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Anthropometric measures and lipid CHD risk factors in Korean Immigrants with Type 2 Diabetes

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Abstract

Objectives—The purpose of this study was to 1) describe anthropometric measures among Korean immigrants with type 2 diabetes (T2DM); and, 2) examine the relationships between measures of obesity with several forms of dyslipidemia in this group.

Background—Obesity and dyslipidemia are commonly associated with T2DM and they are risk factors for coronary heart disease (CHD), the leading cause of death for people with diabetes. Asians are predisposed to abdominal obesity and experience significant CHD risk at lower BMI levels. Despite high prevalence of diabetes among Korean immigrants, relationships among anthropometric measures and lipid-related CHD risk factors have not been examined.

Methods—A convenience sample of 143 adult Korean immigrants with T2DM between the ages of 30–80 participated in the study. Body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR) were obtained using standardized procedures. Total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL), and high-density lipoprotein cholesterol (HDL) were assessed using a finger stick blood test. Hierarchical linear regressions were conducted to identify which of the anthropometric measures was significantly related to individuals' cholesterol levels.

Results—Central obesity measures, not BMI, were significantly associated with dyslipidemia in Korean immigrants with T2DM independent of potential confounds such as hemoglobin A1C, cigarette smoking, age, and cholesterol medication. Different central obesity measures were associated with different cholesterol types for Korean diabetic men and women. In men, WHR was positively associated with LDL and TC levels. In women, WC was negatively associated with HDL.

Conclusions—Central obesity measures (WC and WHR) are better indicators for assessing lipid-related CHD risk factor among Korean immigrants with T2DM than BMI. Gender difference in the association between central obesity measures and lipid types should be considered in CHD risk assessment of Korean immigrants with T2DM.

Keywords

type 2 diabetes; BMI; waist circumference; waist-hip ratio; lipids; Korean Americans

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Coronary heart disease (CHD) is the leading cause of death for people with diabetes.[1] People with diabetes are 2 to 4 times more likely to develop CHD than people without

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diabetes. [2–4] Dyslipidemia, commonly associated with diabetes, is a major risk factor for the development of CHD. [5–6] Randomized trials and large observational studies have demonstrated that elevated total cholesterol (TC), low-density lipoprotein cholesterol (LDL), and serum triglycerides (TG), and low levels of high-density lipoprotein cholesterol (HDL) are associated with an increased risk of CHD.[5–6] Early detection and intervention of abnormal blood lipid levels are essential to reduce CHD risk in individuals with diabetes.

Anthropometric measures such as body mass index (BMI), waist circumference (WC), and waist- to- hip ratio (WHR) have been associated with physiological indicators of CHD risk (e.g., blood pressure, glucose, and plasma lipids).[7–9] Most recently, investigators have examined which anthropometric measure is best able to identify those individuals with increased CHD risk. Measures of central obesity, WC and WHR, have consistently been better predictors of CHD risk factors, such as diabetes, hypertension, and dyslipidemia than BMI, a conventional measure of obesity. [10–12] Particularly, WC has been shown to have a linear relationship with intra-abdominal fat; subsequently, studies have indicated that WC could be used as a surrogate for body fat imaging techniques in predicting CHD risk factor abnormalities. [13–14]

Asians are predisposed to visceral or abdominal obesity, and the health risks associated with obesity occur at a lower BMI in Asians than in Caucasians.[15–18] Because Asians have smaller frames and different body fat composition, the relationships between anthropometric measures and physiological CHD risk factors in the Asian population are considered different from Caucasians. Researchers have noted that Japanese subjects had higher levels of total cholesterol and LDL at lower weights, BMI levels, and smaller WC, as compared to Caucasians, suggesting that associations between BMI, WC, and lipid levels in Japanese differ from those in Caucasians.[19] A meta-analysis of studies with Asian populations (7/10 studies) reported that measures of central obesity were superior to BMI for detecting cardiovascular risk factors, such as hypertension, diabetes, and dyslipidemia for both sexes. [12] A large observational study to identify patterns of dyslipidemia using anthropometric measures in ethnically diverse populations of the Asian-Pacific Region found that BMI, WC, and WHR were linearly associated with the lipids (TC, LDL, HDL, and TG), but no single anthropometric measure was superior at discriminating those individuals at increased risk of dyslipidemia.[20]

