Assessing Health Risks in Rural Communities Surrounding Zacapa, Guatemala

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Abstract

Purpose: To determine the prevalence of diabetes, obesity, and anemia among Guatemalan adults, as well as the rates of obesity among children in Zacapa, Guatemala. Location, gender, age, personal education level, household daily income, or employment status were examined to determine whether they influence rates of obesity and anemia among adults in Zacapa, Guatemala.

Methods: Community health assessments involved gathering height, weight, body mass index, blood glucose, hemoglobin, and blood pressure measurements from eligible participants. Microsoft Excel 2016 and IBM SPSS Version 23.0 were used to present descriptive statistics and analyze the data using binomial logistic regression tests.

Results/Findings: There were 130 child and 232 adult participants involved in this study. The majority of adult participants were female (84.05%) and between the ages of 15-39 (55.60%). 5.29% of adults suffered from diabetes, 32.47% from obesity, and 24.65% from anemia.

Conclusion: This study presented health information about childhood obesity; diabetes, obesity, anemia prevalence among adults, as well as various demographic, health-related behaviors, and socioeconomic factors. Out of the two separate logistic regression models, only the dependent variable of anemia was found to be statistically significant. Several limitations are mentioned.

Keywords: Zacapa, Guatemala, anemia, diabetes, obesity, children

Background:

Conducting community-based needs assessments and gathering culturally appropriate health data among diverse people groups around the world is currently a top priority for public health professionals. Gathering health-related data not only allows public health professionals to create health programs and initiatives that are specific to each community's needs but also allows them to create policies that will incite change on a larger level. Unfortunately, some developing countries are still unable to receive adequate aid due to limited availability of health data, which is evident in Zacapa, Guatemala. One report created by the government of Guatemala, estimates that 228,810 people lived in Zacapa in 2013 with a majority of residents being female (52.2%), living in rural communities (56.9%), and being of non-indigenous backgrounds (99.1%) (Caracterización Departamental Zacapa, 2013). Insufficient data was presented in this report that was reflective of health conditions within the community.

While limited health data exists in Zacapa, the country of Guatemala as a whole has recently been considered a strong economic force within Latin America. The World Bank reports that the country's gross domestic product (GDP) growth rate was 4.1% in 2015 with increasing rates of 2.8% in 2017 and 3.0% in 2018 (The World Bank in Guatemala, 2019). However, despite these economic strides, Guatemalan children and adults disproportionately suffer from malnutrition, food insecurity, stunting, iron deficiency anemia, diabetes, and obesity as compared to other Latin American countries. According to the United States Agency for International Development (USAID) (2018), the prevalence of stunting among children in Guatemala ranged from 47%-70% in 2014-2015, making it the sixth-highest country with chronic malnutrition rates across the globe. If left unaddressed, chronic malnutrition can lead to impaired muscle function, cardio-respiratory function, gastrointestinal function, immunity/wound healing, and increase in

psycho-social effects (e.g., apathy, depression, anxiety, self-neglect) (Saunders & Smith, 2010). Furthermore, indigenous Guatemalan children disproportionally suffer from malnutrition as compared to non-indigenous Guatemalan children (The World Bank in Guatamala, 2019; Lutter, 2009; Ramirez, 2014). Anemia is also common both among children less than five years old and pregnant women throughout Guatemala at approximately 40% and 22%, respectively (United States Department of Health and Human Services (UDHHS), 2017). Reasons for these high prevalence rates often include mother-child nutritional deficiencies during pregnancy, poor nutrition after birth, chronic parasitic infection, lead exposure, or other chronic diseases (UDHHS, 2017).

In 2013, a study focused on global health estimates of undiagnosed diabetes in adults reported that there were approximately 4.4-9.4% diagnosed cases of diabetes mellitus and 20.0-48.0% undiagnosed cases of diabetes mellitus in 2013 in Argentina, Bolivia, and Guatemala (Beagley, Guariguata, Weil, & Motala, 2014). Furthermore, the Central Intelligence Agency reported in 2018 that only 0.38 physicians were available per 1,000 people to provide medical treatments and care for residents of Guatemala (Central Intelligence Agency, 2019). This indicates that a common barrier to disease diagnosis/care within Guatemala is limited access to physicians and adequate health care systems. For this reason, many municipalities in Guatemala still lack health care data, such as Zacapa and other rural communities.

