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

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Abstract

This paper introduces the importance of extending medical awareness to outreach communities and explores the creation of a risk assessment questionnaire to 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), blood glucose levels, 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 fails to reject the null hypothesis since a statistically significant correlation is not found between blood glucose levels and total points. However, 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.

Introduction

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 the villages and remote towns in undeveloped countries. Those whose assessment results indicate the 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 blood glucose tests and HbA1c. Diabetics 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.

Diabetes mellitus, characterized by high blood sugar, can lead to serious health complications and death if left uncontrolled[1]. Symptoms present in the diagnosis of diabetes include polydipsia, polyuria, polyphagia, 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 (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 (any time of day without regard to time since last meal) greater than 200mg/dL[2]. Prediabetics are at an increased risk of developing type 2 diabetes and its complications of heart disease and stroke[1].

Hossain et al have reported that the growing prevalence of overweight and obesity has joined malnutrition and infectious diseases in the developing world, propelling the number of cases of diabetes and hypertension. With rates of obesity tripling in the past 20 years from the adoption of a Western lifestyle, those affected the greatest include people living in the Middle East, Southeast Asia, Pacific Islands, and China[3]. Ma and Chan found the prevalence of diabetes in Asia to be alarming. Type 2 diabetes develops in East Asian participants at a lower mean body mass index (BMI) compared to participants of European descent[4]. Similarly, Hossain et al found Asians to have a predisposition to abdominal obesity, which could lead to metabolic syndrome and impaired glucose tolerance putting them at higher risk for diabetes and cardiovascular disease. They 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 access to overall 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 nine years from 1998 to 2007[6].

Risk assessment questionnaires may be useful to enhance individual's awareness on their risk of developing diseases. 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 successfully 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). Different points 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 this 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]. Heikes et al developed a Diabetes Risk Calculator in the United States to assess the probability an American has undiagnosed diabetes or prediabetes. They used explanatory variables to develop 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 development of a risk assessment questionnaire for Filipinos was not found in the literature.

A risk assessment tool could help people living in outreach villages in developing countries who lack access to clinical care. Those assessed could receive medical insight and education without costly fees for diagnostic testing. The objective of this experiment was to use a risk assessment questionnaire to determine the prevalence of diabetes and prediabetes among Filipinos present in Tandag, Philippines. This experiment explored the correlation between scores on the risk assessment questionnaire and presence or absence of diabetes in the participants by examining the efficacy of the questionnaire as a screening tool to identify participants' risk of having diabetes. This tool will be used to aid efforts to reduce the burden of diabetes in remote villages.

The research hypothesis stated a risk assessment questionnaire would determine if a person is diabetic. Contradictory to the research hypothesis, the null hypothesis proposed a risk assessment questionnaire would not determine if an individual is diabetic. Overall, the data failed to reject the null hypothesis since the statistics were not statistically significant in supporting a strong correlation between total points and blood glucose. However, the experiment showed a positive trend as total points increased with age, BMI, blood pressure, and diabetic symptoms.

Results

It was predicted that the creation of a risk assessment tool would make it possible to determine if a participant was diabetic or prediabetic. After screening four hundred Filipinos for diabetes using the risk assessment tool, the study showed a correlation between body mass index (BMI) and total points (as shown in **Figure 1**). The correlation of 0.61 showed that a participant's risk assessment total points increased as his/her BMI increased. However, **Figure 2** illustrates the data that shows little correlation between a participant's total points score and blood glucose levels, failing to reject the null hypothesis that a risk assessment tool would not determine if a participant was diabetic. The Blood Glucose v Total Points graph showed random correlation as a participant's total points score could not be justified by his/her blood glucose; however, the risk assessment tool predicts well above a blood glucose value of 150mg/dL due to the clusters below the 150 mg/dL value skewing the data.

