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Article

Predictors of High Obesity in Rural Nicaragua: A Cross-Sectional Study

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Abstract: Chronic disease prevalence continues to increase in low- and middle-income countries and countries in Central American regions are not exception. In the present study, we conducted a cross-sectional analysis on a sample of respondents (n=200) who were aged 30 years and over and living in rural communities in Nicaragua. Study results showed that a higher percentage of the respondents who reported their health being fair or poor and female respondents found to have higher levels of BMI compared to their male counterparts ($p < 0.05$). Behavioral factors, such as vegetable consumption and hours of sleep found to be significant predictors of obesity/overweight among rural residents in Nicaragua. Study results highlighted the need for targeted behavioral change interventions including promoting consumption of fruits and vegetables in regular diets among rural residents.

Keywords: obesity; rural; behavioral factors; food

1. Introduction

In recent years, low- and middle-income countries in the Americas have seen a concerning rise in obesity and overweight among adults (WHO, 2014), a trend expected to continue in the coming decades (López Barrera & Hertel, 2022). For instance, in Mexico, the obesity rate (BMI > 30 kg/m²) increased from 24.2% in 2002 to 36.9% in 2022. Similar trends were observed in Chile, where the rate rose from 20.5% in 2000 to 30.7% in 2022, and in other countries (Global Nutrition Report, 2022). These increases were particularly significant among women. In Mexico, the percentage of obese women rose from 29% in 2000 to 41% in 2022, while for men, it was 32.3% in 2022. Projections indicate that by 2030, overweight and obesity will affect 50% of males and 60% of females in Latin America (Aschner, 2016).

In Nicaragua, the percentage of adult obesity has also been steadily increasing, with higher rates among women. The most recent report on obesity in Nicaragua showed that 20.6% of males and 32.1% of females were obese in 2021, up from 10.6% and 20.3% in 2000, respectively (Global Nutrition Report, 2022).

Factors contributing to the rising obesity levels among adults include changes in dietary practices (Uauy, Kain, & Alba, 2001; Melo & Otros, 2023) and sedentary lifestyles (Aschner, 2016; PAHO, 2022). However, studies on obesity and its contributing factors in Nicaragua are limited. Most research has focused on urban areas, leaving a gap in understanding obesity in rural communities. This study aims to explore the risk-taking behaviors of individuals in rural Nicaragua and assess the impact of nutritional and physical activities on obesity.

2. Data and Methods

The data for this study were obtained from a cross-sectional survey conducted in the rural communities of Quebrada Honda, Nadayure, and Diriomito in the department of Masaya,

Nicaragua. Data collection was carried out by family physicians familiar with the area. We selected 200 respondents aged 30 years and older who had no medically diagnosed chronic health conditions. The survey questionnaire included background characteristics (age, educational level, gender, and marital status), self-reported physical and mental health, and behavioral characteristics such as smoking, alcohol and vegetable consumption, participation in physical activities, and hours of sleep.

Additionally, we collected weight data using a digital scale, ensuring patients wore minimal clothing for accuracy. Weight was recorded in kilograms, and the scale was calibrated daily before use. Height was measured using a stadiometer, with results recorded in centimeters. We calculated the Body Mass Index (BMI) using the formula: $\text{Weight (kg)} / \text{Height (m)}^2$. BMI categories were defined as follows: Underweight: BMI < 18.5, Normal weight: BMI 18.5–24.9, Overweight: BMI 25–29.9, and Obesity: BMI ≥ 30.

Waist circumference was measured using a flexible measuring tape at the narrowest part, usually just above the belly button. Hip circumference was measured at the widest part of the hips. The Waist-to-Hip Ratio (WHR) was calculated by dividing the waist circumference by the hip circumference, ensuring both measurements were in the same units. WHR classification followed WHO guidelines: ≥ 0.90 for men and ≥ 0.85 for women, indicating a significantly increased risk of metabolic complications (WHO, 2011).

