Prevalence of Diabetes Mellitus and Pre-Diabetes in the Philippines: A Sub-study of the 7th National Nutrition and Health Survey (2008)

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Abstract

Introduction: Diabetes mellitus is rapidly increasing worldwide but the greatest increase is expected in developing countries including the Philippines. It is of public health concern to monitor countrywide prevalence of diabetes as it leads to significant cardiovascular-related mortality as well as significant complications such end stage renal disease, blindness, lower leg amputations and blindness.

Methodology: This is a national survey to estimate the prevalence of diabetes and pre-diabetes using the criteria of the World Health Organization through a stratified multi-stage sampling design representing each of the 17 regions in the country.

Results and Discussion: The national prevalence of diabetes in the year 2008 was 7.2% (6.5-7.9); impaired glucose tolerance 7.0% (6.1-7.8) and impaired fasting glucose was 2.2% (2.2-3.1). There was a greater prevalence of individuals with diabetes in the urban areas at 8.5% (7.5-9.5) compared to the rural areas at 5.7% (4.6-6.8). Diabetes is slightly more preponderant among females at 7.4% (6.4-8.3) compared to males at 7.0% (6.1-8.0).

Conclusion: The prevalence of diabetes mellitus in the Philippines is rising with the prevalence in 2008 at 7.2%. The prevalence of pre-diabetes exceeds that of diabetes mellitus at approximately 10.2%.

Keywords: diabetes, pre-diabetes, prevalence, Philippines

Introduction

Diabetes mellitus is a disease of public health concern not only because of the costs involved in the care of individuals with this disease but because of the expected micro-vascular and macro-vascular complications resulting from poor blood sugar control which impact on quality of life and shorten life span. In the Philippines, diabetes mellitus has been the top cause of end stage renal disease leading to dialysis since 2001 accounting for 38% of all dialysis cases from 2001-2005.[1] In a local study among newly-diagnosed diabetics in Manila, about 20% already had peripheral neuropathy, 42% had proteinuria, and 2.0% had diabetic retinopathy.[2] Worldwide, diabetes mellitus is the leading cause of non-traumatic lower limb amputation. In the United States, diabetes accounts for more than 60% of non-traumatic lower-limb amputations, and is the leading cause of new cases of blindness among adults aged 20–74 years.[3] Type 2 diabetes mellitus is a major cause of premature morbidity and mortality, particularly from cardiovascular disease (CVD), blindness, amputations and renal failure.

Burden of illness studies are important to be able to assess the trends and patterns of the disease, enlightening therefore the approaches to its prevention and treatment. Diabetes is on the rise worldwide, especially in Western Pacific countries. In 1995, there were 135 million people with diabetes worldwide, with the number expected to rise to 330 million by 2025. The numerical increase will be more in developing than developed countries; a 170% increase, from 84 to 228 million in the former compared to 42% increase, from 51 to 72 million in the latter.[4]

In 1996, the National Diabetes Commission was created by Republic Act 8191 to address the problem posed by the disease. The Commission identified the need for a Second National Diabetes Survey to have an updated estimate of the magnitude of the problem in the country. Furthermore, the survey would provide information useful for the development of a National Diabetes Prevention and Control Program, and guidance in implementation and evaluation of its impact in the country.[5]

The first national diabetes survey that utilized OGTT was conducted between 1982 and 1983. It showed that the prevalence of diabetes in adults based on a 2h plasma glucose ≥11.1 mmol/l was

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4.1%.[6]

The next survey conducted in 1998 by the Food and Nutrition Research Institute (FNRI) assessed the levels of fasting blood sugar among adults, and reported a 3.9% prevalence of fasting plasma glucose greater than 125 mg/dl or 6.9 mmol/l[7].

In the 2003 National Nutrition and Health Survey, diabetes diagnosed by either FBS or through the survey questionnaire (history of pre-existing diabetes) was found in 4.6% of the volunteers. These numbers appear to be small and do not show an alarming trend but may be an underestimate of the actual numbers without the OGTT. Several epidemiologic studies done in the Philippines show results that seem to be different from these survey results.

A cohort derived from a national study population (FNRI-NNS, 1998) was revisited after nine years to investigate the progression of diabetes among adult Filipinos with pre-diabetes.[8] A significant increase of mean FBG's from 91.5 mg/dL to 103.3 mg/dL was observed from 1998 to 2007. The nine-year incidence of T2DM was 16.3%, while the prevalence of T2DM was 28.0%.

