The Prevalence of Cardiovascular Risk Factors and Diabetes Increases with a Body Mass Index of ≥23 kg/m² in Filipino American Women

Irma B. Ancheta, PhD, RN; Cynthia A. Battie, PhD; Ma. Teresa Tuason, PhD; Nancy Borja-Hart, PharmD; Christine V. Ancheta, MPH

Objective: Although elevated body mass index (BMI) increases the risk for cardiovascular disease (CVD) and diabetes universally, the BMI associated with increased risk for these two diseases needs to be established for Filipino American women (FAW). The relationship of BMI with diabetes and other CVD risk factors in FAW was investigated to determine if BMI levels less than the conventional 25 kg/m^2 are associated with increased CVD risk factors.

Methods: In a cross-sectional study conducted in four cities, FAW (n=193), aged 40 to 65 years, were screened for CVD risk factors and diabetes. Mean concentrations and prevalence of CVD risk factors were examined as a function of BMI category (BMI ≤22.9 n=41, BMI 23–24.9 n=46, BMI 25–29.9 n=75, and BMI ≥30 n= 31).

Results: Body mass index correlated significantly with waist circumference (P<.0001), systolic blood pressure (P<.0001), diastolic blood pressure (P<.001), fasting blood glucose (P<.05), hemoglobin A1c (P<.001), triglycerides (P<.001), high sensitivity C-reactive protein (P<.001) and high density lipoprotein -C (P<.001). The prevalence of diabetes, decreased levels of high density lipoprotein-cholesterol, hypertension, elevated triglycerides, and high sensitivity C-reactive protein increased significantly (P<.01–.001) with BMI categories starting at BMI 23–24.9 kg/m^2.

Conclusion: Body mass index was an excellent predictor of elevated CVD risk factors in this population and the prevalence of most of these factors increased at BMIs as low as 23–24.9 kg/m^2 suggesting a need to investigate risk factors and CVD events as a function of BMI in larger studies of Filipino American women. (*Ethn Dis.* 2014;24[1]:48–54)

Key Words: Asian, Minority, Women, Cardiovascular Risk Factors, Filipino, Diabetes

From School of Nursing (IBA); Department of Public Health, University of North Florida, Jacksonville (CAB, Ma.TT); and East Coast Institute for Research (NBH); and College of Public Health, University of South Florida (CVA).

Address correspondence to: Irma B. Ancheta; School of Nursing; University of North Florida; 1 UNF Drive; Jacksonville, FL 32224; 904.620.1454; 904.620.1832 (fax); i.ancheta@unf.edu

Introduction

Cardiovascular disease is the leading cause of death among Filipinos living either in the Philippines[1] or in the United States.[2] Filipinos are the second largest Asian population in the United States and are reported to have a high prevalence of diabetes and hypertension as compared to other Asian ethnicities and non-Hispanic White (NHW) populations.[3–7] Studies such as the Nurses Health Study showed that despite the same body mass index (BMI) levels, Asians had double the risk of developing type 2 diabetes compared to Whites.[8–10] Body mass index has been used as an international index in assessing weight, although the cut-off points for overweight and obesity, especially in those of Asian ethnicity, need more scrutiny.[4,11] The WHO[11] reported that Asians have an increased risk of type 2 diabetes at a substantially lower BMI compared to the conventional cut-off point for overweight of ≥25 kg/m^2. Based upon numerous studies that examined the relationship of BMI to CVD risk as a function of ethnicity, Low et al[12] stated that the BMI levels signaling obesity and overweight need to be specific to ethnicity and/or country of origin.

In support of the premise that there is a need for different BMI cutoffs as a function of ethnicity, Asians are more likely to develop obesity-related morbidities before reaching the overweight BMI of 25 kg/m^2.[4,10] Despite the same BMI levels, Asians have double the risk of developing type 2 diabetes compared to Whites.[8–10] Additionally, marginal increases in weight were associated with diabetes in Asian populations.[6] Palaniappan et al,[4] based upon 43,507 electronic records of Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese and NHW patients, aged ≥35, determined that Asians, in spite of a lower BMI, had a higher prevalence of metabolic syndrome compared to NHWs. This group concluded that BMI ranges for overweight or obesity in the Asian population should be lowered.[4] The above discussion is a strong rationale for examining BMI cutoff criteria for overweight and obesity in Filipinos. Furthermore, it is not known if different BMI criteria should be applied to Filipinos living in America vs those living in their native country.

