

## Abstract

This research included diabetes screening assessment for a population in Belize that may not have ready access to testing. Data gathered on gender, age and ethnicity was correlated with measurement of waist circumference and hemoglobin A1c (HbA1c). The investigator used a point of care screening test for HbA1c to determine whether individuals fell within the normal range, the prediabetes range or diabetic range. A random selection of participants in the Belmopan region were tested. Analysis of the data indicated that 33.1% of the population tested in the prediabetes range for HbA1c. This percentage should be a concern to health care personnel in Belize who may have limited resources for diabetes management of patients. An equally concerning finding is the number of participants in the diabetes range, 8.5%, who had not been previously diagnosed. Diabetes education and screening is essential to the health and wellbeing of the people of Belize.

Index Terms: Belize, Prediabetes, Hemoglobin A1c

Abbreviations: Hemoglobin A1c (HbA1c), The Central America Diabetes Initiative (CAMDI), International Diabetes Federation (IDF), American Diabetes Association (ADA), Analyses of Variance (ANOVA)

A study of the prevalence of diabetes in six Central American countries was carried out by The Central America Diabetes Initiative (CAMDI) and published in *Diabetes Care* April 2012.<sup>1</sup> This paper reported that the prevalence of diabetes in Belize is higher than other Central American countries. Of all the noncommunicable diseases in the world, diabetes constitutes a major concern especially in countries where diagnosis and treatment are not readily available. According to the 2015 report from the International Diabetes Federation (IDF), approximately 415 million adults have diabetes; by 2040 this will rise to 642 million. The regions of South and Central America account for more than 20 million people with diabetes.<sup>2</sup>

In some countries with limited resources, awareness of potential risk for the disease is missing. The 2015 World Health Organization report for Belize listed diabetes the number 2 cause of death in 2012 at 8.9% of the population just under the number one cause of ischemic heart disease at 10.4%.<sup>3</sup> A Centers for Disease Control Fact sheet for Belize published in November 2013 listed Diabetes as one of the top 10 causes of death.<sup>4</sup> The risk for type 2 diabetes which is often seen in middle aged and older adults increases among individuals who are overweight and inactive.<sup>5</sup> An effort to raise awareness of diabetes within country has resulted in an annual Diabetes Summit held in the month of November in correlation with World Diabetes Day. The Diabetes Summit held in Belmopan, Belize November 10, 2016 included a variety of speakers and presentations by health care representatives and high school youth associated with the organization Youth for World Peace Wellness Ambassadors. Coordinated by a diabetes advocate in Belize, support for the Summit was solicited from agencies within country and free

Hemoglobin A1c (HbA1c) screening testing was offered. Hemoglobin A1c was endorsed by the American Diabetes Association (ADA) in 2010 as a screening test for prediabetes and diagnosis of diabetes.<sup>6</sup> Emphasis on awareness and prevention through healthy lifestyles was the theme for this summit which provided an opportunity for screening a variety of participants as part of this pilot research study.

Zakowski states that successful diabetes management relies on early diagnosis and accurate monitoring.<sup>7</sup> Determination of risk factors in different parts of the world and prevalence of diabetes is valuable information to collect. This research intervention provided screening assessment to a population in Belize that may not have ready access to prediabetes testing. Data gathered on gender, age and ethnicity along with screening tests may provide guidance for health care providers within the country. A point of care screening test for hemoglobin A1c was used to determine whether individuals fall within the normal range, the prediabetes range or diabetic range. This test has been determined to be a valuable tool for identification of prediabetes.<sup>8</sup> Participants included Belizeans between the ages of 20-70 and were recruited randomly through informational flyers.. The HbA1c value along with waist circumference and blood pressure measurements provided information valuable for patient education.

Research questions posed for this population include the following; is there a link between gender and prediabetes? Is there a link between ethnicity and prediabetes? Is there a dominating gender or age group at risk? Is there a correlation between high blood pressure, waist circumference, and prediabetes? The premise of this research is to identify prediabetes in a population that can benefit from education programs. A pilot study

conducted in November 2016 resulted in data collection from 36 individuals. Preliminary analysis of data from this group indicated a significant need for additional testing which took place in June 2017.

