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EXAMINING THE PREVALENCE AND RISK FACTORS FOR DIABETES IN LOS ROBLES, NICARAGUA – A PILOT STUDY

Abdoulie Senesie

ABSTRACT

EXAMINING THE PREVALENCE AND RISK FACTORS FOR DIABETES IN LOS ROBLES, NICARAGUA – A PILOT STUDY

By

ABDOULIE SENESIE

12/10/2018

Introduction: Chronic diseases such as diabetes are becoming more prevalent in Central America. According to the World Health Organization, Central America has some of the world's highest prevalence of diabetes. Most studies have underlined urbanization, access to cheap, processed, and energy-dense foods, sedentary lifestyles, increase in obesity, as the main contributing factors to this phenomenon. One of those countries in Central America with high diabetes rates is Nicaragua - which also happens to be the most impoverished. In Nicaragua, diabetes is among the leading causes of death and causes a public health concern. Another issue is the lack of diabetes research in rural Nicaraguan communities. Most of the diabetes research focuses on the capital city Managua and other urban populations; leading to the disproportionate allocation of resources for diabetes intervention to urban areas due to the gap in knowledge about the risk and healthcare burden of diabetes in rural areas. Therefore, understanding the health prevalence and risk factors for diabetes in these communities would have profound public health implications.

Aim: The purpose of this study is to examine the prevalence and risk factors for diabetes in rural settings in Nicaragua. Other interesting public health findings of the community were recorded and analyzed. Recommendations for future studies, public health intervention planning, and implementation of programs will be made based on the information derived from this study.

Methods: The data used for this study was from the Nicaragua Community Health Connection (NCHC) project at the Emory Diabetes Training Academy. One hundred twenty-seven participants from a small rural community in Nicaragua called Los Robles were included in a cross-sectional study. Univariate and bivariate analyses were conducted to obtain descriptive statistics of the sample population using SPSS 22 and SAS 9.3. Chi-square tests were used to describe the relationship between risk factors and diabetes. Multiple logistic regression was used further analyze association. P-Value <0.05 was set as the base for statistical significance.

Results: From the study population (n=127), our mean age was 48 years, 81% were literate, 62% unemployed, and 67% reported a family income of less than 1000 Cordoba (est. $35) bi-weekly. Over half of the study sample were on a high-carb diet, 12% consumed fruits and vegetables daily, while only 23% participated in regular physical activity. We found that the prevalence of diabetes was 10.8% and 19% reported being overweight. From the analysis, unemployment, hypertension, family history of diabetes, high cholesterol, and family history of high cholesterol were associated with diabetes in our study population. Multivariate regression analysis showed a strong association between diabetes and having a family history of diabetes (P=<0.004).

We also found disparities in gender as women had higher rates of diabetes and hypertension. They were also less likely to employed or participate in physical activity.

Conclusions: The results from the study showed a slightly higher prevalence (10.8%) of diabetes in our rural study population than the rate of diabetes (8.5%) in Managua reported in previous studies. Despite limitations in our study, valuable descriptive epidemiology was obtained of Los Robles community. We recommended future studies to validate our findings and immediate implementation of diabetes awareness programs.

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APPROVAL PAGE

SCHOOL BOARD PERCEPTIONS OF RESPONSIBILITIES FOR CHILDHOOD OVERWEIGHT

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Author's Statement Page

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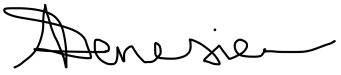
Abdoulie Senesie



Signature of Author

Table of Contents

List of Tables

List of Figures

Chapter I: Introduction

1.1 Background

Diabetes Mellitus, also known as diabetes, is a chronic metabolic disease caused by insufficient insulin production or improper use of insulin by the body, leading to an abnormal increase in blood glucose levels known as hyperglycemia [1, 29]. The three main types of diabetes are type 1 diabetes – the body's inability to produce insulin, type 2 diabetes – ineffective use of insulin by the body, and gestational diabetes – developed during pregnancy [1, 2]. Type 1 diabetes is hereditary, while type 2 diabetes accounts for approximately 90% of all diabetes cases [22]. Some subjects with diabetes do not show any signs for a long time. During this latent period, unmanaged elevated blood glucose can lead to severe and irreversible development of minor and major complications including neuropathy, nephropathy, retinopathy, coronary artery disease, stroke and peripheral vascular disease [6]. Diabetes is a growing public health challenge globally, with an estimated prevalence of 6.4% in the world's adult population and is expected to reach more than 550 million (7.8% of the population) by 2030 [13]. Of the total, 70% of these cases occur currently in low- and middle-income countries [8].