Since BMI is often used as a cost-effective method of community-screening in assessing individuals for increased risk for heart disease,[5] it is critical that studies of BMI in specific Asian subgroup such as the Filipinos be completed to determine BMI cut-off criteria. Elevated BMI has been linked to obesity and obesity-related diseases but the level of these measures that are unsafe for the various Asian subgroups is controversial, especially for Filipino Americans.[5] Assuming that obesity in part contributes to CVD indirectly by elevating other risk factors, our study sought to determine if BMI <25 kg/m^2 is associated with increased CVD risk factors including diabetes, hypertension, inflammatory markers and blood lipids.

Materials and Methods

Study Design

Our investigation was a cross-sectional study of Filipino American women (FAW, n=193), aged 40 to 65, who were recruited during a cardiovascular health screening at places of worship or cultural centers during

Assuming that obesity in part contributes to CVD indirectly by elevating other risk factors, our study sought to determine if BMI <25 kg/m^2 is associated with increased CVD risk factors including diabetes, hypertension, inflammatory markers and blood lipids.

2010–2012. These health screenings were performed in Jacksonville, Florida; Chicago, Illinois; Tampa, Florida and San Francisco, California. To obtain a cross-section of participants, the study setting included places of worship and cultural centers frequently visited by Filipino women of all socioeconomic levels. The research team, with the help of volunteer RNs and church staff, conducted the study. No monetary incentives were given although a heart healthy breakfast was provided to all participants after completion of the study.

Recruitment and Enrollment

Prior to the conduction of the study, University of North Florida's Institutional Research Board (IRB) approved the study and permission to use each facility was obtained from the appropriate facility manager. Approved IRB flyers with the scheduled time and date, and purpose of the study were distributed at the facilities two weeks prior to the study and announcements were given during group meetings. The flyers instructed participants to be fasting for 8–12 hours prior to the screening to ensure accurate laboratory results. In addition, participants were instructed to bring a list of all current medications.

Participants were enrolled if they were female, self-identified as Filipino by ethnicity, and agreed to volunteer for the study. Women who had severe arthritis, any autoimmune disorder, a recent cancer diagnosis and/or presented with any infection or severe inflammation were excluded from the study. Prior to giving consent, participants were given ample time to ask questions or state concerns regarding the study. A signed informed consent was obtained after the study purpose was carefully explained.

Screening Protocol

Total time to complete the study (informed consent, vital signs, body measurements, blood draw and questionnaires) was approximately 45 minutes per participant. A demographic and clinical information questionnaire, including participant's medical history and current medications, was completed for each participant by trained research staff. Upon completion of the survey, blood pressure was obtained using a standard Omron digital HEM-705CP sphygmomanometer on the left or non-dominant arm, after the participant had been seated for 10 min. Measurements were repeated two times with 5 min in between each reading. Subsequently, weight and height were measured using a standard Tanita weighing scale (WB-3000). Waist circumference was measured using a tension tape guided by the NHANES measurement protocol.

Lastly, a licensed phlebotomist drew 5 mL of blood via venipuncture from each participant for a series of tests including the standard lipid panel, hemoglobin A1c, serum glucose, and cardiovascular inflammatory biomarkers (high sensitivity C-reactive protein or hs-CRP and lipoprotein-associated phospholipase A2 or Lp-PLA2). The blood was captured in three test tubes containing EDTA. Sample tubes were labeled with numbers only, centrifuged and immediately frozen. Frozen samples were sent to a CLIA-certified laboratory where assays were performed using standard clinical protocols. The lipid panel assay included total cholesterol, triglycerides, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) (Roche Modular Methodology) performed at Berkeley Heartlab, Inc. (Alameda, CA). Plasma hs-CRP concentration was determined using an automated immunoturbidimetric assay (Roche Modular Methodology Berkeley Heartlab Inc.). Plasma Lp-PLA2 activity was measured by an enzyme-linked immunosorbent assay using two highly specific monoclonal antibodies (diaDexus, Inc. South San Francisco, CA).