## **Materials and Methods**

Participants were recruited for the pilot study in November 2016 through distribution of an informational flyer advertising the free screening and speakers for the Diabetes Summit. Students from a local high school were also invited to attend the presentations. The June 2017 participant recruitment resulted from networking efforts by a diabetes advocate in Belize, and agencies who supported the November 2016 Diabetes Summit. Dates and times for the screening in Belmopan and Belize City was organized through the supporting agencies whose employees were excited to be invited to participate.

IRB approval was granted by Northern Illinois University and each participant was asked to complete registration information and sign a consent form. The registration information including phone number and email address was collected in order to follow up with the participant if necessary. Participant age, gender, and ethnicity was recorded along with a question of whether or not the participant had a previous diagnosis of diabetes. Measurements were made of waist circumference, blood pressure and hemoglobin A1c.

Waist circumference was measured in inches using a cloth tape measure utilizing the recommended technique for waist measurement given by ADA.<sup>9</sup> Blood pressure measurements were performed using an automatic digital arm blood pressure monitor with pressure cuff.<sup>10</sup> The HbA1c measurement was performed with capillary blood collected by fingerstick on a point of care device, A1cNow+ © following manufacturer's recommendations.<sup>11</sup> Quality control for the HbA1c was established using two levels of controls tested on each reagent lot. All materials for testing including biohazard bags for disposal of waste were transported to Belize from the United States.

Once all measurements were completed, a result form was given to each participant with interpretation information (Table I). In addition to receiving results, each participant met with a nurse trained in Belize to address any questions or discuss possible diet or behavior changes for those individuals in the prediabetes risk zone.

### ***Setting***

Belize is a country of a very diverse cultural population. Gathering of data related to ethnicity may provide valuable answers to the research questions. There were six categories identified; namely Creole, Mestizo, Garifuna, Maya, East Indian and other.<sup>12</sup> The group identifying themselves as Creole stem from ancestors of both African and European descent. The Mestizo group identify with descendants from Spanish and Mayan cultures. The Mayan people of Belize have a rich history of religion and culture with temple sites which are prominent attractions for tourists. The group of people identifying themselves as Garifuna are descended from a mixture of African and Caribbean colonists. The East Indian group identify with

descendants of Indian immigrants and the last group of “other” made up of Nigerian, Hispanic, Chinese and African did not identify with any of the previous categories.

At the diabetes summit in November 2016, the screening and speaker sessions took place at the George Price Center in Belmopan, Belize. A table for testing and additional tables for registration and consulting were set up. High school students of the organization Youth for World Peace Ambassadors assisted with the registration and waist measurements. Two Belizean nurses assisted with the patient education. Data from 36 participants was analyzed.

The second round of data collection on June 2017 took place at designated employment agencies in Belmopan and Belize City. The organizations provided a conference room which was set up for the measurements with registration and signing of consent forms taking place outside of the conference room. The following agencies in the community hosted the screening for their employees; Social Security Human Resources office, Belize Natural Energy, Belize Telecommunications, Limited and Help Age. The last group of 20 participants were employees of SMART in Belize City. These organizations stated that providing time for employee screening was beneficial to the health and wellness of the staff. They correlated healthy employees to healthy productivity for the organization. The logistics of taking the screening to the workplace eliminated the need for employee travel to an offsite location. An additional 94 participants were tested for a total of 130 participant data for analysis.

This mixed method research incorporated a qualitative component that included survey questions related to previous diagnosis of diabetes and patient counseling following results. The quantitative data included waist circumference, blood pressure and

hemoglobin A1C measurements. After analysis of the information collected at the pilot study and a literature review of diabetes in Belize, the decision to add measurement of blood pressure on future participants was made.

Each participant was given a unique number for anonymity associated with results. Once all results were obtained participants were provided with a form listing his/her results and an explanation of the meaning of the results. In addition, each participant met with a Belizean nurse for counseling and answering of any questions related to the results. Participants were informed that referral may be made to a physician for follow up consulting if necessary. Recommendations and suggestions for diet choices and exercise options were given in both English and Spanish as necessary.