Purpose of Study

The aim of this study is to determine the prevalence of diabetes, obesity, and anemia among Guatemalan adults, as well as the rates of obesity among children in Zacapa, Guatemala. Additionally, data will be analyzed to determine if location, gender, age, personal education level, household daily income, or employment status may influence rates of obesity and anemia among

adult residents of Zacapa, Guatemala. Conducting this research is of importance because limited data currently exists regarding the health status of adults and children in the region of Zacapa, Guatemala. The information collected was inputted, interpreted, and used to assess and plan better strategies to help this community in the future.

Methods

Study Design and Data Collection

This primary research study was conducted from June 17 to June 24, 2019 in Zacapa, Guatemala using a cross-sectional study design in order to determine the prevalence of diabetes, obesity, hypertension, and anemia among adults and obesity rates among children living in Zacapa, Guatemala. The primary researcher, along with three other co-researchers, traveled to Zacapa, Guatemala during this study period and conducted community health assessments within five rural communities of Zacapa; Agua Caliente, Llano Verde, Santa Rosalia Marmol, Moran, and Nuevo Sunzapote. Community health assessments were conducted in collaboration with the local mission's coordinator at la Iglesia Primitiva and local municipality officials, within local primary (elementary) schools, and at a church setting between the hours of 7:30am-10pm on June 19th, 7:00am-4:00pm, on June 20th, 6:00am-3:30 on June 21st, and 6am-12pm on June 22nd. All necessary arrangements and purchases for the study were made six months prior to the study period.

Community health assessments involved gathering height, weight, body mass index (BMI), blood glucose, iron (anemia), and blood pressure measurements from eligible participants. Community members were eligible to receive blood glucose and anemia checks as part of the community health assessment if they were local residents of Zacapa, at least 15 years old, and if they completed an adult health questionnaire. Children were eligible to get their height and

weight checked if they were between the ages of 4 and 14 years old and if their parent completed a child health form. All qualifying individuals were eligible for participation regardless of gender, health status, occupation, or employment. In addition, eligible participants were able to review their results, receive health education, and express any health-related concerns with a doctor and the public health researchers at the end of their assessment.

Measures

Each adult health questionnaire consisted of 25 questions and was originally written in English. The final version of the adult health questionnaire was translated and printed in Spanish to maximize comprehensibility and communication efforts between the researchers and participants. Data collected on each adult health questionnaire pertained to gender, age, height, weight, blood glucose, BMI, body fat percentage, daily income, marital status, education level, number of children in the household, breastfeeding, oral hygiene, number and types of meals eaten, food access, and local water source. Data collected on each child health sheet included the date, age, birth date, height, weight, BMI, and body fat percentage. In total, there were 232 total adult participants and 130 child participants.

Health assessments pertaining to weight, height, and BMI/body fat percentage were gathered using a digital scale (kg), portable stadiometer, and Omron BMI Body Fat meter, respectively. All participants were instructed to remove their shoes and remain still for all three measurements. The Omron BMI Body Fat meter was chosen for this assessment because it uses bioelectrical impedance and is thought to produce more accurate results as compared to other BMI formulas/devices. Similar findings were reflected in a study by Rockamann, et. al., (2017) in which thumb-to-thumb bioelectric impedance analysis (BIA) devices were more accurate at estimating body fat percentage than dual energy X-ray absorptiometry devices. Blood glucose

levels were assessed using a drop of blood, blood glucose strips, and either a Contour Next or Walgreens True Metrix blood glucose meter. Blood glucose results were considered to be normal if they fell below 99 mg/dL (fasting) or 140 mg/dL (not-fasting) as indicated by the Centers for Disease Control and Prevention (CDC, 2019). Further, individuals were considered to be pre-diabetic if their blood sugar levels were between 100-125 mg/dL(fasting)/140-199 mg/dL (not-fasting), and diabetic at >126 mg/dL (fasting)/ >200mg/dL (not-fasting) (CDC, 2019). Hemoglobin levels were measured using a HemoCue201 device with the same available drop of blood in order to assess for anemia. Appropriate measures for operating this device were followed according to the HemoCue Hb 201+ Operating Manual (HemoCue, 2019). Multiple studies have found the accuracy of the HemoCue Hb 201 device to be comparable to the newest HemoCue Hb 301 device (Jain, Chowdhury, & Jain, 2018; Rappaport, Karakochuk, Whitfield, Kheang, & Green, 2016). Finally, blood pressure readings were acquired using Omron blood pressure devices and according to appropriate procedures (Omron Healthcare Co., 2010).