Data Analysis

A confidential, password-secured database was used for data entry, management, and analysis. Inconsistencies were checked, and the data descriptions were verified by two investigators. Data were analyzed using the Statistical Package for the Social Sciences (SPSS, version 19) and GraphPad® Prism 5 software. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity with no serious violations noted. Certain variables were coded as dichotomous and their frequency distributions were checked for inconsistencies. The correlation of BMI with cardiovascular risk factors was determined by calculating the Pearson correlation coefficient. Means $\pm$ standard deviations of the continuous variables were calculated for the entire group and the BMI subgroups. Analysis of variance with Tukey's post hoc comparisons was used to determine differences in levels of CVD risk factors as a function of BMI subgroup. Dichotomous variables were analyzed using Fisher's Chi-Square tests for independence with Yates continuity correction. Statistical significance was set at $P<.05$.

Table 1. Morphometric measurements and cardiovascular risk factors in relationship to body mass index of the Filipino American women participants, *n*=193[a]

Measurement	Means ± SD	*r*	*P*
Weight, lbs	137 ± 23	-	-
Height, inches	61 ± 3	-	-
Body mass index, kg/m^2	29 ± 4	-	
Waist circumference, inches	37 ± 4	.806	<.0001
Systolic blood pressure, mm Hg	127 ± 19	.341	<.0001
Diastolic blood pressure, mm Hg	82 ± 11	.304	<.001
Fasting blood glucose, mg/dL	101 ± 24	.167	<.050
Hemoglobin A1c, %	5.9 ± .7	.221	<.001
Total cholesterol, mg/dL	201 ± 42	.057	.402
Triglycerides, mg/dL	113 ± 62	.292	<.001
LDL-Cholesterol, mg/dL	115 ± 36	.024	.738
HDL-Cholesterol, mg/dL	62 ± 16	−.420	<.001
Hs-CRP, mg/L	1.71 ± 1.8	.274	<.001
LpPLA2 ng/mL	176 ± 58	.020	.813

[a] The relationships of the variables with body mass index were determined by statistical analysis and the results presented as Pearson product-moment correlations (*r*) with associated *P*. The % of participants with BMI ≥25 and ≤29.9, which is considered overweight was 39%, while 16% of the participants had BMI ≥30, which is considered obese.

RESULTS

Participant Characteristics

The mean age of this study cohort was 55.4 ± 7.1 years old and most (98%) were born in the Philippines but had resided in the United States for >20 years (24.1 ± 13.1 years). The mean age upon arrival in the USA was 31.1 ± 10.9 years. The majority (75%) of participants were married and 88% had some sort of insurance including private insurance (49%). There was a wide distribution of income with 21% living on <$12,000 per annum, 22% in the $41,000–$69,000 category and the rest (16%) in the >$70,000 category. The majority (53%) had a 4-year college degree. Many participants (35%) worked in the health professions. Only 1% of the participants smoked and thus smoking was not thought to be a confounder in this study.

Results of the morphometric analyses are shown in Table 1. The mean weight of the participants was 137 ± 23 lbs, the mean height was 61 ± 3 inches and the mean waist circumference, a measure of central obesity, was 37 ± 4 inches, which is higher than the obesity cut-off of 35 inches.[13] The mean BMI was 29.1 ± 4 (kg/m^2); 39% were overweight (BMI ≥ 25–29.9) and 16% were obese (BMI ≥ 30). Waist circumference and BMI were highly correlated (r=.81, P=.0001).

To determine if the overweight and obesity cut-offs should be lowered, the participants were divided into four groups: BMI ≤22.9 (21%, n=41); BMI 23–24.9 (24%, n=46); BMI 25–29.9 (39%, n= 75) and BMI ≥30 (16%, n=31). The BMI 25–29.9 group was significantly older compared to the other groups (P<0.05) (data not shown) but age did not appear to be correlated with BMI (.034, P=.64) and thus differences in mean ages between groups were not likely to confound the results. Table 1 presents the mean values of the CVD risk factors and their correlation with BMI.