Korean immigrants, the fifth largest group among Asian Americans and Pacific Islanders[21], have experienced a rapid rise of diabetes incidence. According to recent health survey in California—which has the largest population of Koreans in the US [21] the—prevalence of diabetes among Koreans is higher than Chinese, Japanese, Vietnamese, and Caucasians.[22] Although the prevalence of heart disease among Koreans in the U. S. is reported to be lower than that of other Asian subgroups except Vietnamese,[23] CHD is the third leading cause of death in Korea and DM is considered the most prevalent CHD risk factor.[24, 25] Moreover, high levels of total cholesterol in men and low HDL-C in women were also identified as significant risk factors for CHD among Koreans in Korea. [26]

Little is known about the relationship between anthropometric measures and lipids abnormalities among Korean immigrants with type 2 diabetes. However, based on previous research findings, anthropometric measures (e.g., WC and WHR) may serve as a relatively simple and effective measure to identify who among diabetic Korean immigrants are at risk of developing dyslipidemia and most in need of further clinical assessment. Therefore, the purposes of this study are to: 1) describe anthropometric measures among Korean immigrants with type 2 diabetes; and, 2) examine the relationships between indices of body composition (BMI, WC, and WHR) and plasma lipid coronary risk factors in this group. Because men and women have different criteria used as cutoff for central adiposity and men

and women have different normal ranges for HDL, separate analyses will be run to identify gender-specific patterns in this relationship.

Methods

Participants

A convenience sample of 143 adult Korean immigrants was recruited through flyers and posters at community sites including health clinics' waiting areas, pharmacies, and a shopping mall. Interested persons met the researcher in the reception area of the clinic or pharmacy or called to arrange an appointment. To be eligible for inclusion, individuals had to be Korean-born immigrants between the ages of 30 and 80 years, be diagnosed with type 2 diabetes for at least a year, and be able to speak, read, and write in Korean or English. The study was approved by a university institutional review board, and all participants were provided with written informed consent.

Procedure

Participants completed a demographic and clinical questionnaire in either English or Korean and were encouraged to ask for assistance, if needed. A registered nurse conducted several health measurements as described below.

Measures

Anthropometric Measures—Participants were assessed for anthropometric measures: height and weight to assess BMI and waist and hip circumferences to assess the WHR. With participants in bare feet, height was measured in centimeters to the top of the head using a non-stretching measuring tape secured to the wall. Weight was measured in kilograms using a professional body-weight scale; participants wore only light clothing, empty of all belongings, and no shoes. BMI was calculated using the formula: (BMI = kg/m2). WC was measured in centimeters by placing a non-stretching measuring tape in a horizontal plane around a participant's bare abdomen at the top of the iliac crest. The reading was taken after expiration, making sure that the tape was secure but not too tight. Hip measurement was taken at the point of maximum circumference over the buttocks, with the measuring tape held in a horizontal plane touching the skin (the surface of light clothing in this study) but not indenting soft tissue. The WHR was calculated by dividing waist measurement by hip measurement.

Biological Health Indicators (Hemoglobin A1C (A1C), TC, HDL, LDL, TG)—Each participant was assessed for cholesterol (lipid panel) and A1C. Using a finger-stick sample of whole blood, a fasting lipid panel was analyzed with the CardioChek PA™, a cholesterol measuring device that meets the accuracy guidelines of the National Cholesterol Education Program.[27] A1C was measured using the same finger-stick blood sample by the Metrika A1C Now InView, which is certified by the National Glycohemoglobin Standardization Program. [28, 29] A1C levels were also obtained from those patients recruited from a health center who offered their personal A1C records for use in the study. Because the clinic also used the A1C Now InView and these values were written in by the clinic staff, the results provided by participants were used if they had been obtained within the preceding 3 months.

Blood Pressure—Blood pressure was measured with an electronic blood pressure monitor (A&D Medical Model UA-767) using standardized procedures. This device was validated against a mercury sphygmomanometer and has been reported to be as reliable as the conventional stethoscope sphygmomanometer. Two readings 2 minutes apart were taken after a participant had been seated for at least 5 minutes and were then averaged.

