.218	0.413	0	1
Chronic diseases	10158	0.493	0.500	0	1
Log(household total income)	10181	9.958	1.011	7.678	13.998
Household size	10181	1.986	1.005	1	11

Source: The Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 5.

Table A2 Prevalence of country-specific unaffordability in meat (fish, poultry) and fruit (or vegetables)

Country	Meat/fish/poultry unaffordability	Obs.	Fruit/vegetable unaffordability	Obs.
Austria	0.029	1356	0.028	287
Germany	0.051	1360	0.083	348
Sweden	0.032	277	0.016	318
Netherlands	0.024	248	0.103	58
Spain	0.158	621	0.134	157
Italy	0.126	1448	0.263	194
France	0.137	293	0.185	108
Denmark	0.037	81	0.023	301
Switzerland	0.033	540	0.032	62
Belgium	0.086	385	0.072	180
Israel	0.107	515	0.086	139
Czech Republic	0.176	1068	0.184	570
Luxembourg	0.027	222	0.014	70
Slovenia	0.062	722	0.135	74
Estonia	0.325	1045	0.262	523

Source: The Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 5.

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