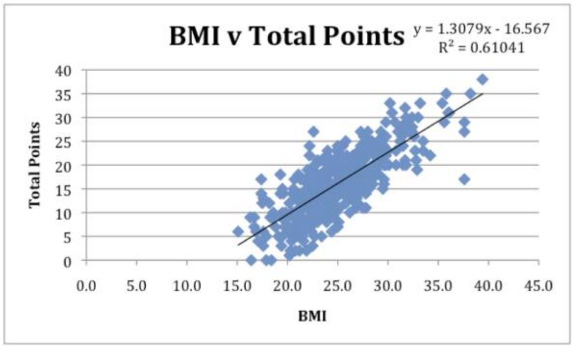


Figure 1. BMI and total points show a positive correlation.

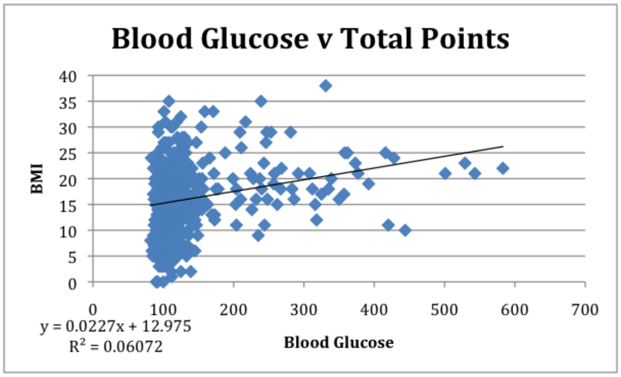


Figure 2. Correlation between blood glucose and total points not statistically significant.

Figure 3 represents the point scoring method for the risk assessment tool based on the collected data. More points were assessed for age, BMI, and waist circumference based on a graduated scale, as advised by my research advisor. Points were also granted for major symptoms 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; erectile dysfunction.

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 ☐

Referred to medical doctor: Yes No

Age (yrs)	BMI (kg/m^2)	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 3. The risk assessment questionnaire was 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 4 illustrates the distribution of total points amongst the age groups. A trend was established throughout each age group as study participants with a normal blood glucose scored less points than prediabetics and diabetics. For example, the average participant with a normal blood glucose 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.

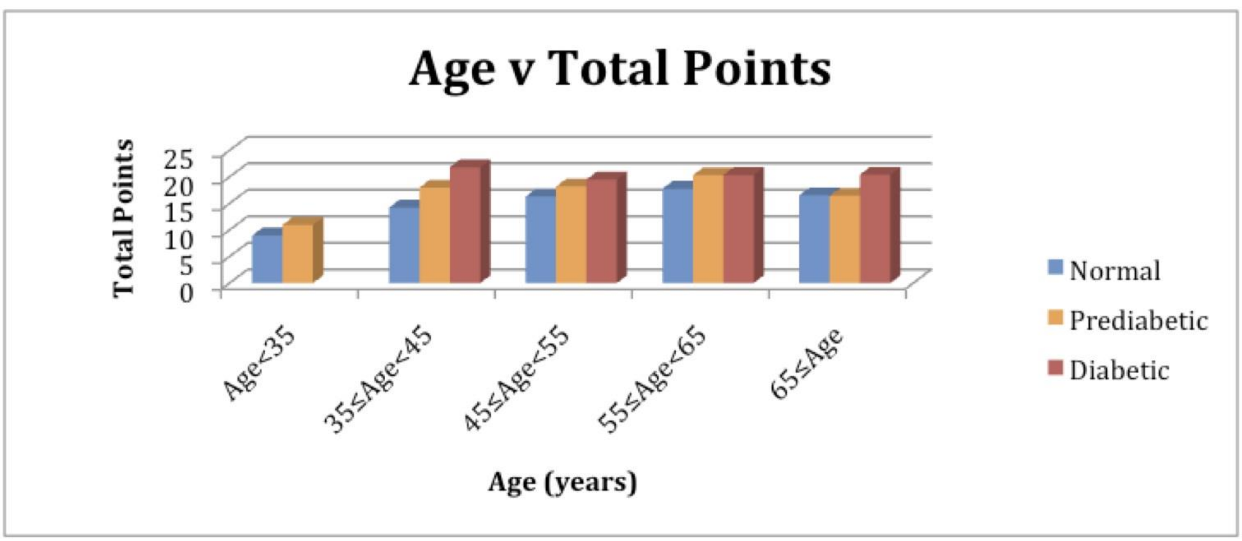


Figure 4. Average total point values for participants identified as having normal blood glucose, prediabetic, and diabetic for each age group.

