InFo
Vol. 10, No. 2
October 2007
pp. 65 – 91

FEATURE

A Study of the Health Status of Filipino Workers in Selected Seventh-day Adventist Institutions in the Philippines

Gina Segovia-Siapco

Abstract: *The Adventist health message is unique among religious groups. For that reason, Adventists have been part of many health studies in developed countries. This small study focuses on the health of Adventist employees in a developing country. Many of the male participants in the study were found to be overweight, and to have elevated risk of heart disease. These results suggest that Filipino Adventist workers may need to be less casual about exercise and diet if they wish to live long, healthy lives.*

In light of the principle that our body is the temple of the Holy Spirit (1Cor. 6:19-20), Seventh-day Adventists (SDAs) embrace a lifestyle that abstains from harmful substances, such as tobacco, alcohol, and stimulants such as coffee and tea, and a diet free from food products coming from "unclean" animals (Leviticus 11). From 1848 onwards, Ellen White received visions which revealed to the early church the crucial relationship between "physical well-being and spiritual experience," especially espousing the importance of diet, exercise, water, fresh air, healthful attire, and rest (White, 1980, p. 276) and abstinence from harmful substances such as tobacco, tea, and coffee (Williams & Cameron, 1996).

In an attempt to determine how this difference in lifestyle from the general population affects health, several studies have been done on SDAs residing in the United States. Results of the first Adventist Health Study reveal that SDAs have lower mortality and morbidity for lifestyle diseases compared to the typical American population (Phillips, 1975; Fraser, 1988; Fraser & Shavlik, 2001).

This has been attributed to a temperate lifestyle, specifically to being cigarette and alcohol-free, and having a more plant-based diet.

Since several factors that result in ill health, such as cigarette-smoking and alcohol-drinking, are controlled for in SDA populations, scientific investigations on this group can provide a lot of information about the effects of nutrition and physical activity on health. Differences in lifestyle within the SDA population, particularly in diet preference, have been found to be associated with health outcomes. For example, cross-sectional data comparisons of SDA vegetarians and non-vegetarians show that vegetarians have lower morbidity rates for chronic diseases compared to their non-vegetarian counterparts (Fraser, 1999).

Factors which result from an imbalance in energy intake and expenditure due to lack of physical activity, such as obesity and overweight, are associated with increased risk for chronic or lifestyle diseases. The World Health Organization defines overweight as body mass index (BMI) of 25 kg/m^2 and greater, and obesity as BMI of 30 kg/m^2 and greater (WHO, 2004). The study of Singh, Lindsted, and Fraser (1999) on SDA men and women who never smoked shows a direct relationship between BMI and mortality risk especially as BMI exceeds 25 kg/m^2. Another study on a smaller number of non-smoking, non-alcohol drinking SDA men demonstrates that mortality risk only starts to increase when BMI reaches 27.5 kg/m^2 or more (Sorkin, Muller, & Andres, 1994).

In the Philippines, there are no published reports about the effects of the SDA lifestyle on health. Unpublished reports of the Asia-Pacific Division's (now divided into the Southern Asia Pacific Division or SSD and the Northern Asia Pacific Division or NSD) survey on the "State of the Church" in 1996 (Bissell & Siapco, 1996; Bissell, Siapco, & Cam, 1996; Bissell & Siapco, 1996) reveal that for the Philippine Unions, between 4% and 7% are strict vegetarians, 10-13% are lacto-ovo vegetarians, 54-64% eat clean meat occasionally, and 9-17% eat clean meat regularly (see Table 1). The unpublished reports, however, do not provide any information about other health practices of the SDA church members in the Philippines.

Table 1
Distribution of SDA members in the three Philippine Unions according to dietary practice, 1996 State of the Church Survey of the Asia-Pacific Division

Dietary Practice	North Philippine Union Mission	Central Philippine Union Mission	South Philippine Union Mission
Strict vegetarian, %	4.1	4.8	6.9
Lacto-ovo Vegetarian, %	10.5	13.3	10.3
Clean meat occasionally, %	61.6	63.5	54.3
Clean meat regularly, %	17.1	10.1	9.1
No response, %	6.7	8.3	19.5