Funding for this study was sought and approved by the Center for Research & Scholarship at Liberty University. The awarded funds were used to cover travel costs (i.e., airline tickets, hotel accommodations, ground transportation, coordinator costs, food); materials and supplies (i.e., gloves, hand sanitizer, lancets, glucose meter strips, etc.) and equipment (i.e., blood glucose meters, HemoCue 201+meter, Omron body fat meters, digital scale, microcuvettes, etc.) throughout the duration of the study period.

Ethical Considerations

Appropriate ethical permissions were sought from the Institutional Review Board (IRB) of Liberty University with which the authors are affiliated, with the submission of the IRB application, adult and child questionnaire, recruitment letter, and consent form. Following review

of our application, the Liberty University IRB approved this study on November 29, 2018 under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies. The consent form explained the purpose and procedures of the study, as well as data confidentiality. No names or identifying information were collected on the consent forms or questionnaires to protect participants' privacy and ensure anonymity. Furthermore, all data acquired through this study will be kept in a secure filing cabinet within the Department of Public and Community Health with only the practicum student and co-researchers being able to access the data. In addition, the data will be deleted and cross-shredded after 3 years. The verbal and written consent of respondents was sought before taking part in the community health assessment. Respondents were assured of their right to participate and withdraw from the study at will. There was no compensation for participating in this study.

Statistical Analysis

The data was entered into Microsoft Excel 2016 and analyzed using both Microsoft Excel 2016 and IBM SPSS Version 23.0. Descriptive statistics were presented regarding demographic and socioeconomic characteristics of adults, demographic characteristics of children, health related behaviors and concerns of adult participants, and distribution/prevalence of diseases among adult participants. The dependent variables in this study were diabetes, anemia, and obesity while the independent variables were location, gender, age, personal education level, household daily income, and employment status. Three separate binomial logistic regression tests was conducted using IBM SPSS Version 23.0 to determine whether any of the independent variables predicted an individual’s outcome of acquiring diabetes, anemia, or high BMI (obesity).

Results

Response Rates & Demographic Characteristics

There were 130 child and 232 adult participants involved in this study; however, varying numbers of adults responded to each question on the questionnaire and/or were able to complete all aspects of the community health assessments, as indicated in Tables 3-6. Table 1 presents demographic characteristics of children, the majority of whom were female between the ages of 8-11 years old (M=8.85) and were seen at the Nuevo Sanzapote location. The mean height and weight for the child participants was 128.06 cm (±17.15) and 29.16 kg (±11.77), respectively. In addition, most children were classified as having a healthy weight (75.19%); however, 24.81% of children were classified as being underweight, overweight, or obese (Table 2). Two children were removed from BMI categorizations due to errors when obtaining the necessary BMI percentages.

Table 1

Demographic Characteristics of Child Participants, Zacapa, Guatemala, June 2019

Characteristic	**Frequency**	**Percent**
Gender (*n=130*)		
Male	59	45.38
Female	71	54.62
Age *(n=130)*		
4-7 years	47	36.15
8-11 years	54	41.54
12-14 years	29	22.31
Location (*n=130*)		
Agua Caliente	31	23.85
Llano Verde	7	5.38

Santa Rosalia Marmol	28	21.54
Moran	28	21.54
Nuevo Sunzapote	36	27.69

Table 2:

BMI Categorizations of Child Participants, Zacapa, Guatemala, June 2019

Characteristic	**Location**					**Total**	**Frequency**
	Agua Caliente	Llano Verde	Santa Rosalia Marmol	Moran	Nuevo Sunzapote		
BMI % (*n=129*)							
Underweight	1	0	5	2	3	11	8.53%
Healthy	23	3	23	22	26	97	75.19%
Overweight	5	3	0	2	4	14	10.85%
Obese	2	1	0	2	2	7	5.43%

