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Original Research

Food Insecurity, Diet Quality, and Hypertension Risk in Rural Nicaragua

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Background

Individuals within rural Nicaragua have demonstrated elevated risk for hypertension (HTN); however, research examining socio-economic and dietary risk factors is limited. Therefore, the objective of this study was to examine the relationship between food security, dietary patterns, and HTN risk in rural Nicaragua.

Methods

This cross-sectional study included adult participants recruited from volunteer-led health clinics in the mountainous region of the Central Highlands in the state of Matagalpa, Nicaragua, in March 2018. Data collection included an oral survey focusing on household socio-demographics, food security, dietary patterns, and anthropometric and blood pressure measurements.

Results

A total of 123 men and women aged 18 years and up participated in the study (85% of whom were female). Participants were 32.2(± 15.7) years old on average. Food insecurity risk was high, with 78.4% of households identified as severely food insecure. The most commonly consumed daily foods included beans (88%), corn tortillas (84%), and rice (80%). The mean BMI was 26.2 kg/m2 (± 3.9), with 45 percent of participants were identified as overweight and 17.4% as obese. Sixty-three percent exhibited elevated blood pressure, and independent t-test results demonstrated food insecurity was marginally associated with blood pressure (p=0.077) and geographic location (p= 0.060) but not weight status (p=0.97). No significant associations were identified via regression analysis

Conclusions

Participants from rural Nicaragua reported a lack of dietary variety which contrasts dietary patterns recommended for optimal blood pressure control and a lack of healthful food access as demonstrated by elevated food insecurity and related HTN.
This study highlights the link between nutrition, socio-economic risks, and health disparities, as well as the need to for future research around healthful food access and hypertension.

INTRODUCTION

In 2015, 29.6% of Nicaragua resided in poverty.[1] Economic opportunities are limited in Nicaragua and its economy is heavily reliant on agriculture.[2] Even with vast amounts of land available, and used for growing food, food insecurity risk remains elevated, particularly within rural areas.[2,3] Food insecurity is defined as a lack of “physical”, social and economic access to nutritious food to meet dietary needs and food preferences for an active and healthy life."[4] Food insecurity is associated with anxiety over food acquisition, stress and chronic disease (CD) risk.[5,6] Limited economic capacity, and poverty are common predictors of food insecurity globally, and Nicaragua bears a high burden of these interrelated factors.

Rural Nicaragua is at particular risk with evidence households earn less than a dollar a day, and 25% report food insecurity.[7] The severity of food insecurity has been found to be associated lower diet quality and food diversity.[8,9] In rural areas fresh produce is often less accessible and overconsumption of foods high in sugar, fat, salt and starches are consistently observed and associated with increased risk of CDs.[10,11] These preventable CDs, such as diabetes, cardiovascular disease and hypertension (HTN) are

directly associated with elevated body mass index (BMI) and poor diet quality.[12]

CD risk and related deaths disproportionately impact a staggering 80% of low, and middle-income countries.[13] Nicaragua faces the dual burden of food insecurity and related malnutrition (poor diet) and obesity.[9,14-16] Furthermore, CDs like HTN, accounts for 19% of global deaths and is asymptomatic.[17] Although food security and diet are significant predictors of obesity and CD risk, poverty remains a high social risk factor for CDs.[18] Rural, impoverished communities without access to a variety of foods, specifically fruits and vegetables, are at higher risk of obesity, CDs and HTN.[8]

In summary, rural Nicaragua is at particular risk for food insecurity, poor diet quality and related CDs such as HTN. Although it is established that food insecurity is associated with poor diet quality and elevated risk for obesity and HTN, research examining these interrelated risk factors in rural Nicaragua are lacking. Research is warranted to address gaps within the literature and to drive future assessment and/or programming. Therefore, the primary objective of this study was to explore the relationship between food security, dietary patterns, and HTN risk in rural Nicaragua. A secondary objective included examination of socio-environmental predictors of HTN risk such as location, sex, age, education, and household size.

