Frailty and food insecurity in older adults

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Abstract

Objective: The objective of the current work was to determine the association between food insecurity and frailty in older adults, within the context of a country with accelerated ageing and nutritional problems.
Design: Cross-sectional analysis of a representative nationwide survey on health and nutrition.
Setting: Mexican nationwide survey.
Subjects: A sample of 7108 adults aged 60 years or older living in communities, representative of Mexican older adults.
Results: Multivariate regression and descriptive analyses of food insecurity and frailty were performed. From a total of 7108 adults aged 60 years or older, with a mean age of 70·7 years, most (54·7 %) were women. Food security categories were: 26·3 % had food security, 40·3 % had mild food insecurity, 20·5 % had moderate food insecurity and 12·9 % had severe food insecurity. Food insecurity categories were associated with frailty, with the severe category having the highest odds ratio of 2·41 (95 % CI 2·03, 2·86; $P < 0·001$) after adjustment for confounding factors.
Conclusions: According to our results, food insecurity is associated to frailty, which in turn is a condition that renders the older adult at a higher risk of developing adverse outcomes. Targeted food programmes for older adults with a high risk of having food insecurity or of being frail may improve health in this population group.

Low- and middle-income countries still face problems related to malnutrition and obesity as well as those related to ageing[1]. Along with infectious diseases, maternal conditions and nutritional disorders, the accelerated ageing of the population impacts both public and individual health[2,3].

Food security – defined by the FAO as a 'situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life' – has been increasingly important to the health of older adults currently living in low- and middle-income countries[4]. Food insecurity and its effects on nutrition deeply impact the overall well-being of aged people, mainly through frailty and functional impairments that could in turn lead to dependency[5,6]. A number of reports have established the deleterious effects of food insecurity on nutritional status of the elderly[7,8]. For example, a recent report showed that food insecurity is related to obesity and chronic diseases in this age group[9,10]. Moreover, malnutrition and obesity are related to oral health problems, gastrointestinal disorders and anorexia, which in turn are related to diabetes and hypertension, two of the most common chronic diseases of this age group[1].

Frailty is a condition that renders the older adult vulnerable to stressors and prone to adverse outcomes. For example, if a frail older adult has a cold, he or she will have an increased probability of contracting pneumonia. Frailty is a continuously growing and recognized phenomenon, both in research and clinical settings, due to its increased demand on health services and its impact on the family (burden)[11–13]. Its predictive value for adverse outcomes has been substantially evidenced[14] in comparison to the lack of knowledge on risk factors that could precede it, not only health-related but also socio-economic determinants. Having more information could improve the care of older adults who suffer from this condition[15,16].

Food insecurity has been studied among older adults in different settings and a consistent association with poorer health has been reported[10,17]. However, this problem has improved with food programmes that not only ameliorate the availability of food but also increase diet variability[18] (currently not available for older adults in Mexico).

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Recent evidence suggests that there is a link between frailty and nutritional disorders[6,19] and consequently with disability[20]. The role of low protein intake and possibly vitamin E along with a persistent inflammatory status seem to be part of this path[5,8,20,21]. On the other hand, food insecurity as a social determinant of frailty has been poorly studied in older adults, in particular in low- and middle-income countries, where social disparities are more common. Data regarding food insecurity in Mexico have shown that older adults have a higher prevalence than expected (67 %). An asociation between food insecurity and low weight was found[22].

The aim of the present work was to determine if an association between frailty and food insecurity exists in a nationwide survey of Mexican older adults. We hypothesized that older adults with higher food insecurity would also have a higher frailty burden.

Methods

The present study is a cross-sectional analysis of the 2012 Mexican Survey on Nutrition and Health (ENSANUT; *Encuesta Nacional de Salud y Nutrición*). The 2012 ENSANUT had a sample of 96 031 individuals, including a representative sample of older adults with specific questions and tests to assess their health, such as depressive symptoms, activities of daily living, cognitive assessment, falls and gait speed, among others. Older adults (aged 60 years or older) who were the head of household were included in the current analysis. The description of the 2012 ENSANUT in its entirety is available elsewhere[23].