In Central America, non-communicable or chronic diseases are becoming a serious health issue. According to the World Health Organization, Central America has some of the world's highest prevalence of diabetes [5, 22]. Studies conducted by the Central America Diabetes Initiative have highlighted access to processed/energy-dense foods, urbanization, and sedentary lifestyles in the countries of Central America as the reasons for the rapid rise in obesity and diabetes [5]. The estimated prevalence of diabetes in the Central America region is nearly 8% and is expected to increase significantly by 2035 [3]. The highest prevalence for diabetes in Central America are in Nicaragua, Guatemala, and Honduras [3]; the poorest amongst these countries is

Nicaragua [7]. According to a report by the Pan American Health Organization (PAHO), Nicaragua has been characterized as needing special financial and technical assistance in combatting its diabetes endemic, due to the health and economic burden the cost of diabetes poses to individuals and the Ministry of Health [22, 27].

1.2 Nicaragua

Nicaragua is the largest country in Central American bordering Costa Rica on the south and Honduras to the north [7, 23]. It has a population of 5 million, and it is considered the 2nd most impoverished country in the Western Hemisphere with as many as half the people living on $1 a day [10]. The country's primary source of economy is agriculture especially from coffee exports [10].

Nicaragua has many health issues, but chronic diseases have spread rapidly, and increasingly affecting the poor [19]. For example, diabetes has been traditionally associated with cardiovascular diseases and chronic kidney disease both contributing to high morbidity and mortality rates in the country and causing great public health concern [26]. Diabetes is also among the top 10 leading causes of deaths in the country with an increasing prevalence rate in Nicaragua. In 2013, the rate of diabetes-related death was 55 per 100,000, which was about 8% of the total deaths reported in Nicaragua [30]. These rates were high compared to the United States, where the diabetes death rate was 15 per 100,000 in the same year [30]. The above statistics illustrate that diabetes is a considerable public health issue in Nicaragua. The Nicaraguan government has begun to address this growing concern in the country through research and awareness initiatives focused on diabetes, aimed to educate the public with the goal of controlling its rapid rise through early diagnosis and proper care [23, 27]. However,

financial and human resources dedicated to these efforts have been highly concentrated in the urban regions of the country [23, 27].

1.3 Lack of Diabetes Research in Rural Areas

The majority of research, awareness campaigns and treatment programs for diabetes are concentrated in urban populations like Nicaragua's capital city – Managua [13]. Urbanization has been identified as the main contributor to diabetes endemic in Nicaragua; consequently, there is a perception that rural populations are less susceptible to diabetes because of their traditional lifestyles. [6, 13, 15] While there is a plethora of data reporting the diabetes prevalence in urban settings, diabetes research is scarce in rural areas. The risk of diabetes in these areas are relatively unknown [6, 13, 15, 16]. Among the few published research studies, the prevalence of diabetes is rarely reported and inconsistent – contributing to a knowledge gap on the impact of how diabetes affects rural populations [15]. Maez, Erickson, and Naumuk reported that rural patients with diabetes are more likely to develop complications from the disease and less likely to receive sufficient care, leading to poorer outcomes compared to urban communities [17]. Over 40% of the Nicaraguan population resides in rural areas [3]. With the anticipated increase of diabetes prevalence within the country, there is a public health need to collect data on the burden of diabetes within rural populations in Nicaragua.

1.4 Purpose of Study & Significance

The purpose of this study is to examine the prevalence and risk factors for diabetes in rural settings in Nicaragua. Recommendations for public health intervention planning, implementation of programs, and for future studies will be based on the information derived from this study.

1.5 Research Questions

1. What is the prevalence of diabetes in rural settings and how does it compare to the national prevalence of diabetes in Nicaragua?
2. Is there a difference in diabetes prevalence in rural versus urban settings?
3. What are the risk factors for diabetes in rural settings?
4. What other public health trends and issues can be gathered about rural communities?

Chapter II: Literature Review

In the last decade, there has been an increased awareness of chronic diseases and its risk factors, yet the prevalence of these diseases continue to rise within the Central American population [16]. For this study, a literature review will be conducted to find a substantial amount of information on the health impact, economic burden, and risk factors for diabetes with a focus on rural Nicaraguan communities. The information gathered will help determine the knowledge gap in diabetes research in Nicaragua, and thus guide the hypothesis for further studies.