## **Results**

Of the 130 participants tested, 57 (43.8%) were men and 73 (56.2%) were women. Their ages ranged from 20 to 64 years with the mean of 38.2. The highest percent (36.4%) of participants were in the age group of 30-39 years of age. Since there are such a variety of ethnic groups in Belize, participants were asked what group they identify themselves with (Table II). The largest group that participated was 47 Creole (36.2%). The next highest number of participants were Mestizo at 42 (32.3%) followed by 22 Garifuna (16.9%). There were 5 Mayan (3.8%), 3 East Indian (2.3%) and 11 people (8.5%) who were categorized in "Other" which consisted of Nigerian, Chinese, Hispanic and African. As indicated by the table, the highest number of participants with a value in the diabetic range were Creole, followed by Garifuna.

The data collection included a question to participants of whether he/she had been previously diagnosed as diabetic. Table III shows that the number of participants who had been previously diagnosed as diabetic was quite small 5 (3.8%), compared to the total number of participants falling into the HbA1c range of diabetic 16 (12.3%). The number of participants with HbA1c in the prediabetic range was 43 (33.1%) confirming the need for education on lifestyle changes for the prevention of prediabetes becoming diabetes.

A series of Analyses of Variance (ANOVA) tested whether any of the dichotomous variables such as gender and already diagnosed as diabetic, or continuous variables such as age, waist measurement, HbA1c result, Blood pressure measurements, differed based on ethnicity. The findings indicated that none of these variables differed significantly based on ethnicity. A second series of ANOVA were used to determine whether any of the dichotomous or continuous variables differed significantly with identification of normal, prediabetic or diabetic based on HbA1c levels. The means of age, waist measurement, and previous diagnosis of diabetes differed significantly.

The mean waist circumference was 38 inches. There was a significant correlation between waist circumference and gender, age and HbA1c levels. Women had lower waist scores than men and older participants were more likely to have higher waist and HbA1c levels. Another significant correlation was that older participants were more likely to have been diagnosed with diabetes than younger participants. Since hypertension is an associated concern with diabetes, blood pressure scores were included in the second data collection set. Participants who were diagnosed as diabetic did have elevated diastolic and systolic blood pressure values as



expected. The statistical analysis did include one blood pressure systolic measurement of 226 which should be considered an outlying data point.

When looking at the correlation of data, three diagnostic classifications were used based on the hemoglobin A1c measurement, namely normal, prediabetes, or diabetes. The normal group included all participants with a HbA1c value = less than 5.7% (<39mmol/mol), the prediabetes group included all participants with a HbA1c range of 5.7-6.4% (39-46 mmol/mol) and finally any participant with a HbA1c value of over 6.5% (>48 mmol/mol) was deemed diabetic. This data was then correlated with ethnicity to answer the research question of whether any ethnic group was at higher risk. Some participants fell into the diabetic range who had never been diagnosed. One of the goals of this project was to identify participants in the prediabetic range who could benefit from changes in diet and activity.

## **Discussion**

Aviles-Santo et.al. report on the differences in HbA1c values for Hispanic versus non Hispanic people in Central America, South America, Cuba and Mexico.<sup>13</sup> This national health and nutrition survey of 2016 did not focus on any particular country in Central America and did not suggest intervention methods based on cultural diversity. Gulley et.al. describe an occupational diabetes screening program at a major corporation in Belize and the cultural considerations needed when advising participants of their glucose results and the significance of the findings.<sup>14</sup> Since the typical Belizean diet consists of rice, tortillas, plantains and fryjacks, patient education on better nutrition sources is important to prevent development of type II diabetes. Gulley et.al. also reflect on the economic issues that contribute to effective or

ineffective chronic disease management. Lack of screening tests and medicine to treat conditions contribute to this very important concern in Belize.

This research presents a picture of the prevalence in different groups of people in Belize. Of the 130 participants tested, 72 fell into the normal range for Hb A1c and 43 fell in the prediabetes range. A finding of 33.1% of a population with prediabetes values is worth addressing with patient education. Even more concerning is 16 participants who fell in the diabetes range with 11 (8.5%) not having been diagnosed previously. Use of patient education materials that address cultural differences will be the next step of this project.

