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Using a Risk Assessment Questionnaire to Identify Prediabetics and Diabetics in Tandag, Philippines

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Summary

This study highlights the importance of extending medical awareness to outreach communities and explores the creation of a risk assessment questionnaire to help detect diabetes in Filipino participants in Tandag, Philippines. The aim of this work is to help indigent Filipinos in remote villages receive medical care if necessary. A risk assessment tool can act as a self-completion questionnaire for participants to identify themselves as diabetics or prediabetics in order to seek appropriate medical attention. Therefore, Filipino participants living in remote villages will not have to travel several hours to receive diabetic blood testing unless diagnosed by the risk assessment tool.

The development of the risk assessment tool takes the following assessments into consideration: blood pressure, body mass index (BMI), waist circumference, family history, and diabetic symptoms. The research hypothesis states that a risk assessment questionnaire will determine if a person is diabetic. The null hypothesis claims that a risk assessment questionnaire will not determine if an individual is diabetic. The data rejects the null hypothesis since a statistically significant correlation is found between blood glucose levels and total points. A positive correlation is found between total points and BMI, supporting that a risk assessment questionnaire can detect those at risk for diabetes and prediabetes.

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Introduction

Diabetes mellitus, a disease characterized by high blood sugar, can lead to serious health complications and even death if left uncontrolled1. Being overweight and having an unhealthy BMI increases the risk of developing type 2 diabetes. Symptoms of diabetes include polydipsia (excessive thirst), polyuria (excessive urine), polyphagia (excessive desire to eat), and unexplained weight loss (2). According to the Centers for Disease Control and Prevention, another factor to look for in individuals with undiagnosed diabetes includes a fasting plasma glucose level (no caloric intake for at least eight hours) greater than or equal to 126 mg/dL (1). Standards used in the diagnosis of diabetes by the American Diabetes Association include a casual plasma glucose level (any time of day without regard to time since last meal) greater than 200mg/dL (2). Prediabetics, those with blood sugar levels higher than normal, are at an increased risk of developing type 2 diabetes and its complications of heart disease and stroke (1).

The growing prevalence of obesity has joined malnutrition and infectious diseases in the developing world, propelling the number of cases of diabetes and hypertension, as reported by Hossain et al. (3). Over the past 20 years, the rate of obesity has tripled in countries like the Middle East, Southeast Asia, Pacific Islands, and China following the adoption of a Western lifestyle (3). Several studies suggest that East Asians are particularly vulnerable to this trend. Ma and Chan, in particular, found the prevalence of diabetes in Asia to be alarming. Type 2 diabetes develops in East Asians at a lower mean body mass index (BMI) compared to those of European descent (4). A predisposition to abdominal obesity among Asians can lead to metabolic syndrome and impaired glucose tolerance, putting them at higher risk for diabetes and cardiovascular disease (3). Hossain et al. concluded that the upsurge in diabetes is a global heath care problem, most noticeable in developing countries with Southeast Asia and the Western Pacific region at the forefront (3). According to Choi, the burden of diabetes in a developing country like the Philippines is more prevalent because of an increase in genetic predisposition, family history, improper diet, limited physical activity, socioeconomic position, gender, and overall access to quality health care. The rate of diabetes is rapidly growing among ethnically diverse populations like the Philippines (5). Soria et al. found a significant increase in type 2 diabetes in the Philippines over a nine-year period from 1998 to 2007 (6). The lack of access to healthcare in the rural communities creates a dire need for a risk assessment questionnaire to serve as an inexpensive and user-friendly tool to screen for diabetes.

The development of a risk assessment questionnaire would be a helpful tool to identify pre-diabetics and diabetics who have less access to medical care in villages and remote towns in undeveloped countries.

Number of male and female participants per age group		
Age<35	F	26
	M	19
35≤Age<45	F	50
	M	25
45≤Age<55	F	67
	M	29
55≤Age<65	F	69
	M	38
65≤Age	F	50
	M	18
Total	F	262
	M	129

Table 1: Summary statistics of age and gender of the 391 study participants.