2.1 Health and Economic Burden of Diabetes in Nicaragua

In 2014, according to the International Diabetes Federation, Nicaragua had the fourth highest rate of diabetes (8 - 10%) in the South and Central American region and the eighth highest rate (12.9%) of impaired fasting glucose (pre-diabetes) in the world [13, 19] The increasing costs in health care, loss of productivity and premature deaths in individuals with diabetes, poses a significant public health concern in Nicaragua [11]. In 2003, an economic analysis was conducted across countries in Central America, including Nicaragua, to assess the burden of diabetes mellitus [4]. Barcelo et al. revealed that Nicaragua's healthcare system was inundated with diabetes-associated hospitalizations due to lack of early diagnosis and poor diabetes management [4]. These accounted for 66% of direct health care cost for diabetes [4], which exceeds the cost of diabetes (50%) in neighboring countries [3].

2.2 Role of Known Risk Factors

There is compelling epidemiological evidence that several modifiable lifestyle factors, such as obesity, sedentary behavior, and unhealthy eating, are driving the diabetes epidemic [7]. Among these, obesity is described as the most critical risk factor for the development of type 2

diabetes [7, 14]. Physical inactivity and poor nutrition have been linked as precursors for individuals who are overweight or obese [7, 24]. The association between physical inactivity and poor nutrition with obesity has been established in many studies in Central America [7]; however, few studies have examined the link between physical activity and diet with diabetes [24]. Even with this knowledge, studies illustrating these associations could not be found for populations based in Nicaragua when conducting this literature review.

However, there are reports available reporting on dietary habits of the population within Nicaragua. For example, in 2015, PAHO published a nutrition report disclosing that fat and sugar accounted for nearly one-quarter of all caloric intake (14.75% and 11.68%, respectively) in the country [23]. Urban settings held slightly higher rates (15.08% and 11.75%, respectively), while rural settings showed lower rates [23]. Additionally, Laux et al. reported that over 95% of urban and rural households in Nicaragua, use sugar, salt, and oil more than six times per week [15]. Despite these numerous reports on dietary habits within the country, none described a link between nutrition and diabetes. Research by Stanner shared that this knowledge gap could be on account of the difficulty of measuring diet, the lack of universal dietary guidelines, or the absence of standardized definitions of a low or high-carbohydrate diet [28]. As a result, this literature review concentrated on the prevalence of obesity in Nicaragua and its association with diabetes.

In Nicaragua, the rate of overweight adults ranges from 45 – 49% [22, 28]. Laux et al. examined the prevalence of obesity, tobacco use, and alcohol consumption in six rural Nicaraguan communities and found that being overweight or obesity affected more than half of the study population [15, 16]. The association between obesity and diabetes in Nicaragua has

been confirmed in several studies using abdominal obesity and body mass index as baseline measurements [5, 15].

2.3 Rural vs. Urban Health

Diabetes research in Central America has been primarily focused on urban populations or middle-income countries. In Nicaragua, the majority of the national diabetes studies have been based on sample populations of Managua. The disproportionate allocation of research in an urban setting in Nicaragua has been attributed to the logistical difficulties in accessing rural communities [7, 16].

The prevalence of diabetes reported is representative of large urban cities and then generalized to diverse rural populations in Nicaragua, which leads to an inaccurate depiction of the rate of diabetes when comparing urban and rural settings [3]. Recent studies have attempted to determine the prevalence of diabetes in rural Nicaragua. Laux et al. reported the rate of diabetes as 3-5% in five rural communities, even though many risk factors for diabetes commonly found in urban areas were present in rural Nicaragua, notably, obesity and diet high in fried foods [15, 16]. Other studies comparing urban and rural communities have also documented lower rates of diabetes in rural settings [15, 17].

2.4 Hypothesis for Thesis

Based on the literature review, the following hypotheses were developed:

1. The prevalence of diabetes in rural settings will be lower than the national prevalence of 8.5%.
2. Obesity will be strongly associated with diabetes.