Cholesterol Medication—Participants were asked to list all the cholesterol medications they were currently using. Many did not know the correct name(s) of cholesterol medications they were taking and could only provide the number of medications. For this reason, the type (statins vs. other cholesterol lowering medications) or dosage information could not be obtained. If they did provide a list of medications, then the list was converted to a count score. Since majority of participants were taking only one cholesterol medication, this was dichotomized as yes or no response.

Smoking—Smoking status was assessed with two questions used by the Centers for Disease Control and Prevention (CDC) to define current smokers [30]; "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes everyday, some days, or not at all?" Responses with "yes" and "everyday or some days" were coded as "current smoker."

Overview of Analyses

SPSS 16.0 was used to conduct all data analyses. To examine gender differences in key study variables, t-test was conducted. Since there were significant gender differences in key study variables (ps<.05; see Table 1), subsequent analyses (correlations and regressions) were run for men and women separately. In order to identify which of the three anthropometric measures was significantly related to individuals' cholesterol levels, three separate hierarchical linear regressions were conducted: one for each of the cholesterol types (i.e. HDL, LDL, and TC). Demographic and theoretically important variables were entered initially as controls (e.g. age, cholesterol medication use, smoking status), and then the three anthropometric measures were entered simultaneously on the second step.

Results

Demographics

A total of 143 individuals participated in the study. The sample was 51.7% women, and the mean age was 62.4 years (SD = 12.8; range = 30 to 80). The mean duration of residence in the United States was 21.7 years (SD = 9.2), and the mean duration of diabetes was 6.8 years (SD = 6.2). Most participants (85.3%) were taking medication for diabetes, more than two thirds (70.6%) were taking medication for hypertension, and close to two thirds (59.4%) were taking medication for cholesterol. More than two thirds of the sample (68.5%) indicated that their general health was poor or fair.

Anthropometric measures and lipid CHD risk factors

Gender specific description of anthropometric measures and lipids are presented in Table 1. The percentages of subjects with abnormal anthropometric values according to guidelines for Asian populations are described in Table 2, along with the percentages of subjects with abnormal values of lipids according to the American Diabetes Association (ADA)'s standards of care. [31] Most participants (80.4%) exceeded the overweight parameter of BMI (23 kg/m^2) recommended by the World Health Organization for Asians.[32] Similarly, more than three quarters of men and women had central obesity (women > men), according to the Asia-Pacific criteria for waist circumference (men =90 cm, women=80 cm).[10]

More than half (51.7%) had LDL-C levels above recommended treatment goal, and nearly half (47.3%) of those individuals were taking cholesterol-lowering medication. More than half of men and women had HDL-C levels lower than recommended parameters to prevent CHD. About 16% were current smokers.

Gender Differences in Study Variables

As noted in Table 1 &2 there were significant differences between men and women in some of the key variables being considered in this study. Hence data analyses addressed the hypotheses separately for men and women. Women had significantly higher levels of HDL (t (141) = −4.80, p <.001), total cholesterol (t (141) = −2.06, p <.05), and were older in age (t (141) = −2.03, p <.05) than the men in this sample. However, men had significantly larger waist sizes (t (141) = 6.38, p <.001), waist-to-hip ratios (t (141) = 8.68, p <.001), and more smokers (t (141) = 2.26, p <.05) than women. There were no systematic gender differences in LDL, A1C levels, number of cholesterol medications taken, perceptions of general health, and BMI levels.

Correlations between anthropometric measures and lipids

Correlations between key study variables and outcomes are presented in Table 3. In men, WHR was positively related to TC, while age and taking cholesterol medication were negatively related to LDL and TC. In women, all three anthropometric measures: WC, WHR, and BMI were negatively related to HDL. Larger WC, WHR, and higher BMI levels were all indicative of lower HDL levels. Women's WCs were negatively related to TC. Triglyceride (TG) was not related to any of the variables in men or women.

Multivariate model for Total, LDL, HDL and TG

To examine which of the three anthropometric measures is the best indicator for each of the four cholesterol types in men and women, multiple regression analyses were conducted (Table 4 and Table 5). The anthropometric measures—WC, WHR, and BMI—were simultaneously entered into the regression, after controlling for demographic variables (age) and health measures (A1C levels, cholesterol medication use, and smoking). The interaction between gender and anthropometric measures was not associated with any outcomes. Measures of central obesity were tested and shown not to be multicollinear.