A mixed methods study by Dekker et. al. presented a needs assessment in Toledo, Belize, an area south of where most of our participants resided.<sup>15</sup> These researchers assessed a patient population for the understanding of type 2 diabetes and hypertension as a means of determining quality of care in country. A common thread between the Gulley study, Dekker study and the study being reported is the barrier to care related to financial constraints, transportation difficulties and in some cases inadequate means for daily access to fruits and vegetables. A common conclusion from the studies in Belize is the valuable support provided by employer promoted health and wellness programs which ultimately enhance employee performance. For this project, going to the workplace was the ideal method of gaining participation. Partnering with International organizations for funding of supplies to meet the needs of screening an even larger population will be beneficial to the future health outlook for Belize. .

The complications resulting from uncontrolled diabetes can be devastating. They include loss of sight, limbs and kidney function.<sup>16</sup> The purpose of this study was to bring awareness and

possible intervention to a population who could make changes in diet and activity to prevent advancement to type 2 diabetes. Belize has a rich culture of medicinal plants and their use. Giovannini et.al. have studied the use of medicinal plants used in seven Central American countries, of which Belize was one.<sup>17</sup> Follow up studies could also look at the role of medicinal plants growing in Belize that might be useful for management of diabetes. Since availability of pharmacological resources are limited, a future study to identify how use of some of these described plant species affect hemoglobin A1c values could be extremely beneficial to the people of Belize.

### **Acknowledgement**

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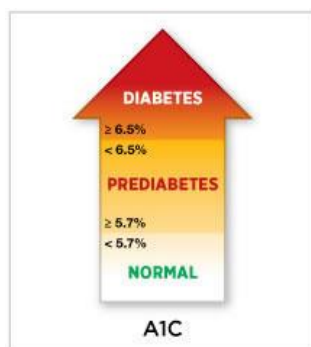
Table I: Patient Education information

**Interpretation:** The A1C test measures your average blood glucose for the past 2 to 3 months. The advantages of being diagnosed this way are that you don't have to fast or drink anything.

Blood Pressure Measurement \_\_\_\_\_

For a **normal reading**, your **blood pressure** needs to show a top number (systolic **pressure**) that's between 90 and 120 and a bottom number (diastolic **pressure**) that's between 60 and 80. A **normal reading** would be any **blood pressure** below 120/80 mm Hg and above 90/60 mmHg.

Waist circumference \_\_\_\_\_ inches HbA1C result \_\_\_\_\_% \_\_\_\_\_mmol/mol