METHODS

STUDY DESIGN

This exploratory cross-sectional study used a convenience sampling method to recruit participants for paper and pencil surveys, anthropometric measurements, and blood pressure measurements. Adult participants (⩾ 18 years old) were recruited during volunteer-led community health clinic and outreach days in the communities of Tierra Blanca (TB), La Rocha (LR), and La Hermandad (LH) within the northern, rural mountainous Central Highlands of Nicaragua, Matagalpa. The clinic and outreach days occurred on two separate days, one serving TB/LR together and another serving LH. The Principal Investigators (Co-PIs) had previous cross-cultural communication and clinical training as well as extensive experience volunteering within each community (10+ years). Prior to conducting the survey, all research assistants (RAs) were trained by the PI on cross-cultural communication, anthropometrics, and clinical measures. Local community members, familiar with the study area were hired and trained to assist with recruitment, interpretation, and data collection. All study materials were translated into Spanish. This study was approved by the Institutional Review Board at Winthrop University prior to all data collection.

SITE DESCRIPTION

The LH community is a more economically developed community, and it is approximately ninety miles from the LR and TB communities; and TB and LR are approximately three miles apart. Both communities are isolated from urban settings, have limited access to education, and are primarily sustained through small agriculture, animal husbandry, and labor jobs. The study was conducted through volunteer-led health outreach clinics in a collaboration between Winthrop University and Nicaragua's Ministry of Health (MINSA) health services volunteers (e.g., physicians, nurses). A local community organizer and nurse who had been collaborating and working with researchers from Winthrop University for over a decade assisted with recruiting community members and building the collaboration with medical staff volunteers (e.g., local physicians). These volunteer-led health outreach clinics included basic health screenings and treatment by a visiting American dentist.

RECRUITMENT AND DATA COLLECTION

Participants were invited to participate in the study as they waited for services at the health clinics. All community members present for the clinic were invited to participate and all chose to participate. The research team and local interpreters emphasized that non-participation in the study would in no way impede or hinder services provided at the health/dental clinic. Once written informed consent was obtained, participants were invited to complete a paper and pencil survey that included the Household Food Insecurity Access Scale (HFIAS) questionnaire, a qualitative food frequency questionnaire (FFQ), and sociodemographic questions. Survey data were collected orally with assistance from interpreters and/or RAs. At the end of the survey, participants were asked to have anthropometric measurements taken using a calibrated SECA digital scale and stadiometer to measure weight and height, respectively. Weights were recorded to the nearest 0.1 kg, and heights were recorded to the nearest 0.1 cm. Prior to height and weight measurements, participants were asked to remove shoes. The same RA conducted these measures throughout the data collection to minimize variability. The blood pressure was measured and recorded in mmHg for each participant in a sitting position with left the arm supported and extended. The survey, anthropometric assessment, and clinical measurement ranged from 45 to 60 minutes.

MEASURES

Data collection included socio-demographic and household characteristics: age, gender, income, household size, and school attendance. Food insecurity was measured using the nine-item HFIAS, a validated scale used by USAID to measure food security in low-income countries.[19] General dietary patterns were collected using a qualitative FFQ developed specifically for this study to represent local, culturally appropriate Nicaraguan foods (see Appendix A/Supplementary Material for the English version). The FFQ was based on the co-PI's previous data collection, personal experience, and familiarity with local dietary patterns and preferences. To account for lower literacy, pictures of each food item were included in the FFQ. Anthropometric and clinical data were categorized as follows: height and weight were used to calculate BMI in kg/m^2, and blood pressure was classified using current clinical guidelines for hypertension

Table 1. Food Insecurity Data from HFIAS Food Insecurity Questionnaire Reported from Two Rural Nicaraguan Communities

	TB/LR	LH	Overall
	n (%)	n (%)	n (%)
HFIAS Scaled Score—Mean (SD)*	8.1 (5.7)	10.2 (6.6)	9.2 (6.2)
Food Security Categories—Frequency (%)			
Food Secure	n/a	1 (1.8)	1 (1.0)
Mild Food Insecurity	3 (6.5)	4 (7.1)	7 (6.9)
Moderate Food Insecurity	6 (13.0)	8 (14.3)	14 (13.7)
Severe Food Insecurity	37 (80.4)	43 (76.8)	80 (78.4)

