Profile of the Adult Filipino with High Blood Sugar in the 8th National Nutrition Survey: Validation of the Philippine Guidelines for Screening

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ABSTRACT

AIMS: Practice guidelines on diabetes in the Philippines have recommendations for screening using risk factors with thresholds based on international data. This paper investigated whether there is a basis to support these screening recommendations using data from the 8th Philippine National Nutrition Survey (NNS).

METHODOLOGY: This is a cross-sectional analytic study of data from the results of the 8th Philippine NNS that was conducted across the country from June 2013 to April 2014. Crude odds ratios were obtained for each variable to determine their association with diabetes, and multivariate logistic regression analysis was performed to assess the independent association of demographic and clinical characteristics with diabetes.

RESULTS: These variables were found to be significantly associated with diabetes and impaired fasting glucose: male gender; age ≥ 40 years; hypertension with BP ≥ 140/90 mm Hg; triglyceride levels ≥ 150 mg/dL; overweight with BMI ≥ 23 kg/m^2; and abdominal obesity with waist circumference ≥ 90 cm in male and ≥ 80 cm in female adults.

CONCLUSION: The risk factors associated with diabetes mellitus among adult Filipinos are similar to other countries but the development of diabetes is associated with relatively younger age, and lower BMI and waist circumference.

Keywords: *risk factors, diabetes mellitus, Philippines*

INTRODUCTION

In 2011, the Philippine Practice guidelines for the Diagnosis and Management of (Type 2) Diabetes Mellitus among adults was developed by the UNITE for DM Philippines, a coalition of 4 organizations caring for individuals with diabetes. This was first disseminated online in the websites of diabetes organizations, in major conferences, conventions, and post-graduate courses of both internists and diabetes specialists, and has since then been published and used as a reference by doctors. It has also been updated as new data became available.

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The practice guideline enumerated several demographic and clinical risk factors for diabetes mellitus (DM) as the basis for the screening of adults by health care professionals. In brief, the guidelines state that all Filipinos aged 40 and above should be screened for diabetes (in a health care setting) but that they may also be screened at a younger age provided that they have at least one risk factor for diabetes.[1] These risk factors were however culled from international data and have never been investigated if they are indeed supported by local data. The cut-offs for age were based on previous National Nutrition Survey (NNS) results which showed that the national prevalence of diabetes is exceeded at the age group of 40-49, as opposed to the lower decade of 30-39 years. The other risk factors were listed based on international data including those from our Asian counterparts but have never been validated in our population.

The sections in the guideline pertaining to screening and testing of adult Filipinos for diabetes and pre-diabetes, which will be studied in this research include the following: (1) testing should be considered in all adults 40 years old and above; and consider earlier testing if with at least one other risk factor such as a history of IGT or IFG; overweight with a Body Mass Index (BMI) of ≥ 23 kg/m^2 or obese with a BMI of ≥ 25 kg/m^2, or waist circumference ≥ 80 cm (females) and ≥ 90 cm (males), or a waist-hip ratio

(WHR) of greater than or equal to 1 for males and ≥ 0.85 for females; having a first degree relative with Type 2 diabetes; sedentary lifestyle or physical inactivity; hypertension defined as a blood pressure of greater than or equal to 140/90 mm Hg; serum HDL < 35 mg/dL (0.9 mmol/L) and/or serum triglycerides > 250 mg/dl (2.82 mmol/L). These factors are included in the guidelines but were not investigated in the NNS and were not included in this study: among women, history of gestational diabetes mellitus or delivery of a baby weighing 8 pounds or above, or history or presence of polycystic ovary syndrome (PCOS); diagnosis or history of any vascular diseases including stroke, peripheral arterial occlusive disease, coronary artery disease; presence of acanthosis nigricans; and finally, a diagnosis of schizophrenia.