Those whose assessment results indicate potential pre-diabetic or diabetic ranges could then be verified with diagnostic testing of blood glucose and counseled to seek appropriate medical care from a doctor and/or nurse. More participants could be screened with the use of a risk assessment questionnaire due to cost savings with diabetic diagnostic tools like random and plasma glucose tests, oral glucose tolerance test, and hemoglobin A1c test (which measures average blood glucose over the past several months). Diabetics need to be identified since they may have comorbidities such as hypertension and obesity that can be burdensome to their families, making them less able to contribute to their community as a whole. Several countries have examined this concept, including Finland, Canada, and the United States.

A diabetes risk assessment tool developed in Finland, the Finnish Diabetes Risk Score (FINDRISC), screens participants by using a risk-scoring model rather than diagnostic tests with blood glucose. The FINDRISC model relies on information a participant can self-complete, and has screened more than ten percent of the Finnish population (7). FINDRISC is a helpful assessment tool to use as a base risk assessment questionnaire. Lindstrom and Tuomilehto followed 4,746 subjects for ten years from a 1987 survey (from the National Population Register) and 4,615 subjects for five years from a 1992 survey (from the FINDRISK Studies). After ten years of background research Lindstrom and Tuomilehto created a risk assessment form where different point values were assessed for age, body mass index, waist circumference, history of antihypertensive drug treatment and high blood glucose, physical activity, and daily consumption of fruits, berries, or vegetables. From these data, they developed the Diabetes Risk Score and found it to be a reliable, quick, simple, inexpensive, and noninvasive model to identify type 2 diabetics at high risk (8).

Robinson et al. sought to validate the CANRISK prognostic model, the tool developed by Canadian diabetes experts that adapted the FINDRISC model to include ethnicity, gender, education, and macrosomia (high prenatal birth rate). The CANRISK model assesses participant's height, weight, BMI, gender, waist circumference, amount of physical activity per day, consumption frequency of vegetables, ethnicity, and family history. Robinson et al. found the CANRISK to be a statistically valid tool in Canada's multi-ethnic population and more accurate than the FINDRISC model (7).

Additionally, Heikes et al. developed a Diabetes Risk Calculator in the United States to assess the probability that an American has undiagnosed diabetes or prediabetes. They used explanatory variables to develop

Diabetes Risk Assessment Questionnaire

Measurements **Patient #**__________
Gender: male female

1) Age: ________
2) Height (cm): ________(m): _________
3) Weight (lbs): __________ (kgs):___________
4) Waist Circumference (inches): _____________
5) Blood Pressure: ___________________
6) BMI = weight (kg)/ height $(m)^2$ (calculated by medical team): _______________

Questions

7) Family history of diabetes:
Parent: Yes No
Sister/Brother: Yes No
8) Average daily activity or exercise level per day (circle one):
none/little moderate/a lot
9) Signs and symptoms of diabetes (check all that apply):
a. Excessive thirst/ urination/ hunger ☐
b. In feet, numbness, tingling or burning pain and/or find wounds you do not remember getting ☐
c. Excessive weight loss or weight gain ☐
d. Females: vaginal itchiness ☐
e. Females: had a baby weighing more than 9 pounds (4 kgs) ☐
f. Males: erectile dysfunction ☐
10) Hours/minutes since last meal: ___________________

Lab
Blood glucose level: ______________

Referred to medical doctor: Yes No

TOTAL POINTS: __________

Age (yrs)	BMI (kg/m²)	Waist Circumference (in)		Symptoms
2pts ≥ 35	3pts ≥ 22	**Male**	**Female**	5pts for baby > 9 lbs
3pts ≥ 45	5pts ≥ 25	2pts ≥ 33	2pts ≥ 30	2pts for diastolic ≥ 89
4pts ≥ 55	7pts ≥ 28	4pts ≥ 36	4pts ≥ 33	2pts for systolic ≥ 150
5pts ≥ 65	9pts ≥ 31	6pts ≥ 39	6pts ≥ 36	1pt for each diabetic symptom
	11pts ≥ 34	8pts ≥ 42	8pts ≥ 39	3pts for family history (Parent, brother, or sister)
	13pts ≥ 37	10pts ≥ 45	10pts ≥ 42	
			12pts ≥ 45	

Figure 1: The risk assessment questionnaire used to assess a patient's risk for diabetes and prediabetes. Point values were used to calculate the total points from the risk assessment tool.