* The HFIAS scaled score is on a scale of 0-27, with 27 indicating fully food secure.

as specified by the American Heart Association and American College of Cardiology, which include separate interpretation of systolic and diastolic pressure to identify hypertesion.[20,21]

DATA ANALYSIS

Analyses were performed with IBM SPSS version 26.0 and included descriptive, bivariate, and linear regression analyses. Bivariate analysis included independent t-tests to examine variances in food insecurity risk (HIFAS raw scores) between socio-demographic risk factors (e.g. community location, education level). Linear regression analysis was performed to examine potential influences on BMI and systolic and diastolic blood pressures. The continuous dependent variables BMI (kg/m2), diastolic, and systolic blood pressure measures (mmHg) were examined using the independent variables: socio-demographics, education, and food insecurity score (HIFAS raw score).

RESULTS

Of the total study population, 62 (51.2%) were from TB/LR and 59 (48.8%) were from La Hermandad (Table 1). Most participants (85%) were female, with an average age of 32.23 (± 15.73) years and a household size was 4.87. The average period of school attendance (SA) was 3.14 years (± 2.74 years).

With a mean overall HFIAS score of 9.2 (± 6.2) (Table 1), 99% of the study population was classified as food insecure, with 78.4% classified as severely food insecure. The majority of participants (80.4%) reported severe household food insecurity risk, with some moderately food insecure (13%) and a few households mildly food insecure (6.5%). The TB/LR HFIAS scaled food insecurity risk score was 8.1 (± 5.7) compared to LH which was found to be at lower risk for food insecurity with a score of 10.2 (± 6.6).

Dietary patterns were also reported, and the foods reported by most that were consumed daily included high starch foods: beans (100%), corn tortillas (94.4%), and rice (90.8%) (Table 2). Onions (75.3%), tomatoes (61.4%), and bananas (48.6%) were the most frequently reported daily fruit and vegetables consumption (over half of the sample). In addition to daily consumption, top foods consumed weekly included: chicken (76.1%), cabbage (35.7%), and bananas (35.7%).

Anthropometric and related BMI measures identified almost half (44.6%) of the participants as overweight and 14.9% as obese (Table 3). Very few participants were identified as underweight (2.4%). For blood pressure readings, slightly over half were within normal ranges (54.2%), with others identified as having elevated (15.8%) blood pressure or being within the range for hypertension stage I (30%). There were no participants in hypertensive stage II or hypertensive crisis. independent t-test results demonstrated food insecurity was marginally associated with blood pressure (p=0.077) and geographic location (p= 0.060) but not weight status (p=0.97).

Results from linear regression analysis examined predictors of BMI within rural Nicaraguan communities and included data on location, age, sex, household size, school attendance (SA, years), and FIS score. The data showed that as age increased by one year, BMI decreased (B=-0.27) (Table 4). People from LH had a higher average BMI than people from Tierra Blanca (B=1.406). There was no effect on location or BMI (Beta=0.174, p=0.85). The data concluded females had a higher BMI than males (B=0.764) and as school access increased by one year, BMI increased (B=0.63). As the household size increased, BMI decreased (B=-0.33) and as the FIS score increased by one point, BMI increased (B=.065). BMI increased as schooling increased by one year (B=.063). There was no significant individual predictor effect on BMI based on the p values for each predictor (p>.999).

In addition, predictors for systolic blood pressure in rural Nicaraguan communities were examined using linear regression, which included location, age, sex, number of people in the household, school access (SA, years) and FIS score. The data showed that as age increased each year, systolic blood pressure decreased (B=-.069) (Table 5). The community of LH had lower systolic blood pressure than TB (B=-6.743). Based on the data, males had a higher systolic blood pressure than females (B=-6.821). As the number of people in a household increased, systolic blood pressure decreased (B=-.223). It was concluded that as school attendance increased by one year, systolic blood pressure decreased (B=-.443), and as FIS score increased by a point, systolic blood pressure decreased (B=-.443). The individual

Table 2. Reported Daily and Weekly Food Consumption from Two Rural Nicaraguan Communities (n=109)

