Social Determinants of Health (Social Risk) and Nutritional Status Among Community-Dwelling Older Adults Living in a Rural Setting: The Atahualpa Project

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Abstract

Background: Several studies have attempted to clarify the role of social determinants of health (SDH) on nutritional status of older adults, but results are inconsistent due to differences in SDH assessments at different levels of population development. In this study, we assessed this association in community-dwelling older adults living in rural Ecuador. **Methods:** SDH were measured by the Gijon's Social-Familial Evaluation Scale (SFES) and nutritional status by the Mini Nutritional Assessment (MNA®). Multivariate logistic regression models were fitted to assess the association between SDH components and nutritional status. Locally weighted scatterplot smoothing (LOWESS) and a generalized linear model were used to evaluate the potential non-linearity of the association between the Gijon's SFES and MNA® scores. **Results:** A total of 295 individuals (mean age: 72.1 ± 7.6 years; 58% women) were enrolled. There was an inverse association between the total Gijon's SFES and nutritional status (OR: 0.75; 95% C.I.: 0.65-0.86; *P* < .001). Three of five components of the Gijon's SFES (family situation, social relationships, and support networks) were inversely associated with nutritional status in multivariate logistic regression models. A LOWESS plot, together with a generalized linear model, showed an inverse linear relationship between the continuous Gijon's SFES and MNA® scores. One standard deviation of increase in the continuous Gijon's SFES score (2.39 points) decreased the MNA® score by 0.78 points. **Conclusion:** Study results show a significant inverse association between high social risk and a good nutritional status. Components of the Gijon's SFES measuring social isolation are responsible for this association.

Introduction

Malnutrition has been associated with several adverse outcomes, particularly in fragile populations and the elderly.[1-3] While the percentage of older adults who are at risk of malnutrition or malnourished is higher among those whose reside in long term care facilities, malnutrition is also a growing problem among community-dwellers.[4] Debilitating conditions, food insecurity, and inequities in preventive healthcare may account for a sizable proportion of malnourishment among older adults.[5] In addition, a high social risk—often assessed by the social determinants of health (SDH)—has an important contributory role in the development of malnutrition. Several studies have attempted to clarify the role of SDH on the nutritional status of older adults, but results are inconsistent due to

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differences in the SDH that were used to assess social risk at different levels of population development.[6-8]

Race/ethnicity, poverty, illiteracy, and disparities in access to healthcare have been identified as important determinants of health in developed countries.[9] However, these determinants appear to be less significant among people who live in remote rural communities, a fact that underscores the importance of selecting a proper field instrument to investigate SDH in underserved populations. SDH assessment should be tailored to the level of development of a given community and the interpretation of that assessment must be adapted accordingly.[10] Drawing on the existing Atahualpa Project cohort, this study evaluates the association between SDH and the nutritional status of community-dwelling older adults living in a rural Ecuadorian village.[11] In order to obtain a meaningful SDH assessment, we relied on a field instrument previously validated in the same population.[12,13] This instrument has been officially endorsed by the Ecuadorian Minister of Health for the assessment of social risk in rural settings.[14]

Methods and Materials

This study includes community-dwelling older adults who were actively enrolled in the Atahualpa Project Cohort as of October 2021. Characteristics of the village and its inhabitants have been detailed elsewhere.[11] This population shares characteristics such as race/ethnicity (Amerindian ancestry), low levels of education, socioeconomic status, and dietary habits, factors that reduce the possibility of unexpected confounders on analyses. The diet is rich in oily fish, fruits, and carbohydrates, but limited in other types of meat, dairy products, and highly processed foods. Overall, physical activity is adequate, since inhabitants get around the village mainly by walking or bicycle riding, as very few people own a motor vehicle. The village has only 1 government sponsored health center which is staffed by 2 general physicians, 2 nurses, an odontologist, and an obstetrician.

Following a cross-sectional design, Atahualpa residents aged ≥60 years received face-to-face clinical interviews in order to assess SDH, nutritional status, cardiovascular risk factors, and symptoms of depression. The association between SDH components and the nutritional status was investigated by means of logistic regression models, adjusted for demographics, level of education, cardiovascular risk factors, and symptoms of depression. The study protocol and comprehensive informed consent forms (signed by all participants) were approved by the I.R.B. of our Institution.