In 2002, a cross-sectional population-based study was done in Luzon, the largest island in the country. This survey assessed the occurrence of diabetes and impaired glucose tolerance among a random sample of 7044 adults, aged 20–65 years who were residents of urban and rural areas in Luzon. Blood glucose level was measured by OGTT using the WHO criteria. Among the 7044 participants in the survey, 362 (5.1%) had diabetes, a prevalence that is slightly higher than the national prevalence of 4.1% that was seen in 2003. Two-thirds of the 362 diabetics were identified for the first time from the results of the OGTT while the other third reported an earlier diagnosis. There were 573 participants with IGT (8.1%).[5]

This survey of 2008 is important because it attempts to track the trends in the prevalence of diabetes and pre-diabetes, continuing on the work of previous surveys. Secondly, it again uses the OGTT to attempt to give a better estimate of the true prevalence of diabetes especially because of the important findings of the Luzon study where two-thirds of the diabetics of the volunteers with diabetes were identified for the first time using the OGTT. Another objective of this study is to compare the cardiovascular risk profile between those with normal glucose tolerance, pre-diabetes and diabetes Finally, this survey will also describe differences in the trends of diabetes and pre-diabetes among Filipino adults between genders, across age groups and between the rural and urban areas.

Methodology

Sampling Design of the National Nutrition Survey. The 7th NNS utilized the Philippine National Statistics Office (NSO) 2008 Labor Force Survey (LFS) master sample employing a stratified multi-stage sampling design in order to represent each of the 17 regions in the country. In each region, a stratified three-stage sampling was done.

The first stage of the sampling was the selection of the primary sampling units (PSU's) with probability proportional to the estimated number of households. PSU's consisted of a barangay or contiguous barangays with at least 500 households. A barangay is the smallest socio-political unit in the Philippines that is roughly equivalent to a village in other countries.

The second stage was the selection of enumeration areas (EA's) within sampled PSU's with the probability proportional to size. EA's consisted of contiguous areas in a barangay or a barangay with 150-200 households and served as the secondary sampling unit (SSU). All members of the sampled households are included in the survey requiring individual data.

The last stage was the selection of housing units within the sampled EA's and served as the ultimate sampling unit (USU). As such, the household was considered as a cluster in which all the units within a cluster were part of the survey.

The clinical and health component in particular covered only one of the four replicates of the master sample and 25 percent of sample households were considered as sub-sample. Sub-sampling of households for clinical and health component was resorted due to budgetary constraints. A replicate is defined as a sub-sample that possesses the properties of the full master sample such that each replicate is able to generate national level estimates of adequate precision.

Response Rates. This survey called the NNHeS II (or 7th NNS Clinical and Health Component) covered all 17 regions and 79 provinces of the Philippines including the National Capital Region (NCR). A total of 852 enumeration areas with an average of four households per EA were surveyed totaling to 3,744 households. From each household, an average of two individuals 20 years and up were included, covering a total of 7,702 individuals.

At the individual level, only 7,142 adults were included in the BP measurements, 6,176 adults with FBS results and 6,276 with blood lipid results obtaining a response rates of 92.7%, 80.2% and 82.7%, respectively. The response rate obtained from interview of adults using various questionnaires was 94.1% or 7,248 individuals. Finally, the lowest response rate was for the OGTT which was only 64.0% or 4,930 individuals.

Data Collection and Study Variables

The study used standardized methods of anthropometric, clinical and health assessment for the data collection. Only assessments pertaining to this aspect of the NNHeS on diabetes mellitus and its correlates will be mentioned. Thus, even if anthropometric assessments were obtained including height, weight, waist circumference and wait hip ratio, these are not included in the current report. The following assessments were done:

Clinical assessment was used to determine the prevalence of hypertension, diabetes, dyslipidemia and other risks factors for coronary artery diseases (CAD) through measurement of blood pressure, fasting blood sugar, and blood lipids, respectively. Blood sample were drawn by venipuncture after 10-12 hour fast, to determine FBS, serum total cholesterol, high-density lipoprotein cholesterol (HDL-c), low- density lipoprotein cholesterol (LDL-c) and triglyceride levels by trained and registered medical technologists.

Face-to-face interview on various questions on various selected medical conditions were done as well as clinical histories, previous diagnosis and treatment (previous or current), as well as family history of diabetes mellitus. In addition, lifestyle risk factors such as smoking, alcohol intake, physical inactivity and diet were included. A guide for interviewing was used in the conduct of face-to-face interview developed by the FNRI-DOST.

Operational Definitions

High blood pressure (hypertension) was defined as having single visit systolic BP of 140 mmHg and above, or diastolic BP of 90 mmHg and above, or history of diagnosis of hypertension, or intake of anti-hypertension medications.