Table 3 displays various demographic and socioeconomic characteristics of all adult participants including gender, age, location of service, marital status, daily income, employment status, personal education level, education level of the head of household, personal transportation status, number of children under the age of 21 in the household, number of adults in the household, number of children, and status of giving birth within the past two years. Overall, the majority of adult participants were female (84.05%) between the ages of 15-39 (55.60%). This indicates that the proportion of female participants (84.05%) was more than five times that of male participants (15.95%). All adult participants were seen at five different locations throughout the study period, Agua Caliente, Llano Verde, Santa Rosalia Marmol, Moran, and Nuevo Sunzapote, with the most participants being seen at Nuevo Sunzapote (28.02%). Approximately

70% (70.43%) of adults identified as being married or living with a partner, 38.84% indicated a daily household income of 31-60 Quetzal per day ($4.05-$7.85 USD), and 77.16% reported being unemployed. More than half of adult participants documented that their highest level of education was primary school (elementary school) with slightly lower primary school attendance levels among the heads of the households (42.08%). Additionally, most adult participants indicated that they do not own their own vehicle for transportation (65.50%), have 1-3 children living in their household that are under the age of 21 (60.71%), have 1-3 adults living in their household (77.29%), have 1-3 children (60.71%), and have not given birth within the past two years (60.26%) (females only).

Table 3:

Demographic and Socioeconomic Characteristics of Adult Participants, Zacapa, Guatemala, June 2019

Characteristic	**Frequency**	**Percent**
Gender (*n=232*)		
Male	37	15.95
Female	195	84.05
Age *(n=232)*		
15-39 years	129	55.60
40-65 years	77	33.19
66-90 years	26	11.21
Location (*n=232*)		
Agua Caliente	48	20.69
Llano Verde	26	11.20
Santa Rosalia Marmol	38	16.38
Moran	55	23.71
Nuevo Sunzapote	65	28.02

Married or Live with a Partner (*n=230*)		
Yes	162	70.43
No	68	29.57
Household Total Daily Income (*n=224*)		
0-30 Quetzal	60	26.79
31-60 Quetzal	87	38.84
61-100 Quetzal	45	20.09
101+ Quetzal	32	14.29
Currently Employed (*n=232*)		
Yes	53	22.84
No	179	77.16
Personal Education Level (*n=230*)		
None	36	15.65
Primary	129	56.09
Secondary	35	15.22
Career	15	6.52
Bachelors	9	3.91
Masters	1	0.43
Other	5	2.17
Head of Household Education Level (*n=221*)		
None	54	24.43
Primary	93	42.08
Secondary	23	10.41
Career	16	7.24
Bachelors	4	1.81
Masters	1	0.45
Other	5	2.26
Don't Know	2	0.90

I Am the Head of the Household	23	10.41
Own a Vehicle for Transportation (*n=229*)		
Yes	78	34.06
No	150	65.50
Number of Children in Household <21 years (*n=224*)		
0	54	24.11
1-3	136	60.71
4-7	27	12.05
8-11	4	1.79
12+	3	1.34
Number of Adults in Household (*n=229*)		
1-3	177	77.29
4-7	48	20.96
8-11	2	0.87
12+	1	0.44
Number of Children (*n=231*)		
0	38	16.45
1-3	125	54.11
4-7	61	26.41
8-11	6	2.60
12+	1	0.43
Given birth in the past two years (females with children only) (*n=229*)		
Yes	32	13.97
No	138	60.26
Male or no children	59	25.76

Table 4 summarizes the health-related behaviors and concerns of the adult participants. As the results show, in general, the majority of adult participants reported visiting a doctor or

health care worker at least once per year (37.23%), having previously breastfed (69.16%), brushing their teeth eight or more times per week (52.16%), having stomach pains within the past two weeks (65.95%), and eating three meals per day (68.97%). While most adult participants reported "never" worrying about getting food (38.56%) and "no" to being unable to purchase food in the last year due to not having money (65.09%), more than half of participants reported "often" skipping meals so that other members of their family could eat (53.02%). Furthermore, 61.21% of adult participants reported "yes" to believing that they eat a balanced, nutritious diet regularly while 52.8% reported being typically hungry for 4-6 hours before eating their next meal. Common locations identified for purchasing food included "tiendas" (stores) and "despensas" (pantries), while common identified sources of drinking water included "agua potable" (drinking water), "del chorro" (water from the stream), "agua del rio" (water from the river), and "agua purificado" (purified water).