HDL-C analysis

Men: The regression significantly modeled immigrant Korean male diabetics' HDL-C levels (F (7,61) = 2.32, p < .05). However, none of the anthropometric measures were significantly related to men's HDL-C levels.

Women: The regression model significantly predicted female diabetics' HDL-C levels (F (7,66) = 3.33, p <.01; R^2 = .26). After controlling for all the demographic, health, and anthropometric measures, only women's WC was significantly related to HDL-C levels. As women's WC increased, their HDL levels decreased (b = −2.05, SE = .76, p < .01). WHR and BMI were not significantly related to women's HDL levels.

LDL-C analysis

Men: The same approach was used to examine the relationship between the various anthropometric measures and LDL-C levels. For men, the model significantly predicted the variation in LDL levels (F (7, 58) = 4.23, p < .01; R^2 = .34). After adjusting for age, A1C levels, cholesterol medication use, and smoking, men's WHR was the sole anthropometric measure associated with men's LDL levels. Immigrant male Korean diabetics' larger WHR was related to their higher LDL levels (b = 281.47, SE = 125.41, p < .05).

Women: Women's anthropometric measures were unrelated to LDL levels, F (7,64) = 1.70, *n.s.*.

Total cholesterol

Men: Total cholesterol was significantly predicted by the regression model ($F_{(7,61)} = 5.60$, $p < .001$; $R^2 = .39$). Two of the anthropometric measures were related to men's total cholesterol levels: WC and WHR. Larger waist circumferences were related to lower levels of total cholesterol ($b = -6.01$, $SE = 2.98$, $p < .05$). In contrast, larger waist-to-hip ratios were indicative of higher total cholesterol levels ($b = 391.13$, $SE = 141.70$, $p < .01$).

Women: In contrast women's anthropometric measures were unrelated to total cholesterol levels ($F_{(7, 66)} = 1.63$, *n.s.*).

Triglycerides—Individuals' TG levels were modeled using the same regression approach. The model did not significantly predict the variance in TG levels ($F_{(8,134)} = .65$, *n.s.*).

Discussion

This study is one of the first to examine the relationships between anthropometric measures and lipids in an Asian immigrant subgroup population at risk for increased CHD risk. The results of the present study showed that after controlling of potential confounds (A1C, cigarette smoking, age, and cholesterol medication), central obesity measures, not BMI, are important indicators of dyslipidemia in Korean immigrant men and women with type 2 diabetes. This finding is consistent with previous studies that indicated that WC and WHR are better predictors for CHD risk factors (e.g. DM, lipids, BP) than BMI among Asians.[33–35] A study with Chinese adults indicated that WC adds additional cardiovascular risk information to that of BMI and enhances the accuracy of cardiovascular risk assessment.[36] Similarly, central obesity measures (WC and WHR) may provide useful information about dyslipidemia in Korean immigrants with type 2 diabetes, prompting further clinical evaluation in those individuals with abnormal measures.

The present study also found that the key anthropometric correlates were different for Korean diabetic men and women (WHR and WC for men, WC for women), and each predicted only certain types of lipids. Korean diabetic men's WHR predicted LDL and TC, while their WC predicted TC. Korean diabetic women's WC predicted HDL only. Evidence suggests that LDL and HDL are strongly influenced by abdominal fat and measures of central obesity may provide information as reliable as imaging studies on lipids risk.[13–14] However, these associations have not been examined in Korean immigrants with type 2 diabetes in the US to date. In the present study, WHR and WC had a significant relationship with lipids in men, and only WC had a significant relationship with lipids in women. Further, each of their role was specific to certain lipid type (men's WHR was associated with LDL and TC and men's WC was associated with TC, while women's WC was associated only with HDL). Considering that LDL is a major risk factor for CHD, the finding in men is consistent with a recent large case controlled study of 27,000 participants worldwide, in which WHR showed a highly significant association with the risk of myocardial infarction. [37] The significant association between women's WC and HDL found in this study is also consistent with other recent studies. [38, 39]

This gender specific pattern of meaningful lipids for CHD risk in this immigrant sample is consistent with findings from a Korean epidemiological study that identified TC in men and HDL in women as significant CHD risk factors. [26] Considering that the mean duration of stay in the US in this study sample is 22 years, there may be two possible explanations for this consistency. One may be similar lifestyle habits (e.g., diet and exercise) in both countries suggesting that immigration did not bring much change. The other possibility may be population specific genetic makeup related to lipids profile. As Korean immigrant population grows, further study may be needed to examine potential difference and

similarities in lipid CHD risk factors between immigrants and native population in the country of origin.