Diabetes was defined in this study as follows: Fasting blood sugar of greater than 125 mg/dL according to the World Health Organization (WHO) guidelines, or two-hour post load blood sugar of > 200 mg/dL after a 75 gm oral glucose challenge, or history of diagnosis of diabetes (nurse or physician diagnosed), or intake of oral anti-diabetic agents or insulin use.

Pre-diabetes is an intermediate stage between normal glucose tolerance and diabetes mellitus, and has two main categories:

Impaired fasting glucose defined as an FBS of 110-125 mg/dL following the WHO criteria, or an FBS of 100-125 mg/dL following the criteria of the American Diabetes Association;

Impaired glucose tolerance defined as a two-hour blood sugar of 140-199 mg/dL after a 75-gm oral glucose load.

Table I: **Assessment criteria for Fasting Blood Sugar (FBS) and Oral Glucose tolerance Test Results based on the WHO Classification**

Classification	FBS (mg/dL)	Blood sugar 2 hours after a 75-gm glucose load (mg/dL)
Desirable (Normal)	< 110	< 140
Impaired (prediabetes)	110 – 125 (IFG)	140 – 199 (IGT)
High (DM)	> 125	> 200

Body Mass Index (BMI) was computed as the weight in kilograms divided by the square of height in meters. This was assessed using recommended WHO criteria: < 18.5 kg/m^2 for chronic energy deficiency (CED), 18.5 to 24.9 kg/m^2 for normal, 25.0 to 29.9 kg/m^2 for overweight and ≥ 30 kg/m^2 for obese.

High **waist-hip ratio (WHR)** used the cut-offs of 1.0 or more for males and 0.85 or more for females.

Blood lipids, namely the Total Cholesterol (TC), Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), Triglycerides (TG) used the following cut-offs consistent with those of the Philippine NNHeS study groups and recommended by the Third Report of the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III): high total cholesterol or hypercholesterolemia (>240 mg/dL), high LDL-c (>160 mg/dL), low HDL-c (<35 mg/dL), and high triglycerides (>200 mg/dL). Individuals with abnormal levels of TC, LDL, HDL or TG are considered having dyslipidemia.

Data Editing, Encoding and Analysis: Data encoding used the MySQL database. To ensure correctness and validity of data, a two-round proofreading of the databases was done by hired validators. The first-round involved manual validation and the second was done through machine validation. When the data were cleaned, several data files were merged to create a master dataset followed by another checking and validation of the dataset to eliminate errors and inconsistencies. Weights were assigned and attached to the master dataset by a statistician in order that the distributions of the sample correspond more closely to their actual distributions in the whole population.

Stata software was used to process and analyze the clinical and health data to come up with the prevalence of disease and risk factors according to age.

Outcomes: Prevalence was computed as the number of persons meeting the criteria for diabetes or pre-diabetes all over the number of patients who responded or who underwent the test.

Results

The mean fasting blood sugar (FBS) of the volunteers was 88.1 mg/dL with a nationwide prevalence of

impaired fasting glucose (IFG) of 2.7% and diabetes (using FBS) of 4.8%. The highest prevalence of IFG was seen at ages 60-69, but generally the greatest increment was seen beginning at age 40 years old. Likewise for diabetes mellitus, the highest prevalence was at ages 50-59, and 60-69 but the prevalence of 5.7% at age 40-49 already exceeded the national prevalence of 4.8%.

were identified by FBS and by previous diagnosis or history, and the OGTT added only a small proportion of individuals with diabetes.

There is very little difference between genders for both pre-diabetes and diabetes mellitus. Male volunteers had more IFG, but females had a greater proportion with IGT. Diabetes was slightly more common among women at 7.4% versus 7.0% for males.

Table II: **Mean fasting blood glucose (FBG) and percent distribution among adults 20 years old and over by age. Philippines, 2008 (n=6177)**

Age (y)	FBS (mg/dL)		% Distribution by FBS (mg/dL) levels					
			Desirable (< 110)		Impaired Fasting glucose (110-125)		High FBS (> 125)	
	Mean	95% CI	%	95% CI	%	95% CI	%	95% CI
20-29	79.1	78.2-80.0	99.0	98.5-99.6	0.6	0.2-1.0	0.4	0.0-0.7
30-39	86.1	83.9-88.3	95.1	93.8-96.4	1.7	0.9-2.4	3.2	2.0-4.3
40-49	90.0	88.2-91.7	90.6	88.9-92.2	3.7	2.6-4.8	5.7	4.4-7.0
50-59	95.8	92.8-98.8	87.3	84.9-89.7	3.7	2.4-5.0	9.0	7.0-11.1
60-69	95.4	92.0-98.9	86.3	83.5-89.1	4.6	2.9-6.3	9.1	6.8-11.4
> 70	88.3	85.8-90.9	91.7	89.0-94.4	3.9	2.0-5.8	4.4	2.4-6.4
Overall	88.1	87.1-89.2	92.5	91.8-93.3	2.7	2.2-3.1	4.8	4.2-5.4