The Gijon's Social-Familial Evaluation Scale (SFES) was used to assess SDH. This field instrument rates 5 components of social risk that include family situation, economic status, housing, social relationships, and support networks.[15] Each component has 5 questions weighted on a 1 to 5 scale, for a maximal score of 25, with increased scores indicating higher social risk. The Gijon's SFES questionnaire was administered by a trained geriatrician blinded to the results of other tests.

The Spanish version of the Mini Nutritional Assessment (MNA®; Nestle Nutrition, Vevey, Switzerland), originally developed by Guigoz et al,[16] was used to assess nutritional status. This is a widely-used and validated field instrument that has been administered either in a short form (6 questions) or in its complete form that includes 18 questions divided into 4 domains (maximum score is 30 points).[17] We used the complete MNA® form for the present study. The instrument was administered to all participants by a certified nutritionist blinded to the results of other tests.

Demographics, level of education, cardiovascular risk factors, and symptoms of depression were recorded as relevant covariates. Interviews and procedures for determining cardiovascular risk factors followed recommendations of the American Heart Association (AHA), including physical activity, blood pressure, fasting glucose, and total cholesterol blood levels.[18] The body mass index and assessment of the intake of healthy dietary components (also proposed by the AHA as cardiovascular risk factors) were not taken into account because of collinearity, since the MNA® included body mass index determinations and several questions about food intake.[16] Symptoms of depression (dysphoria, lack of interest, self-deprecation, hopelessness, devaluation of life, anhedonia, and inertia) were assessed by means of the depression axis of the Depression-Anxiety-Stress Scale-21.[19]

Data analyses were carried out by using STATA version 17 (College Station, TX, USA). In unadjusted analyses, continuous variables were compared by linear models and categorical variables by x^2 or Fisher exact test as applicable. Locally weighted scatterplot smoothing (LOWESS) was used to evaluate and plot the potential non-linearity of the association between the SDH and MNA® scores. Multivariate logistic regression models were fitted using the SDH score (and each of its components) as independent variables and the nutritional status as the dependent variable, after adjusting for demographics, level of education, cardiovascular risk factors, and symptoms of depression.

Results

A total of 478 Atahualpa residents aged ≥60 were enrolled in the Atahualpa Project from 2012 to 2019. Of them, 121 died, 34 declined consent, and 15 emigrated from the village. The remaining 308 were actively enrolled in the cohort as of October 2021, and were eligible to participate in the present study. Ten of these individuals were
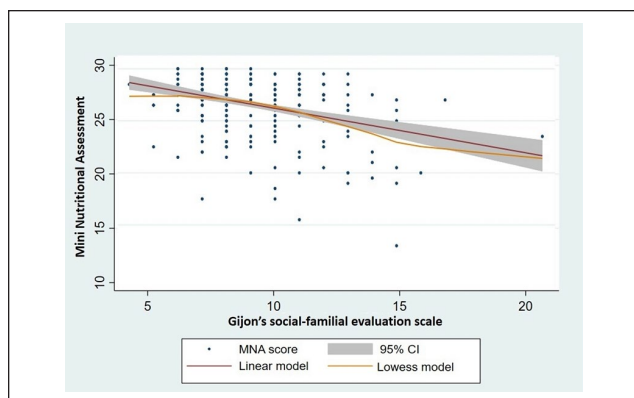
Figure 1. Locally weighted scatterplot smoothing (LOWESS) and a generalized linear model adjusted for demographics and level of education showing an inverse linear relationship between scores of the Gijon's Social-Familial Evaluation Scale and the Mini Nutritional Assessment (MNA®).

bedridden and 3 declined further consent, leaving 295 study participants.