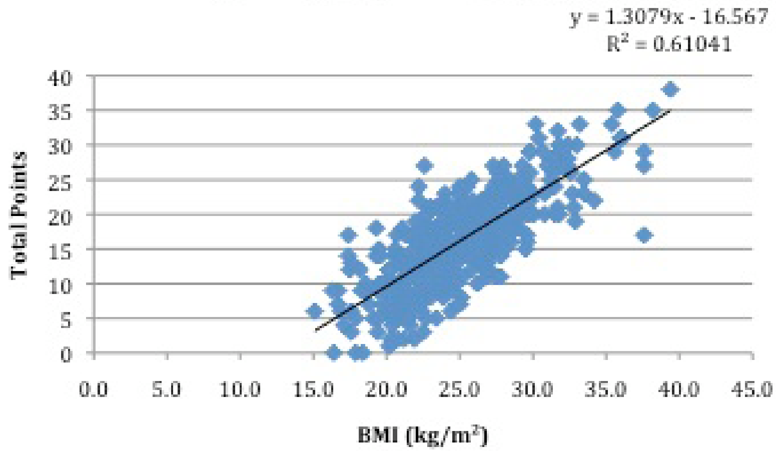

Figure 2: BMI and Total Points show a positive correlation. As BMI increased, total point scores increased.

their classification tree, which uses questions known to an average individual and requires no calculations. They found their risk calculator to compare favorably in its ability to detect people at high risk for undiagnosed diabetes (9).

The FINDRISC, CANRISK, and US Diabetes Risk Calculator are effective risk assessment questionnaires for their respective countries. However, the development of a risk assessment questionnaire for the Philippines was not found in the literature. The existing ones fail to recognize factors specific to Filipinos, such as their body type, genetic predisposition to developing diabetes, diet high in carbohydrates, minimal exercise, and limited access to quality healthcare

The current study investigated whether total scores on the risk assessment measurement were correlated with the presence of diabetes, as measured by blood glucose levels among Filipinos recruited in Tandag, Philippines. Tandag is a rural community in the southern most province of the Philippines, and is the capital of Surigao del Sur on the island of Mindanao. Tandag has a population of approximately 50,000 people. This tool will be used to aid efforts in reducing the burden of diabetes in remote villages.

The research hypothesis stated a risk assessment questionnaire would aid in determining if a person is diabetic. The null hypothesis proposed a risk assessment questionnaire would not determine if an individual is diabetic. Overall, the data rejected the null hypothesis: we found a statistically significant correlation between total points scored on the questionnaire and blood glucose. The experiment showed a positive correlation between total points and age, BMI, blood pressure, and diabetic symptoms.

Results

Four hundred participants at the Adela Serra Ty Memorial Medical Center in Tandag, Philippines were administered the risk assessment questionnaire and assessed for blood pressure, BMI, and blood glucose levels. The population studied included 262 females and 129 males; the summary statistics of age and gender are depicted in **Table 1**. These patients were Filipinos who gave consent to lab screenings and to completing the risk assessment questionnaire (as shown in **Figure 1**). They included those with known medical conditions waiting for treatment, the participant's accompanying family or friends, government officials, and healthcare workers. Nine of the four hundred risk assessment forms were incomplete due to the patients retaining the form or the screening team's failure to complete the form; therefore, they were excluded from analysis. The risk assessment questionnaire assessed age, height, weight, circumference, blood pressure, BMI, family history of diabetes, average daily activity or exercise level per day, and common signs and symptoms of diabetes.

Figure 1 represents the point scoring method for the risk assessment tool based on the collected data. More points were assigned for higher age, BMI, and waist circumference based on results from logistic regression models for the CANRISK and FINDRISC studies (7). Dr. Joseph Aloi helped to select the point cutoffs for BMI, waist circumference, and diabetic symptoms based on clinical expertise in diabetes. Additional points were also granted for extenuating factors like giving birth to a baby weighing greater than nine pounds, high diastolic and systolic blood pressure (greater than 130 mmHg and 90 mmHg, respectively), family history of diabetes, and other diabetic symptoms like excessive thirst/urination/hunger; numbness, tingling or burning pain in feet and/or unknown source of wounds; excessive weight loss or weight gain; vaginal itchiness; and erectile dysfunction. Amount of exercise per day was not included in the point system because it was difficult to quantify among