It is, therefore, the objective of this study to utilize the results of the 8th NNS of 2013, specifically the anthropometric and clinical data to identify the association of various risk factors with the presence of diabetes mellitus (DM) and pre-diabetes (mainly impaired fasting glucose) among adults. Specifically, this study would like to determine the optimal cut-offs for age, body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR) that are associated with diabetes and pre-diabetes. This study would also like to determine the association of a family history of DM, and the presence of various components of the metabolic syndrome such as hypertension, overweight, and obesity, measures of visceral adiposity, low HDL cholesterol, and high triglyceride levels with the presence of diabetes mellitus. The most recent survey of 2018 which has a rolling design that spans several years has not yet been completed and hence, the publicly available data from the 2013 survey was analyzed.

MATERIALS AND METHODS

Study Design: This is a cross-sectional analytic study of the data taken from the results of the 8th Philippine National Nutrition Survey, specifically the Clinical and Health Survey done in 2013. Data was requested through the Public Use Files (PUF) of the Food and Nutrition Research Institute at the website http://enutrition.fnri.dost.gov.ph/site/puf.php/ [2].

Population: Included in this study were adults, 20 years old and older, including non-pregnant and non-lactating females who were interviewed as part of the 2013 National Nutrition and Health Survey regarding demographic data, history of cigarette smoking or alcohol intake, physical activity and dietary information. Participants were included in this study if they also underwent anthropometric measurements, blood pressure determination, and testing for fasting blood sugar and fasting lipid profile including total cholesterol, triglycerides, HDL-cholesterol, and LDL-cholesterol (calculated).[2] Excluded in the public use files are those with incomplete data sets.

Sampling design. Multi-Stage Stratified Sampling Design. The methodology for this survey has been previously described in the Executive summary of the 8th National Nutrition Survey (NNS) done in 2013.[2] Briefly, the 2013 NNS adopted the 2003 master sample of the Philippine Statistics Authority (formerly the National Statistics Office), that utilized the 2009 Labor Force Survey list of households. The survey was conducted from June 2013 to April 2014, covering all 17 regions of the country and 80 provinces including the National Capital Region (NCR).[2] The 2013 NNS used four replicates from the master sample of the Philippine Statistics Authority (formerly the National Statistics Office), obtained from the 2009 Labor Force Survey list of households. These four replicates were used to obtain national, regional, and provincial estimates for measurements of anthropometry, blood pressure, and questionnaire-based information. For the biochemical and dietary components, one replicate was used to get national estimates.

The stratified random sampling involved 3 stages. The first stage or stratum was the Primary Sampling Unit which is one "barangay" (village) or contiguous "barangays" with at least 500 households. The second stage was the Enumeration area with 150-200 households, and the third stage was the households.

A total of 39,253 eligible households nationwide were identified from the list of the PSA, with almost an equal distribution between urban and rural at 18,125 and 21,128 households respectively. From these eligible households, only 91% responded to the survey for a final inclusion of 35,825 households with 15,866 households in the urban areas (87.5% response rate) and 19,959 households in the rural areas (94.5% response rate).

The response rate for the different components was at least 90.1% for the questionnaire and 85.2% for physical measurement components. The blood exams had response rates at 83.4% for FBS and lipid profile.

From the total population in 2013 of 97.7 M people, 35,825 households responded out of 39,253 eligible households, with 172,323 individuals included in the main 8th NNS and finally, 19,566 adults were included in the Clinical and Health survey of the NNS.

Sample Size. A minimum sample size of 624 patients with diabetes is required for this study given a 7% prevalence from diabetes taken from the 2008 NNHES with an error of 2% and a 95% confidence interval.[3]

The operational definitions of the variables and outcomes are summarized in Appendix A.

Ethical Considerations. The protocol for the 8th National Nutrition Survey 2013 was approved by the Food and Nutrition Institute (FNRI) Institutional Ethics and Review Committee. Written consent to participate in the National Nutrition Survey (NNS) was obtained from all participants before the interview, data gathering, urine collection, and other measurements. Only those who signed the informed consent form were included in the study. Data

from the NNHES 2013 had been previously reported and published.

The protocol for this specific research was submitted for review and registered with the UP-Manila Research Ethics Board (REB) and was considered to be exempt from review given the nature of the study which utilized the public use files of the NNS. There are no risks involved in this study since none of the data released to the investigator from the public use files of the FNRI had subject identifiers that could be linked to the participants such as name, initials or date of birth, address (only the province or region of the country were released) and included processed rather than raw data such as age (rather than the date of birth), the region of the country, anthropometric data such as weight, and clinical data such as blood pressure.