The mean age of included individuals was 72.1 ± 7.6 years (median age: 71 years), 170 (58%) were women, and 219 (74%) had primary school education only. Individual cardiovascular risk factors in the poor range included: physical activity: 7 (2%); blood pressure: 110 (37%); fasting glucose: 104 (36%); and total cholesterol blood levels: 49 (17%). Symptoms of depression were noticed in 29 (10%) individuals. The mean Gijon's SFES score was 9.1 ± 2.4 points (median score: 9 points). Mean scores of individual components were as follows: Family situation: 1.6 ± 1.1 points; Economic status: 3.2 ± 0.9 points; Housing: 1.8 ± 0.8 points; Social relationships: 1.4 ± 0.8 points; and Support networks: 1.1 ± 0.4 points. The mean score of the MNA® was 26.6 ± 2.7 points (median score: 27.5 points), with 249 (84.4%) individuals having a score ≥ 24 points (well-nourished). Of the remaining 46 individuals, 44 had a score between 17 and 23.5 points (at risk of malnutrition) and only 2 had a score <17 (malnourished). The 2 latter groups were combined for analyses; therefore, the cutoff of the MNA® used for logistic regression models was ≥ 24 points.

Unadjusted analyses of investigated covariates showed that well-nourished individuals were younger ($P < .001$) and had better physical activity ($P = .013$) than those at risk for malnutrition/malnourished, but there were no other differences across groups. Using the continuous MNA® score, a LOWESS plot, together with a generalized linear model adjusted for demographics and level of education, showed an inverse linear relationship between the continuous Gijon's SFES and MNA® scores (Figure 1). One standard deviation of increase in the continuous Gijon's SFES score (2.39 points) decreased the MNA® score by 0.78 points.

Table 1 shows an inverse association between the total Gijon's SFES and nutritional status (OR: 0.75; 95% C.I.: 0.65-0.86; $P < .001$). Three of five individual components of this scale (family situation, social relationships, and support networks) were inversely associated with nutritional status in both unadjusted analyses and multivariate logistic regression models. In all these models, increased age and high blood pressure remained as significant covariates in the association between SDH and nutritional status.

Discussion

This population-based study shows a significant inverse association between high social risk and a good nutritional status. Some individual components of SDH, namely, economic status and housing, were not independently associated with nutritional status. This suggests that the impact of those components is superseded by family situation, poor social relationships, and deficient support networks. Our results align with previous studies that indicate social isolation is associated with an increased risk of malnutrition among older adults.[20,21]

Of interest, social isolation—or the feeling of loneliness—has not only been associated with malnutrition but with the occurrence and progression of several adverse health outcomes.[9,12] Malnutrition also contributes to these adverse outcomes, thus creating a vicious circle that compromises the quality of life of older adults and other vulnerable groups.

Some studies have shown that economic need and food insecurity are important factors associated with malnutrition.[7,20] This does not seem to be the case for inhabitants of this remote village, as the coastal location of Atahualpa allows them to obtain nutrients from oily fish that are enriched in proteins and ω-3 PUFAs at an affordable cost.[22] This may also help explain the low frequency of individuals at risk of malnutrition in the present study (15.6%), when compared to that reported in other underserved communities.[23,24]

Despite the beneficial effects of dietary oily fish intake on the nutritional status of Atahualpa residents, this is superseded in some individuals by the impact of loneliness. Indeed, it has been observed that loneliness does not necessarily mean living alone or not having partners or friends, but refers more particularly to the feelings and perceptions of a given individual on their lack of social support in times of stress, illness, or loss.[25]

The cross-sectional design makes an inference of causality less compelling but common sense and biological plausibility suggest that high social risk leads to malnutrition and not the reverse. The homogeneity of the study population limits the generalizability of the findings which may not necessarily be replicated in populations of older adults living in urban settings or long-term care facilities. These limitations are counterbalanced by strengths of this study,

Table 1. Unadjusted Analyses and Multivariate Logistic Regression Models Showing the Inverse Association Between Social Determinants of Health, as Measured by the Gijon's Social-Familial Evaluation Scale (SFES), and the Nutritional Status.