Table III: **Mean to-hour –post load and percent distribution among adults 20 years old and over by age. Philippines, 2008 (n=4930)**

Age (y)	Blood sugar two-hr after 75-gm glucose load (mg/dL)		% Distribution by 2H-PLG (mg/dL) levels					
			Desirable (< 140)		Impaired 2H-PLG (140-199)		High 2H-PLG (> 200)	
	Mean	95% CI	%	95% CI	%	95% CI	%	95% CI
20-29	87.5	85.5-89.4	96.7	95.4-97.9	2.9	1.7-4.1	0.4	1.2e06-.9
30-39	91.5	89.4-93.6	94.4	92.7-96.1	4.5	2.9-6.0	1.0	0.4-1.6
40-49	101.1	98.3-103.8	88.8	86.8-90.8	7.6	5.9-9.3	3.6	2.4-4.8
50-59	107.4	103.8-111.0	85.4	82.8-88.1	10.0	7.7-12.3	4.5	3.1-6.0
60-69	109.6	104.9-114.2	84.0	80.6-87.3	9.8	7.1-12.4	6.2	4.2-8.3
> 70	114.8	109.2-120.4	79.5	74.6-84.4	15.0	10.6-19.4	5.5	2.9-8.1
Overall	98.8	97.4-100.1	90.0	89.2-91.1	7.0	6.1-7.8	3.0	2.4-3.4

The mean two-hour blood sugar after a 75-gm oral glucose load of the volunteers was 99.0 mg/dL. The nationwide prevalence of impaired glucose tolerance (IGT) is 7.0% with the highest prevalence of 14.5% seen at age >70 years old. The prevalence of diabetes based on the two-hour blood sugar after a 75-gm OGTT is 3.0% with the highest prevalence at age 60-69, similar when the FBS criteria is used.

Diabetes Mellitus. A summary of the prevalence of diabetes mellitus using the three different criteria is given in Table IV. The overall prevalence of diabetes mellitus using any of the three criteria is 7.2%. Using any of the criteria, the greatest proportion of diabetics is seen at ages 60-69, and 50-59. However, the national prevalence is already exceeded even at age 40-49 years.

This implies that majority of the diabetic individuals

Pre-diabetes. This survey is important because it documents the individuals with pre-diabetes or those with increased risk for diabetes. Table IV emphasizes that the prevalence of IGT is equal to the prevalence of diabetes; combining this number with those who have IFG brings the prevalence of pre-diabetes to 9.7%. Thus, the prevalence of pre-diabetes and diabetes combined is approximately 16.6%, or one out of every six Filipino has either pre-diabetes or diabetes.

The criteria used for the diagnosis of pre-diabetes in this survey are the WHO criteria which uses a higher cut-off for normal blood sugar of < 110 mg/dL, unlike the American Diabetes Association whose criteria specify a normal FBS of < 100 mg/dL. If the more stringent criteria are used, the proportion of individuals with IFG will be even greater. (Table VI)

Table IV: Prevalence of Diabetes Mellitus by Age Categories, Philippines, 2008

Age (y)	Prevalence of Diabetes Mellitus			
	Based on FBS [a]	Based on 2Hour Post Load Glucose [b]	Based on the DM Questionnaire [c]	True Diabetes [d]
20-29	0.4 (0.0-0.7)	0.4 (1.2e06-.9)	0.6 (0.2-1.0)	1.0 (0.4-1.5)
30-39	3.2 (2.0-4.3)	1.0 (0.4-1.6)	1.4 (0.8-2.0)	3.7 (2.7-4.8)
40-49	5.7 (4.4-7.0	3.6 (2.4-4.8)	4.2 (3.1-5.3)	8.3 (6.9-9.7)
50-59	9.0 (7.0-11.1)	4.5 (3.1-6.0)	8.1 (6.2-9.9)	13.0 (10.8-15.2)
60-69	9.1 (6.8-11.4)	6.2 (4.2-8.3)	9.4 (7.0-11.8)	16.1 (13.2-18.9)
>70	4.4 (2.4-6.4)	5.5 (2.9-8.1)	7.3 (4.8-9.8)	12.3 (9.2-15.4)
Overall	4.8 (4.2-5.4)	3.0 (2.9-8.1)	4.0 (3.4-4.5)	7.2 (6.5-7.9)

a Based on FBS level > 125 mg/dL
b Based on 2H-PPG= > 200 mg/dL
c Based on DM questionnaire: having a previous diagnosis by a nurse or physician OR on current medication
d True diabetes: positive in any of the three assessment methods: FBS, 2H-PPG and DM questionnaire.