For the study of frailty, Rockwood *et al.*'s frailty index was used, in which a higher score indicates a higher frailty status, and was integrated, as Searle *et al.* indicate, with forty-four deficits from different dominions excluding those that could be present in early life[24]. Deficits included memory complaints, dependence (activities of daily living), depressive symptoms, co-morbidities, violence or accident-related health problems, hearing and vision impairment, nutritional conditions, physical performance tests, self-esteem and satisfaction with life. Each one of the deficits was given a score between 0 and 1 (the majority of deficits are dichotomous but some are distributed into more than two categories). Each individual's deficit score was added and divided by all deficits taken into account (*n* 44), giving a total theoretical frailty score ranging from 0 to 1 (considered to be theoretical since scores nearing 1 are seen to be incompatible with life; see online supplementary material, Supplemental Table 1). The frailty index was further divided into those with a score ≥0·21 and those with <0·21, the first group being considered frail. This cut-off value has already been validated in Mexican older adults; those with frailty index score ≥0·21 have higher mortality risk[25].

Food insecurity was assessed with the previously validated questionnaire ELCSA (*Encuesta Latinoamericana y del Caribe de Seguridad Alimentaria*; Caribbean and Latin-American Survey on Food Security)[22,26,27]. Only the head of the family answered this questionnaire and it represents household-level food insecurity. The ELCSA questionnaire is composed of two sections, the first related to adults and the second to individuals younger than 18 years[22]. The first section is composed of eight questions that start with the sentence: 'In the last 3 months, due to lack of money or other resources, did you or any other adult in this household …' followed by eight different questions. For older adults with an 18-year-old or younger person living in the same household, there are seven additional questions, with a different beginning: 'In the last 3 months, due to lack of money or other resources, did any 18-year or younger person living in this household …' followed by the rest of the question. One point was given for each question answered 'yes', the higher the score the higher food insecurity. Further categorization of food insecurity according to the final score was defined as: none (score = 0), mild (score = 1–5 for the complete questionnaire or score = 1–3 for the adult-only questionnaire), moderate (score = 6–10 for the complete questionnaire or score = 4–6 for the adult-only questionnaire) and severe (score = 11–15 for the complete questionnaire or score = 7–8 for the adult-only questionnaire)[22].

Other variables assessed were age, sex, education (none, primary school, high school, college and post-graduate), marital status, urban stratus (living in a location with 7500 habitants or higher), self-reported speaking of an indigenous language, smoking (never smoked, fewer than 100 cigarettes, at least 100 cigarettes in life) and alcohol consumption (drinking five or more alcoholic beverages at least once weekly). To take into account income, a composite variable for the total monthly income of the household members was estimated, regardless if the income was from obtained from work or from other sources; this variable is in pesos, reference values for $US equivalence in 2012 are provided.

A complete description stratified by sex was carried out, with means and standard deviations for continuous variables, and frequencies for nominal variables. Bivariate analyses using the χ^2 test between categories of frailty index score (the lower the score the lower the frailty burden and vice versa) and each of the items of the ELCSA, in addition to the severity categories (for the whole test scores) were done to test the differences.

A multivariate analysis (multiple logistic regression) was performed between the categories of the frailty index and the food insecurity severity categories (with food security as the reference category). Unadjusted and adjusted multiple logistic regression models controlling for confounding variables were added: age, sex, marital status, urban stratus, speaking indigenous language,

household income, smoking status and current alcohol drinking. In order to show if estimates changed, a thirty-nine-item frailty index was constructed, excluding nutrition-related items, to fit the model just like the forty-four-item frailty index, and is presented in the online supplementary material. In addition, estimates were also run with 212 older adults from the sample who were not head of the household (data available upon request).

Results

From the total population, 7108 adults aged 60 years or older were considered head of the household. The mean age was 70·7 (SD 8·1) years, with a predominance of women (54·7 %). Of all the levels of education, primary represented 55·4 % (*n* 3940). The majority of the older adults included in the analysis were married, 55·4 % (*n* 3942). Older adults living in an urban stratus represented 61·1 % (*n* 4347), and up to 12·7 % (*n* 908) spoke an indigenous language. The mean monthly estimated income for the household was 795·12 (SD 2553·83) Mexican pesos (average equivalence in 2012 was 1 \$US = 13·16 Mexican pesos).