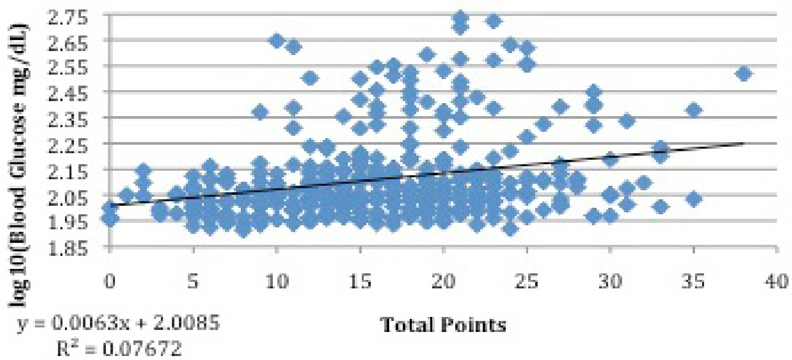

Figure 3: Log_{10}(Blood Glucose) versus total points showed a positive relationship, which indicates that a participant's total points score could plate him/her at a higher risk for diabetes.

participants who worked outdoors in the fields planting rice and harvesting other crops.

We predicted that the creation of a risk assessment tool would make it possible to determine if a participant was diabetic or prediabetic. We found a positive linear correlation between body mass index (BMI) and total points (as shown in **Figure 2**). The correlation of 0.610 showed that a participant's risk assessment total points increased as his/her BMI increased. **Figure 3** illustrates the data that show a positive correlation between a participant's total points score and blood glucose, therefore rejecting the null hypothesis that a risk assessment tool would not determine if a participant were diabetic. A logarithmic transformation was used to shift the blood glucose data toward a normal distribution. These data demonstrate that the cumulative score can help identify individuals at risk for diabetes.

Diabetics and prediabetics predictably scored higher total points than those with normal blood glucose levels. As **Figure 4** illustrates, a trend was established throughout each age group as study participants with normal blood glucose scored fewer points than those identified as prediabetics and diabetics. For example, the average participant with normal blood glucose levels in the 45 to 55 age group scored 16 points compared to a prediabetic who scored 18 points and a diabetic who scored 20 points. Normal blood glucose was defined as random blood sugar (non fasting) less than 140 mg/dL, prediabetic between 140 mg/dL and 199 mg/dL, and diabetic greater than 200 mg/dL.

Figure 5 establishes the total point ranges defined for normal blood glucose, prediabetics, and diabetics. The ranges represent the middle 50% of participants for each group. The average total point score for a participant with normal blood glucose would be 15 compared to 18 for a prediabetic participant and 21 for a diabetic participant. The average total point score increased as defined by the parameters of the participant's blood glucose designations of normal, prediabetic, or diabetic.

Discussion

The purpose of this study was to create a risk assessment questionnaire in order to identify prediabetic or diabetic individuals in remote villages in the Philippines. The data were recorded based on random blood glucose readings because the participant's time since last meal varied. A fasting blood glucose level requires a patient to abstain from eating for eight hours and is therefore a more accurate interpretation of an individual's blood glucose level. If a random blood glucose reading is taken, this means the person could have just eaten, which could lead to a spike in blood glucose skewing the data. It was difficult to collect a fasting blood glucose as communication with the patients is difficult since they live in remote villages and commuted to Adela Serra Ty Medical Center to be screened for eyeglasses, eye

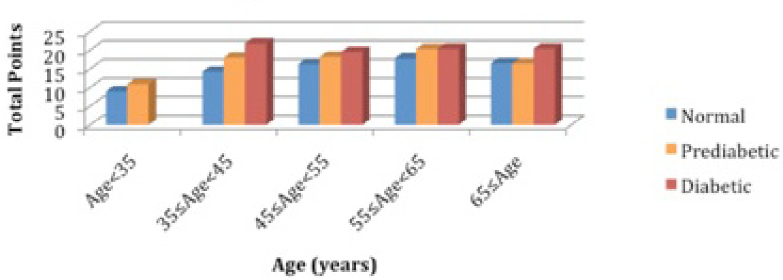

Figure 4: Average total point values for participants identified as having normal blood glucose, prediabetic, and diabetic for each age group. In each age group, diabetics had a higher total point score than prediabetics and those with normal blood glucose.