Cholesterol management in people with diabetes, particularly LDL and HDL, is critical because of their strong independent association with CHD. [40, 41] As such, both ADA and National Cholesterol Education Program (NCEP) practice guidelines emphasize early detection of these lipids abnormalities and target them in the treatment and risk reduction for CHD. [31, 41] Central obesity measures (WC and WHR) may serve as a relatively simple and effective way to identify diabetic Korean immigrants who are at risk of dyslipidemia and most in need of further clinical assessment or more frequent monitoring of lipids. WHR and WC may offer the best information on the CHD lipid risk status (by LDL and TC) for Korean immigrant men with type 2 diabetes and WC may offer the best CHD lipid risk status (by HDL) for Korean women with type 2 diabetes. Clinicians working with diabetic Korean immigrants should consider including gender specific central obesity measure in their initial and ongoing CHD risk assessment and provide the patient with education and counseling for CHD risk reduction and weight loss accordingly for each gender.

Additional noteworthy finding in this study sample was that the percentages of abnormal central obesity measures and lipids abnormalities were higher in women than men. This poses a serious concern because women's risk for fatal CHD associated with diabetes is 50% higher than it is for men. [42] Korean women with type 2 diabetes deserve urgent attention for screening and management of central obesity and lipid abnormality to reduce their CHD risk. Intervention to raise HDL in obese diabetic Korean women should focus on effective weight loss program targeting WC.

A few counterintuitive findings were encountered in this study. First, correlations between anthropometric measures and lipids showed that Korean diabetic men's age was inversely related to LDL and TC. However, reduction of total cholesterol with aging has been observed in clinical and epidemiologic studies and it has been suggested that this age-dependent reduction is substantially explained by the effect of poor health status.[43] Considering that more than half of the present study participants were elderly and more than two thirds indicated their general health to be poor or fair, age and health status may partially explain this finding. Moreover, age has been shown to attenuate or change the direction of the relationship between lipid risk factors and WC. [44–46] In Iwao et al's study [46], WC was positively related to LDL and TC in men before the age of 65, but negatively related to LDL and TC in men over age 65. This may potentially explain women's larger WC being related to lower TC as well as men's larger WC associated with lower TC. Further studies are needed to elucidate the underlying factors (e.g., genetic factors) in the relationship between WC and TC in Korean immigrant men and women with type 2 diabetes.

This study has several limitations. First, because it used a convenience sample from community sites in a West Coast Korean ethnic enclave, the results cannot be generalized to the broader population of Korean immigrants. Second, the sample comprised first generation immigrants only. Thus, generalizing the results to Koreans born in the United States may not be appropriate. Third, since this is a cross-sectional study, the findings cannot explain causal relationships. Fourth, this study used Asian criteria for anthropometric measures, which may have influenced the proportion of sample for BMI and central obesity measures. The immigrant population may need different anthropometric criteria than native country population because different lifestyle and social environment may have different effect on obesity. Further study is needed in this area as the Asian population in the US grows. The strengths of this study include generation of knowledge for CHD risk and risk assessment

for diabetic Korean immigrants, for whom there is little health information, and the presentation of gender specific data for CHD risk assessment for this at-risk Asian subgroup.

Summary and Implications

This study revealed that measures of central obesity (WC and WHR) are associated with dyslipidemia among Korean immigrants with type 2 diabetes. BMI was not associated with lipids. The association was specific to lipid type and gender. In men, WHR was positively associated with LDL and TC levels, while WC was negatively associated with TC. In women, WC was negatively associated with HDL. The unique gender specific patterns in the relationship between central obesity measures and lipid types should be considered in CHD risk assessment of Korean immigrants with type 2 diabetes. For example, in women, WC may be more clinically relevant and meaningful than WHR because WC matters most for HDL in women. In addition, present study found that a higher percentage of Korean women with type 2 diabetes had abnormal WC and WHR than men. Nurses and health care providers should pay special attention to Korean immigrant women with diabetes in screening and monitoring for lipid CHD risk factors given that women with diabetes carry higher CHD risk than men with diabetes.