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 a normal blood glucose would be 15 compared to 18 for a prediabetic participant and 21 for a diabetic participant. The average total point score rose as defined by the parameters of the participant's blood glucose designations of normal, prediabetic, or diabetic.

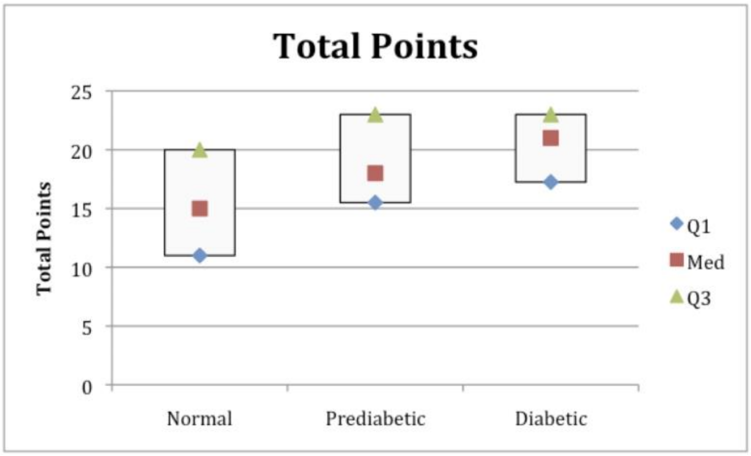


Figure 5. The range in total points for the middle 50% of participants with normal blood glucose, prediabetes, and diabetes.

Review

The purpose of this experiment was to create a risk assessment questionnaire in order to determine prediabetics and diabetics in remote villages in the Philippines. The data was recorded based on random blood glucose readings since the participant's time since last meal varied per participant. The random blood glucose scale stated that participants with 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 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 poor correlation between blood glucose and total points with an r^2 value of 0.06. These statistics failed to reject the null hypothesis, which stated that a risk assessment questionnaire would not determine if a person was prediabetic or diabetic**.** However, the experiment showed a positive trend as total points increased with age, BMI, blood pressure, and diabetic symptoms. For example, the correlation between total points and BMI had an r^2 value of 0.61, which supported BMI as relevant in 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.

Although little research has been conducted on diabetes in Tandag, Philippines, it was found that risk assessment questionnaires may be useful to enhance an individual's awareness of his/her risk of developing diabetes. Countries to include 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. There is lack of research on a diabetes risk assessment model for the Philippines or any other Asian/South Pacific country. The current risk assessment questionnaire was comparable to the FINDRISC, CANRISK, Diabetes Risk Score, and Diabetes Risk Calculator 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 studied took into account ethnic differences present in the Philippines.

Based on the data collected, more points were assessed for age, BMI, and waist circumference based on a graduated scale. Therefore, the graduated scale explained why the total points correlated strongly with these factors. 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. Weaknesses in this study, which led to discrepancies in findings, included failure to question whether participants had known diabetes and if so, whether they were compliant with taking their diabetic medication (in which case they would have been eliminated from the study).