Fasting glycemia tests were performed by laboratory personnel, ensuring proper technique, transport, and processing of samples. Blood pressure was measured using an aneroid sphygmomanometer, calibrated daily. The study protocol was approved by the Institutional Ethics Committee at the Military Hospital in Nicaragua.

Bivariate analysis with Chi-square tests was conducted to understand the significant associations between variables. Two logistic regression analyses were performed to predict WHR: Model 1 adjusted for behavioral characteristics and self-reported health, and Model 2 adjusted for behavioral, background variables, and self-reported health. The dependent variable was coded as 0 for normal or moderate WHR and 1 for high WHR. All analyses were conducted using SPSS Statistics 29.0.2.

3. Results

Table 1 presents the background characteristics of the respondents. Median age of the respondents found be in the age group 45-49, with highest percentage of the respondents in the age group 30-34 (23.5 percent). Approximately, half of the respondents reported with primary level of education.

Table 1. General Characteristics and self-perceived health.

Background Characteristics of the Respondents (n=200)		
Characteristics	n	Percentage
Age		
30-34	47	23.5
35-39	24	12.0
40-44	23	11.5
45-49	28	14.0
50-54	22	11.0
55-59	20	10.0
60-64	14	7.0
65+	22	11.0
Gender		
Male	45	22.5
Female	155	77.5
Educational level		
Primary	98	49.0

Secondary	79	39.5
Professional	14	7.0
No education	9	4.5
Self reported health		
Excellent	1	0.5
Very good	9	4.5
Good	54	27.0
Fair	135	67.5
Poor	1	0.5
Mental health issues in the last 30 days		
Never	97	48.5
Less than 3 days	12	6.0
3-7 days	8	4.0
8+ days	83	41.5
Has a health professional ever told		
High blood pressure	57	28.5
Diabetes	18	9.0
Depression	1	0.5

When asked about self-perceived health, more than two-thirds of the respondents (68 percent) reported their health being either fair or poor health, an overwhelming 41.5 percent of the respondents mentioned having 8 or more days with mental health problems. When asked for if a health professional ever diagnosed any health conditions, 28.5 percent reported having diagnosed with high blood pressure.

In terms of risk-taking behaviors, a small percentage of the respondents reported smoking cigarettes (3.5 percent) and consuming alcohol (5.0 percent). On the other hand, when it comes protective behaviors such as consuming vegetables, over two-thirds of the respondents reported never eating vegetables or salad. We also found that three-fourths of the respondents had a routine medical checkup in the last year. The average number of hours of sleep per day was 7 hours (see Table 2).

Table 2. Behavioral and clinical characteristics of the respondents (n=200).

Characteristics	n	Percentage
Last routine medical check-up		
Less than 1 year	151	75.5
1-2 years ago	43	21.5
More than 2 years ago	4	2.0
Never	2	1.0
Smoking status		
Yes	7	3.5
Use of alcohol		
Yes	10	5.0
Vegetable consumption		
Once a week	41	20.5
Two or more times a week	25	12.5
Never	134	67.0
Salad consumption		
Once a week	9	4.5
Two or more times a week	59	29.5
Never	132	66.0
Hours of sleep per day(mean, Std. dev.)	200	(7.3 1.46)

BMI		
Less than 25	33	16.5
25.0-29.9	84	42.0
30.0+	83	41.5
Blood pressure		
Normal	147	73.5
Elevated	36	18.0
High grade 1	15	7.5
High grade 2	2	1.0
Glycemia level		
Normal	152	76.0
Above normal	48	24.0
Waist-hip ratio		
Low	18	9.0
Moderate	22	11.0
High	160	80.0

In addition, we have collected information on several key clinical health measures. These measures include, BMI, blood pressure, glycemic levels and waist-hip ratio (Table 2). In general, BMI of 30+ was found to be among 41.5 percent of the respondents, over one-fourth of the respondents reported with elevated or higher blood pressure, and a similar percentage of the respondents with above normal glycemic levels and 80 percent with high waist-hip ratio.