Statistical Methods. Summary statistics were reported as mean ± standard deviation for quantitative continuous measures with a normal distribution (e.g. age in years, waist circumference, and waist-hip ratio), as median (interquartile range) with non-normal distribution (e.g. blood pressure, HDL, triglycerides), and as count (percent) for qualitative discrete measures (e.g. gender, hypertension). Shapiro-Wilk's test was used to check for normality of quantitative measures. Independent *t*-test or Mann Whitney test was be used to compare means of two groups while Pearson's chi-square test or Fisher's exact test were used to compare proportions. Missing data were estimated using multiple imputations by chained equations using all variables to support missing-at-random assumptions.

Multivariate logistic regression analysis was performed to assess the independent association of demographic and clinical characteristics with diabetes. Odds ratio and 95% confidence intervals were then estimated and the cut-off points for age, body mass index, and triglycerides with the most precise estimates were selected. Statistical significance was based on *p*-value ≤ 0.05. STATA v13 was used in data processing and analysis.

This manuscript including the reporting and analysis of the results followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Guidelines on Reports of Cross-sectional studies.[4]

RESULTS

Of the 19,566 adult Filipinos included in the 2013 NNHES, 1,107 individuals or 5.6% had elevated blood sugar fulfilling the criteria for diabetes, 14% were pre-diabetic and 80.3% had normal glucose tolerance.

Diabetes. The mean age (standard deviation, SD) for individuals with diabetes was 54.4 (12.9) years. The majority were 30 years or older (96.2%). Hypertension (43.3%), low HDL at < 35 mg/dL (55.5%), elevated triglycerides at ≥ 150 mg/dL (65%), overweight at BMI ≥ 23 kg/m^2 (64%), elevated waist circumference at ≥ 90 cm in male and ≥ 80 cm in female adults (51.9%), an elevated waist-hip ratio of ≥ 1 in male and ≥ 0.85 in female adults (45.3%) and low physical activity were more common in diabetic adults than those with normal glucose tolerance.

Univariate analysis showed that these factors except gender had a crude association with diabetes. (Table 1) After adjusting for the effects of covariates, older age, low physical activity, presence of hypertension, elevated triglycerides, obesity, and elevated waist circumference at ≥ 90 cm in male and ≥ 80 cm in female adults increased the likelihood of diabetes. Increased waist to hip ratio at ≥ 1 in males and ≥ 0.85 in female adults was also significantly associated with diabetes. Age ≥ 40 years, triglyceride levels ≥ 250 mg/dL and BMI ≥ 25 kg/m^2 had more precise estimates than the other categories. (Table 2)

Combined diabetes and Impaired fasting blood glucose. Eventually, during screening, the health care provider not only screens for diabetes but also for pre-diabetes, since both have been known to be associated with an increased occurrence of cardiovascular complications. Screening for pre-diabetes also makes sense, since by identifying individuals with these conditions, aggressive lifestyle modification or treatment may reverse the condition and eventually prevent diabetes. Thus, this part of the study is the most relevant as screening would be directed towards all forms of dysglycemia.

Of the 19,566 adult Filipinos included in this survey, there were 19.76% adults with levels of FBS that satisfy the criteria for either diabetes (n=1,107) or impaired fasting glucose (n= 2,760). The mean age ± SD was 51.3 ± 14.5 years, most of whom were in the ≥ 30-year category (91.3%). (Table 3) The majority were male (51%). The population with dysglycemia also had hypertension (37.3%) versus 19.8 for normal glucose tolerance, low HDL at < 35 mg/dL (49.9%), elevated triglycerides at ≥ 150 mg/dL (52.9%), overweight at body mass index ≥ 23 kg/m^2 (57.1%), with elevated waist circumference at ≥ 90 cm in male and ≥ 80 cm in female adults (43.4%), and the elevated waist-hip ratio of ≥ 1 in male and ≥ 0.85 in female adults (43.9%) and low physical activity (45.1%) were more common in adults with blood glucose > 100 mg/dL than those with normal glucose tolerance.