Table V: Prevalence of Blood Glucose Abnormalities among Filipino Adults by Gender, NNHeS 2008, Philippines

Glucose abnormalities	Male % (95%CI)	Female % (95%CI)	Total % (95%CI)
Impaired Fasting Glucose (IFG)	2.9 (2.3-3.5)	2.5 (1.9-3.1)	2.7 (2.2-3.1)
Impaired Glucose Tolerance (IGT)	6.7 (5.6-7.8)	7.2 (6.1-8.3)	7.0 (6.1-7.8)
Both IFG/IGT	0.4 (0.2-0.6)	0.6 (0.3-1.0)	0.5 (0.3-0.7)
Diabetes Mellitus (DM)	7.0 (6.1-8.0)	7.4 (6.4-8.3)	7.2 (6.5-7.9)

Table VI: Prevalence of IFG according to WHO and ADA criteria, NNHeS 2008

Gender/ Age group	IFG (WHO criteria) 110-125 mg/L		IFG (ADA Criteria) 100-125 mg/dL	
	%	95% CI	%	95% CI
Male	2.9	2.3-3.5	7.9	6.8-8.9
20-29	0.7	2.3-3.5	3.9	2.4-5.4
30-39	1.9	0.8-3.0	6.3	4.4-8.0
40-49	4.1	2.5-5.8	9.9	7.5-12.2
50-59	3.8	1.8-5.7	10.5	7.3-13.6
60-69	6.0	3.1-8.9	11.5	7.6-15.3
> 70	2.9	0.5-8.4	9.7	5.0-14.5
Female	2.5	1.9-3.1	6.7	5.8-7.6
20-29	0.5	-0.02-1.0	2.1	1.0-3.2
30-39	1.5	0.4-2.5	4.6	2.7-6.4
40-49	3.3	1.9-4.7	8.3	6.2-10.3
50-59	3.6	2.0-5.3	9.5	7.0-12.1
60-69	3.5	1.6-5.4	11.2	7.6-14.8
> 70	4.6	2.0-7.2	7.7	4.2-11.3
TOTAL	2.7	2.2-3.1	7.2	6.5-7.9

The use of the ADA criteria increases the prevalence of IFG from 2.7% to 7.2%. Totaling the prevalence of pre-diabetes using ADA criteria brings it to 14.2% combining IFG and IGT; adding on the 7.2% prevalence of diabetes to the pre-diabetes prevalence yields a 21.4% total prevalence of diabetes and pre-diabetes in the country. Thus, it is estimated that one out of every five Filipino has diabetes or pre-diabetes based on the ADA criteria. Simply adding together the different proportions is however, not directly possible since the response rates are different for the FBS and OGTT.

Prevalence of Diabetes and Pre-diabetes in the Urban versus Rural Areas. A comparison of the burden of diabetes and pre-diabetes in the urban versus rural areas shows a greater prevalence of both of these conditions in the urban areas. For pre-diabetes, the prevalence of IFG is comparable between the urban and rural areas at 2.5-2.6%. The difference is with regards to IGT that shows a prevalence of 8.4% (0.7) in the urban areas versus 5.6% (0.5) in the rural areas. This difference was true for both male and female, but was more prominent in females (9.0 (0.9) in urban versus 5.3 (0.7) in rural women.

For diabetes, the prevalence was also greater for the urban than the rural areas at 8.3% (0.5) versus 5.8 (0.4) respectively. Comparing males and females show persistence of the same trends seen for pre-diabetes, but again the difference between rural versus urban is greater for females.

The over-all prevalence of diabetes in the urban areas is greater than the national prevalence of diabetes at 8.3% (0.5) versus 7.2 (0.7). Conversely, the prevalence of diabetes in the rural areas is less than the national prevalence at 5.8 (0.6) versus 7.2 (0.7) respectively.