Decades after receiving the health reform message, many workers of the SDA church in the Philippines still continue to struggle with stress-related problems due to the demands of the workplace, as well as poor dietary habits and neglect of regular physical activity that could balance mental exertion. The pressures, stresses, and sustained work demands consequential to the logarithmic increase in the use of modern technology in the workplace all contribute to a more sedentary lifestyle among SDA workers. The mushrooming of fast food centers even in remote rural areas increases the availability of foods high in trans fats that have been shown to be associated with myocardial infarction and conditions that contribute to chronic disease risk (Clifton, Keogh, & Noakes, 2004; Mozaffarian, Pischon, Hankinson, Rifai, Joshipura, Willett, & Rimm, 2004; De Roos, Bots, & Katan, 2001). Due to pressure and demands associated with the nature of their jobs, pastors, administrators, and office workers are especially more vulnerable to stress and the lack of adequate rest and/or regular physical exercise which could have a negative impact on their health. To the knowledge of this researcher, no research has been done to determine the health status of SDAs in the Philippines compared to the general Philippine population; neither has the health status of the Filipino SDA workforce been studied.

The aim of this study is two-fold: to investigate the health status of SDA workers from selected institutions in the Philippines using biologic and anthropometric methods of health assessment, and to determine the association between these variables. Although done on a small scale, it is hoped that this study will pave the way for a more thorough investigation of the health status of the Filipino SDA church members in the future.

Review of Health Status Indicators

Several measures can be used as health status indicators. This study focused only on two methods: anthropometric and biological. Anthropometric variables include height, weight, circumferences, and body composition (fat mass, fat-free mass, total body water, percent body fat). Biological assessment includes fasting blood sugar (FBS), total serum cholesterol (TC), high density lipoprotein cholesterol (HDL-cholesterol), low density lipoprotein cholesterol (LDL-cholesterol), serum triglycerides, and blood pressure measurement.

Anthropometric Measurements as Health Status Indicators

Assessing weight status is part of the routine procedure to evaluate chronic disease risk. Body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR) are used as indicators of obesity (Hu, Tuomilehto, Silventoinen, Barengo, & Jousilahti, 2004). Thus, it is not surprising if BMI, WC, and WHR are found to be independent risk factors or associated with chronic diseases such as cardiovascular disease, type 2 diabetes, and certain cancers (Farin, Abbasi, & Reaven, 2006; Zhu, Heshka, Wang, Shen, Allison, Ross, & Heymsfield, 2006; Asia Pacific Cohort Studies Collaboration, 2004; Hu, et al., 2004; Borugian, Sheps, Kim-Sing, Olivotto, van Patten, Dunn, Coldman, et al., 2003; Seidell, Pérusse, Després, & Bouchard, 2001; Iwao, Iwao, Muller, Elahi, Shimokata, & Andres, 2001). BMI is most commonly used to assess weight status. A BMI of between 18.5 kg/m^2 and 24.9 kg/m^2 has been set as the full normal range (WHO, 2000) but a group of investigators suggested 18.5 to 22.9 kg/m^2 to be set as the normal range for Asians because of increased comorbidities even at lower levels of BMI (Annurad, Shiwaku, Niogi, Enkhmaa, Shimono, & Yamane, 2003; James, et al., 2001). This new classification has been adopted by the Western Pacific Regional Office (WPRO) of the WHO. The WHO classifies overweight as BMI of 25 kg/m^2 and greater while a BMI of 30 kg/m^2 and above is classified as obese. The classification set by the WPRO has BMI of 23 kg/m^2 and above as overweight and BMI of 25 kg/m^2 and above as obese (Anuurad, et al., 2003).

While BMI is used as an indicator of overall adiposity, WC, and WHR are utilized as indicators of central obesity. The deposition of fat around the abdominal area and/or upper part of the body is termed central adiposity. Central adiposity was found to be associated with increased mortality for all causes in the Shanghai Women's Health Study, a prospective study among a cohort of Chinese women (Zhang, Shu, Yang, Li, Cai, Gao, & Zheng, 2007). Waist circumference greater than 102 cm (~40 in) for men and greater than 88 cm (~35 in) for women has been found to be associated with increased health risks (Janssen, Katzmarzyk, & Ross, 2002). Waist-to-hip ratios of 0.85 for women and 1.00 for men are indicative of central adiposity, and have been found to be associated with several chronic problems (North West Adelaide Health Study, 2007). In a study among African Americans and Whites, waist-to-hip ratio has been found to be associated with coronary heart disease (Folsom, Stevens, Schreiner, & McGovern, 1998).

