Prevalence of food insecurity and association with mental health in an indigenous population in Panamá

Rebekah J Walker[1,2], Aprill Z Dawson[1,2], Jennifer A Campbell[1,2] and Leonard E Egede[1,2,]*

[1]Division of General Internal Medicine, Department of Medicine, Medical College of Wisconsin, Milwaukee, WI, USA:
[2]Center for Advancing Population Science, Medical College of Wisconsin, Milwaukee, WI, USA

Abstract

Objective: Understanding food insecurity and its health consequences is important for identifying strategies to best target support for individuals and communities. Given the limited information that exists for indigenous groups in Latin America, this study aimed to understand the association between food insecurity and mental health in an indigenous population in Panama.

Design: Cross-sectional data were collected using a survey conducted with Kuna Indians residing off the coast of Panama. Data sources included measures from the Panamanian prevalence of risk factors associated with CVD survey, and validated measures for psychosocial factors and standardised health outcome measures. Regression models with each of the mental health outcomes (depression, serious psychological distress, perceived stress) were used to examine the association between food insecurity and mental health outcomes.

Setting: Indigenous Kuna community residing on the San Blas Islands of Panama.

Participants: Two-hundred nine adults.

Results: Food insecurity was reported by 83 % of the participants. Across demographic categories, the only significant difference was by age with higher prevalence in younger ages. After adjusting for demographics, higher food insecurity was significantly associated with higher number of depressive symptoms and more serious psychological distress, but not with levels of perceived stress.

Conclusions: Based on these findings, treatment for mental health in the Kuna community may need to account for social determinants of health and be tailored to meet the needs of younger age groups in this population. In addition, interventions designed to decrease food insecurity should be considered as a possible means for improving mental health.

Introduction

Worldwide, food insecurity has emerged as a leading public health crisis with recent estimates showing approximately 750 million people, or 1 in 10, globally experience severe levels of food insecurity[1]. As defined by the Food and Agriculture Organization of the United Nations, food insecurity exists when people have a lack of 'physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences'[2,3]. Factors that increase the risk for food insecurity include low levels of education, limited social networks and limited economic development, occurring at both the individual, population and country level[3–5]. Indigenous communities, defined as communities that are culturally separate from the dominant society, experience an increased risk for food insecurity compared to the majority population[6,7]. This increased risk for food insecurity may be attributed to indigenous communities experiencing marginalisation and limited access to needed resources as a result of upholding a unique social identity while maintaining political and economic structures outside of mainstream society[7–10].

Latin America has the second-highest prevalence of food insecurity in the world, with 51 % of the population reporting any level of food insecurity[11]. They also have a large indigenous population, with about 45 million indigenous peoples living in Latin America, making up

Corresponding author: Email legede@mcw.edu

almost 8·5 % of the population in this region[12]. Panama has the third-highest population of indigenous peoples in the region, with 12 % of the population reporting indigenous status[12]. The Kuna Indians are one of Latin America and Panama's largest indigenous communities residing on both the mainland and off the coast in the nearby San Blas Islands[13]. With a significant history of marginalisation, the Kuna experience high levels of poverty and poorer health compared to the general Panamanian population due to isolation and limited access to resources[13]. However, though research on food insecurity has been conducted in other indigenous communities, such as the Inuit communities of Canada and the aboriginal communities of Australia, limited research has been completed with the Kuna Indians of Panama[3,4,14].

Recent work conducted with the Kuna Indians of Panama found an extremely high prevalence of mental health conditions, including depression and suicidal ideation[15]. Conversations with local community leaders suggested social factors, such as food insecurity may play a role in this finding as the community noted changes in access to food over the past decade. Prior evidence collected through research with other indigenous and non-indigenous groups suggests this relationship may indeed exist[16–24]. However, little work has been conducted in Latin America and no published work on the relationship between social factors, such as food insecurity, and mental or physical health exists for the Kuna Indians. Since prior work found that indigenous communities may experience food insecurity differently, an investigation into the prevalence of food insecurity in the Kuna Indians and its possible association with mental health outcomes is highly warranted. Therefore, this study aimed to evaluate food insecurity in an indigenous population in Panamá and understand its association with mental health outcomes.