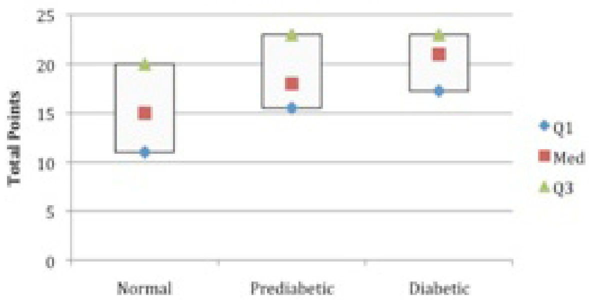

Figure 5: The range in total points for the middle 50% of participants with normal blood glucose, prediabetes, and diabetes showed that diabetics had a mean total point score higher than prediabetics and those with normal blood glucose. Q1 represents the bottom quarter of the data, Med represents the median or middle 50% of the data, and Q3 represents the 75th percentile of data.

diseases, or prosthetics. Based on his clinical diabetes, Dr. Joseph Aloi determined the classification of random blood glucose: blood glucose levels less than 140 mg/dL were identified as having normal blood glucose levels, participants scoring between 140 mg/dL and 199 mg/dL were identified as prediabetic, and participants scoring greater than 200 mg/dL were identified as diabetic.

The intent of the study was to find a relevant positive correlation between blood glucose and total points based on a point scale that assessed age, blood pressure, BMI, waist circumference, diabetic symptoms, time since last meal, and family history of diabetes. The results showed a positive correlation between blood glucose and total points with an r^2 value of 0.0767 and a *p*-value of 0.001. These statistics rejected the null hypothesis and supported the hypothesis that a risk assessment questionnaire could determine if a person was prediabetic or diabetic. The experiment showed a positive trend as total points increased with age, BMI, blood pressure, and diabetic symptoms. For example, the positive correlation between total points and BMI supports the relevance of BMI for identifying those at risk for diabetes. Also, the average points for participants with normal blood glucose, prediabetes, and diabetes increased as blood glucose increased. The average total points for a diabetic was 21, compared to 18 for a prediabetic, and 15 for a participant with normal blood glucose. Point assessed for increasing age, unhealthy BMI, and diabetic symptoms correlated with those participants identified as prediabetic or diabetic.

Although little research has been conducted on the prevalence of diabetes in Tandag, Philippines, we found that risk assessment questionnaires may be useful to alert an individual to his/her risk of developing diabetes. Finland, Canada, and the United States have developed self-completed diabetes risk assessment tools to aid the study participant in identifying his/her risk for developing diabetes. The risk assessment questionnaire used in this study was comparable to these models in that it was formulated to be a self-completed form that would not require blood glucose testing to identify those at risk for diabetes or prediabetes. However, the risk assessment questionnaire study took into account ethnic differences present in the Philippines, such as points assessed for lower BMI cutoff values due to Filipino body type.

We found a correlation between total scored points and age, BMI, and waist circumference. This is not surprising, because these factors were among heavily weighed factors in the questionnaire. Also, more points were allotted for known diabetic risk factors such as giving birth to a baby weighing greater than nine pounds, higher diastolic and systolic blood pressures, family history, and other known diabetic symptoms.

A major weakness in this study was the failure to record whether participants had known diabetes, and if so, whether they were compliant with taking their diabetic medication (in which case they should have been eliminated from the study). Future studies can improve the accuracy of the diabetic risk assessment questionnaire by recording whether participants are diabetic and/or taking diabetic medication. Additionally, fasting blood glucose levels could be assessed since they are more accurate.

The burden of diabetes in a developing country like the Philippines is more prevalent because of an increase in genetic predisposition, unknown family history, improper diet, limited physical activity, socioeconomic position, and access to quality health care. Education on living a healthy lifestyle, coupled with the use of a diabetes risk assessment tool to identify those at risk, could reduce the human and financial costs of the burden of obesity.

Materials and Methods

Adults eighteen years or older were recruited for this study including those needing glasses, cataract surgery, or prosthetics. In this experiment participants were screened for diabetes and pre-diabetes. Items needed to complete the screening included a scale (Taylor) to measure weight (in pounds), a tape measure (Dritz) to measure height (in centimeters) and waist circumference (in inches), a sphygmomanometer (Panasonic) to measure blood pressure, 400 lancets (Medipurpose; Htl-Strefa Medlance Plus) for finger pricks, 400 blood glucose strips (Accu-Chek Aviva) for blood drop collection, and two glucometers (Accu-Chek Aviva) to read blood glucose levels. Dr. Aloi and pharmaceutical medical supply companies (Roche Diagnostics, HTL–Strefa, Med.purpose, Select, and Kimberly-Clark) donated the diabetic testing supplies.