Biologic Measurements as Health Status Indicators

The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian, Bakris, Black, Cushman, Green, Izzo, Jones, et al., 2003) classifies blood pressure levels as follows: normal = systolic blood pressure (SBP) < 120 mm Hg or diastolic blood pressure (DBP) < 80 mm Hg; prehypertension = SBP of 120-139 mm Hg or DBP of 80-89 mm Hg; stage 1 hypertension = SBP of 140-159 mm Hg or DBP of 90-99 mm Hg; and, stage 2 hypertension = SBP ≥ 160 mm Hg or DBP ≥ 100 mm Hg. Hypertension is strongly correlated with stroke and coronary heart disease (Wolf-Maier, Cooper, Banegas, Giampaoli, Hense, Joffres, Kastarinen, et al., 2003).

Elevated levels of serum total cholesterol and LDL-cholesterol are risk factors for cardiovascular disease while a high level of HDL-cholesterol is protective (Wannamethee, Shaper, & Ebrahim, 2000; Linn, Fulwood, Carroll, Brook, Johnson, Kalsbeek, & Rifkind, 1991). The desirable level for total cholesterol is < 200 mg/dL; 200-239 mg/dL is considered borderline high while ≥ 240 mg/dL is high. Optimal level for LDL-cholesterol is <100 mg/dL, 100-129 mg/dL is near or above optimal, 130-159 mg/dL is borderline high, 160-189 mg/dL is high, and ≥ 190 mg/dL is very high. HDL-cholesterol level is considered low at < 40 mg/dL and considered high at ≥ 60 mg/dL. Elevated serum triglycerides can be a direct or an indirect contributory factor to cardiovascular disease and at very high levels could lead to acute pancreatitis (Yuan, Al-Shali, & Hegele, 2007). The normal serum triglyceride level is <150 mg/dL, borderline high is 150-199 mg/dL, high is 200-499 mg/dL, and very high is ≥ 500 mg/dL.

Research Methods and Procedures

This section provides an idea of how the study was done, who the study participants were, how the variables were measured, and how the data was analyzed. Assumptions and limitations due to circumstances surrounding the study are also mentioned in each subsection.

Study Design and Participants

The study has a cross-sectional design—that is, measurements were done at a single time for each of the participants. Biologic (systolic and diastolic blood pressure, fasting blood sugar, total serum cholesterol, HDL-cholesterol, LDL-cholesterol, and serum triglycerides) and anthropometric (BMI, WC, hip circumference [HC], WHR, fat mass [FM], fat-free mass [FM], % body fat, and total body water [TBW]) data were collected from participants of nutritional status assessments conducted at three different sites in the years 2006 and 2007. Participants were SDA workers at three SDA institutions in the Philippines which were composed mostly of district pastors and office workers, and a few administrators and maintenance workers. All participants were Filipinos with ages ranging between 21 and 62 years. Since the intent was to describe the cross-sectional metabolic and anthropometric measures, no inclusion or exclusion criteria were used in the selection of participants.

Anthropometric measurements were performed on all the participants according to written protocols. However, not all of the participants were able to undergo all the biologic procedures—only 72 out of the 113 participants had tested for fasting blood glucose, total serum cholesterol, and serum triglycerides. Furthermore, only 38% (43 out of 113) had additional tests for high-density lipoprotein or HDL-cholesterol and low-density lipoprotein or LDL-cholesterol. Although the latter variables have been included in this report, precaution is needed in inferring the results to the whole group or to SDA Filipino workers in general.

Biologic Measures

Blood pressure was measured using manual sphygmomanometers—a mercury sphygmomanometer was used at two of the institutions/sites while an aneroid sphygmomanometer was used at one of the institutions/sites because of the unavailability of a mercury sphygmomanometer. Aneroid sphygmomanometers have a tendency to be inaccurate (O'Brien, Waeber, Parati, Staessen, & Myers, 2001), whereas mercury sphygmomanometers are considered more accurate, and thus, are recommended for research purposes. The use of the aneroid sphygmomanometer in one of the sites is considered a limitation of the study. Blood pressure was measured by trained nurses and/or study personnel who had past training and considerable experience in taking blood pressure measurements. To avoid and reduce inter-measurer bias, the measurers were required to follow written protocols. Participants were asked to rest for no less than 5 minutes before taking blood pressure measurements. Blood pressure was taken while the participant was seated. Two measurements were made with a 1-minute interval between measurements. The average of the two measurements was reported.