Table 4:

Health-Related Behaviors and Reported Concerns of Adult Participants, Zacapa, Guatemala, June 2019

Characteristic	**Frequency**	**Percent**
Frequency visiting a doctor or healthcare worker (*n=231*)		
Never	26	11.26
At least once every five years	27	11.69
At least once every year	86	37.23
At least once at 6 months	54	23.38
At least once every month	38	16.45
Currently or previously breastfed (women with children only) (*n=227*)		
Yes	157	69.16
No	11	4.85

Male or no children	59	25.99
Frequency brushing teeth per week (*n=232*)		
0	4	1.72
1-2	20	8.62
3-4	71	30.60
5-7	16	6.90
8+	121	52.16
Stomach pain in the past two weeks (*n=232*)		
Yes	153	65.95
No	79	34.05
Meals eaten per day (n=232)		
0	0	0.00
1	2	0.86
2	39	16.81
3	160	68.97
4	16	6.90
5	14	6.03
6+	1	0.43
Ever worry about getting food to eat (n=227)		
Often	53	23.35
Sometimes	63	27.75
Rarely	28	12.33
Never	83	36.56
Frequency of skipping meals to feed other family members (n=232)		
Never	23	9.91
Rarely	60	25.86
Sometimes	26	11.21

Often	123	53.02
Unable to purchase food in the last year due to not having money (n=232)		
Yes	81	34.91
No	151	65.09
I believe that I eat a balanced, nutritious diet regularly (n=232)		
Yes	142	61.21
No	90	38.79
Length of time spent hungry before eating next meal (n=231)		
Never	36	15.58
1-3 hours	64	27.71
4-6 hours	122	52.81
7-9 hours	8	3.46
10 hours or more	1	0.43

Table 5 provides the means and standard deviations of quantitative health variables for all adult participants including age, height, weight, blood glucose, BMI, body fat percentage, hemoglobin, and systolic/diastolic blood pressure. As noted on Table 5, the average age of participants was approximately 40 years old with a height of 154.09 cm (60.66 in.) and weight of 65.24 kg (143.82 lbs.). A mean blood glucose reading of 121.85 indicated normal values for non-fasting individuals with additional widely distributed values (SD 51.99). The average BMI value for the population was calculated as 27.5, indicating that the general adult population seen at all five locations were generally overweight. Further, while variable depending on gender, a mean body fat percentage >30% also indicated that many adult participants were obese. The average hemoglobin level was 12.9 for both men and women, which was considered acceptable for females but low for males. Average systolic and diastolic blood pressure levels generally fell within normal limits as well (121.96/81.29).

Table 5:

Means and Standard Deviations of Quantitative Variables Among Adults, Zacapa, Guatemala, June 2019

Characteristic	N	Mean	Standard Deviation
Age	232	40.28	17.77
Height (cm)	231	154.09	7.99
Weight (kg)	231	65.24	15.42
Blood Glucose (mg/dL)	227	121.85	51.99
BMI	231	27.52	6.12
Body Fat %	200	34.08	10.00
Hemoglobin (mg/dL)	215	12.93	1.48
Systolic Blood Pressure (mmHg)	228	121.96	20.01
Diastolic Blood Pressure (mmHg)	228	81.29	11.61

Table 6 illustrates the prevalence and distribution of disease per location of service in Zacapa. Over two-thirds of adult participants had blood glucose levels that fell within normal ranges (<100 mg/dL fasting, <140 mg/dL non-fasting) with 20.71% of individuals displaying pre-diabetic (100-125 fasting mg/dL, 140-199 mg/dL non-fasting) or diabetic levels (>126 mg/dL fasting, >200 mg/dL non-fasting). The majority of participants from all locations were equally classified as being of normal weight (32.47%) or obese (32.47%). Approximately one-fourth of adults suffered from anemia and about half of adults had both systolic and diastolic blood pressure readings that fell within elevated to hypertensive levels. Llano Verde had the highest prevalence rate of diabetes (12%), obesity (44%), anemia (36.0%), high systolic blood pressure (hypertension stage 1&2, 48.0%), and high diastolic blood pressure (hypertension stage

1&2, 76.0%) as compared to the other communities. Moran was the only location in which adult participants displayed systolic and diastolic blood pressure within hypertensive crisis levels.