Chapter III: Methods and Procedures

3.1 Data Sources and Study Setting

This study used data collected from the Nicaragua Community Health Connection (NCHC) project. The NCHC project is a partnership between the Social Enterprise at Goizueta Business School, the Comunidad Connect, and the Emory Diabetes Education and Training Academy. The project aimed to understand health issues in rural Nicaraguan communities [20]. The pilot study site for this project was in Los Robles, located in the Jinotega department in Nicaragua [10, 20]. Los Robles is a homogenous society, comprised of coffee farmers with a population of approximately 2,000 persons. It is located in the central northern part of Nicaragua near Lake Apaná – nearly 10 miles from the city of Jinotega [10, 20]. Los Robles consists of 10 neighborhoods, containing 400 homes, with an estimate of 500 families [10].

Figure 1. Map of Nicaragua

https://www.worldatlas.com/na/ni/ji/where-is-jinotega.html

3.2 Primary Data Collection and Sample Population

The NCHC data was collected in 4 weeks in late 2013, using a survey questionnaire created by the Emory Diabetes Education and Training Academy in consultation with health care professionals and local community health workers. The questionnaire was endorsed by the Nicaraguan Ministry of Health and approved by the Internal Review Board at Emory University. The final study survey consisted of 40 questions inquiring about socio-demographics, diet, lifestyle characteristics, access to food and healthcare, health diagnosis, family health history, and self-perception of physical/mental health. The surveys were administered by “Brigadistas," trained local community health volunteers, and individually completed by willing participants residing in Los Robles.

Participants were selected in a simple random sampling (SRS) of households in the ten neighborhoods in Los Robles. The final number of surveys collected was 150. Completed questionnaires with missing values and unanswered questions about sex and age were excluded from this study. The final sample size of this study was 127, approximately 6% of the population of Los Robles [20].

3.3 Variables and Measurements

The following variables and measurements with their definitions were examined in this study.

3.3a Dependent Variables

The primary dependent or outcome variable of interest in this study was self-reported diagnoses of diabetes. The question to obtain this data was, “Did a doctor tell you that you have diabetes?” The response options to this questions were: "Yes," "No," and "I

Don't Know." Individuals who responded "Yes" to the question as mentioned above were categorized as having diabetes and considered cases in this study. Individuals who responded “No” to ever being diagnosed with diabetes were labeled as controls; and, those who responded “I Don’t Know” were omitted in the analysis.

3.3b Independent Variables

The independent variables of interest in this study were grouped into three classifications: socio-demographics, lifestyle behaviors, and self-reported physician diagnostic and family history of specific metabolic syndromes.

Socio-demographic Variables

The variables used to measure socio-demographic characteristics included in this study were:

- Sex – “Male” or “Female”
- Age – Self-reported age at the time of the survey
- Literate – determined by the selection of “Yes” when responding to the question “Can you read and write?”
- Employed – determined by the selection of “Yes” when responding to the question “Do you have a job?”
- Income – estimated from the family’s bi-weekly income in the Nicaraguan national currency called Cordoba (NIO). $27.25 NIO = $1 USD [10].

Lifestyle behavior Variables

The following self-reported lifestyle behaviors were examined:

- Smoking - dichotomous self-reported smoking status at the time of the survey

- Alcohol consumption – dichotomous self-reported alcohol consumption at the time of the survey
- Physical activity – based on the self-reported level of physical activity, type of physical activity, and frequency of physical activity (number of hours per day and number of days per week). Participants were considered physically active if they exercised at least 30 minutes a day and three days per week, based on the recommendations from the American Diabetes Association in 2013 [2, 24].
- Coffee consumption – determined by the selection of “Yes” when responding to the question "Do you drink coffee?" Participants who consumed coffee were also asked about the frequency of consumption (i.e., once a week, daily, or 3 times a day).

Diet

- Consumption of non-starchy fruits and vegetables – dichotomous self-reported consumption of fruits and vegetables. Due to varied definitions of “non-starchy” fruits and vegetables, participants were also given a detailed list of foods to indicate what they commonly consumed, and the frequency of consumption.
- High carbohydrate diet – participants who reported eating four or more carbohydrate-rich foods and did not consume non-starchy fruits and vegetables daily were categorized as having a high carbohydrate diet. Carbohydrate-rich foods were identified using the Glycemic Index (GI), which ranks foods by their blood glucose response and the glycemic load (GL). Six foods were identified [rice,

bread, potatoes, corn, plantains, and pasta] and considered carbohydrate-rich based on having a GI of >70 and a GL of >10 [9].