BMI, Diabetes and CVD Risk Factors

Table 2 contains the mean values of the CVD risk factors as a function of BMI category as well as the % of each group with unhealthy levels of the risk factor. Body mass index was minimally correlated with fasting blood glucose (r=.167, P=.02) but more strongly correlated with hemoglobin A1c (r= .221, P<.001). Although fasting blood glucose was determined, a more reliable measure of diabetes is the plasma hemoglobin A1c test.[14] Additionally, fasting serum glucose may need to be considered as a limitation since fasting was self-reported. According to the American Diabetes Association guidelines,[14,15] the non-diabetic range for the hemoglobin A1c is 4% to 5.6%. A hemoglobin A1c between 5.7% and 6.4% indicates an increased risk of diabetes, while a level ≥6.5% indicates diabetes. The mean hemoglobin A1c value was 5.93 ± .71% with 32% of participants at risk for diabetes and 7% with diabetes. Although there were no differences in mean values of hemoglobin A1c as a function of BMI group, the % of participants with diabetes increased significantly; the % of participants increased from 0% in the lowest category to 38% in the BMI ≥ 30 group. More importantly, the % of participants with diabetes increased from 0% in the BMI ≤22.9 group to 14% in the BMI 23–24.9 group (P<.01).

Both diastolic and systolic blood pressure were strongly correlated with BMI. Hypertension was defined as a systolic blood pressure ≥140 mm Hg and/or a diastolic blood pressure greater ≥90 mm Hg,[16] or normotensive with the use of an antihypertensive medication.[17] Although the mean values for the blood pressure measurements were only elevated in the two BMI ≥25 groups, the % of participants with hypertension increased starting at BMI 23–24.9. The prevalence ranged from 4% in the lowest BMI group to 82% of the BMI ≥30 group. Moreover, in support of a need for a lower BMI for this population, a significant difference in prevalence of hypertension was demonstrated between the lowest group and the BMI 23–24.9 group (4% vs 22%, P<.01).

Body mass index was correlated with the inflammatory marker hs-CRP (P<.001), but had no correlation with Lp-PLA2 (P=.81). The prevalence and mean values of intermediate and high

Table 2. Cardiovascular risk factor mean values and prevalence as a function of body mass index category in the Filipino American women

Variable	Body Mass Index			
	≤22.9, *n*=41	23–24.9, *n*=46	25–29.9, *n*=75	≥30, *n*=31
HbA1c %	5.67 ± .22	6.38 ± 2.61	6.02 ± .50	6.40 ± 1.08
Prev. Diabetes, % group[a]	0	14[g]	16[g]	38[i]
Systolic BP, mm Hg	119 ± 22	125 ± 15	137 ± 3.1[f]	139 ± 19[f]
Diastolic BP, mm Hg	79 ± 11	81 ± 8.4	82 ±11[e]	87 ± 12[f]
Prev. Hypertension, % group[b]	4	22[g]	62[h]	82[i]
TGL, mg/dL	89 ± 36	110 ± 55	127 ±71[f]	142 ± 79[f]
Prev. Elevated TGL, % group[c]	11	20[g]	22[g]	41[h]
HDL-C, mg/dL	70 ±16	60 ± 13	60 ± 14	55 ±14
Prev. Reduced HDL-C, % group[c]	8	28[g]	52[h]	61[h]
hs-CRP, mg/L	1.08 ± 1.76	1.13 ±1.03	1.86 ±1.79[e]	2.52 ±1.91[f]
Prev. Intermediate Risk[d]hs-CRP 1–2.9 mg/L, % group	10	30[h]	28[h]	41[i]
Prev. High Risk[d]hs-CRP >3 mg/L, % group	11	12	30[h]	46[i]

[a] Diabetes was defined as having a level of hemoglobin A1c ≥6.5%.
[b] Hypertension included those on medicine for hypertension as well as those with systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mmHg.
[c] Elevated TGL levels were ≥150 mg/dL and reduced HDL-C ≤60 mg/dL.
[d] The intermediate and high risk of CVD based upon hs-CRP levels followed the guidelines presented from the JUPITER Trial.[18]
[e,f] Analysis of variance with Tukey's post-tests demonstrated differences between groups with [e] referring to $P<.05$ compared to both the BMI ≤22.9 and BMI 23–24.9 groups and [f] referring to $P<.01$ compared to both the BMI ≤22.9 and the BMI 23–24.9 groups.
[g,h,i] Fisher's exact tests were used to determine differences in prevalence between the three highest BMI groups and the lowest BMI group: [g]$P<.01$; [h]$P<.001$; [i]$P<.0001$.