Results from the bivariate analysis show that females tend to have significantly higher BMI compared to males and lower levels of vegetable consumption leads significant level of higher BMI. These variables (gender and vegetable consumption) along with salad consumption found to be significantly associated with high waist-hip ratio (Table 3).

Table 3. Bivariate distribution of health characteristics by background and behavioral characteristics of the respondents.

Variables	Waist-Hip ratio		Sig.
	Low/Moderate	High	
Age			p<0.05
<40	28.2	71.8	
40+	15.5	84.5	
Gender			p<0.05
Male	35.6	64.4	
Female	15.5	84.5	
Marital Status			ns
Living alone	20.6	79.4	
Living with someone	19.7	80.3	
Education level			ns
Primary or less	17.8	82.2	
More than primary	22.6	77.4	
Self-reported Health			ns
Good or better	21.9	78.1	
Fair or poor	19.1	80.9	
Hours of sleep			p<0.05
7 hours or less per day	26.7	73.3	
More than 7 hours	17.1	82.9	
Vegetable consumption			p<0.001
Once or never a week	12.8	87.2	

2 or more times	37.3	62.7
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Table 4 shows the odds of predicting high levels of WHR for the respondents in the study. Two models are included in the table. Model 1 provides the odds ratio for behavioral variables and self-reported health and Model II has controlled for behavioral and self-reported health variables in predicting high WHR. Results showed that after controlling for background variables (age, gender, marital status and educational levels), behavioral variables such as hours of sleep and vegetable consumption were significant predictors of WHR. That is, odds of having high WHR were two times higher for those who reported more than 7 hours of average sleep in the past week. It was also observed that odds of having high levels of WHR were lower among individuals who reported consuming vegetables/salads 2 or more during the past week.

Table 4. Odds of predicting high waist-hip ratio in rural Nicaragua (n=200).

Variables	Model I		Model II	
	AOR	Sig.	AOR	Sig.
Age				p<0.05
<40			1.00	
40+			2.76	
Gender				p<0.001
Male			1.00	
Female			3.58	
Marital Status				ns
Living alone			1.00	
Living with someone			1.37	
Educational level				ns
Primary or less			1.00	
More than primary			0.95	
Self-reported health		ns		ns
Regular or poor	1.00		1.00	
Good or better	1.27		1.70	
Hours of sleep		p<0.05		p<0.05
7 hours or less	1.00		1.00	
7+ hours	2.38		2.07	
Veg. consumption		p<0.001		p<0.001
No veg.	1.00		1.00	
2+ times	0.20		0.21	
-2 Log likelihood	180.93		168.39	

4. Discussion

Adult obesity in Nicaragua is a significant public health concern. According to the Global Nutrition Report, approximately 32.1% of adult women and 20.6% of adult men in Nicaragua are living with obesity. These rates indicate that obesity is more prevalent among women than men and exceed the regional averages for Latin America and the Caribbean, particularly for women.

Our study results have highlighted three key points. First, this study used WHR to measure the prevalence of obesity in adults, as opposed to the commonly used BMI measure. While previous studies have noted the discrepancy of using BMI in predicting risks for CVD (Lopez-Jaramillo, Reuda-Causen, Silva, 2007; Reuda-Causen, Silva, Lopez-Jaramillo, 2008; Zhang et al., 2024), very few studies have used WHR to describe the prevalence of obesity and overweight in Latin American countries, particularly in Nicaragua.

Studies from developing countries in Asia (Adams et al., 2006) and the United States (Zhang et al., 2024) showed higher risks of CVD with lower levels of BMI. Zhang et al. (2024) established that

WHR is independently associated with mortality regardless of BMI or comorbidities and recommended that WHR might be a better indicator of mortality compared to BMI, particularly for Hispanic and Latino populations. Despite these recommendations, studies on obesity and overweight in Nicaragua often relied heavily on measuring BMI. Thus, the results presented in this study are unique in using WHR and contribute further to our understanding of the growing public health concerns regarding overweight and obesity in Nicaragua. Future studies must consider using WHR as a viable measure for assessing obesity and overweight among adults and in developing prevention efforts addressing these issues.