Univariate analysis showed that these factors except low physical activity had a crude association with impaired blood glucose. After adjusting for effects of covariates, male gender, age 40 years and older, presence of hypertension, elevated triglycerides 150 mg/dL or higher, overweight with body mass index 23 kg/m^2 or higher and elevated waist circumference ≥ 90 cm in male and ≥ 80 cm in female adults had increased likelihood of dysglycemia (either diabetes or IFG). (Table 4)

DISCUSSION

The data from the 8th NNS in 2013 showed a prevalence of diabetes at 5.6% and impaired fasting glucose (pre-diabetes) at 14% using the ADA criteria with a combined prevalence of dysglycemia among adult Filipinos at

Table 1. Distribution of Subjects According to Selected Demographic and Clinical Characteristics and Absence or Presence of Diabetes, N=16,906, Philippines.

Characteristics	Diabetes/Elevated Blood Sugar (FBS > 125 mg/dL) n = 1,107	No diabetes (Normal glucose tolerance) n = 15,799	Risk for Diabetes		
			p-value	OR	95% CI
Age (years), Mean, SD	54.4 ± 12.9	41.8 ± 16.7	<0.0001*		
≥ 40	960 (86.7%)	8,002 (50.6%)	<0.0001*	6.363	(5.334, 7.591)
≥ 35	1,027 (92.8%)	9,584 (60.7%)	<0.0001*	8.325	(6.616, 10.475)
≥ 30	1,065 (96.2%)	11,045 (70%)	<0.0001*	10.914	(8.003, 14.884)
Gender					
Male	510 (46.1%)	7,317 (46.3%)	0.876	0.990	(0.876,1.119)
Female	597 (53.9%)	8,482 (53.7%)			
Blood pressure (mmHg)					
Systolic	130.0 (25.0)	116.0 (23.0)	<0.0001*		
Diastolic	81.0 (17.0)	76.0 (13.0)	<0.0001*		
Hypertension	480 (43.4%)	3,130 (19.8%)	<0.0001*	3.099	(2.734, 3.512)
HDL (mean, sd)	33.6 (15.4)	37.8 (15.4)	<0.0001*		
Low HDL, N (%)	614 (55.5%)	6,241 (39.5%)	<0.0001*	1.907	(1.687, 2.156)
Triglyceride (mean, SD)	180.5 (121.2)	123.0 (81.4)	<0.0001*		
≥150	720 (65.0%)	5,419 (34.3%)	<0.0001*	3.564	(3.136, 4.050)
≥250	290 (26.2%)	1,453 (9.2%)	<0.0001*	3.505	(3.033, 4.049)
BMI in kg/m^2 Mean (SD)	24.9 (5.7)	22.0 (5.0)	<0.0001*		
≥23	709 (64.0%)	6,076 (38.5%)	<0.0001*	2.851	(2.511, 3.236)
≥25	535 (48.3%)	3,638 (23.0%)	<0.0001*	3.128	(2.764, 3.539)
≥27.5	294 (26.6%)	1,713 (10.8%)	<0.0001*	2.974	(2.579, 3.429)
≥30	139 (12.6%)	688 (4.4%)	<0.0001*	3.154	(2.599, 3.827)
Waist circumference (cm)	86.2 ± 11.5	77.2 ± 10.3	<0.0001*		
Elevated waist circumference	575 (51.9%)	3,802 (22.8%)	<0.0001*	3.660	(3.234, 4.141)
Waist-hip ratio	0.93 ± 0.07	0.87 ± 0.07	<0.0001*		
Elevated waist-hip ratio	502 (45.3%)	4,749 (30.1%)	<0.0001*	1.931	(1.707, 2.184)
Physical activity					
Low	553 (50.0%)	6,967 (44.1%)	<0.0001*	1.265	(1.120, 1.429)
High	554 (50.0%)	8830 (55.9%)			

OR: crude odds-ratio

Data presented as mean ± standard deviation, median (interquartile range) or count (percent).