Methods

Research approvals

The current research was developed in collaboration with the Panamá Ministry of Health, the Kuna Congress and Indigenous Health International, an approved 501(c)(3) non-profit organisation. Founded in 2012, the mission of Indigenous Health International is to meet the health care needs of indigenous communities around the world. Indigenous Health International supports indigenous communities in Panamá by conducting need assessments, delivering health care and conducting research to improve health services. Data used in this study was collected as an initial step in a long-term relationship with the Kuna community to guide future programs. Indigenous Health International received approval from the Panamá Ministry of Health, Director of Indigenous Health in Panamá, the national Kuna Congress and local Kuna community leaderships prior to initiation of any study procedures, and received approval to publish results of the initial data collection after discussion with the community. In addition, the current research protocol, research procedures and study-related documentation was approved by the Western Institutional Review Board, an accredited organisation that provides human subjects and regulatory compliance across 70 countries.

Population

This study was conducted in partnership with community members in the Ustupu/Ogobsucum islands, located within the indigenous zone off the coast of Panama (see Fig. 1). Approximately 3500 adults live in the two communities. The communities share a health clinic run by the Panamanian Ministry of Health and an airport allowing access to the islands. Ustupu and Ogobsucum are two of the Kuna Indian communities of Panama, the second largest Indigenous population in the country. A report published by the World Bank on poverty in indigenous populations in Panama noted that Kuna is the second largest indigenous group in Panama, and the majority live in San Blas Island indigenous zone off the coast of Panama[13]. The remote location requires boat or air travel to access the population, which lives in villages characterised by strong social cohesion, political organisation and leadership responsible for maintaining cultural traditions[13]. Agriculture, seafood farming and artisan activities are the primary activities and sources of livelihood[13].

All adults in the community (age 18 or older) were eligible to participate and provided verbal consent as approved by the Western Institutional Review Board to ensure they were aware of their participation in a research study. No incentive was offered, and medical care was provided separately from participation and completion of the survey.

Recruitment

No regular census exists for the community, so a sampling frame was not possible and convenience sampling was used. Recruitment was completed over a 1-week period in August 2013, so a variety of methods were used to invite all community members to participate if willing. First, community members trained by the research team approached individuals in the local health clinic and explained the study. Community members were trained to explain the nature of the project and that it was research, consent participants verbally and administer the questionnaire. Those selected were willing to work with the research team for the week and could speak Spanish and the local Kuna language. Second, local community leadership announced that survey administration would be conducted at the health clinic during evening meetings held daily and invited individuals to participate. Finally, word of mouth was used to inform community members of the ongoing study. Information on those who declined were not

Fig. 1 (colour online) Map of Panama indicating San Blas region

collected, however, few individuals who were approached directly to participate declined.

Data collection

Data were collected using a paper-based questionnaires. Questions were developed using measures from the 'Panamanian prevalence of risk factors associated with cardiovascular disease in 18 year or older population survey', a national survey used in Panamá to assess CVD risk factors in an adult population in 2010[25], validated measures for psychosocial factors[26–28] and standardised health outcome measures. All surveys were translated into Spanish and back translated to ensure validity. Community members were trained to deliver the survey by reading questions word for word in Spanish or translating into the local spoken language, Kuna, if requested. Participants were able to complete the survey on their own in Spanish if preferred, and community members trained by the research team then checked through for completion and clarified any answers if necessary. Training included discussion of the overarching study, review of the survey and community members taking the survey themselves to ensure understanding of questions and response options. Scoring was completed by the research team after data were entered into a secure database and downloaded for analysis.

Food insecurity

To quantify food insecurity in the population using a validated scale, the short form US Department of Agriculture Food Security questionnaire[29], a six-item scale developed by the US Department of Agriculture for use by households with and without children, was used. Questions ask about whether respondents were worried food would run out, the frequency of food not lasting until more money was available, not being able to afford balanced meals, whether meal sizes were cut, or respondents were hungry, lost weight or ate less because of money. Questions were asked about both the respondent and members of their household and were not based on the level of income. Questions have been validated across multiple populations, including indigenous people in the USA. As questions do not specify food type, respondents can answer based on their personal food preferences. The scale has been validated outside the USA, including in a Caribbean community, finding similarly high Cronbach alpha of 0·87 and item response correlation coefficients ranging from 0·70 to 0·78[30]. Individuals that respond negative to all answers are assigned zero, with points for responses scored so higher scores indicate greater food insecurity. Individuals scoring zero or one were categorised as food secure, and individuals scoring two or more were categorised as food insecure, based on scoring outlined in the original report[29].