risk levels of hs-CRP were examined as a function of BMI category. Based upon the guidelines of the JUPITER Trial[18] intermediate risk levels were defined as 1–2.9 mg/L and high risk levels were defined as >3.0 mg/L. The lower two groups (BMI≤ 22.9 and BMI 23–24.9) had similar mean levels of hs-CRP but the BMI 25–29.9 group had significantly higher hs-CRP than the BMI ≤22.9 group ($P<.001$). The highest BMI group (BMI ≥30) had significantly elevated hs-CRP compared to the lowest two BMI groups ($P<.001$). The proportion of those with intermediate risk levels of hs-CRP increased in all groups, including the BMI 23–24.9 group, compared to the BMI ≤22.9 group. However, the proportion of those with high risk levels of hs-CRP did not increase until BMI was ≥25.

Body mass index was not correlated with LDL-C or total cholesterol but was significantly correlated with HDL-C and triglycerides ($P<.001$ and $P<.01$, respectively). The BMI ≤22.9 group had the highest HDL levels compared to all other groups ($P<.001$). Additionally, the proportion of those with low HDL increased significantly in all groups compared to the BMI ≤22.9 group; indeed, the prevalence of low HDL was 28% in the BMI 23–24.9 group compared to 8% in the BMI ≤22.9 group. The mean values of triglycerides were elevated in the two highest BMI groups compared to the lowest BMI group but were not different between the BMI 23–24.9 group and the lowest BMI group. However, the proportion of participants with elevated triglycerides was statistically higher in the BMI 23–24.9 group compared to the lowest group.

DISCUSSION

Our community-based study found that approximately 40% of the participants were overweight and 16% were obese, using conventional BMI criteria. The prevalence of all risk factors that correlated with BMI were highest in the BMI ≥30 group. In support of our premise that the conventional BMI cutoffs may not be applicable to Filipino American women, the prevalence of many CVD risk factors were increased in the BMI 23–24.9 group compared to the lower BMI group including hypertension, diabetes, intermediate risk level of hs-CRP and low HDL, triglycerides and intermediate risk levels of hs-CRP. However, the prevalence of high-risk levels of hs-CRP were not different between the lowest BMI group and the BMI 23–24.9 group. The BMI cut-off point for observed risk varies from 22–25 kg/m^2 in different Asian populations and separate cut-off points need to be established based on Asian ethnicity.[4,11] Our work supports this recommendation and suggests that the healthy BMI for Filipino American women may need to be lowered from 25 kg/m^2. However, our work examined CVD risk factors in a small, non-random sample, warranting further investigations using larger populations and CVD events as well as risk factors.

Historically, BMI is the established measurement index in assessing obesity, a major risk factor for cardiovascular disease,[19,20] although it is well known that BMI has several limitations and that its utility has been questioned given that Asians have a higher prevalence of body fat than White populations with similar BMI.[21–24] Twenty years ago, the WHO provided recommendations for

BMI categories for overweight and obesity.[25] These BMI categories are associated with increased risk of type 2 diabetes and CVD.[25] In 2004, the WHO working group examined recommended BMI cut-off for Asians to determine if population specific BMIs are warranted. The WHO group established that despite a lower than BMI cutoff of 25 kg/m^2 Asians had a higher prevalence of body fat than Caucasians with the same age, sex and BMI.[11] More importantly, WHO recommended that since Asians have a predisposition to develop central obesity and metabolic syndrome, the addition of waist circumference measurement should be used as a guiding tool when evaluating BMI. Palaniappan et al study,[4] discussed above, using electronic records of 43, 507 Asian Americans and NHWs confirmed WHO recommendations. Interestingly, results from this study found that Asians have a higher prevalence of metabolic syndrome across all BMI categories when compared to NHWs. Metabolic syndrome was prevalent among Asian women at a BMI of 19.6 kg/m^2 and at 19.9 kg/m^2 for Asian men compared while in NHWs the prevalence does not increase until BMI $\geq$25 kg/m^2.