Result	
NGSP Hba1c(%)	IFCC HbA1c (mmol/mol)
<5.7	<39
5.7-6.4	39-46
>6.5	>48

Table II: Prevalence of Diabetes and Prediabetes by Ethnicity

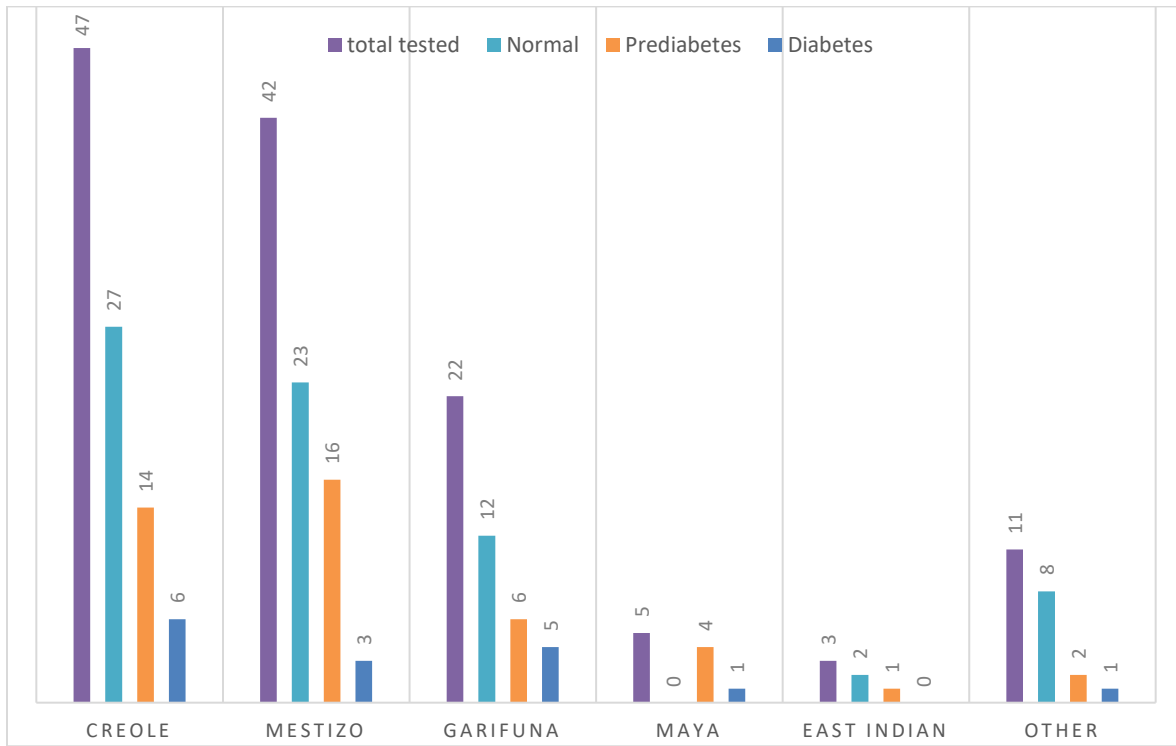


Table III: Prevalence of Diabetes by previous diagnosis

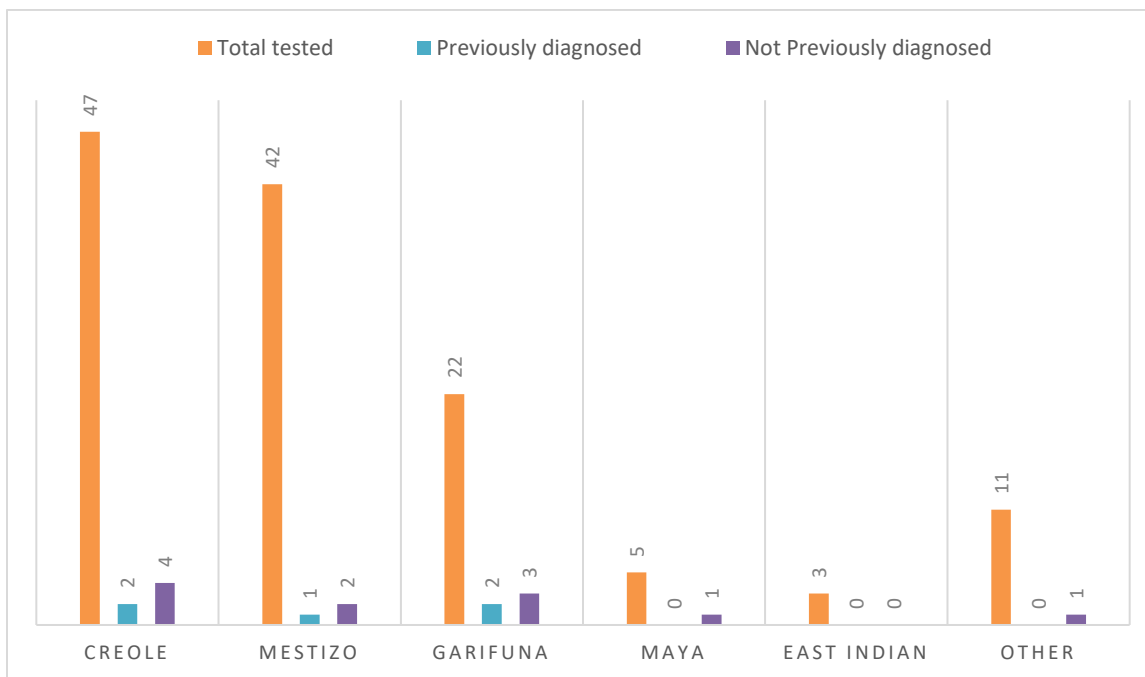




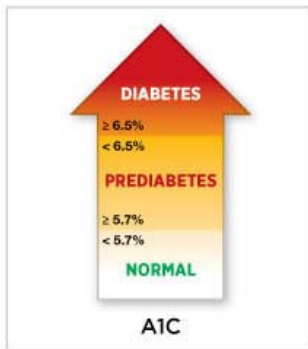
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Blood Pressure Measurement \_\_\_\_\_