	Total series (n = 295)	Well-nourished (n = 249)	At risk of malnutrition (n = 46)	Unadjusted analyses	Logistic regression models
Gijon's SFES score	9.1 ± 2.4	8.7 ± 2	10.8 ± 3.4	<0.001*	OR: 0.75; 95% C.I.: 0.65-0.86; *P* < .001*
Family situation	1.6 ± 1.1	1.5 ± 1	2.3 ± 1.3	<0.001*	OR: 0.65; 95% C.I.: 0.50-0.85; *P* = .001*
Economic status	3.2 ± 0.9	3.1 ± 1	3.3 ± 0.9	0.207	OR: 0.93; 95% C.I.: 0.65-1.34; *P* = .705
Housing	1.8 ± 0.8	1.7 ± 0.8	1.8 ± 0.8	0.437	OR: 0.74; 95% C.I.: 0.48-1.14; *P* = .175
Social relationships	1.4 ± 0.8	1.2 ± 0.6	2 ± 1.2	<0.001*	OR: 0.46; 95% C.I.: 0.30-0.69; *P* < .001*
Support networks	1.1 ± 0.4	1.1 ± 0.3	1.3 ± 0.7	0.002*	OR: 0.32; 95% C.I.: 0.17-0.62; *P* = .001*

*Statistically significant result.

including the assessment of SDH by means of an instrument adapted to the particular circumstances of the population. Moreover, this same homogeneity serves to minimize the impact of racial prejudice, disparities in income, and access to health care, all of which contribute to SDH in other settings. As a result, the finding of a significant relationship between high social risk and poor nutritional status is strengthened and is less likely to be confounded by these other factors.

In conclusion, this study shows an inverse association between higher levels of social risk and adequate nutritional status. It further suggests that strategies or policies aimed at reducing social risk are likely to improve nutritional deficiencies that contribute to adverse health outcomes. For example, regularly scheduled group activities that facilitate social networking among older adults living in rural settings can be accomplished by healthcare social workers or by trained community leaders. These activities may reduce social risk and the risk of malnutrition. Subsequent studies are needed to get more insight as to which specific interventions are needed to reduce malnutrition by improving social disparities in rural settings.

Authors' Contributions

OHD: study design, manuscript drafting; DAR: data collection and analysis; RMM: statistical analysis, significant intellectual contribution to manuscript content; BYR: study coordinator, data collection and analysis; MJS: significant intellectual contribution to manuscript content.

Declaration of Conflicting Interests

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. Boulos C, Salameh P, Barberger-Gateau P. Factors associated with poor nutritional status among community dwelling Lebanese elderly subjects living in rural areas: results of the Amel study. *J Nutr Health Aging*. 2014;18:487-494.

2. Vest MT, Papas MA, Shapero M, McGraw P, Capizzi A, Jurkovitz C. Characteristics and outcomes of adult inpatients with malnutrition. *JPEN J Parenter Enteral Nutr*. 2018;42:1009-1016.

3. Petermann-Rocha F, Pell JP, Celis-Morales C, Ho FK. Frailty, sarcopenia, cachexia and malnutrition as comorbid conditions and their associations with mortality: a prospective study from UK Biobank. *J Public Health*. Published online January 11, 2021. doi:10.1093/pubmed/fdaa226

4. Castro PD, Reynolds CM, Kennelly S, et al. An investigation of community-dwelling older adults' opinions about their nutritional needs and risk of malnutrition; a scoping review. *Clin Nutr*. 2021;40(5):2936-2945.

5. Kraef C, Wood B, von Philipsborn P, Singh S, Peterson SS, Kallestrup P. Primary health care and nutrition. *Bull World Health Organ*. 2020;98:886-893.

6. Acar Tek N, Karaçil-Ermumcu MŞ. Determinants of health related quality of life in home dwelling elderly population: appetite and nutritional status. *J Nutr Health Aging*. 2018;22:996-1002.

7. Donini LM, Scardella P, Piombo L, et al. Malnutrition in elderly: social and economic determinants. *J Nutr Health Aging*. 2013;17:9-15.

8. Maseda A, Diego-Diez C, Lorenzo-López L, López-López R, Regueiro-Folgueira L, Millán-Calenti JC. Quality of life,

functional impairment and social factors as determinants of nutritional status in older adults: the VERISAÚDE study. *Clin Nutr*. 2018;37:993-999.