* Significant at 5% level

Table 2. Multivariate Analysis of Factors Associated with Diabetes, N=16,906, Philippines.

	p-value	OR	95% CI
Age ≥ 40 years	<0.0001	7.213	(4.125, 12.612)
Age ≥ 35 years	<0.0001	10.060	(3.262, 31.023)
Low physical activity	<0.0001	2.181	(1.788, 2.659)
Hypertension	<0.0001	2.456	(2.019, 2.988)
Triglycerides ≥ 150	<0.0001	9.017	(6.513, 12.484)
Triglycerides ≥ 250	<0.0001	2.769	(2.225, 3.447)
Body mass index ≥ 25 kg/m^2	<0.0001	2.130	(1.554, 2.920)
Body mass index ≥ 30 kg/m^2	<0.0001	2.133	(1.523, 2.987)
Elevated waist circumference	<0.0001	3.212	(2.363, 4.366)

OR: adjusted odds-ratio, CI: confidence interval

approximately 20%. This is in contrast to the prevalence of diabetes 10 years ago in the 6th NNS (2003) at 3.4% representing a more than 2% increase over ten years. The prevalence of diabetes in the 7th NNS (2008) was 4.8% based on the FBS, and IFG of 7.2% using the same criteria of fasting blood sugar of 100-125 mg/dL, for a combined dysglycemia prevalence of approximately 12%.

Three observations can be made regarding the prevalence of diabetes and pre-diabetes in the Philippines. The first is a slow but steady increase in the prevalence over the last 10 years. In a population of nearly 100 million individuals where approximately 60% are adults, this 2% increase amounts to approximately an additional 1 million Filipinos with diabetes in the past 10 years.

The second observation is that the prevalence of diabetes in this survey is an underestimate since only a single

Table 3. Distribution of Participants According to Selected Demographic and Clinical Factors and Categories of Dysglycemia (Combined DM and IFG), N= 19,666, Philippines.

Variables	Combined Pre-diabetes & Diabetes (FBS ≥ 100 mg/dL) n = 3,867	No diabetes (Normal glucose tolerance) n = 15,799	Risk for Impaired Blood Glucose		
			p-value	OR	95% CI
Age in years	51.3 ± 14.5	41.8 ± 16.7	<0.0001*		
≥ 40	3,043 (78.7%)	8,002 (50.6%)	<0.0001*	3.598	(3.312, 3.910)
≥ 35	3,333 (86.2%)	9,584 (60.7%)	<0.0001*	4.048	(3.674,4.459)
≥ 30	3,531 (91.3%)	11,045 (69.9%)	<0.0001*	4.523	(4.024, 5.084)
Gender					
Male	1,973 (51.0%)	7,317 (46.3%)	<0.0001*	1.208	(1.126, 1.296)
Female	1,894 (49.0%)	8,482 (53.7%)			
Blood pressure (mmHg)					
Systemic	127.0 (26.0)	116.0 (23.0)	<0.0001*		
Diastolic	80.0 (18.0)	76.0 (13.0)	<0.0001*		
Hypertension	1,444 (37.3%)	3,130 (19.8%)	<0.0001*	2.412	(2.236, 2.603)
HDL	35.1 (15.4)	37.8 (15.4)	<0.0001*		
Low HDL	1,931 (49.9%)	6,241 (39.5%)	<0.0001*	1.528	(1.423, 1.639)
Triglyceride	154.9 (108.8)	123.0 (81.4)	<0.0001*		
≥150	2,043 (52.8%)	5,419 (34.3%)	<0.0001*	2.145	(1.998, 2.304)
≥250	705 (18.2%)	1,453 (9.2%)	<0.0001*	2.201	(1.996, 2.428)
Body mass index in kg/m^2	23.8 (6.0)	22.0 (5.0)	<0.0001*		
≥23	2,207 (57.1%)	6,076 (38.5%)	<0.0001*	2.128	(1.981, 2.285)
≥25	1,582 (40.9%)	3,637 (23.0%)	<0.0001*	2.315	(2.150, 2.493)
≥27.5	818 (21.2%)	1,713 (10.8%)	<0.0001*	2.206	(2.012, 2.419)
≥30	359 (9.3%)	688 (4.4%)	<0.001*	2.248	(1.968, 2.567)
Waist circumference, cm	83.2 ± 11.6	77.2 ± 10.3	<0.0001*		
Elevated waist circumference	1,679 (43.4%)	3,602 (22.8%)	<0.0001*	2.598	(2.414, 2.797)
Waist hip ratio (WHR)	0.91 ± 0.07	0.87 ± 0.07	<0.0001*		
Elevated WHR	1,699 (43.9%)	4,749 (30.1%)	<0.0001*	1.823	(1.697, 1.960)
Physical activity					
Low	1,745 (45.1%)	6,967 (44.1%)	0.249	1.042	(0.971, 1.119)
High	2,122 (54.9%)	8,832 (55.9%)			