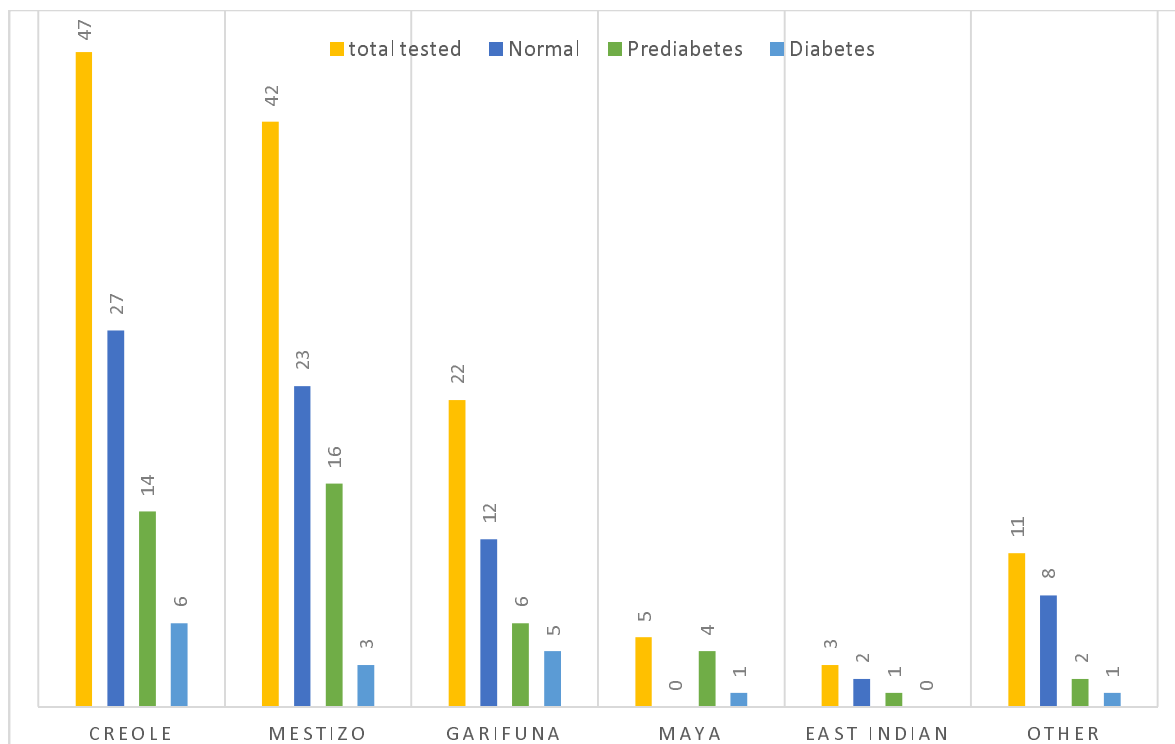
For a **normal reading**, your **blood pressure** needs to show a top number (systolic **pressure**) that's between 90 and 120 and a bottom number (diastolic **pressure**) that's between 60 and 80. A **normal reading** would be any **blood pressure** below 120/80 mm Hg and above 90/60 mmHg.

Waist circumference \_\_\_\_\_ inches HbA1C result \_\_\_\_\_%



Result	A1C
Normal	less than 5.7%
Prediabetes	5.7% to 6.4%
Diabetes	6.5% or higher

Table II: Prevalence of Diabetes and Prediabetes by Ethnicity



**TABLE III: PREVALENCE OF DIABETES BY PREVIOUS DIAGNOSIS**