Food/Beverage Item*	*Daily Frequency (%)*	Food/Beverage Item*	*Weekly Frequency (%)*
Beans	109 (100)	Chicken	83 (76.1)
Corn Tortillas	103 (94.4)	Cabbage	39 (35.7)
Rice	99 (90.8)	Bananas	39 (35.7)
Onions	82 (75.2)	White potatoes	37 (33.9)
Corn	79 (72.4)	Malanga	35 (32.1)
Tomatoes	67 (61.4)	Sweets	35 (32.1)
Bananas	53 (48.6)	Green Peppers	34 (31.1)
White Potatoes	43 (39.4)	Pork	32 (29.3)
Lemons	41 (37.6)	Mangos	32 (29.3)
Malanga	35 (32.1)	Oranges	32 (29.3)
Coffee (w/sugar)	34 (31.1)	Pineapple	30 (27.5)
Coffee	32 (29.3)	Watermelon	30 (27.5)
Green Peppers	33 (30.2)	Lemons	29 (26.6)
Milk	32 (29.3)	Avocados	28 (25.6)
Avocado	28 (25.6)	Tomatoes	28 (25.6)
Bread	28 (25.6)	Beef	26 (23.8)
Cabbage	27 (24.7)	Cheese	21 (19.2)
Carrots	24 (22.0)	Coke	21 (19.2)
Mango	24 (22.0)		
Sweets	24 (22.0)		
Oranges	22 (20.1)		

*Food listed reported by a minimum of 20 participants. Other foods were reported but daily and/or weekly consumption were minimal. Other foods/beverages included: fish, nuts, chips, sweet potatoes

Table 3. Body Mass Index (BMI) and Blood Pressure Data from Two Rural Nicaraguan Communities (n=121)

	Males	Females	Overall
BMI-- Mean (SD)	25.28 (2.8)	26.43 (4.1)	26.2 (3.9)
BMI Categories-- Frequency (%)			
Underweight (< 18.5 kg/m^2)	n/a	3 (2.9)	3 (2.4)
Normal (18.5-24.9 kg/m^2)	8 (44.4)	34 (33.3)	43 (35.5)
Overweight (25-29.9 kg/m^2)	9 (50)	45 (44.1)	54 (44.6)
Obese (≥ 30 kg/m^2)	1 (5.6)	17 (16.7)	18 (14.9)
Blood Pressure-- Mean (SD)			
Systolic mm Hg	131.8(19.9)	124.2 (17.0)	125.5 (17.6)
Diastolic mm Hg	81.0 (10.4)	77.9 (12.2)	78.4 (11.9)
Blood Pressure Categories-- Frequency (%)			
Normal (<120 systolic & < 80 diastolic)	7 (38.9)	58 (57.4)	65 (54.2)
Elevated (120-120 systolic & < 80 diastolic)	1 (5.6)	18 (17.8)	19 (15.8)
Hypertension I (130-139 systolic or 80-89 diastolic)	10 (55.6)	25 (24.8)	35 (30.0)

predictors on systolic blood pressure were not significant based on the p value for each predictor (p>0.999).

Predictors for diastolic blood pressure in rural Nicaraguan communities include location, age, sex, number of people in the household, school access (SA, years), and FIS score. The data show that as age increases each year, diastolic blood pressure decreases (B=-.012) (Table 6). The community of LH had lower diastolic blood pressure than TB (B=-1.519). Based on the data, males had a higher diastolic blood pressure than females (B=-1.322). As the number of people in a household increased, diastolic blood pressure increased (B=.035). It was concluded that as school attendance increased by each year, diastolic blood pressure decreased (B=-.848) and as the FIS score increased by a point, systolic blood pressure decreased (β=-.020). The only individual predictor of diastolic blood pressure with a sig-

Table 4. Linear Regression Predictions of Body Mass Index (BMI) Predictors with Rural Nicaraguan Communities (n=121)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Data Location TB/LR vs.LH	1.406	.808	.174	1.739	.085
Age	-.027	.025	-.103	-1.059	.292
Sex Female Vs. Male	.764	1.143	.065	.669	.505
# in Household	-.333	.210	-.151	-1.580	.117
SA in Yrs	.063	.143	.043	.441	.660
FIS Score	.065	.063	.099	1.026	.307