Measures of mental health

Three measures of mental health, capturing three separate mental health constructs, were included in the study. Prevalence of depression and serious psychological distress in this population have been reported elsewhere[15].

1. **Depression** measured by the nine-item Patient Health Questionnaire. The nine-item Patient Health

Questionnaire is a valid and reliable measure across multiple populations with internal reliability of Cronbach's alpha greater than 0·85[26]. Participants are asked nine questions about the frequency of symptoms for depression, and responses could range from not at all to nearly every day. Higher scores indicate more depressive symptoms or more frequent symptoms of a similar kind. Based on a sensitivity and specificity of 88 % for major depressive disorder, scores greater than or equal to 10 are categorised as depression[26].

2. **Serious psychological distress** measured using the six-item K6 scale. The six-item scale was originally developed for population-level screening for non-specific psychological distress[27] and is routinely used by the US National Health Interview Survey and the WHO Mental Health Survey[31]. Higher scores indicate more distress. Based on the validated scale, a cut-off of 13 or above is categorised as serious psychological distress.

3. **Perceived stress** measured using the perceived stress scale, a four-item scale that assesses the degree to which the respondent finds regular situations stressful. Responses range from never to very often, and questions ask about the frequency of feelings related to events in the previous month[28]. The Cronbach alpha value is 0·69, and scores are highly correlated with stress, depression and anxiety[32]. Higher scores indicate higher perceived stress.

Demographic variables

Demographic variables collected using self-report included: age (continuous), sex (dichotomous male/female), education based on years in school (categorised into primary, secondary, some college or college graduate or higher), marital status (categorised into single/separated/divorced/widowed as not married or married/other union) and monthly family income. Monthly family income was categorised following discussions with community leaders to provide context for different levels of income. Individuals reporting they did not know their income were categorised as 'poor' as they were considered subsistence farmers/fishers. Those making < $250 balboas per month [1 balboa = US$1] were categorised as 'low income'. Those making $250 balboa per month or more were categorised as 'moderate income'. These levels of income were specific to the indigenous community as mainland Panamanian income levels are generally higher.

Statistical analysis

To evaluate food insecurity in the indigenous Kuna population of Panama and understand its relationship on mental health, a series of analyses were conducted. First, frequencies were calculated to describe the demographic characteristics of the population surveyed (age, gender, education, income and marital status). Secondly, the proportion and 95 % CI of food insecurity was determined for the categories of each demographic characteristic and compared using Chi-squared tests. Third, a logistic regression model was run with food insecurity as the outcome and independent variables including each of the demographic characteristics to understand independent correlates of food insecurity. Finally, three unadjusted and three adjusted multiple linear regression models were run to understand the relationship between food insecurity and mental health outcomes. In the first unadjusted and adjusted models, depression score served as the dependent variable, with food insecurity as the independent variable and demographic characteristics as covariates in the adjusted model. In the second unadjusted and adjusted models, serious psychological distress score served as the dependent variable, with food insecurity as the independent variable and demographic characteristics as covariates in the adjusted model. In the third unadjusted and adjusted models, perceived stress score served as the dependent variable, with food insecurity as the independent variable and demographic characteristics as covariates in the adjusted model. Analyses were run using Stata v.14, and significance was determined based on two-tailed alpha of $P < 0.05$.

Results

The survey was completed by 211 individuals, of which 209 answered all questions in the food insecurity scale and were included in this analysis. Table 1 presents the sample demographics for the population. Of the sample, 40·1 % were age 18–39, 73 % were female, 70·3 % were married and 53·7 % had more than a primary school education. Approximately 51·9 % were poor, while 37 % reported low income and 11·1 % reported moderate income.