What's New and Important

- Measures of central obesity (WC and WHR) are associated with lipids CHD risk factors in Korean immigrants with type 2 diabetes.

- The association is specific to lipid type and gender; WHR was positively associated with LDL and TC levels in men, while WC was negatively associated with TC. In women, WC was negatively associated with HDL.

- BMI is not associated with lipids.

- Higher percentage of diabetic Korean women has WC and WHR exceeding normal values than diabetic Korean men.

Acknowledgments

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Table 1

Characteristics of subjects (Mean ± SD)

	Total sample (n =143)	Men (n =69)	Women (n =74)	t – statistic
Age	62.44 ± 12.76	60.22 ± 13.34	64.51 ± 11.92	−2.03[*]
Weight (kg)	68.00 ± 11.54	75.18 ± 9.95	61.31 ± 8.53	8.97[***]
Height (cm)	162.13 ± 9.12	169.36 ± 5.56	155.38 ± 6.13	14.25[***]
BMI (kg/m2)	25.77 ± 3.15	26.21 ± 3.24	25.36 ± 3.03	1.61
WC (cm)	91.64 ± 9.25	96.16 ± 7.77	87.43 ± 8.53	6.38[***]
WHR	.89 ± .05	.92 ± .04	.86 ± .04	8.68[***]
TC	189.04 ± 54.23	179.49 ± 49.02	197.95 ± 57.58	−2.06[*]
LDL	108.52 ± 39.98	104.01 ± 40.28	112.65 ± 39.53	−1.27
HDL	44.28 ± 13.30	39.14 ± 11.36	49.08 ± 13.25	−4.80[***]
TG	173.81 ± 105.67	171.04 ± 94.84	176.39 ± 115.45	.30
A1C	7.59 ± 1.45	7.67 ± 1.45	7.53 ± 1.46	.57
SBP	130.06 ± 19.72	129.94 ± 19.81	130.16 ± 19.78	.07
DBP	74.66 ± 12.17	76.09 ± 12.62	73.32 ± 11.66	1.36

Note:

[*]
$p < .05$;

[**]
$p < .01$;

[***]
$p < .001$

Abbreviations: BMI, body mass index; WC, waist circumference; WHR, waist-to-hip ratio; TC, total cholesterol; LDL, low density lipoprotein; HDL, high density lipoprotein; TG, Triglyceride; A1C, glycosylated hemoglobin; SBP, systolic blood pressure; DBP, diastolic blood pressure

Table 2

The number and percentage of subjects with an abnormal value (N = 143)

	Total sample	Men 69 (48.3%)	Women 74 (51.7%)
BMI ≥ 23kg/m²[§]	115 (80.4%)	56 (81.2%)	59 (79.7%)
WC (cm%) [‡] (> 90 men, >80 women)		57 (82.6%)	63 (85.1%)
WHR [†] (>0.9 men, >0.8 women)		52 (75.4%)	69 (93.2%)
TC ≥ 200 mg/dL	48 (33.6%)	21 (30.4%)	27 (36.5%)
LDL ≥ 100 mg/dL	74 (51.7%)	32 (46.4%)	42 (56.8%)
HDL, mg/dL ≤ 40 men, ≤ 50 women		37 (53.6%)	45 (60.8%)
TG ≥ 150mg/dL	68 (47.6%)	35 (50.7%)	33 (44.6%)
A1C ≥ 7%	84 (58.7%)	44 (63.8%)	40 (54.1%)
SBP > 130 mmHg	61 (42.7%)	28 (40.6%)	33 (44.6%)
DBP > 80 mmHg	51 (35.7%)	30 (42.0%)	21 (29.7%)
Smoking	23 (16.1%)	16 (23.2%)	7 (9.5%)

Abbreviations: BMI, body mass index; WC, waist circumference; WHR, waist-to-hip ratio; TC, total cholesterol; LDL, low density lipoprotein; HDL, high density lipoprotein; TG, Triglyceride; A1C, glycosylated hemoglobin; SBP, systolic blood pressure; DBP, diastolic blood pressure

[*] Adapted from: American Diabetes Association, Clinical Practice Recommendations, 2009. *Diabetes Care.* 2009; 32(suppl 1): 19–32.