Table 5. Linear Regression Predictions of Systolic Blood Pressure (mmHg) Predictors with Rural Nicaraguan Communities (n=121)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Data Location TB/LR vs. LH	-6.743	3.413	-.197	-1.976	.051
Age	-.069	.108	-.062	-.639	.524
Sex Female Vs. Male	-6.821	4.814	-.137	-1.417	.160
# in House	-.223	.893	-.024	-.250	.803
SA in Yrs	-.443	.602	-.071	-.736	.464
FISscore	-.152	.265	-.055	-.572	.568

Table 6. Linear Regression Predictions of Diastolic Blood Pressure (mmHg) Predictors with Rural Nicaraguan Communities (n=121)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Data Location TB/LR vs. LH	-1.519	2.399	-.064	-.633	.528
Age	-.012	.076	-.015	-.153	.879
Sex Female Vs. Male	-1.322	3.384	-.038	-.391	.697
# in House	.035	.628	.005	.056	.956
SA in Yrs	-.848	.423	-.197	-2.004	.048*
FISscore	-.020	.186	-.010	-.107	.915

nificant p value was school attendance (p=.048). The other individual predictors were not significant based on the p values for each predictor (p>0.999).

DISCUSSION

The primary objective of this study was to explore rates of food insecurity, dietary patterns, and HTN risk in rural Nicaragua. A secondary objective included the examination of socio-environmental predictors of HTN risk. Although food insecurity is associated with poor diet quality and, thereby, obesity and HTN risk, few studies have investigated these interrelated factors in isolated rural populations within the same investigation. This study identified high rates of severe food insecurity, limited diet quality, overweight/obesity, and HTN risk. Specifically, elevated diastolic blood pressure was inversely associated with longer school attendance. These findings highlight the need to address these interrelated risk factors to alleviate health in-

equities within low-income countries, especially rural areas. In addition, despite the agricultural focus within Nicaragua, poverty, and related socio-demographic limitations such as a lack of education and related economic capacity likely further drive food and nutrition related barriers to achieving optimal health.

Seventy-eight percent of all participants identified as severely food insecure. Of the two rural communities of TB/LR and LH, severe food insecurity was highest in TB/LR (80.4% vs. 76.8%, respectively). LH may have had a lower comparative rate because community members had access to an established agricultural cooperative, which supported economic resources and capacity of the community. The TB/LR community is more remote and has less economic development. These differences may account for the difference seen in food insecurity. This relationship has been identified within the literature with economic development and resources a primary indicator for food security, especially within low-income income communities, with income to be the primary driver in nutrient intake and overall food quality status.[22,23]

Overall, our food insecurity rates mirror the findings of other studies conducted within Nicaragua. In a rural northwestern Nicaraguan sample, Perez et al. found 89% to be food insecure (vs. 89% in our study).[3] In Léon, Nicaragua, 50% were mildly food insecure, and 25% reported moderate to severe food insecurity (vs. 20.6%, mild/moderate food insecurity in our study).[24] Further, Perez et al. found that while a majority of the study population was food insecure (89%), close to half (48%) also rated their health as poor, which emphasizes the impact of food insecurity on overall health.[3]

The high percentage of food insecurity may also be related to the lack of dietary variety reported in this rural study population. The primary daily dietary staples included beans, tortillas, and rice. While these are not processed foods, there was regular consumption of fruits and vegetables reported outside of the weekly consumption of cabbage and bananas. Other studies examining diet quality in Central America have also identified beans, rice, and tortillas as primary staples with limited to no fruits and vegetables.[25-27] Low fruit and vegetable intake leads to nutrient deficiencies, one of the top 10 causes of mortality globally.[28] High food insecurity, as reported in this study, has also been found in other studies to be associated with limited access to healthy foods and decreased food variety and diversity, as was also reported in this study.[26,29] It is likely the high food security, limited dietary variety may be associated with low educational attainment (mean SA was 3.14 years) and economic capacity, as well as the rural location, which further limits economic opportunities.