Table 1 Sample demographics (*n* 209)

Characteristic	Percent
Age	
18–39	40·1
40–59	32·4
60–90	27·5
Gender	
Male	27·0
Female	73·0
Education	
None	17·6
Primary	28·6
Secondary/University	53·8
Monthly income	
Poor	51·9
Low income	37·0
Moderate income	11·1
Marital status	
Married	70·4
Not married	29·6

Table 2 Food insecurity status by age, gender, education, and income (95 % CI and OR values)

	Food insecure (%, 95 % CI)		
	OR	95 % CI	P-value
Overall	83·3 %	77·5, 88·0	
Gender			
Men	76·8 %	63·6, 87·0	0·13
Women	85·6 %	79·0, 90·8	
Age			
18–39	**90·2 %**	**81·7, 95·7**	**0·02**
40–59	**85·1 %**	**74·3, 92·6**	
60–90	**71·9 %**	**58·5, 83·0**	
Education			
None	77·1 %	59·9, 89·6	0·18
Primary	78·6 %	65·6, 88·4	
Secondary/University	87·7 %	79·9, 93·3	
Monthly income			
Poor	83·0 %	74·5, 89·6	0·24
Low income	88·3 %	79·0, 94·5	
Moderate income	73·9 %	51·6, 89·8	

Bold font indicates statistical significance ($P < 0.05$).

Table 3 Independent correlates of food insecurity

	OR	95 % CI
Age		
18–39 (Ref)		
40–59	0·58	0·18, 1·85
60–90	**0·18**	**0·04, 0·77**
Gender		
Male (Ref)		
Female	1·34	0·42, 4·29
Education		
None (Ref)		
Primary	0·30	0·07, 1·35
Secondary/University	0·48	0·09, 2·67
Monthly income		
Poor (Ref)		
Low income	1·36	0·48, 3·81
Moderate income	0·33	0·08, 1·26
Marital status		
Not married (Ref)		
Married	2·14	0·87, 5·26

Bold font indicates statistical significance ($P<.05$).
Adjusted models included covariates for gender, age, education, income, and marital status.

Food insecurity was reported by 83·3 % (95 % CI 77·5, 88·0) of the sample population. Table 2 presents food insecurity status by age, gender, education and income. The only demographic variable where food insecurity prevalence varies across levels was age. Individuals in younger age groups reported higher levels of food insecurity, with 90·2 % (95 % CI 81·7, 95·7) of those between 18 and 39 reporting food insecurity, compared to 85·1 % (95 % CI 74·3, 92·6) of those between 40 and 59 and 71·9 % (95 % CI 58·5, 83·0) of those between ages 60 and 90 years.

Table 3 presents results of the regression model for demographic correlates of food insecurity in the Kuna Indian sample. All demographic variables (gender, age,

Table 4 Independent association between food insecurity and mental health

	Food insecurity	
	OR	95 % CI
Depression		
Unadjusted	**0·44**	**0·10, 0·78**
Adjusted	**0·43**	**0·03, 0·84**
Serious psychological distress		
Unadjusted	**0·54**	**0·23, 0·85**
Adjusted	**0·68**	**0·30, 1·07**
Perceived stress		
Unadjusted	−0·06	−0·24, 0·12
Adjusted	−0·15	−0·38, 0·08

Bold font indicates statistical significance ($P<.05$).
Outcome for each model was continuous mental health score, primary independent was food insecurity.
Adjusted models included covariates for gender, age, education, income, and marital status.

education, income and marital status) were included in the same model to investigate independent associations after taking other demographic factors into account. Ages 60–90 compared to age 18–39 remained independently associated with food insecurity (OR = 0·18, 95 % CI 0·04, 0·77).

Table 4 presents the unadjusted and adjusted regression models for each of the three mental health outcomes. In unadjusted models, food insecurity was significantly positively associated with depressive symptoms (β = 0·44, 95 % CI 0·10, 0·78) and serious psychological distress (β = 0·54, 95 % CI 0·23, 0·85), but not with stress (β = −0·06, 95 % CI −0·24, 0·12). After adjusting for demographics, food insecurity was still significantly positively associated with depressive symptoms (β = 0·43, 95 % CI 0·03, 0·84) and serious psychological distress (β = 0·68, 95% CI 0·30, 1·07).