Table 6:

Distribution and Prevalence of Disease Among Adults per Location, Zacapa, Guatemala, June 2019

Characteristic	Location					Total	Percent
	Agua Caliente	Llano Verde	Santa Rosalia Marmol	Moran	Nuevo Sunzapote		
Blood Glucose							
Normal	35	18	34	40	53	180	79.30
Pre-diabetes	8	4	3	11	9	35	15.42
Diabetes (%)	1 (2.27)	3 (12)	4 (9.76)	3 (5.56)	3 (4.62)	12	5.29
Total	44	25	41	54	65	227	100.0
BMI							
Underweight	2	0	2	2	2	8	3.46
Normal	19	2	18	23	13	75	32.47
Overweight	13	12	9	17	22	73	31.60
Obese (%)	14 (29.17)	11 (44)	9 (23.68)	13 (23.64)	28 (40.08)	75	32.47
Total	48	25	38	55	65	231	100.0
Hemoglobin							
Normal	23	16	31	46	46	162	75.35
Anemic (%)	11 (32.35)	9 (36.0)	6 (16.22)	8 (14.81)	19 (29.23)	53	24.65
Total	34	25	37	54	65	215	100.0
Systolic Blood Pressure							
Normal	24	5	25	20	42	116	50.88
Elevated	8	8	4	11	12	43	18.86
Hypertension Stage 1 (%)	6 (13.04)	6 (24.0)	6 (15.79)	8 (14.81)	5 (7.69)	31	13.60

Hypertension Stage 2 (%)	8 (17.39)	6 (24.0)	3 (7.89)	12 (22.22)	6 (9.23)	35	15.35
Hypertensive Crisis (%)	0	0	0	3 (5.56)	0	3	1.31
Total	46	25	38	54	65	228	100.0
Diastolic Blood Pressure							
Normal	21 (45.65)	6 (24.0)	24 (63.16)	17 (31.48)	39 (60.0)	107	46.93
Hypertension Stage 1	14 (30.43)	10 (40.0)	8 (14.81)	20 (37.03)	22 (33.85)	74	32.46
Hypertension Stage 2	11 (23.91)	9 (36.0)	6 (11.11)	16 (29.63)	4 (6.15)	46	20.17
Hypertensive Crisis	0	0	0	1 (1.85)	0	1	0.44
Total	46	25	38	54	65	228	100.0

Analysis

Separate binomial logistic regressions were performed to determine the effects of location, gender, age, personal education level, household daily income, and employment status on the likelihood that participants were obese or have anemia. Before conducting the binomial logistic regression analyses, the researcher met/tested for the seven applicable assumptions concerning having a dichotomous dependent variable, having one or more continuous or nominal independent variables, demonstrating independence of observations, having mutually exclusive and exhaustive dependent and independent variables, having a minimum of 15 cases per independent variable, data not showing multicollinearity, and not having significant outliers.

Linearity of the continuous variables with respect to the logit of the obesity dependent variable was assessed via the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 18 terms in the model resulting in statistical significance being accepted at $p < 0.0027$ (Tabachnick & Fidell, 2014). Based on this assessment, all continuous independent variables were found to be linearly related to the logit of the obesity dependent variable. No

outliers were identified. The logistic regression model was not statistically significant, χ^2 (6) = 11.632, *p*= 0.071 (Tables 7-8). The model explained 7.9% (Nagelkerke R^2) of the variance in obesity and correctly classified 65.8% of cases. Sensitivity was 13.6%, specificity was 91.7%, positive predictive value was 45.0% and negative predictive value was 68.1%. Of the six predictor variables, only two were statistically significant: sex and employment status as shown in Table 9. Females had 3.47 times higher odds of exhibiting obesity than males. Not being employed was associated with a reduction in the likelihood of exhibiting obesity.