Using the criteria set forth by the American Diabetes Association for diabetes (hemoglobin of $\geq$6.5%), our results demonstrated that diabetes was non-existent for those with a BMI $\leq$22.9, but was present in 68% of those with a BMI $\geq$23. In an in-patient cross-sectional sample of 15,826 patients, the prevalence of type 2 diabetes was higher for Filipinos among all Asians (7.1% vs 6.7%–6.9%, respectively) and when compared to NHWs (7.1% vs 6.8%, respectively) and was almost similar to those of Blacks and Hispanic Latinos (7.1% vs 7.2%, respectively).[26] In another study, diabetes was classified through ICD-9 codes, abnormal laboratory values, or use of oral anti-diabetic medication. Results of that study showed that when comparing 21,816 Asian and 73,728 NHWs, participants aged >35 years, the odds of diabetes were higher in Filipinos in both sexes (women OR 3.94, men OR 4.56), compared to NHWs.[3] In the prospective cohort analysis of the Diabetes Study of Northern California (DISTANCE), which included a 2,123,548 sample from the Kaiser Permanente Northern California, findings indicated that Filipinos, South Asians and Pacific Islanders have the highest incidence (4.7, 17.2, and 19.9 cases per 1,000 person-years, respectively) and prevalence (16.1%,15.9% and 18%, respectively) of diabetes among all racial and ethnic subgroups.[27] Given the prevalence of diabetes in Filipinos and the link shown in our study to BMI, it is important to educate Filipinos about the risk of being overweight. Follow-up studies need to be performed to confirm the premise that even a BMI of 23 kg/m^2 puts this group at risk for diabetes.

Our results showed that hypertension was prevalent in this group of FAW. Moreover, elevated blood pressure was significantly associated with BMI with the lowest probability of hypertension seen in those with BMI $\leq$24.9. Our results are in line with those of Gentilucci et al who indicated that Filipinos migrating to Europe have a higher incidence of elevated BMI (BMI $\geq$25) associated with a high prevalence of hypertension[28] and with another study demonstrating that regardless of living in the United States or Philippines, BMI is strongly associated with a high incidence and prevalence of hypertension among Filipinos.[4,6,29,30] Hypertension is an important risk factor in FAW as the odds for stroke were significantly higher in this group of women compared to other Asians, based upon a study of the electronic health records of 94,423 Asians from 2007–2010.[5]

Our results showed that hypertension was prevalent in this group of Filipino American women. Moreover, elevated blood pressure was significantly associated with BMI with the lowest probability of hypertension seen in those with BMI $\leq$24.9.

Several studies have shown the association of certain CVD inflammatory markers and heart disease including the findings that elevation of hs-CRP can independently predict vascular events.[31–32] Yet the relationship of inflammatory markers to elevated weight is not well understood especially in FAW. Results of our study showed that BMI was significantly associated with hs-CRP levels and not with LpPLA2. Additionally, our findings indicated that FAW had a much lower hs-CRP and LpPLA2 mean when compared to larger studies: 1) Ridker et al[33] showed a mean hs-CRP of 2.0 $\pm$ .8–4.4 mg/L on the development and validation of the RRS; 2) the Justification for the Use of Statins in Prevention: an Intervention Trial Evaluating Rosuvastatin (JUPITER) study showed a median hs-CRP level of 4.2 mg/L for the treatment group and 4.3 mg/L for the placebo group;[34] and 3) the Atherosclerosis Risk in Communities (ARIC) Study showed a hs-CRP weighted mean levels of 4.05 mg/L for cases compared to non cases of 3.04 mg/L and an LpPLA2 of 404 μg/L for cases and 372 μg/L for non cases.[35]

Our study examined the association of BMI with the lipid panel. Results showed that BMI was inversely correlated with HDL-C. The higher the BMI levels the lower the HDL-C, leading to increased risk for heart disease. Even the BMI 23–29.9 group had a higher risk for lower HDL-C. Body mass index was also significantly associated with elevated triglyceride levels. Results showed that the higher the BMI level, the higher the triglyceride level that may in turn lead to an increased risk for the development of atherosclerotic plaques.

Limitations

Our cross sectional study using a convenience, non-random sample warrants caution in drawing conclusions that apply to the larger population of FAW. Age did not correlate with BMI, and therefore, we did not age-adjust our results. Moreover, differences may be seen in FAW as a function of whether born in the Philippines vs born in the United States. Length of time in the United States may also be a confounder that was not considered in our study. Given the non-random sample, the generalizability of the conclusions to all Filipino American women is not known and thus further studies are necessary. Longitudinal studies with larger populations could examine CVD events as well as risk factors. Whether the findings are applicable to Filipino males is not known but we focused on women because Asian American women are highly understudied and underserved.