Discussion

In an adult indigenous population in Panama, food insecurity was very high at 83·3 % of individuals surveyed. Younger individuals were significantly more likely to be food insecure, with 90 % of those between the ages of 18–39 reporting food insecurity. When investigating the relationship between food insecurity and mental health outcomes, those who were food insecure reported more depressive symptoms and serious psychological distress but did not report higher levels of perceived stress. These results provide the first investigation of food insecurity and mental health in a remote indigenous population in Panama and provide important considerations when designing an intervention to promote mental health and well-being in this population.

The rates of food insecurity were high in the Kuna population studied, and analysis by demographic characteristics suggests a particular need to tailor interventions for younger adult age groups. While studies in indigenous groups have shown overall high levels of food insecurity,

the influence in this population on younger adults is unique. For example, 62·5 % of Inuit communities in Canada reported food insecurity, 19–25 % of the Alaska Native population has been noted as experiencing food insecurity and 67·8 % of children from an indigenous community in Ecuador lived in a food insecure household[8,14,33]. A systematic review of food insecurity in rural and peasant populations found very little work has been conducted in Central and South America, highlighting the importance of our findings focussed on an indigenous population in Panamá[6]. Given the high prevalence of food insecurity in this community, and the evidence from other regions on the impact on long-term health, this study highlights an urgent need to begin addressing food insecurity in the Kuna community. Additional research is needed to identify the unique situations faced by younger indigenous individuals contributing to increased prevalence in those ages 18–39, to allow targeted interventions for this age group.

Additionally, food insecurity was associated with both depression and serious psychological distress in the Kuna Indian community, indicating the need to focus on social determinants of health when addressing mental health concerns. This relationship has been shown in other populations, but this is one of the first to our knowledge focussed specifically on the relationship between food insecurity and mental health in an indigenous population, and the first investigating the indigenous Kuna community. A study of aboriginal people living off reserves noted a relationship between food insecurity and high stress[34], and a study of First Nations people in Canada found an association between food insecurity and self-report of a mental health diagnosis by a health professional[35]. A study of coping strategies in Bangladesh found that while food insecurity was high across all groups, the means of coping varied by ethnic identity, with indigenous groups using more protective coping strategies[36]. One particularly strong factor that is often present in indigenous communities is social support mechanisms and social cohesion in the community[7,8]. In a study of social structures and food insecurity in a rural Kenyan island community, Nagata et al. found higher food insecurity associated with lower levels of instrumental social support[37]. Strong social networks may lower levels of stress and anxiety generally associated with food insecurity[21], and therefore, may modify the direction of the relationship in indigenous populations. Another factor that may be specific to indigenous populations is access to indigenous farming and food sources. A study in Botswana found households with more access to traditional and indigenous foods had lower levels of food insecurity[38]. Indigenous communities often view health in a different way than western models of health, incorporating physical, mental and spiritual factors and encompassing the health of themselves and those around them[39]. This perspective lends itself to solutions that address concerns like food insecurity and mental health in the same intervention. Recognising that food insecurity is not only an aspect of food but is also tied to mental health and incorporating the cultural framework of indigenous populations into mental health treatment delivery may help improve food insecurity and mental health simultaneously.

While this study provides unique information on an underserved indigenous group in Panamá, there are some limitations. First, as each indigenous population has specific cultural and environmental factors unique to their community, the generalisability of these results may be limited. However, given the paucity of research on this topic in indigenous groups, these results recommend future research in populations previously not included in food insecurity and mental health research, and urgent action to address high levels of food insecurity. Secondly, the limited sample size and cross-sectional nature of the data collection preclude these results from indicating causality and should be considered as an association only. And finally, mental health symptoms were collected through self-report and not validated through a clinical interview. While a mental health diagnosis cannot be assumed, the self-report of symptoms is appropriate for preliminary research and was agreed upon as the best method by leaders of the community in which this work was conducted.

In conclusion, over 80 % of an indigenous community on the islands off Panamá reported food insecurity, with the highest levels reported between the ages of 18–39. Food insecurity was associated with higher levels of depressive symptoms and serious psychological distress, suggesting a need to incorporate social determinants of health into mental health treatment models. This study supports a targeted effort to address food insecurity in this population and the need to incorporate mental health and access or availability of food into a combined intervention.