9. Ferrario MM, Veronesi G, Kee F, et al. Determinants of social inequalities in stroke incidence across Europe: a collaborative analysis of 126 635 individuals from 48 cohort studies. *J Epidemiol Community Health*. 2017;71:1210-1216.

10. Riva M, Bambra C, Curtis S, Gauvin L. Collective resources or local social inequalities? Examining the social determinants of mental health in rural areas. *Eur J Public Health*. 2011;21:197-203.

11. Del Brutto OH, Peñaherrera E, Ochoa E, Santamaría M, Zambrano M, Del Brutto VJ. Door-to-door survey of cardiovascular health, stroke, and ischemic heart disease in rural coastal Ecuador-the Atahualpa Project: methodology and operational definitions. *Int J Stroke*. 2014;9:367-371.

12. Del Brutto OH, Mera RM, Recalde BY, Del Brutto VJ. On the association between social determinants of health and disability in stroke-free older adults living in rural settings. The Three Villages Study. *J Prim Care Community Health*. 2020;11:2150132720961265.

13. Del Brutto OH, Mera RM, Rumbea DA, Recalde BY, Sedler MJ. Social determinants of health and cognitive performance of older adults living in rural communities: the Three Villages Study. *Int J Geriatr Psychiatry*. 2022;37(2):gps.5671.

14. Ministerio de Salud Pública del Ecuador. Guías clínicas geronto-geriátricas de atención primaria de salud para el adulto mayor. Septiembre 2008. Accessed January 20, 2022. https://vicenteayalabermeo.files.wordpress.com/2011/04/guc3adas-adulto-mayor.pdf

15. García González JV, Díaz Palacios E, Salamea García A, et al. Evaluación de la fiabilidad y validez de una escala de valoración social en el adulto. *Aten Primaria*. 1999;23:434-440.

16. Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: the Mini Nutritional Assessment as part of the geriatric evaluation. *Nutr Rev*. 1996;54:s59-s65.

17. Guigoz Y, Vellas B. Nutritional assessment in older adults: MNA® 25 years of a screening tool & a reference standard for care and research; what next? *J Nutr Health Aging*. 2021;25:528-583.

18. Lloyd-Jones DM, Hong Y, Labarthe D, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic impact goal through 2020 and beyond. *Circulation*. 2010;121:586-613.

19. Osman A, Wong JL, Bagge CL, Freedenthal S, Gutierrez PM, Lozano G. The Depression Anxiety Stress Scales-21 (DASS-21): further examination of dimensions, scale reliability, and correlates. *J Clin Psychol*. 2012;68:1322-1338.

20. Krzymińska-Siemaszko R, Deskur-śmielecka E, Kaluźniak-Szymanowska A, et al. Socioeconomic risk factors of poor nutritional status in Polish elderly population: the results of PolSenior2 Study. *Nutrients*. 2021;13:4388.

21. Boulos C, Salameh P, Barberger-Gateau P. Social isolation and risk for malnutrition among older people. *Geriatr Gerontol Int*. 2017;17:286-294.

22. Del Brutto OH, Mera RM, Ha JE, Gillman J, Zambrano M, Sedler MJ. Dietary oily fish intake and frailty. A population-based study in frequent fish consumers living in rural coastal Ecuador (the Atahualpa Project). *J Nutr Gerontol Geriatr*. 2020;39:88-97.

23. Ghimire S, Baral BK, Callahan K. Nutritional assessment of community-dwelling older adults in rural Nepal. *PLoS One*. 2017;12:e0172052.

24. Krishnamoorthy Y, Vijayageetha M, Kumar SG, Rajaa S, Rehman T. Prevalence of malnutrition and its associated factors among elderly population in rural Puducherry using mini-nutritional assessment questionnaire. *J Fam Med Prim Care*. 2018;7:1429-1433.

25. Bucholz EM, Krumholz HM. Loneliness and living alone. What are we really measuring? *Arch Intern Med*. 2012;172:1084-1085.