Those who never smoked comprised 53·2 % (*n* 3788) and 35·8 % (*n* 2545) smoked at least 100 cigarettes in their lives. Of the total population, 2·5 % reported alcohol consumption in the last week (see Table 1). Regarding food security categories: 26·3 % had food security, 40·3 %

mild food insecurity, 20·5 % moderate food insecurity and 12·9 % severe food insecurity.

For the frailty index, descriptive statistics were as follows: score mean was 0·201 (SD 0·09), with 45·2 % having a score ≥0·21. The deficit with the highest mean was Hb (0·572) and the lowest was having suffered aggression in the last year (0·014). Mean of the frailty index for each food insecurity category was as follows: secure 0·194 (SD 0·09), mild 0·214 (SD 0·094), moderate 0·228 (SD 0·094) and severe 0·237 (SD 0·097), with a significance of 0·076 (*F* statistic for linear trend 0·03).

From the total of households, 1801 had people 18 years old or younger living with them; therefore the complete ELCSA questionnaire was considered (fifteen items; (Table 2). In the bivariate analysis, all of the ELCSA items were significantly different between older adults with a frailty index ≥0·21 or <0·21, with the exception of five items from the last seven questions (only for households with 18-year-olds or younger persons). Regarding categories of food insecurity, the proportion of older adults with frailty index score ≥0·21 increased as follows: secure 36·10 %, mild food insecurity 43·99 %, moderate food insecurity 52·19 % and severe food insecurity 56·20 % (*P* < 0·001; Table 2).

Multiple logistic regression models were significant for all categories, when compared with the reference (food security). Mild food insecurity unadjusted OR was 1·39 (95 % CI 1·23, 1·56; *P* < 0·001) and 1·46 (95 % CI 1·28, 1·66; *P* < 0·001) for adjusted OR. In the case of moderate food

Table 1 General characteristics, stratified by sex, of the representative sample of community-dwelling Mexican adults aged 60 years or older, 2012 Mexican Survey on Nutrition and Health (ENSANUT; *Encuesta Nacional de Salud y Nutrición*)

	Total (*n* 7164)*		Men (*n* 3241; 45·2 %)		Women (*n* 3923; 54·7 %)	
	Mean or *n*	SD or%	Mean or *n*	SD or %	Mean or *n*	SD or %
Age (years), mean and SD	70·7	8·1	70·8	8·0	70·6	8·1
Education†, *n* and %						
None	2157	30·3	844	39·1	1313	60·8
Primary school	3940	55·4	1833	46·5	2107	53·4
High school	722	10·2	339	46·9	383	53·0
College or higher	289	4·1	196	67·8	93	32·1
Married†, *n* and %	3942	55·4	2264	57·4	1678	42·5
Urban, *n* and %	4347	61·1	1863	42·8	2484	57·1
Indigenous, *n* and %	908	12·7	426	46·9	482	53·1
Estimated monthly income†,‡, mean and SD	795·12	2553·83	1237·00	3254·88	430·71	1694·90
Children living in household, *n* and %	1801	25·3	819	45·4	982	54·5
Smoking status†, *n* and %						
Never smoked	3788	53·2	809	21·3	2979	78·6
Smoked fewer than 100 cigarettes in life	775	10·9	444	57·2	331	42·7
Smoked at least 100 cigarettes in life	2545	35·8	1959	57·3	589	23·0
Drinking five or more alcoholic beverages at least once weekly†, *n* and %	176	2·5	147	83·5	29	16·5
Food insecurity category†, *n* and %						
Secure	1868	26·3	880	47·1	988	52·8
Mild	2864	40·3	1302	45·4	1562	54·5
Moderate	1457	20·5	614	42·1	843	57·8
Severe	919	12·9	416	45·2	503	54·7
Frailty index ≥0·21†, *n* and %	3213	45·2	1190	37·0	2023	51·9

*Percentages for totals are for the column, percentages for men and women are for the lines.
†*P* < 0·001 for the comparison between men and women.
‡Estimated income is in Mexican pesos. The average equivalence in 2012 was 1 \$US = 13·16 Mexican pesos.