Self-Reported Physician Diagnosis and Family Health History of specific Metabolic Syndromes

- Self-reported physician diagnosis – participants' health status was obtained using variations of the question, "Did a doctor tell you that you have…?" with three response options: "Yes," "No," or "I Don't Know." The self-reported physician diagnosis of interest was: hypertension, high cholesterol, and being overweight/obese. Individuals who responded "Yes" were categorized as having the diagnosis, those who responded "No" were not categorized as having the diagnosis. "I don't know" responses were omitted from the analysis.
- Family health history of certain metabolic syndromes – participants, were also asked about their family health history for the following: diabetes, hypertension, high cholesterol, and death from heart attack or stroke. Participants had three response options: "Yes," "No," or "I Don't Know." For this study, only "Yes" and "No" responses were included in the data analysis; thus, "I Don't Know" responses were omitted from the analysis.

3.4 Secondary Data Analysis

The data collected from this survey was approved for use in this thesis by the Georgia State University IRB. Before analysis, the data was anonymized and aggregated. Each survey was classified as one observation. A cross-sectional study was then conducted to examine the

prevalence and risk factors for diabetes within the study population. This data was used to detect any notable public health trends in the Los Robles community.

Data analyses were performed using SPSS 22. SAS 9.3 was used to verify variable frequencies. Bivariate analyses were conducted to measure the rate differences in selected risk factor variables among diabetes cases by obtaining 95% Confidence Intervals (CI). Chi-Square analysis was used to examine the relation between diabetes and selected independent variables. Odds ratio were generated for comparison, with the statistical significance level (P-value) set at <0.05. Additionally, the independent variables that demonstrated a statistically significant relationship with diabetes were included in a multivariate logistic regression analysis to examine possible association, while controlling for confounders.

Chapter IV: Results

4.1 Demographic Descriptions

A summary of the socio-demographic data obtained from the study population is shown in Table 1. The mean age for the study population was 48 years, and 77% of the population was comprised of females. The literacy level was 81%, similar to the overall literacy rate of Nicaragua [18]. 62% of participants reported being unemployed, and 67% of the respondents reported a family income of less than 1,000 Cordoba – which is less than USD 2.50 per day [10].

Table 1. Demographics of Study Population

Variable	N	% (SD)
Study Population	127	100
Sex		
Female	98	77
Male	29	23
Mean Age (years)	48	(+/-19)
Age Groups		
<20 years	6	4
20 – 29 years	20	16
30 – 39 years	21	17
40 – 49 years	23	18
50 – 59 years	18	14
=>60 years	39	31
Job (Employed)		
Yes	45	38
No	73	62
Literacy (Read and Write)		
Yes	104	83
No	22	17
Family Income (Bi-Weekly)		
<500 NIO[*]	35	35
500 – 1000 NIO	33	33
1000 – 1500 NIO	24	24
>1500 NIO	9	9

[*] *$27.25 NIO = $1 USD [10].*

In Table 2, 12% of participants reported consuming healthy fruits and vegetables daily. About 84% of respondents said (not included in the table) they consumed four or more carbohydrate-rich foods, and 78% drank coffee at least three times daily. In regards to physical activity, 43% reported performing the physical activity; however, only 23% could be classified as physically active based on the definition provided in the "Methods and Procedures" section of this thesis. 8% of participants identified as smokers, while 10% reported regular alcohol consumption - all of whom were males.

Table 2. Descriptive statistics of lifestyle behaviors in study participants

Variable	**N**	**%**
Smoking (Do you Smoke?)		
Yes	10	8
No	117	92
Alcohol (Do you Drink Alcohol?)		
Yes	8	6
No	118	94
Regular Physical Activity^		
Yes	29	27.6
No	76	72.4
Consume Non-Starchy Fruits & Vegetables Daily		
Yes	15	12
No	110	88
Coffee (How often do you drink it?)		
3 Times Daily	95	78
Once a Day or Less	26	22

^*Regular physical activity = exercising at least 30mins a day and three days a week*

Based on an analysis of data from this study, the prevalence of diabetes among participants was 10.8% (Table 3). Self-reported diagnosis of hypertension was 41%, and high cholesterol was 26%. The prevalence of hypertension and high cholesterol in Nicaragua has been estimated at 25% and 33%, respectively [8, 11]. Only 19% of study participants reported being

told by a doctor that they were overweight/obese. For family health histories, 38% of the study population reported a history of diabetes, 71% reported a history of hypertension, and 22% said high cholesterol. 35% of participants reported the death of a family member due to heart attack or stroke.