Dysglycemia and Other Cardiovascular Risk Factors. Diabetes mellitus by itself imposes a greater risk for cardiovascular diseases. How do diabetics and pre-diabetics compare with those who have normal glucose tolerance? Generally, individuals with diabetes and pre-diabetes are older with a mean age of 52.9 (range 51.7-54.2) years in the former, and 51.3 (49.4-53.2) years and 51.0 (50.2-52.9) for IGT and IFG respectively. Those who have normal glucose tolerance who comprised the majority of the volunteers had a mean age of 42.5 years (42-43.0).

Table VII: Prevalence of Diabetes, IFG and IGT among Volunteers who underwent the 75-gm OGTT (N=4930)

Age	Diabetes				Prediabetes				
	FBS	2-hr BS (OGTT)	History	Any of the 3 criteria	FBS 110-125 (WHO criteria)	FBS 100-125 (ADA)	2-hr BS 140-199	FBS 110-125 & 2-hr BS 140-199 (WHO criteria)	FBS 100-125 & 2-hr BS 140-199 (ADA criteria)
20-29	0.4	0.4	0.4	1.0	0.8	3.5	2.9	0.07	0.07
30-39	1.1	1.0	0.4	2.0	1.9	6.2	4.5	0.7	1.2
40-49	2.9	3.6	1.9	5.5	3.9	9.8	7.6	0.8	2.2
50-59	3.3	4.5	3.2	7.6	3.8	10.5	10.0	1.0	2.5
60-69	3.6	6.2	3.9	9.6	4.6	11.4	9.8	0.8	2.5
> 70	1.3	5.5	5.1	10.6	3.9	9.2	15.0	1.0	1.3
Overall	2.0	3.0	1.9	4.8	2.8	7.9	7.0	0.7	1.5

Table VIII: Distribution of Study Participants in the Urban Areas According to Levels of Glucose Tolerance

Normal Glucose Tolerance			Prediabetes				Diabetes	
			IGT (2hr RBS 140-199)		IFG (FBS 110-125)			
	Mean	95% CI	%	95% CI	%	95% CI	%	95% CI
Total	88.2	86.7-89.7	8.4	7.1-9.8	2.5	1.9-3.2	8.5	7.5-9.5
Male	88.6	86.4-90.8	7.6	5.9-9.4	2.5	1.6-3.4	8.2	6.7-9.8
Female	87.9	85.9-89.9	9.0	7.2-10.8	2.6	1.7-3.4	8.7	7.4-10.1

Table IX: Distribution of Study Participants in the Rural Areas According to Levels of Glucose Tolerance

Normal Glucose Tolerance			Pre-diabetes				Diabetes	
			IGT (2hr RBS 140-199)		IFG (FBS 110-125)			
	Mean	95% CI	%	95% CI	%	95% CI	%	95% CI
Total	92.0	90.8-93.2	5.6	4.6-6.6	2.8	2.2-3.4	5.8	4.9-6.6
Male	91.7	90.1-93.3	5.8	4.5-7.2	3.0	2.2-3.9	5.8	4.7-6.9
Female	92.2	90.7-93.8	5.3	4.0-6.6	2.5	1.7-3.3	5.7	4.6-6.8

Table X: Distribution of Study Participants according to Levels of Glucose Tolerance and Cardiovascular Risk profile

	Normal Glucose Tolerance	Impaired Glucose Tolerance	Impaired fasting glucose	Diabetes Mellitus
Age (mean years, s.d)	42.5 (42.0-43.0)	51.3 (49.4-53.2)	51.0 (50.2-52.9)	52.9 (51.7-54.2)
Systolic BP, mm Hg (mean, s.d.)	121.9 (121.2-122.5)	131.2 (128.4-134.1)	135.5 (131.4-139.5)	134.6 (132.5-136.7)
Diastolic BP, mm Hg (mean,s.d.)	79.2 (78.8-79.6)	84.5 (83.0-86.0)	85.1 (83.0-87.2)	84.6 (83.4-85.9)
Total cholesterol > 200 mg/dL (%)	29.4 (27.9-30.9)	41.5 (36.2-46.8)	43.9 (36.0-51.9)	54.8 (49.6-60.0)
LDL-cholesterol > 130mg/dL (%)	30.2 (28.7-31.8)	39.5 (34.0-45.0)	39.9 (32.0-47.9)	45.9 (40.9-50.9)
Triglycerides > 150 mg/dL (%)	27.6 (26.2-29.0)	41.0 (35.2-46.7)	42.9 (35.0-50.8)	53.5 (48.9-58.1)
HDL cholesterol < 40/50 mg/dL (%)	80.0 (78.7-81.4)	78.2 (73.5-83.0)	81.7 (75.4-88.1)	84.0 (80.4-87.5)

The diabetics and pre-diabetics had higher systolic and diastolic blood pressure compared to those who had normal glucose tolerance, with the mean values falling within the range of pre-hypertension. (Table 10)

With regards to the lipid profile, both the individuals with pre-diabetes and diabetes have a generally higher prevalence of elevated cholesterol.