CONCLUSIONS

In support of numerous other studies, our study demonstrated that increased BMI was highly associated with central obesity, hypertension, diabetes (elevated hemoglobin A1c), dyslipidemia (decreased HDL-C and elevated triglyceride levels) and CVD inflammation (elevated hs-CRP levels). Our novel finding is that the prevalence of these risk factors increases significantly starting at a BMI of 23–24.9. Thus, BMI cut-off levels for FAW may need to be lowered to <23 kg/m^2 in order to prevent development of CVD in contrast to the conventional BMI recommendations for overweight and obesity.

ACKNOWLEDGMENTS

The authors would like to acknowledge the support received from the University of North Florida Brooks Professorship Grant and diaDexus Inc. for their generous support of the study and the LpPLA2 testing. We are most grateful for all Filipino American women participants and research study volunteers without whom this study would not have been possible.

REFERENCES

1. Republic of the Philippines Department of Health. Leading Causes of Mortality. www.doh.gov.ph/node/198.html. Accessed October 29, 2013.
2. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics–2012 update: a report from the American Heart Association. *Circulation*. 2012;125(1):e2–e220.
3. Wang EJ, Wong EC, Dixit AA, Fortmann SP, Linde RB, Palaniappan LP. Type 2 diabetes: identifying high risk Asian American subgroups in a clinical population. *Diabetes Res Clin Pract*. 2011;93(2):248–254.
4. Palaniappan LP, Wong EC, Shin JJ, Fortmann SP, Lauderdale DS. Asian Americans have greater prevalence of metabolic syndrome despite lower body mass index. *Int J Obes (Lond)*. 2011;35(3):393–400.
5. Holland AT, Wong EC, Lauderdale DS, Palaniappan LP. Spectrum of cardiovascular diseases in Asian-American racial/ethnic subgroups. *Ann Epidemiol*. 2011;21(8):608–614.
6. Araneta MR, Barrett-Connor E. Ethnic differences in visceral adipose tissue and type 2 diabetes: Filipino, African-American, and White women. *Obes Res*. 2005;13(8):1458–1465.
7. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-based guidelines for the prevention of cardiovascular disease in women–2011 update: a guideline from the American Heart Association. *Circulation*. 2011;123(11):1243–1262.
8. Deurenberg-Yap M, Schmidt G, van Staveren WA, Deurenberg P. The paradox of low body mass index and high body fat percentage among Chinese, Malays and Indians in Singapore. *Int J Obes Relat Metab Disord*. 2000;24(8):1011–1017.
9. Wen CP, David Cheng TY, Tsai SP, et al. Are Asians at greater mortality risks for being overweight than Caucasians? Redefining obesity for Asians. *Public Health Nutr*. 2009;12(4):497–506.
10. Pan WH, Flegal KM, Chang HY, Yeh WT, Yeh CJ, Lee WC. Body mass index and obesity-related metabolic disorders in Taiwanese and US Whites and Blacks: implications for definitions of overweight and obesity for Asians. *Am J Clin Nutr*. 2004;79(1):31–39.
11. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004;363(9403):157–163.
12. Low S, Chin MC, Ma S, Heng D, Deurenberg-Yap M. Rationale for redefining obesity in Asians. *Ann Acad Med Singapore*. 2009;38(1):66–69.
13. Grundy SM, Cleeman JI, Daniels SR, et al. Diagnosis and management of the metabolic syndrome. An American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Executive summary. *Cardiol Rev*. 2005;13(6):322–327.
14. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2013;36 Suppl 1:S67–S74.
15. American Diabetes Association. Living with diabetes: A1C. www.diabetes.org/living-with-diabetes/treatment-and-care/blood-glucose-control/a1c/. Accessed October 29, 2013.
16. US Department of Health and Human Services. The Seventh Report of the Joint National Committee on Prevention, Detection Evaluation, and Treatment of High Blood Pressure. 2004.
17. International Diabetes Foundation. The IDF consensus worldwide definition of the Metabolic Syndrome. 2006. www.idf.org/webdata/docs/IDF_Meta_def_final.pdf. Accessed October 29, 2013.
18. Pearson TA, Mensah GA, Alexander RW, et al. Markers of inflammation and cardiovascular disease: application to clinical and public health practice: A statement for healthcare professionals from the Centers for Disease Control and Prevention and the American Heart Association. *Circulation*. 2003;107(3):499–511.
19. World Health Organization. Cardiovascular Diseases. www.who.int/mediacentre/factsheets/fs317/en/. Accessed July 28, 2013.
20. Center for Disease Control and Prevention. About BMI for Adults. www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html. Accessed July 28, 2013.
21. Prentice AM, Jebb SA. Beyond body mass index. *Obes*. Rev 2001;2:141–147.
22. Deurenberg P, Deurenberg-Yap M. Validity of body composition methods across ethnic population groups. *Forum Nutr*. 2003;56:299–301.
23. Gallagher D, Visser M, Sepulveda D, Pierson RN, Harris T, Heymsfield SB. How useful is body mass index for comparison of body fatness across age, sex, and ethnic groups? *Am J Epidemiol*. 1996;143:228–239.
24. He M, Tan KC, Li ET, Kung AW. Body fat determination by dual energy X-ray absorptiometry and its relation to body mass index and waist circumference in Hong Kong Chinese.