Table 3 Metabolic Profiles and Family Health History of Chronic Diseases

Variable	**N**	**%**
Overweight/Obese		
Yes	18	19
No	76	81
Diabetes (DM)		
Yes	11	10.7
No	91	89.3
Hypertension (HTN)		
Yes	44	41
No	63	59
High Cholesterol		
Yes	21	20.6
No	81	79.4
Family History of Diabetes		
Yes	47	38
No	77	62
Family History of Hypertension		
Yes	88	71
No	36	29
Family History of High Cholesterol		
Yes	22	22
No	80	78
Family History of Death from Heart Attack or Stroke		
Yes	42	35
No	78	65

4.2 Risk Factors and Their Relationship with Diabetes

Table 4 presents the results of a bivariate analysis on diabetes and selected variables. In this analysis, a positive association was found between diabetes and unemployment (P-value=0.036). Study participants who self-reported high cholesterol (P-value =0.034), a family history of high cholesterol (P-value=0.004), or family history of death from heart attack or stroke (P-value=0.02), also had an association with diabetes. Participants who reported a family history of diabetes were also associated with diabetes (P-value=0.049).

Table 4. Odds Ratio, 95% CI (Confidence Interval), and P-Value (0.05) of Selected Variables and their association with Self-Reported Diabetes.

Variable	Odds Ratio	95% CI	P-Value^
Age (Median Split)			
<48years	0.65	0.19 – 2.30	0.505
>48years (Reference Group)			
Sex			
Female	1.17	0.23 – 5.88	0.848
Male (Reference Group)			
Job			
No	1.13	1.03 – 1.24	**0.036**
Yes (Reference Group)			
Family Income			
*<1000 NIO**	2.39	0.48 – 11.9	0.275
>1000 NIO (Reference Group)			
High Cholesterol			
Yes	4.17	1.02 – 16.97	**0.034**
No (Reference Group)			
Hypertension			
Yes	3.5	0.95 – 12.93	**0.049**
No (Reference Group)			
Overweight/Obese			
Yes	3.45	0.74 – 16.03	0.098
No (Reference Group)			
Diet			
High Carb Diet	1.05	0.30 – 3.69	0.939
Regular Carb Diet (Reference Group)			
Physical Activity			
Yes	0.874	0.17 – 4.48	0.872
No (Reference Group)			
Family History of Diabetes			
Yes	3.5	0.95 – 12.9	**0.049**
No (referent group			
Family History of High Cholesterol			
Yes	6.25	1.57 – 24.8	**0.004**
No (Reference Group)			
Family History of Death from Heart Attack or Stroke			
Yes			
No (Reference Group)	2.67	1.16 – 6.15	**0.02**

^Variables and their ORs, 95% CI, and P-Values (<0.05) in bold indicates statistical significance values

4.3 Multivariate Logistic Regression

Multivariate logistic regression analysis was conducted for the independent variable with a significant unadjusted odds ratio, while and controlling for confounders — the regression analysis established that the association between diabetes and a family history of diabetes was statistically significant (P-value=0.004). The other associations as mentioned in Section 4.2, were no longer statistically significant (P-value≥0.05). Based on this analysis, family history of diabetes was considered a predictor for a diagnosis of diabetes with confidence.