For total cholesterol, both the individuals with IGT and IFG have a 10% higher prevalence than those with normal glucose tolerance (prevalence of 29.4%), while diabetics have an almost 25% higher risk at 54.9%. The same trend also exists with regards to LDL-cholesterol. Individuals with normal glucose tolerance have a prevalence of 30.2% while those with IGT

and IFG have a prevalence of 39.6 and 41.4% respectively, while those with diabetes mellitus have a prevalence of 46.2%. Finally, the prevalence of low HDL cholesterol less than 40 mg/dL is similar to the national prevalence that is pegged at 65%. Those with normal glucose tolerance, IGT, IFG and diabetes have similar prevalence at 64.3%, 63.2, 64 and 66.0% respectively.

Discussion

Prevalence of diabetes mellitus. In 2003, the estimated national prevalence of diabetes among adults 20-79 years old was 4.6% based on FBS and history or past diagnosis of diabetes. This comprises approximately 3.9 million Filipinos. The International Diabetes Federation estimated that the prevalence of diabetes in the Philippines in 2007 will be 6.5% and projected this prevalence to increase to 7.9% by 2025.9 In the 2008 survey, the prevalence of diabetes using any of the three criteria (FBS, OGTT or history) is now 7.2%, closely approximating the estimates of the International Diabetes Foundation (IDF).

The table below summarizes the prevalence of diabetes mellitus in the Philippines for the last 10 years according to the National Nutrition and Health Survey:

Table XI: **Trends in the Prevalence of Diabetes in the Philippines, 1998-2008**

	1998	2003	2008
FBS > 125	3.9	3.4	4.8
DM based on history	---	2.6	4.0
FBS or OGTT or History	---	4.6*	7.2

* FBS or history

Although the methods used to diagnose diabetes in the last three surveys have been different, there is a clear trend towards an increasing prevalence of diabetes mellitus. Clearly therefore, our diabetes prevention strategies have not been successful in halting the steady increase in diabetes mellitus in the country.

Comparison with other countries in the Western Pacific region. The diabetes epidemic is projected to have the greatest impact in developing countries, including countries in the western Pacific region. A comparison of our current national prevalence to those of our neighboring countries shows similar numbers: China 4.5%, China (Hong Kong) 10.2%, Indonesia 4.6%, Japan 7.3%, Malaysia 10.9%, Singapore 12.7%, Taiwan 5.7%, and Thailand 7.1% with the Western Pacific average prevalence of 5.0%.[10]

Prevalence of Pre-diabetes. This survey is also important because it documents the state of glucose intolerance before actual diabetes diagnosis, a condition generally called pre-diabetes. Other authors label impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) as conditions of increased risk for diabetes. It is important to recognize these hyperglycemic states early because timely treatment by dietary modification (decreased caloric intake) and physical activity and exercise can still modify the risk for development of diabetes mellitus.

The distribution of the prevalence of pre-diabetes is as follows: IFG 2.7 % (2.2-3.1), IFG and IGT 0.5% (0.3-0.7) and IGT 7.0 (6.1-7.8), for a total prevalence of 10.2% using the WHO Criteria. The WHO uses a fasting blood glucose criterion of 110 mg/dL to 139 mg/dL for the diagnosis of IFG. Using the ADA criterion which has a lower threshold of 100 mg/dL (up to 125 mg/dL), increases the total prevalence of IFG from the WHO prevalence of 2.7% (2.2-3.1) to 7.2% (6.5-7.9). Totaling the prevalence of pre-diabetes using ADA criteria brings it to 14.2% combining IFG and IGT. When the FBS threshold of 100 mg/dL as recommended by ADA is therefore used, half of patients with pre-diabetes will be diagnosed. As suggested by the Philippine Practice guidelines[11] for diabetes, those who are high risk for cardiovascular diseases such as those with obesity and metabolic syndrome, people who have had acute coronary syndromes or are high risk for cardiovascular events should undergo the 75-gm OGTT.

Diabetes and Pre-diabetes. Using the ADA criteria, adding on the 7.2% prevalence of diabetes to the pre-diabetes prevalence of 14.2% yields a 21.4% total prevalence of diabetes and pre-diabetes in the country. Thus, it is estimated that one out of every five Filipino has diabetes or pre-diabetes based on the ADA criteria.