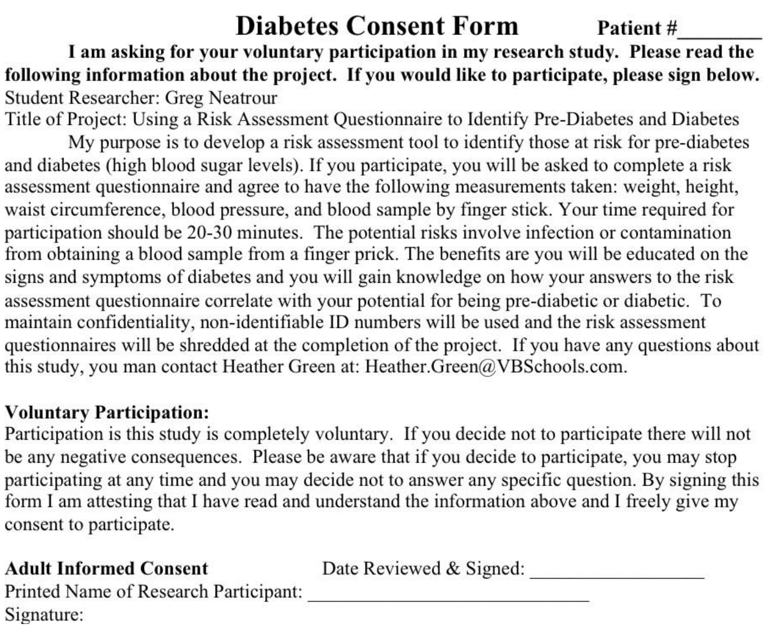
In future studies additional assessments could be conducted to improve the diabetic risk assessment questionnaire so it could be used as a tool to identify diabetics in the field without performing blood glucose testing. Participants could be asked if they are diabetic and/or taking diabetic medication. Additionally, fasting blood glucose levels could be assessed since they are a more accurate measure for detecting diabetes than random blood glucose.

Overall, 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 the diabetes risk assessment tool to identify those at risk could reduce the human and financial costs of the burden of obesity.

Materials and Methods

Participants and their families at the Adela Serra Ty Memorial Medical Center in Tandag, Philippines were asked to volunteer for a diabetes screening and education. Eligibility included Filipinos present who gave consent to lab screenings and to completing the risk assessment questionnaire. The consent form is shown in **Figure 6.** The participants screened were those with known medical conditions waiting for treatment, the participant's accompanying family or friends, government officials, and healthcare workers.

Possible participants included those needing glasses, cataract surgery, or prosthetics. The demographics were varied and the exclusion criteria included adults eighteen years or older.



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.

In this experiment participants were screened for diabetes and pre-diabetes. Items needed to complete the screening included a scale (brand – Taylor) to measure weight (in pounds), a tape measure (brand – Dritz) to measure height (in centimeters) and waist circumference (in inches), a sphygmomanometer (brand – Panasonic) to measure blood pressure, 400 lancets (brand – Medipurpose and Htl-Strefa Medlance Plus) to prick the finger, 400 blood glucose strips (brand – Accu-Chek Aviva) to collect the blood drop, and two glucometers (brand - Accu-Chek Aviva) to read the blood glucose levels. Dr. Aloi and the pharmaceutical companies donated the diabetic supplies. Using the tape measure as a guide, a handmade ruler was made to measure height and was attached to a wall. Risks were minimized by using gloves (brand – Kimberly-Clark), wearing clean scrubs and/or a lab coat, wiping the finger tip with an alcohol wipe (brand – 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 (brand – Select), and covering the wound with a bandage (brand – 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 a red biohazard bag.

Prior to the screening, the participant gave consent to the project with the aid of a translator. Consent forms were available in English and Tagalog, the predominant native language in Tandag, Philippines.

The participants were kept anonymous by number; the same 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 was asked to sit comfortably again with his/her arm resting on a table at a 45-degree angle. Clean gloves were worn and the glucometer was calibrated for each new box of blood glucose strips. A blood glucose strip was placed in the glucometer. An alcohol wipe was used to clean the pointer finger of the participant of his/her non-dominant hand. The area was air dried for a few seconds. The lancet was unlocked by twisting off the cap. The needle was handled cautiously since it released once pushed after the cap was removed. The lancet was placed on the side of the tip of the participant's finger and the needle was pushed. An alcohol wipe was used to clean the initial blood before squeezing out one drop of blood from the wound. The blood was collected on the tip of the blood glucose strip while keeping the strip in the glucometer. The finger was wiped with a gauze pad and pressure was applied before placing a bandage over the wound. 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. Since 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. For this research on Filipinos using random blood sugar levels, designations of less than 140 mg/dL were considered normal, between 140 mg/dL and 199 mg/dL were labeled pre-diabetic, and greater than 200 mg/dL were identified as diabetic.

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 3** 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 total.

Acknowledgements

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