Int J Obes Relat Metab Disord. 2001;25: 748–752.

25. World Health Organization. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Consultation. WHO Technical Report Series Number 854. Geneva: World Health Organization, 1995.
26. Holland AT, Zhao B, Wong EC, Choi SE, Wong ND, Palaniappan LP. Racial/ethnic differences in control of cardiovascular risk factors among type 2 diabetes patients in an insured, ambulatory care population. *J Diabetes Complications*. 2013;27(1):34–40.
27. Karter AJ, Schillinger D, Adams AS, et al. Elevated rates of diabetes in Pacific Islanders and Asian Subgroups: The Diabetes Study of Northern California (DISTANCE). *Diabetes Care*. 2013;36(3):574–579.
28. Gentilucci UV, Picardi A, Manfrini S, M et al. Westernization of the Filipino population resident in Rome: obesity, diabetes and hypertension. *Diabetes Metab Res Rev*. 2008;24(5):364–370.
29. Ancheta IB, Battie CA, Tuason T, Ancheta CV. A comparison of metabolic syndrome (MetS) risk factors in Filipino women and Filipino American women: a pilot study. *Ethn Dis*. 2012;22(4):404–409.
30. Ye J, Rust G, Baltrus P, Daniels E. Cardiovascular risk factors among Asian Americans: results from a National Health Survey. *Ann Epidemiol*. 2009;19(10):718–723.
31. Ridker PM. Moving beyond JUPITER: will inhibiting inflammation reduce vascular event rates? *Curr Atheroscler Rep*. 2013;15(1):295.
32. Ganguli D, Das N, Saha I, et al. Association between inflammatory markers and cardiovascular risk factors in women from Kolkata, W.B., India. *Arq Bras Cardiol*. 2011;96(1):38–46.
33. Ridker PM, Fonseca FA, Genest J, et al. Baseline characteristics of participants in the JUPITER trial, a randomized placebo-controlled primary prevention trial of statin therapy among individuals with low low-density lipoprotein cholesterol and elevated high-sensitivity C-reactive protein. *Am J Cardiol*. 2007;100(11):1659–1664.
34. Ridker PM, Danielson E, Fonseca FA, et al. Rosuvastatin to prevent vascular events in men and women with elevated C-reactive protein. *N Engl J Med*. 2008;359(21):2195–2207.
35. Ballantyne CM, Hoogeveen RC, Bang H, et al. Lipoprotein-associated phospholipase A2, high-sensitivity C-reactive protein, and risk for incident coronary heart disease in middle-aged men and women in the Atherosclerosis Risk in Communities (ARIC) study. *Circulation*. 2004;109(7):837–842.

AUTHOR CONTRIBUTIONS

Design and concept of study: I. Ancheta, Battie
Acquisition of data: I. Ancheta, Tuason, Borja-Hart, C. Ancheta
Data analysis and interpretation: I. Ancheta, Battie, Tuason, C. Ancheta
Manuscript draft: I. Ancheta, Battie, Tuason, Borja-Hart, C. Ancheta
Statistical expertise: Battie, Tuason
Acquisition of funding: I. Ancheta
Administrative: Battie, C. Ancheta
Supervision: I. Ancheta