OR: crude odds-ratio, CI: confidence interval
Data presented as mean ± standard deviation, median (interquartile range) or count (percent).
* Significant at 5% level

Table 4. Multivariate analysis of factors associated with Elevated blood glucose (Combined Diabetes and Impaired Fasting Glucose), Philippines.

Variables	*p*-value	OR	95% CI
Male	<0.0001	1.511	(1.291, 1.769)
Age ≥ 40 years	<0.0001	3.304	(2.699, 4.044)
Age ≥ 35 years	<0.0001	2.650	(1.822, 3.856)
Age ≥ 30 years	<0.0001	5.447	(3.097, 9.582)
Hypertension	<0.0001	1.653	(1.493, 1.831)
Triglycerides ≥ 150	<0.0001	1.691	(1.511, 1.892)
BMI ≥ 23 kg/m^2	<0.0001	1.468	(1.264, 1.706)
BMI ≥ 25 kg/m^2	<0.0001	1.412	(1.204, 1.657)
Elevated waist circumference	0.030	1.182	(1.017, 1.373)

OR: adjusted odds-ratio, CI: confidence interval

determination of FBS was done. While the change in the prevalence of high blood sugar > 125 mg/dL in the last 5 years is not that remarkable at less than 1% increase, one must keep in mind that the methods used in this survey underestimate the total prevalence of diabetes. The national nutrition and health survey of 2008 was a landmark one because other than just FBS, a 75-gm OGTT was done, and as well a history of diabetes or intake of medications were all part of the diagnostic criteria for diabetes. This survey in 2008 yielded a national prevalence of diabetes of 7.2% (CI 6.5-7.9%) when the combined criteria of a clinical history of diabetes, an elevated FBS, and the 2-hr RBS were used.[3]

The third significant observation is the doubling of the prevalence of IFG from 7.2% in 2008 to 14% in the 2013 survey. This presents not only a huge opportunity for prevention of diabetes, but on the other hand, pre-diabetes is not just "mild" diabetes but represents a continuum of conditions where elevated blood sugar is just the tip of the problem. Even at this stage, microvascular as well as macrovascular complications can already occur among these individuals, and thus, aggressive lifestyle modification that includes dietary modification to lose weight, increased physical activity, smoking cessation and even pharmacologic therapy to prevent or manage cardiovascular diseases and risk factors is needed.

The primary objective though, of this study is to ascertain whether selected risk factors for screening adults for diabetes or pre-diabetes which were enumerated in the national practice guidelines are valid. This study confirms that the following factors were strongly associated with elevated blood glucose (combined diabetes and IFG): male gender, presence of hypertension; overweight with BMI $\geq$ 23 kg/m^2; and elevated waist circumference $\geq$ 90 cm in male and $\geq$ 80 cm in female adults. Although age $\geq$ 30 years had the highest OR at 5.447 (95% CI 3.097, 9.582; *p-value < 0.0001*), this category or cut-off had the widest confidence interval implying less precision compared to the older ages. Thus, retaining the previous cut-off age of age $\geq$ 40 years as the recommended age for routine screening still appears to be acceptable.