Gender distribution. There is very little difference between genders for both pre-diabetes and diabetes mellitus. Male volunteers had more IFG, but females had a greater proportion with IGT, but the difference is small. Likewise, diabetes was slightly more common among women at 7.4% versus 7.0% for males.

Age Distribution. Using any of the criteria, the greatest proportion of diabetics is seen at ages 60-69 (15.9%), and 50-59 (13%). However, the national prevalence is already exceeded even at age 40-49 years at 8.2%, while the prevalence at age 30-39 is 3.8%. There is therefore basis for the recommendation of Philippine practice guidelines for the screening and diagnosis of diabetes to routinely screen all adults for diabetes mellitus beginning at age 40 years, and younger if with any of the risk factors for diabetes such as family history, obesity, hypertension, dyslipidemia or in women, previous gestational diabetes mellitus.

Cardiovascular diseases and diabetes. This study is consistent with the view that diabetics are at higher risk for cardiovascular diseases. The diabetics are of course generally older, and are probably more overweight or obese accounting for many of these cardiovascular risks.

Both diabetics and pre-diabetics had higher systolic and diastolic blood pressure compared to those who had normal glucose tolerance, with the mean values falling within the range of pre-hypertension. Both the mean values and the overall prevalence are also greater for total cholesterol, LDL-cholesterol and triglyceride levels. Diabetics and pre-diabetics do not only need to be identified early by glycemic testing, they also need to be routinely screened and treated for hypertension and dyslipidemia in order to modify risks for cardiovascular events and mortality.

Conclusions

The estimated national prevalence of diabetes in the Philippines was 7.2% in 2008, which translates to approximately 6.377 million diabetics in a national population of 88.57 million at that time. This number is rapidly approximating the projected prevalence of 7.8% in 2025 as predicted by the IDF. The estimated national prevalence of pre-diabetes using the WHO criteria is 10.2%.

Public health efforts to screen for pre-diabetes and diabetes need to be accelerated, and systematic and systemic prevention strategies are necessary to reduce the burden of diabetes and its complications.

References

1. **Philippine Renal Disease Registry. http://www.redcop-nkti.org/Prdr.htm**
2. **Fojas. MC, Lantion-Ang FL, Jimeno CA, Santiago D, Arroyo M, Laurel A, Sy H, and See J.** Complications And Cardiovascular Risk Factors Among Newly-Diagnosed Type 2 Diabetics In Manila. Phil. J. of Int Medicine, 47(2):99-105, 2009.
3. **U.S. Diabetes Fact Sheet.** http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf
4. **H. King, R.E. Aubert, W.H.** Herman, Global burden of diabetes, 1995–2025: prevalence, numerical estimates, and projections. Diab. Care, 21: 1414–1431, 1998
5. **Baltazar JC, Ancheta CA, Aban IB, Fernando RE, Bauilod MM.** Prevalence and correlates of diabetes mellitus and impaired glucose tolerance among adults in Luzon, Philippines. Diabetes Research and Clinical Practice, 64:107–115, 2004.
6. **Azurin JC, Basaca-Sevilla V, Sumabat LM, Fernando RE, de Guzman G, Flores CL.** Diabetes survey in the Philippines, Philip. J. Public Health, 24:12–29, 1986
7. **Food and Nutrition Research Institute.** Philippine Nutrition Facts and Figures. Food and Nutrition Research Institute, Taguig, Metro Manila, Department of Science and Technology, Philippines, April 2001.
8. **Soria MLB, Sy RG, Vega BS, Ty-Willing T, Abenir-Gallardo A, Velandria F, Punzalan FE.** The incidence of type 2 diabetes mellitus in the Philippines: A 9-year cohort study. Diabetes Research and Clinical Practice., 86:130–133, 2009
9. **International Diabetes Federation.** IDF Diabetes Atlas, 3rd edn. Brussels, Belgium. 2006 Retrieved http://www.idf.org/diabetesatlas
10. **International Diabetes Federation.** IDF Diabetes Atlas, 4th edn. Brussels, Belgium, 2009. http://www.idf.org/diabetesatlas
11. **Jimeno CA on behalf of the Technical review Committee of the UNITE for DM Clinical Practice Guidelines.** A Summary of the Philippines UNITE for Diabetes Clinical Practice Guidelines for the Diagnosis and Management of Diabetes. J of the ASEAN Federation of Endocrine Societies (JAFES), 26 (1): 26-30, 2011.