Table 7:

Omnibus Tests of Model Coefficients for Obesity Dependent Variable, Zacapa, Guatemala, June 2019

		Chi-square	df	Sig.
Step 1	Step	11.632	6	.071
	Block	11.632	6	.071
	Model	11.632	6	.071

Table 8:

Model Summary for Obesity Dependent Variable, Zacapa, Guatemala, June 2019

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	241.236	.057	.079

Table 9:

Logistic Regression Predicting Likelihood of Obesity based on Location, Sex, Age, Personal Education, Household Daily Income, and Employment Status, Zacapa, Guatemala, June 2019

							95% CI for Odds Ratio	
	B	**S.E.**	**Wald**	**df**	**p**	**Odds ratio**	**Lower**	**Upper**
Location	0.150	0.116	1.686	1	0.194	1.162	0.926	1.459
Sex	1.244	0.543	5.252	1	0.022	3.470	1.197	10.054
Age	-0.005	0.010	0.255	1	0.614	0.995	0.975	1.015
Personal Education	0.038	0.145	0.067	1	0.795	1.038	0.781	1.380
Household Daily Income	0.137	0.170	0.655	1	0.418	1.147	0.823	1.600
Employment	-0.918	0.401	5.235	1	0.022	0.399	0.182	0.877
Constant	-0.882	1.123	0.617	1	0.432	0.414		

Linearity of all independent continuous variables with respect to the logit of the anemia dependent variable were found to be linearly related, $p < 0.05$; therefore, a Bonferroni correction was not needed for this dependent variable. There were six standardized residuals with value of 2.654, 3.067, 2.719, 2.827, 2.719, 2.540 standard deviations, which was kept in the analysis. The logistic regression model was significant, χ^2 (6) = 12.981, p= 0.043 (Tables 10-11). The model explained 94.0% (Nagelkerke R^2) of the variance in anemia and correctly classified 75.9% of cases. Sensitivity was 0.0%, specificity was 100.0%, positive predictive value was 0% and negative predictive value was 75.87%. Of the six predictor variables, age was the only variable that was statistically significant as shown in Table 12. Females were 1.037 times more likely than males to present with anemia.

Table 10:

Omnibus Tests of Model Coefficients for Anemia Dependent Variable, Zacapa, Guatemala, June 2019

		Chi-square	df	Sig.
Step 1	Step	12.981	6	.043
	Block	12.981	6	.043
	Model	12.981	6	.043

Table 11:

Model Summary for Anemia Dependent Variable, Zacapa, Guatemala, June 2019

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	206.900	.063	.094

Table 12:

Logistic Regression Predicting Likelihood of Anemia based on Location, Sex, Age, Personal Education, Household Daily Income, and Employment Status, Zacapa, Guatemala, June 2019

							95% CI for Odds Ratio	
	B	**S.E.**	**Wald**	**df**	**p**	**Odds ratio**	**Lower**	**Upper**
Location	-.106	.122	.758	1	.384	.899	.707	1.143
Sex	-.250	.492	.258	1	.611	.779	.297	2.043
Age	.036	.011	10.301	1	.001	1.037	1.014	1.060
Personal Education	.117	.165	.504	1	.478	1.124	.814	1.552
Household Daily Incor	.086	.187	.212	1	.645	1.090	.756	1.572

Employment	-.012	.445	.001	1	.978	.988	.413	2.364
Constant	-2.584	1.244	4.316	1	.038	.075		

Discussion

Diabetes, anemia, and obesity are health conditions that remain of eminent concern for health professionals around the world. According to the World Health Organization (WHO) (2018), the number of persons, living with diabetes, rose globally from 108 million in 1980 to 422 million in 2014. Likewise, the number of persons suffering from obesity has approximately tripled since the year 1975 (WHO, 2018). The WHO also reported that, globally, 496 million non-pregnant women and 273 million children suffered from anemia in 2011 (Stevens et al., 2013). The high prevalence of these diseases indicates that additional assessments and initiatives should be conducted to reduce the increasing global impact of diabetes, obesity, and anemia among people groups around the world. Therefore, this study sought to present the prevalence of diabetes, obesity, anemia, and other health conditions within adult populations living Zacapa, Guatemala, as well as obesity rates among children within Zacapa, Guatemala. The study also sought to determine if location, gender, age, personal education level, household daily income, or employment status could predict rates of diabetes, obesity, and anemia among these adult residents.