BMI $\geq$ 25 kg/m^2 had similar precision (OR 1.412, 95% CI = 1.264 - 1.706, *p-value < 0.0001*) as the lower cut-off of 23 kg/m^2 in terms of its association with dysglycemia, but the latter had a slightly higher odds ratio (OR 1.468, 95% CI = 1.264 - 1.706, *p-value < 0.0001*). Thus, the cut-off BMI that appears to be better associated with both pre-diabetes and diabetes is $\geq$ 23 kg/m^2 rather than the higher cut off of 25 kg/m^2 as indicated in the guidelines. Early screening even at much lower BMI thresholds is justified in terms of diabetes prevention. This is also consistent with the observation that Asians appear to develop diabetes and metabolic syndrome at much lower BMI compared to their western counterparts, and that the age at which Asians develop diabetes appears to be lower. Abdominal or central obesity as measured by the WC or WHR is also known to be highly associated with Type 2 diabetes and other metabolic diseases and is highly prevalent among Asians.[5,6]

The results of this survey are similar to data from other countries especially Asian countries. For example, BMI $\geq$ 25 kg/m^2 was found to have an OR for men of 1.52, and for women of 1.59 for predicting diabetes. Elevated WC $\geq$ 90 cm for males and $\geq$ 80 cm for females had an OR of 1.54 and 1.70 respectively for diabetes.[7,8] Likewise, hypertension is known to be associated with diabetes and is one of the components of the metabolic syndrome. An increase in blood pressure per 1 SD had the following relative risks: 1.56 (1.31-1.85) for systolic BP, and 1.52 (1.27-1.83) for diastolic BP.[9]

Finally, how similar or different are these recommendations compared with the rest of the world? For example, one of the most commonly used recommendations is the American Diabetes Association Standards of Care. In their 2020 standards, it is recommended that routine testing be conducted at age 45 years old but also recommends considering testing for prediabetes and/or Type 2 diabetes in asymptomatic adults of any age with overweight or obesity (BMI $\geq$ 25 kg/m^2 or $\geq$ 23 kg/m^2 in Asian Americans).[10] On the other hand, the Canadian Diabetes Association recommends screening individuals as early as age 40 years in primary care offices and recognizes that one of the risk factors for Type 2 diabetes is being a member of a high-risk population such as African, Arab, Asian, Hispanic, indigenous or South Asian descent, and low socioeconomic status.[11]

The results of this study will hopefully provide the rationale for the local recommendations on screening for diabetes and prediabetes.

The strength of this study is that it is population-based, and thus, results are generalizable to the average adult Filipino and it has external validity. This study though has several limitations, some of which have already been mentioned. The most important limitation is that the definition of diabetes is only based on a single determination of fasting blood glucose, without regard for previous history or current intake of medications. Secondly, this study did not include other known factors for the development of diabetes since these were not collected in the National Nutrition Survey. These include the following: previous IGT or IFG, GDM or birth of a large baby or PCOS, first-degree relative, conditions associated with insulin resistance (acanthosis nigricans), associated conditions such as schizophrenia, tuberculosis, or auto-immune diseases such as psoriasis or lupus. Finally, the inherent weakness of a cross-sectional design is its inability to determine whether risk factors reliably predict the outcomes i.e. the outcomes are investigated with risk factors at one point in time. These associations can best be investigated using a longitudinal or prospective cohort design.

CONCLUSION

Risk factors associated with diabetes mellitus and pre-diabetes among adult Filipinos are similar to other countries, but the development of diabetes is associated with relatively younger age, lower BMI, and waist circumference.

Acknowledgments: This paper would like to acknowledge the men and women of the Food and Nutrition Institute (FNRI)-DOST headed by Dr. Mario Capanzana for their prompt reply to the requests for the data, and of course, for ensuring that the surveys run smoothly every 5 years. Likewise, I would like to express my gratitude to Ms. Ethel Estanislao for the statistical analysis.

Statement of Authorship: The author certifies fulfillment of ICMJE authorship criteria.

Author Disclosure: The author declares no conflict of interest.

Funding Source: None.