4.4 Other Significant Public Health Findings (Not Included in Tables)

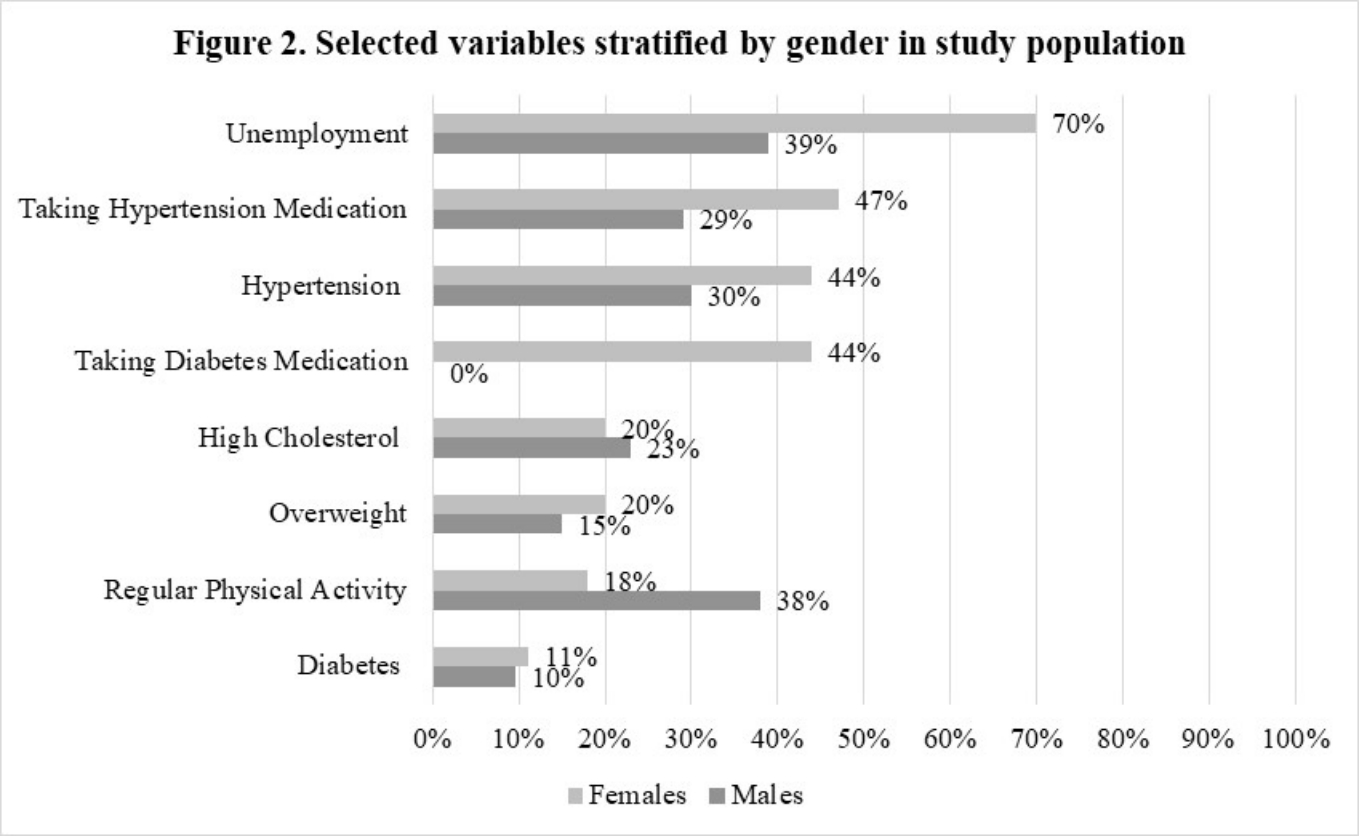


Figure 2 illustrates a selection of variables stratified by sex. Among the two sexes, women reported higher rates of unemployment compared to men (70% and 38%, respectively). Men were three times more likely to have a job than women (OR=3.425, 95% CI=1.699-6.902, and p-

value<0.001). Women also reported higher rates than men in diabetes (11% vs. 9.5%), hypertension (44% vs. 38%), and overweight/obese status (20% vs. 15%). For physical activity, women reported a much lower rate (18%) than men (38%). This result was confirmed in our bivariate analysis where the odds of women participating in regular physical activity were significantly less than men (OR = 0.277, 95%CI = 0.13 – 0.61 and P-Value 0.001).

Other interesting findings in this study were: individuals who reported being employed were three times more likely to engage in regular physical activity (OR=3.609, 95% CI = 1.435 – 9.074, and P-value 0.005). Similar associations were also demonstrated among those who reported a bi-weekly family income of less than 1000 Cordoba and participated in physical activity (OR=0.288, 95% CI = 0.102 – 0.812 and p-value 0.016). Those who actively participated in physical activity were less likely to be on a high carbohydrate diet (OR=0.41, 95% CI = 0.182 – 0.923, and P-value 0.03).

Chapter V: Discussion and Conclusion

5.1 Discussion of Research Questions & Hypotheses

The primary objective of this study was to determine the prevalence of diabetes in the rural community of Los Robles, in comparison to findings from previously published studies concerning rural and urban communities in Nicaragua. Socio-demographic, behavioral, and health risk factors for diabetes were examined as well. Additionally, this study explored other significant public health issues within the community, based on trends observed in the collected data. The motivating factor for conducting this study was due to limited and inconsistent diabetes research available regarding rural Nicaraguan communities. The results from this study provided valuable information concerning the research questions and most importantly, the prevalence of diabetes in Los Robles.