In a review examining the relationship between food insecurity and overweight/obesity, numerous studies have found that adequate access to food variety played an important role in the relationship between food insecurity and overweight/obesity.[9,30] Our study identified 54% of the total study population as overweight and 14.9% as obese. Similar studies conducted in semi-rural areas of Nicaragua reported rates of overweight and obesity ranging from 22 to 55%, with significant positive trends for women and those at lower income levels.[9,31] In another low-income country, those who reported being food insecure were less likely to eat fruit (40%) or green vegetables or salads (28%).[32] We also identified an inverse trend (although not significant) between years of school access and BMI, however, this trend was minimal in our study in comparison to other study findings in low-income countries examining educational attainment and food insecurity as well as direct relationships between education, gender and overall diet quality and health status.[24,26,31-36] Future studies in lower-income countries should continue to examine education's relationship to economic capacity and health.

Overall, HTN risk was high within the two rural Nicaraguan samples examined in this study. A study by Wong-McClure et al., in Nicaragua, found the overall prevalence of metabolic syndrome to be 30.3%, which is higher than in other low-income or developing countries and includes elevated blood pressure and abdominal obesity.[37] A study based in nearby Honduras found a significant co-occurrence of food insecurity and high BMI.[38] Other studies in low-income countries have also identified food insecurity as being associated with a high risk of dietary inadequacy and obesity.[39] These studies' conclusions support our findings regarding the relationship between food insecurity, HTN, and obesity. Elevated BMI increases a person's risk for developing CDs; therefore, it is not surprising that high rates of overweight/obesity and HTN risk were observed within this study.[40]

Previous research has linked rural communities with the prevalence of CD risks, including obesity and HTN.[12,41-43] Two separate studies conducted in rural Nicaraguan clinics identified HTN rates of 21% and 41% of their study population, respectively, which is comparable to the 30% found in hypertensive ranges seen in our study population.[41,42] Furthermore, although HTN is associated with excess weight, dietary patterns are also related to blood pressure. Dietary patterns which include a wide variety of fruits, vegetables, and plant-based proteins with high fiber are associated with reduced HTN risk.[44] There was very little consistent intake of fruits, vegetables, dairy, or nuts and seeds reported in our sample, which, combined with increased food insecurity and obesity rates reported in this population, most likely contributes to observed elevated blood pressure.

LIMITATIONS

Although this study fills several gaps within the field, it is not without limitations. The data for this study were primarily collected orally, and this may have biased the participants' responses. However, we did intentionally recruit and train local community members to assist with data collection to reduce potential bias. Self-reported data and low literacy rates may have also affected the accuracy of the information collected. Blood pressure measurements were collected only once. Although best practices include multiple blood pressure measurements on separate days when diagnosing hypertension, this study did not seek to diagnose hypertension but to examine general risk. These lim-

itations may have impacted the overall quality of understanding and interpretation of the data. In addition, the sample size in this explorative study was small and specific to a rural mountainous region, which may have limited the significance or generalizability of our findings to urban or other populations within Nicaragua.

CONCLUSION

This study identified elevated rates of severe food insecurity, low diet variety and quality, obesity, and HTN risk. In this study, longer school attendance was associated with a lower risk of elevated diastolic blood pressure. Efforts to improve health outcomes are complex and will need to address socioeconomic drivers of nutrition and health such as education and poverty, especially for women. Future research should examine community-based capacity building in rural, agricultural communities to expand crops and/or sustainable programs (e.g., animal husbandry) to support improved socioeconomic status, related food security, and diet variety and quality in rural Nicaragua.

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CONFLICT OF INTEREST

None

ETHICAL STANDARDS DISCLOSURE

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Institutional Review Board at Winthrop University. Written informed consent was obtained from all subjects/patients.

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SUPPLEMENTARY MATERIALS

Food Frequency Questionnaire for Individuals in Nicaragua

Download: https://nortonhealthcaremedicaljournal.scholasticahq.com/article/84102-food-insecurity-diet-quality-and-hypertension-risk-in-rural-nicaragua/attachment/172345.docx