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were approved by the Western Institutional Review Board. The Western Institutional Review Board, is an accredited organisation that has been providing human subjects and regulatory compliance for more than 40 years across 70 countries. Verbal consent was obtained from all subjects. Verbal consent was witnessed and formally recorded. *Consent for publication*: Consent for publication was obtained from leaders of both study communities.

References

1. Food and Agriculture Organization of the United Nations (FAO), IFAD, UNICEF, *et al.* (2020) In Brief to The State of Food Security and Nutrition in the World 2020. Transforming food systems for affordable healthy diets. Rome, FAO. doi: 10.4060/ca9699en.
2. Jaron D & Galal O (2009) Food security and population health and well being. *Asia Pac J Clin Nutr* **18**, 684–687.
3. Food and Agriculture Organization of the United Nations (FAO) (2006) *Food Security: Policy Brief*. June Issue 2. Rome: FAO; available at http://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf.
4. Frongillo EA, Nguyen HT, Smith MD *et al.* (2017) Food insecurity is associated with subjective well-being among individuals from 138 countries in the 2014 Gallup World Poll. *J Nutr* **147**, 680–687.
5. United Nations (2015) The Millennium Development Goals Report 2015. New York, NY; available at http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf.
6. Restrepo-Arango M, Gutierrez-Builes LA & Rios-Osorio LA (2018) Food security in Indigenous and peasant populations: a systematic review. *Cien Saude Colet* **23**, 1169–1181.
7. Power EM (2008) Conceptualizing food security or aboriginal people in Canada. *Can J Public Health* **99**, 95–97.
8. Walch A, Bersamin A, Loring P *et al.* (2018) A scoping review of traditional food security in Alaska. *Int J Circumpolar Health* **77**, 1419678.
9. Skinner K, Pratley E & Burnett K (2016) Eating in the city: a review of the literature on food insecurity and indigenous people living in Urban Spaces. *Societies* **6**, 1–17.
10. Gracey M & King M (2009) Indigenous health part 1: determinants and disease patterns. *Lancet* **374**, 65–75.
11. Jones AD (2017) Food insecurity and mental health status: a global analysis of 149 countries. *Am J Prev Med* **53**, 264–273.
12. Economic Commission for Latin America and the Caribbean (2014) *Indigenous Peoples in Latin America*. Santiago, Chile: United Nations; available at https://www.cepal.org/en/infografias/los-pueblos-indigenas-en-america-latina (accessed on July 14, 2021).
13. Vakis R & Lindert K (2000) Poverty in indigenous populations in Panama: a study using LSMS data. Human Development Department LCSHD Paper Series No. 55; available at https://www.researchgate.net/publication/252356790_Poverty_in_Indigenous_Populations_in_Panama_A_Study_Using_LSMS_Data.
14. Huet C, Rosol R & Egeland GM (2012) The prevalence of food insecurity is high and the diet quality poor in Inuit communities. *J Nutr* **142**, 541–547.
15. Walker RJ, Campbell JA, Dawson AZ *et al.* (2019) Prevalence of psychological distress, depression and suicidal ideation in an Indigenous population in Panama. *Soc Psychiatry Psychiatr Epidemiol* **54**, 1199–1207.
16. Weaver LJ & Hadley C (2009) Moving beyond hunger and nutrition: a systematic review of the evidence linking food insecurity and mental health in developing countries. *Ecol Food Nutr* **48**, 263–284.
17. Siefert K, Heflin CM, Corcoran ME *et al.* (2001) Food insufficiency and the physical and mental health of low-income women. *Women Health* **32**, 159–177.
18. Siefert K, Heflin CM, Corcoran ME *et al.* (2004) Food insufficiency and physical and mental health in a longitudinal survey of welfare recipients. *J Health Soc Behav* **45**, 171–186.
19. Vozoris NT & Tarasuk VS (2003) Household food insufficiency is associated with poorer health. *J Nutr* **133**, 120–126.
20. Hadley C, Tegegn A, Tessema F *et al.* (2008) Food insecurity, stressful life events and symptoms of anxiety and depression in east Africa: evidence from the Gilgel Gibe growth and development study. *J Epidemiol Community Health* **62**, 980–986.