In this study population, the prevalence of diabetes was found to be 10.8%. This is higher than previously reported diabetes prevalence in studies conducted in rural Nicaraguan communities and higher than the national prevalence of 8.5% [5, 16, 22]. This finding did not support the hypothesis that diabetes prevalence will be lower in our study population compared to the reported national diabetes prevalence. This raises a public health concern since the results show a gross underestimate of individuals with diabetes in rural settings. Thus suggesting that chronic diseases, like diabetes, are no longer "diseases of affluence," since they disproportionately affect individuals who are poor, less educated and in rural communities [13, 22].

The results also did not confirm the hypothesis that obesity – the most significant risk factor for diabetes, will be strongly associated with diabetes. In this study, only 19% reported a

physician diagnosis of being overweight/obese, which is much lower than the published data of 45 - 49% of adults in Nicaragua being overweight or obese [15, 23, 29]. When compared to published literature conducted in rural Nicaragua communities, this finding was significantly lower than the reported overweight/obesity rate of >50%. It is assumed that information bias and self-perception of being overweight may be a factor for underreporting. Additionally, there was no statistically significant association between physical inactivity and diabetes or being overweight and diabetes – even though 28% of the study population engaged in regular physical activities.

A bivariate analysis supported the association of diabetes with the following risk factors: hypertension, high cholesterol, family history of high cholesterol, and family history of diabetes. However, when controlling for confounders in a multivariate logistic regression, the association between having a family history of diabetes and being diagnosed with diabetes demonstrated a significant association. Unemployment also had a significant association with diabetes.

During the analysis of the data, public health trends were discovered when stratifying a selection of variables by sex. Women were three times less likely to have a job compared to men and demonstrated higher rates of diabetes and hypertension. Women were also less likely to participate in physical activity than men. These findings supported published literature stating that women have lower socioeconomic status and poor health outcomes when compared to men in Nicaragua [25].

5.2 Study Limitations

The main limitations of this study were the small sample size and the oversampling of women – which was not representative of the population. As a result, the findings of this study

are not generalizable to the Los Robles community. The low response rate for questions impeded the validation of some findings using multivariate analyses to control for known confounding factors.

Another limitation of this study is attributed to the type of research method pursued this thesis: a cross-sectional study. Cross-sectional studies are a snapshot of a community in time, and one cannot measure incidence rates or rule out recall/information bias. Moreover, follow-up questions were unable to be posed to participants, causing some data not to be fully captured. For example, participants were asked how often they consumed coffee but were not asked if sugar was added before consumption. Additionally, for physical activity, the frequency of exercise was asked but not the type. Other limitations to this study include; the inability to validate survey responses, identify undiagnosed cases with anthropometric measurements, and the inability to establish risk relationship to diseases.

5.3 Implications of Findings and Recommendations

With the findings from this study, the hope is that there will be an increased awareness of diabetes in rural settings and a call to action from the Nicaraguan Ministry of Health to allocate more health resources for diabetes preventative interventions in Los Robles and similar rural communities. Based on published literature, effective interventions should begin with strategic community-based diabetes awareness campaigns to educate residents about health behaviors such as healthy eating and regular exercise [17, 19]. Particular attention should be paid to women, and the unemployed as the results have revealed that they are more susceptible to diabetes.

Follow-up research studies should be conducted to confirm the results of this study. It is recommended that future studies include larger, representative sample size, and very specific questions regarding lifestyle behaviors and demographics. Clinical measurements and tests (i.e., anthropometric measurements, A1C tests, fasting blood glucose and oral glucose tolerance test) should be taken to validate self-reported diagnosis and account for undiagnosed cases of diabetes [2, 29]. It is also anticipated that the impact of our study will lead to emulations in other rural communities across Nicaragua.

5.4 Conclusion

Diabetes is a chronic disease that knows no boundaries and affects both urban and rural populations. The lack of diabetes research in rural Nicaraguan communities is what prompted this study in Los Robles, to address the current knowledge gap. This study gathered relevant information on the prevalence and risk factors for diabetes while observing other public health trends in the community. The result of this analysis suggests that immediate intervention is needed, focusing on raising diabetes awareness and educating residents on prevention. Studies have shown that population-based programs designed to assess and communicate diabetes risk may be helpful in preventing or delaying the onset of diabetes [21]. Further studies should also be conducted to validate the finding from this study and to build upon what is currently known about rural Nicaraguan communities. With genuine and concerted efforts, the serious public health implications of diabetes can be reduced in rural communities.

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