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Appendix A: Operational Definition of Variables and Outcomes[2]

1. Diabetes mellitus was defined based on a single fasting blood glucose of greater than or equal to 126 mg/dL (7.0 mmol/L) after an overnight fast, or no caloric intake for at least 8 hours up to a maximum of 14 hours. Likewise, probable impaired fasting glucose (pre-diabetes) was defined as an FBG of 100 to 125 mg/dL. Since only one determination of blood glucose was obtained during the NNS, and no history was taken of previous diagnosis of DM or intake of anti-diabetic medications, these definitions are therefore presumptive of diabetes and are likely an underestimate.

   The thresholds of blood glucose for defining diabetes were adapted from the Philippine UNITE for Diabetes Clinical Practice guidelines (CPG) and from the American Diabetes Association standards. [3,10]

2. Body-Mass Index (BMI) was calculated as the weight in kilograms divided by height squared in meters and is classified by the WHO as follows: underweight (<18.5), normal weight (18.5-24.9), Pre-obese (25-29.9), Obese I (30-34.9), Obese II (35-39.9). On the other hand, the Asia-Pacific classification is as follows: underweight (<18.5), normal weight (18.5-22.9), overweight (23-24.9), Obese I (25-29.9), Obese II (≥30). Both classifications are used in this study.

3. Measures of adiposity

   a. Waist circumference was classified as follows according to the WHO-Asia Pacific cut-offs: For males, normal (<90 cm), borderline (90-101 cm), and high (≥102); for females, normal (<80 cm), borderline (80-87 cm), and high (≥88 cm).

   b. Elevated Waist hip ratio (WHR) was defined as > 1.0 Males, ≥ 0.85 females.

4. Hypertension was defined in this survey using the cut-off values of JNC VII (2003) as follows: normal (<120/<80 mmHg), pre-hypertension (120-139 and diastolic 80-89 mmHg), stage I hypertension (systolic 140-159 or diastolic 90-99 mmHg), stage II hypertension (systolic ≥160 or diastolic ≥100 mmHg). Only one determination of blood pressure was done after an adequate rest and proper positioning. Since only a single determination was done and those who were previously diagnosed and/or already on medications were not considered as part of the definition, this is likely an underestimate.

5. Cut-off values for components of the lipid profile were defined according to the NCEP-ATP III (2001) are as follows: Total cholesterol (in mg/dl) desirable (<200), borderline high (200-239), high (≥240); LDL-cholesterol (in mg/dl) optimal (<100), near optimal/above optimal (100-129), borderline high (130-159), high (160-189), very high (≥190); HDL-cholesterol (in mg/dl) low (<40), borderline (50-59), desirable (≥60); triglyceride (in mg/dl) desirable (<150), borderline (150-199), high (200-399), very high (<400).

6. Alcohol consumption status was classified according to the WHO categories (2014) as follows: lifetime abstainers are people who have never consumed alcohol, former drinkers are people who have previously consumed alcohol but have not done so in the previous 12-month period, and current drinkers are people who were currently consuming alcohol during the survey period. On the other hand, binge drinking status for males is defined as drinking five or more standard drinks in a row, while for females it is drinking four or more standard drinks in a row.

7. Cigarette smoking status is categorized by the WHO STEPS Surveillance Manual as follows: current smokers are those who smoke during the time of survey either on a daily basis (at least 1 cigarette a day), or on a regular/occasional smoking, or those who do not smoke daily but who smoke at least weekly, or those who smoke less often than weekly; former smokers are those who have ever smoked in the past year prior to the survey whether on a daily basis or an aggregate lifetime consumption of at least 100 cigarettes but not daily; and never smokers are those individuals who have never smoked at all.

8. A person not meeting any of the following criteria is considered physically inactive or insufficiently physically active and therefore at risk for chronic disease based on the WHO STEPS Surveillance Manual:

   a. 3 or more days of vigorous-intensity activity of at least 20 minutes per day or

   b. 5 or more days of moderate intensity activity or walking of at least 30 minutes per day

9. Unhealthy diet is the failure to meet the WHO recommended intake of 400g of fruits and vegetables per day based on the 24-hour food recall.