Table 2 Bivariate analyses of positive answers to food insecurity questionnaire items and the frailty index score among the representative sample of community-dwelling Mexican adults aged 60 years or older, 2012 Mexican Survey on Nutrition and Health (ENSANUT; *Encuesta Nacional de Salud y Nutrición*)

	Frailty index ≥ 0·21		Frailty index < 0·21		
	n	%	*n*	%	*P* value
'In the last 3 months, due to lack of money or other resources, did you or any other adult in this household …'*					
'… were worried because of shortage of food?'	2205	68·63	2239	57·48	<0·001
'… run out of food?'	948	29·51	824	21·16	<0·001
'… not have a healthy, nutritive or balanced diet?'	1666	51·85	1664	42·72	<0·001
'… have a diet with a poor variety?'	1824	56·77	1815	46·6	<0·001
'… skip breakfast, lunch or dinner?'	822	25·58	703	18·05	<0·001
'… eat less than you should?'	1182	36·79	1030	26·44	<0·001
'… were hungry but not eat?'	833	25·93	693	17·79	<0·001
'… just eat once a day or skip an entire day?'	600	20·54	531	13·63	<0·001
'In the last 3 months, due to lack of money or other resources, did any 18-year or younger person living in this household …'†					
'… was left without a healthy, balanced, or nutritive diet?'	312	37·37	309	31·99	0·049
'… had a diet based on scarce variety of food?.	352	42·16	349	36·13	0·018
'… had to skip breakfast, lunch or dinner?'	135	16·17	144	14·91	0·645
'… had to eat less than he/she should?/	197	23·95	202	20·91	0·392
'… had to reduce the quantity of served meals?'	224	26·83	218	22·57	0·102
'… was hungry but did not eat?'	119	14·25	119	12·32	0·335
'… only ate once in a day or did not eat at all?'	93	11·14	99	10·25	0·706
Food insecurity category‡					
Secure	679	36·10	1202	63·90	<0·001
Mild	1236	43·99	1574	56·01	
Moderate	786	52·19	720	47·81	
Severe	512	56·20	399	43·80	

*These questions were asked of all older adults (*n* 7108).
†These questions were asked only of older adults with an 18-year-old or younger person living in the same household (*n* 1801; 25·34 %).
‡Percentages are for frail and non-frail.

insecurity, unadjusted OR was 1·93 (95 % CI 1·68, 2·12; *P* < 0·001) and 2·02 (95 % CI 1·74, 2·35; *P* < 0·001) for adjusted OR. Finally, severe food insecurity unadjusted OR was 2·27 (95 % CI 1·93, 2·66; *P* < 0·001) and 2·41 (95 % CI 2·03, 2·86; *P* < 0·001) for adjusted OR (Table 3). Estimates did not change substantially with the thirty-nine-item frailty index (see online supplementary material, Supplemental Table 2).

Discussion

The aim of the current analysis was to determine if there was an association of food insecurity with frailty and according to our study an association was found. As far as we know, the present study is the first to describe this association in Latin American older adults[12,28]. Our results showed that the prevalence of food insecurity among households with older persons is very high and represents 73·8 % of the total sample. The frequencies of the food insecurity categories are similar to those reported by Rivera-Márquez *et al.* and are considered to be worse when compared with other countries[22]. Also, our study revealed an incremental association between the frailty index score and the categorization of the ELCSA food insecurity questionnaire that is independent of other confounding variables. As shown in our results in the multivariate analyses, the probability of having a score ≥0·21 in the frailty index is 1·46 times for the group with

mild food insecurity, 2·02 for the group with moderate food insecurity and 2·41 times for the group with severe food insecurity; this shows an incremental and independent association between frailty and food insecurity. Severity of food insecurity is associated with higher probability of being considered frail when compared with those older adults with food security; in addition, this association is independent of other factors that have been also associated with frailty, as previously described in Mexican older adults. Having a frailty index score ≥0·21 increases mortality risk of the individual[25,29], therefore as the severity of food insecurity increases so does the probability of getting frail and the risk of mortality.