Diabetes Consent Form **Patient #_______**

I am asking for your voluntary participation in my research study. Please read the following information about the project. If you would like to participate, please sign below.
Student Researcher: Greg Neatrour
Title of Project: Using a Risk Assessment Questionnaire to Identify Pre-Diabetes and Diabetes
My purpose is to develop a risk assessment tool to identify those at risk for pre-diabetes and diabetes (high blood sugar levels). If you participate, you will be asked to complete a risk assessment questionnaire and agree to have the following measurements taken: weight, height, waist circumference, blood pressure, and blood sample by finger stick. Your time required for participation should be 20-30 minutes. The potential risks involve infection or contamination from obtaining a blood sample from a finger prick. The benefits are you will be educated on the signs and symptoms of diabetes and you will gain knowledge on how your answers to the risk assessment questionnaire correlate with your potential for being pre-diabetic or diabetic. To maintain confidentiality, non-identifiable ID numbers will be used and the risk assessment questionnaires will be shredded at the completion of the project. If you have any questions about this study, you man contact Heather Green at: Heather.Green@VBSchools.com.

Voluntary Participation:
Participation is this study is completely voluntary. If you decide not to participate there will not be any negative consequences. Please be aware that if you decide to participate, you may stop participating at any time and you may decide not to answer any specific question. By signing this form I am attesting that I have read and understand the information above and I freely give my consent to participate.

Adult Informed Consent Date Reviewed & Signed: _________________
Printed Name of Research Participant: ___________________________
Signature: ____

Figure 6: The consent form was translated into Tagalog, the predominant native language in Tandag, Philippines.

Using the tape measure as a guide, a handmade ruler was made to measure height and was attached to a wall. Risk of biohazard contamination was minimized by using gloves (Kimberly-Clark), wearing clean scrubs and/or a lab coat, wiping the finger tip with an alcohol wipe (Select) and allowing the area to air dry thoroughly, working over an absorbent paper with plastic backing, using a new sterile lancet per person, squeezing out a single blood drop onto the test strip, wiping off the finger with gauze (Select), and covering the wound with a bandage (Band-Aid). The used lancets were placed in a red sharps biohazard container. The swabs, gloves, and any other materials contaminated with blood were disposed of in biohazard waste.

Prior to screening, the participant gave consent to the project with the aid of a translator. Consent forms (as shown in **Figure 6**) were available in English and Tagalog, the predominant native language in Tandag, Philippines. Each participant was assigned a random number to ensure anonymity. The patient identifying number was placed on the participant's hand, on the consent form, and on the risk assessment questionnaire. Once consent was granted, the participant answered questions such as gender, age, family history of diabetes, average daily activity or exercise level, diabetes signs and symptoms (excessive thirst/urination/hunger, numbness/tingling or burning pain, poor wound healing, weight loss/gain, vaginal itchiness, high birth weight, erectile dysfunction), and time since last meal.

Once the responses were recorded on the risk assessment form, the participant sat in a chair with his/her arm resting on a table and blood pressure was measured and recorded. Next, the participant was asked to remove his/her shoes and height and weight were measured and recorded. Then, the participant's waist circumference was measured and recorded using the tape measure. Lastly, the participant's blood glucose was taken by triggering the lancet on the participant's non-dominant pointer finger and the blood glucose level was read from the glucometer and recorded on the risk assessment form.

If the blood glucose was greater than 140 mg/dL and/or the blood pressure was high (systolic above 130 mmHg or diastolic above 90 mmHg), the participant was referred to a local doctor for prescriptions and medical advice. Given this experiment spanned three days, two different local Filipino doctors and several Filipino nurses volunteered their services. Handouts, diagrams, and charts on diabetes education were available in English and Tagalog. The nature of this experiment did not require fasting blood glucose, although some participants were asked by the doctor to return the next day to have a fasting blood sugar taken.

The participant's body mass index (BMI) in kg/m^2 and risk assessment were calculated. The following point values were assigned as listed in **Figure 1** based on ethnic differences in Filipinos and on the experience of the research advisor. The points were added up for each participant and the process was repeated for 400 participants in total. The data collected were analyzed using Microsoft Excel.

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