Information collected from child participants indicated that approximately one-fourth of all children were classified as being obese. Becoming obese during childhood is a cause for concern because children are at a five times greater risk of acquiring obesity into adulthood as compared to children who are not obese during childhood (Torres, Solberg, & Carlstrom, 2002). In order to address this problem, public health professionals within this area should begin creating more programs and regulations to address/prevent childhood obesity in Zacapa. In doing

so, children will maintain an appropriate weight for their age and height and will develop into healthy adults, which will ultimately reduce the disease burden on the population.

As previously indicated, the majority of participants were female. The reason for this unequal distribution of genders may be attributed to cultural habits and customs. More specifically, many male adults within the community health assessment areas were observed waiting outside for their significant others and children to complete the assessments as opposed to getting checked themselves. Reasons for these differences can often be associated with multifactorial causes related to machismo, as discussed in several other studies (Davis & Liang, 2015). Therefore, it is important to consider these gender specific differences when creating culturally appropriate programs that promote preventative care among all members of the household, not only women and children.

The results of this study also revealed that the majority of participants were married or living with a partner (70.43%). This distribution of responses is normal given the culture of marrying young and/or having children at younger ages. However, this distribution indicates that effective birth control and family planning education is necessary among younger age groups within Zacapa in order to maintain stable birth rates within Guatemala. One-fourth of participants indicated that they made between 0-30 quetzals in combined household income per day, which equates to a maximum of 840 quetzals per month. The Global Living Wage Coalition estimates that each household needs at least 900 quetzals per month to pay for housing expenses alone. Therefore, this indicates that at least 25% of adults within Zacapa do not make sufficient money to adequately cover their living expenses. This is evident due to a reported 77.16% rate of unemployment and 65.50% rate of people that do not own a vehicle. Not having sufficient sources of income ultimately increases a person's likelihood for disease, malnutrition, and

poverty, amongst other conditions. In turn, public health professionals should partner with appropriate government officials in order to increase available opportunities for employment within Zacapa and surrounding areas.

Most adults indicated they had received education from a primary school, with a limited number of persons receiving secondary education and above. Varying levels of education levels may be attributed to a variety of factors including having to work and provide for the family, having to stay home and take care of children, lower expectation for receiving formal education, amongst other reasons. Despite 77.06% of adult participants indicating that they visit a doctor or healthcare worker every month, one time per year, 5.29% of adult participants had blood glucose levels indicative of diabetes, 32.47% were obese, and 24.65% had anemia.

Conclusions

Overall, this study presented health information about childhood and adult obesity, diabetes, anemia prevalence among adults, as well as various demographic, health-related behaviors, and socioeconomic factors. Out of the three separate logistic regression models, only the dependent variable of anemia was found to be statistically significant. Age was the only variable that was shown to be statistically significant in predicting incidence of anemia among this population. This indicates that appropriate nutrition education should be provided to women starting at a young age in order to reduce their likelihood of becoming anemic as they get older. While binomial regression significance was not found with diabetes, increasing age showed a pattern of increased likelihood to acquire diabetes. Likewise, gender was associated with an increased likelihood of exhibiting obesity while unemployment status was associated with a reduction in the likelihood of exhibiting obesity. Reasons for these discoveries may be associated with gender roles in some way. For example, men are expected to go out and work to provide for

their family; therefore, they engage in more physical activity than women. Persons who are unemployed may also have more time to be at home and cook homemade meals as opposed to employed individuals who may eat out at restaurants or quick food marts more frequently.

Limitations for this study included having overheating problems with the HemoCue and blood glucose meter devices. Overheating technicalities reduced the number of individuals who were able to receive this assessment and may also have influenced accurate readings before or after the malfunctions. Likewise, if the HemoCue strips were not filled completely with blood, hemoglobin levels may have displayed inaccurate results. Data were also impacted by taking a lunch break during each community health assessment due to some participants that were waiting to receive assessments did not choose to return after the lunch break and therefore were unable to be seen. Finally, the results of the binomial logistic regression involving anemia may also have been skewed due to the inclusion of several outliers

Recommendations

Additional studies should be conducted to support the data presented within this study and provide more information regarding the health status of individuals within Zacapa, Guatemala. In doing so, more specific health interventions can be conducted within these adult and child populations to improve long-term health.

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