Key factors that may aggravate the level of food insecurity are out-of-pocket health expenses and unexpected medical bills, particularly when referring to old people. A particular factor is how the older adults experience food insecurity and the skills they could use to obtain and prepare appropriate foods[7,30]. Nevertheless, in a family with chronic poverty, it is possible that neither food nor adequate health services are affordable. Bhargava *et al.* found that those with food insecurity have lower out-of-pocket expenses[17]. Both are explained by the limited financial resources for such expenses and are indicators of the effects of poverty. Although it is possible that food insecurity among older people is different from that of other age groups, due to different health conditions of each group; notwithstanding, some research points to the fact that either children and adults have lower physical

Table 3 Unadjusted and adjusted* multiple logistic regression models for frailty index† as the dependent variable and food insecurity categories as the independent variables (with food security as the reference) among the representative sample of community-dwelling Mexican adults aged 60 years or older, 2012 Mexican Survey on Nutrition and Health (ENSANUT; *Encuesta Nacional de Salud y Nutrición*)

Food insecurity category	Unadjusted			Adjusted		
	OR	95 % CI	P value	OR	95 % CI	P value
Secure	Reference		–	Reference		–
Mild	1·39	1·23, 1·56	<0·001	1·46	1·28, 1·66	<0·001
Moderate	1·93	1·68, 2·12	<0·001	2·02	1·74, 2·35	<0·001
Severe	2·27	1·93, 2·66	<0·001	2·41	2·03, 2·86	<0·001

*Adjusted for age, sex, marital status, urban stratus, speaking indigenous language, household income, smoking status and current alcohol drinking.
†Frailty index score ≥0·21 and frailty index score <0·21.

activity when facing food insecurity[31]. On the other hand, it is possible to go from having food security during childhood to having food insecurity during adulthood. It is also possible that social mobility exists from poverty to wealth. Evidence shows that economic mobility is weak in Mexico, particularly in sectors of chronic and extreme poverty[32].

Reports show that strong communities and social networks are protective factors that can be of support to old people, not only financially, but also with things such as transportation and preparing meals, among others[7,30]. This points to the fact that strategies to ameliorate the availability of food for older adults are needed. There is a need for including social dynamics into the study of frailty, as well as to more deeply explore its potential protective role among the aged. There is evidence on how nutritional conditions impact older adults' health and in particular frailty status[6,20,21].

The current analysis is cross-sectional; there is a need for longitudinal studies exploring the role of the exposure time to food insecurity, in order to study the causal association between developing frailty and its consequences. A hypothetical path from food insecurity to frailty would be: low-protein/high-carbohydrate diets leading to muscle mass loss/obesity, leading to sarcopenia/obese sarcopenia, leading to frailty, leading to disability/death/institutionalization[6,8,21]. This path should take into consideration the exposure time, since a long time with reduced nutritional intake and lower diet variability may also lead to physiological imbalance, with its subsequent lower response to stressors. This is a vicious cycle that could be broken by reinforcing strategies to enhance food security in poor households.

On the other hand, programmes such as Meals on Wheels also ameliorate the impact of food insecurity on older adults[33]. Nevertheless, in middle-income countries such as the one from this report, a targeted and not generalized intervention to ameliorate food security could diminish the progression to disability. Currently a government programme aims to 'eliminate hunger' in all the population, without targeting or including the particular needs of older adults, which may not be helpful. Nowadays there is no evaluation of the impact on older

adults of this recent food programme[34,35]. In addition, there is uncertainty on how help-seeking behaviours would be in Mexican older adults when food programmes are available; these behaviours seem to be rather complex in the older adult population[36].

One of the main limitations of our study is the lack of information on how long the older adult has had food insecurity. There is no certainty that food insecurity has been present long enough to produce nutritional derangements, that in turn has become a symptom or deficit due to a continuous bad diet. Further studies aimed at untangling these trajectories – food insecurity, nutritional deficit, physical impact and disability – could shed light on how these interactions take place and how an intervention strategy could be implemented to break the cycle.

There is evidence that an appropriate diet could improve the health of frail older adults; however, it is not clear if this condition in itself is associated with frailty. This could give a different perspective and shift the paradigm towards the prevention of frailty, and not only the treatment of its consequences[6,18,20,21,37].

There is an increasing need for recognizing all aspects that could shape ageing in a complex society where older adults are not necessarily included. Older adults with food insecurity have worse health conditions (such as frailty) and may develop adverse outcomes as a result, making their inclusion in modern societies even more difficult. Closing the gap in knowledge regarding determinants of ageing is the beginning of an age-inclusive world.

participation: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the ethics committee of the National Institute of Public Health in Mexico. All participants signed written informed consent.

Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980016000987

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