[§] World Health Organization recommendation for Asians, 2002.

[‡] World Health Organization Asia-Pacific Criteria, 2000.

[†] The Obesity in Asia Collaboration, 2008

Table 3

Correlations between the major outcomes and the study variables by gender (N=143)

		Age	General health	A1C	Cholesterol medication	Smoking	WC	WHR	BMI
Men	HDL	−.11	−.17	−.04	.12	−.22	−.21	.05	−.18
	LDL	−.26*	−.01	.17	−.47***	.20	−.15	.18	−.08
	TC	−.41**	−.03	.11	−.45***	.22	−.17	.26*	−.03
Women	HDL	−.24*	.00	.11	−.10	−.09	−.45***	−.26*	−.25*
	LDL	−.03	−.02	.08	−.09	.26*	−.19	.10	−.21
	TC	−.03	.13	.09	−.02	.22	−.25*	.00	−.22

Note:

*
p<.05;

**
p<.01;

***
p < .001

A1C, glycosylated hemoglobin; WC, waist circumference; WHR, waist-to-hip ratio; BMI, body mass index; HDL, high density lipoprotein; LDL, low density lipoprotein; TC, total cholesterol

Table 4

Multivariate linear model for HDL, LDL, and Total Cholesterol for men (N = 69)

	HDL			LDL			TC		
	b	SE	β	b	SE	β	b	SE	β
Age	-.29*	.12	-.34	-.16	.40	-.05	-.75	.46	-.21
A1C	-.33	.95	-.04	2.56	3.13	.09	1.16	3.59	.03
Cholesterol medication	4.67	2.79	.20	-36.09***	9.22	-.44	-34.74**	10.56	-.35
Smoking	-9.38**	3.43	-.35	10.95	11.59	.11	4.67	13.01	.04
WC	-.99	.79	-.27	-2.88	2.58	-.22	-6.01*	2.98	-.38
WHR	39.04	37.40	.13	281.47*	125.41	.27	391.13**	141.70	.30
BMI	-.15	.75	-.04	-.49	2.54	-.04	1.65	2.85	.11
F (df)	2.32* (7, 61)			4.23** (7, 58)			5.60*** (7,61)		
R^2	.21			.34			.39		

Note:

*
$p < .05$;

**
$p < .01$;

***
$p < .001$

Abbreviations: HDL, high density lipoprotein; LDL, low density lipoprotein; TC, total cholesterol; A1C, glycosylated hemoglobin; WC, waist circumference; WHR, waist-to-hip ratio; BMI, body mass index

Table 5

Multivariate linear model for HDL, LDL, and Total Cholesterol for women (N=74)

	HDL			LDL			TC		
	b	SE	β	b	SE	β	b	SE	β
Age	−.05	.14	−.04	.35	.44	.11	.54	.65	.11
A1C	1.87	1.11	.21	.76	3.55	.03	2.83	5.17	.07
Cholesterol medication	1.40	3.18	.05	−1.60	10.46	−.02	7.59	14.81	.07
Smoking	−2.82	4.86	−.06	34.77*	15.52	.26	45.07	22.67	.23
WC	−2.05**	.76	−.52	−3.91	2.45	−.33	−6.79	3.57	−.40
WHR	−37.04	44.10	−.12	204.56	142.84	.21	164.49	205.74	.12
BMI	.67	.71	.15	−.08	2.28	−.01	.31	3.33	.02
F (df)	3.33**(7,66)			1.70 (7, 64)			1.63 (7,66)		
R^2	.26			.16			.15		

Note:

*
$p<.05$;

**
$p<.01$;

***
$p < .001$

Abbreviations: HDL, high density lipoprotein; LDL, low density lipoprotein; TC, total cholesterol; A1C, glycosylated hemoglobin; WC, waist circumference; WHR, waist-to-hip ratio; BMI, body mass index