21. Sorsdahl K, Slopen N, Siefert K *et al.* (2011) Household food insufficiency and mental health in South Africa. *J Epidemiol Community Health* **65**, 426–431.
22. Tsai AC, Tomlinson M, Comulada WS *et al.* (2016) Food insufficiency, depression, and the modifying role of social support: Evidence from a population-based, prospective cohort of pregnant women in peri-Urban South Africa. *Soc Sci Med* **151**, 69–77.
23. Lund C, De Silva M, Plagerson S *et al.* (2011) Poverty and mental disorders: breaking the cycle in low-income and middle-income countries. *Lancet* **378**, 1502–1514.
24. Jalal CS, Frongillo EA & Warren AM (2015) Food insecurity mediates the effect of a poverty-alleviation program on psychosocial health among the ultra-poor in Bangladesh. *J Nutr* **145**, 1934–1941.
25. McDonald A, Motta J, Roa R *et al.* (2011) Prevalencia de factores de riesgo asociados a enfermedad cardiovascular en la población adulta de 18 años y más. *Provincias de Panamá y Colón*. Ministerio de Salud – Panamá; available at https://cspcocle.files.wordpress.com/2011/11/prevalencia-de-factores-de-riesgos-asociados-a-enfermedad-cardiovascular.pdf.
26. Kroenke K, Spitzer RL & Williams JBW (2001) The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* **16**, 606–613.
27. Kessler RC, Andrews G, Colpe LJ *et al.* (2002) Short screening scales to monitor population prevalence and trends in non-specific psychological distress. *Psychol Med* **32**, 959–976.
28. Cohen S & Williamson G (1988) Perceived stress in a probability sample of the United States. In *The Social Psychology of Health*, pp. 31–67 [S Spacapan & S Oskamp, editors]. Newbury Park, CA: Sage.
29. Bickel G, Nord M, Price C *et al.* (2000) *Guide to Measuring Household Food Security, Revised*. Alexandria VA: U.S. Department of Agriculture, Food and Nutrition Service; available at https://fnsprod.azureedge.net/sites/default/files/FSGuide.pdf.
30. Gulliford MC, Mahabir D & Rocke B (2004) Reliability and validity of a short form household food security scale in a Caribbean community. *BMC Public Health* **4**, 22.
31. Cohen RA & Zammitti EP (2016) *Access to Care among Adults Aged 18–64 with Serious Psychological Distress: Early Release of Estimates from the National Health Interview Survey, 2012 – September 2015*. Atlanta, GA: National Center for Health Statistics, Center for Disease Control and Prevention.
32. Andreou E, Alexopoulos EC, Lionis C *et al.* (2011) Perceived stress scale: reliability and validity study in Greece. *Int J Environ Res Public Health* **8**, 3287–3298.
33. Walrod J, Seccareccia E, Sarmiento I *et al.* (2018) Community factors associated with stunting, overweight and food insecurity: a community-based mixed-method study in four Andean Indigenous communities in Ecuador. *BMJ Open* **8**, e020760.

34. Willows N, Veugelers P, Raine K (2011) Associations between household food insecurity and health outcomes in the Aboriginal population (excluding reserves). *Health Rep* **22**, 15–20.

35. Deaton BJ, Scholz A & Lipka B (2020) An empirical assessment of food insecurity on First Nations in Canada. *Canadian J of Agric Econ* **68**, 5–19.

36. Ali HMA & Vallianatos H (2017) Women's experiences of food insecurity and coping strategies in the Chittagong Hill tracts, Bangladesh. *Ecol Food Nutr* **56**, 462–478. Epub 2017/10/13. doi: 10.1080/03670244.2017.1381604.

37. Nagata JM, Fiorella KJ, Salmen CR *et al.* (2015) Around the table: food insecurity, socioeconomic status, and instrumental social support among women living in a rural Kenyan Island Community. *Ecol Food Nutr* **54**, 358–369.

38. Kasimba SN, Motswagole BS, Covic NM *et al.* (2018) Household access to traditional and Indigenous foods positively associated with food security and dietary diversity in Botswana. *Public Health Nutr* **21**, 1200–1208.

39. Stephens C, Nettleton C, Porter J *et al.* (2005) Indigenous peoples' health – why are they behind everyone, everywhere? *Lancet* **366**, 10–11.