Our study results also found that a higher proportion of respondents (more than 80%) reported higher levels of WHR (Table 2), with this percentage being higher among women compared to men. Approximately 85% of females reported having high levels of WHR, while 65% of men reported the same levels. Gender was significantly associated with predicting WHR, and the odds of predicting higher levels of WHR were 3.58 times higher among women compared to men ($p < 0.001$) (Table 4). Higher prevalence of obesity and overweight among women was also reported in previous studies. For example, Aschner (2016) reported higher WHR or obesity levels in females, and several national-level reports and studies from Latin American countries (Aschner, 2016; Reynaldo et al., 1998) also reported higher levels of obesity among females. In addition to biological determinants, social and cultural factors play significant roles in predicting gender differences in obesity in Nicaragua. Economic deprivation may contribute to higher rates of obesity among women of low socioeconomic status due to their greater exposure to and dependence on high energy-dense foods (Peterman et al., 2010). People who do not have physical or economic access to adequate food will seek to satisfy their energy needs through low-cost foods with low nutritional quality, which usually have high levels of saturated fats, monosaccharides, and energy intake (Peterman et al., 2010).

Second, we learned that the self-perceived health status of residents living in rural communities who reported being in fair or poor health was very high among rural residents of Nicaragua. Further analysis (not shown in the Tables) found that respondents who reported their health as either fair or poor tended to be older (44 years and above), reported higher levels of WHR, and had fewer average hours of sleep (less than 7 hours per day). Behaviorally, these respondents also tended to work longer hours (9+ hours on average per day) and consumed fewer or no vegetables. Knowing the background profile of respondents with higher WHR, prevention efforts can be targeted to address behavioral challenges, including improving vegetable consumption and sleep quality. Targeted interventions to improve obesity among populations living in vulnerable communities were also recommended in a recent report from PAHO and WHO, emphasizing the critical importance of reducing unhealthy diets and improving physical activity and sleep quality (PAHO, 2011). A systematic review by Melo et al. (2023) further highlighted the importance of market-based food interventions, including but not limited to higher taxes on processed foods and beverages with high sugar content and nutritional labeling on packaged foods to address the growing obesity levels in Latin American countries.

Finally, while fruit and vegetable production in rural Nicaragua is a critical component of the country's agricultural sector and contributes significantly to both food security and the livelihoods of small-scale farmers, the consumption of healthy food, such as fruits and vegetables, among rural residents was weak or considered non-existent in their regular diet. Our results showed that respondents who reported weak or no consumption of vegetables tended to have higher WHR compared to their counterparts. Based on a review of experimental data, researchers have suggested that foods found in vegetarian diets may have metabolic advantages for the prevention of type 2 diabetes (Fraser, 1999), and fruits and vegetables are associated with a 40% reduction in type 2 diabetes (Jenkins, Kendall, Marchie, et al., 2003; Fung, Schulze, Manson, Willett, & Hu, 2004; Snowdon & Phillips, 1985; Vang, Singh, Lee, Haddad, & Brinegar, 2008; Chaussain, Georges, Gendrel, Donnadieu, & Job, 1980).

5. Conclusions

Despite significant and notable improvements in Nicaragua's health sector in recent years, the rise of non-communicable diseases among the most vulnerable populations, particularly those in rural areas, poses a major threat to the public health system. WHR may be a better indicator of mortality compared to BMI, especially for Hispanic and Latino populations. The results presented in this study are unique in using WHR, contributing further to our understanding of the growing public health concerns regarding overweight and obesity in Nicaragua. Massive healthy eating campaigns are needed to impact rural areas, as the identified eating habits were significant predictors of a high waist-hip ratio (WHR), which is clearly a risk factor for cardiovascular morbidity and mortality from chronic diseases.

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