Blood samples were taken from participants after an overnight fast of no less than 10 hours. Blood samples were brought and analyzed for total cholesterol, (including HDL-cholesterol and LDL-cholesterol for some), fasting blood sugar, and triglyceride levels at hospital laboratories located near the data collection sites. Information about the coefficient of variation in these laboratories is not available. It is assumed that hospital laboratories follow strict protocols to ensure accurate blood testing results.

Anthropometric Measures

Using standardized protocols, weight, height, waist, and hip circumferences were measured. To avoid and reduce inter-measurer errors, measurers were trained on how to take anthropometric measurements; they were also required to follow written protocols. Body weight and body composition (fat mass, percent body fat, fat-free mass, and total body water) were determined using the TANITA® TBF 300A Bioelectrical Impedance (BIA) scale (TANITA Corporation of America, Arlington Heights, IL, USA). When measured, participants were without shoes, with empty pockets, not wearing heavy clothing, and were instructed to remove belts, wristwatches and heavy jewelry, if any. Height was measured using a mounted stadiometer with the participant standing in an upright position without shoes. Weight was measured to one-tenth of a kilogram while height was measured to one-tenth of a centimeter. Fat mass, fat-free mass, total body water, and percent body fat were all measured to 0.1. Two measurements were taken and the means used for data analysis (Lohman, Roche, & Martorell, 1991). From the weight and height, BMI was computed by dividing weight (W_{kg}) in kilograms by the square of height (H_m) in meters ($BMI = W_{kg}/(H_m^2)$).

Waist and hip circumferences were determined by using a non-stretchable tape measure. Waist was located midway between the palpated iliac crest and the palpated lowest rib margin, measured at the last part of expiration, and recorded to 0.1 of an inch. Hip was measured around the widest part of the buttocks to 0.1 of an inch.

Statistical Procedures

Descriptive statistics (mean, standard deviation) were used to characterize the sample in terms of their demographic variables and anthropometric and metabolic measurements. This was done for all participants and for gender groups. Independent t-tests were performed to determine if there are significant differences between gender groups in the metabolic and anthropometric measures.

The group was divided into two categories of BMI: normal ($BMI < 25.0$ kg/m^2) and overweight ($BMI \geq 25.0$ kg/m^2). Due to small sizes, underweight and class I obese participants were included under each of the above categories, respectively. Under each of the BMI categories, the participants were further divided according to waist circumference categories: normal WC and high WC. Independent t-tests were done to determine if there are significant differences between the groups. To determine which anthropometric and biologic variables are correlated, Pearson's product moment correlation and partial correlation analyses were performed. Statistical Package for the Social Sciences (SPSS) version 15 for Windows was used to analyze the data.

Results

A profile of the study participants and separate descriptive and comparative analyses of the biologic and anthropometric values for the sample are discussed in this section. Comparison of groups classified under categories of BMI and waist circumference and correlations between the biologic and anthropometric variables are discussed in the latter part of the section.

Profile of the Study Participants

Participants in the study ranged from 21 to 62 years old in age (mean age = 43.6 years, SD = 10.6 years). Females accounted for 48% of the participants; mean ages of the two gender groups were similar (see Table 2). Participants were from three SDA institutions in the Philippines—two from the north (labeled as Institutions A and B) and one from the south (labeled as Institution C). Twenty-three (20.4%) were from Institution A, 28 (24.8%) from Institution B, and 62 (54.9%) from Institution C. The majority of the participants were office workers (42.5%); pastors/teachers accounted for 25.7%, maintenance workers 20.3%, and administrators 11.5%. In this report, the comparison between groups was only done between genders but not according to other grouping variables due to the small sample size.

Biologic Measurements: Description and Comparison by Gender Groups

Table 2 shows a summary of the results for the biologic measurements of the whole group. The same table also shows a comparison of these measures by gender groups. Results show that the mean systolic and diastolic blood pressures of the participants are within normal levels. However, males have significantly higher diastolic blood pressure compared to females. Although the mean fasting blood sugar levels are within normal limits for all the participants and for each gender group, the mean total cholesterol levels are all borderline high for both genders and the group as a whole. (Note: borderline high total cholesterol is 200-239 mg/dL). As shown in Table 2, there are no significant differences between the gender groups on fasting blood sugar and total cholesterol levels. Mean HDL-cholesterol for females and for all participants are within normal levels; however, males have significantly lower mean HDL-cholesterol compared to females (Note: HDL- cholesterol below 40.0 mg/dL is considered low). Mean LDL-cholesterol is borderline high for all participants and the female group (borderline high LDL-cholesterol is 130-159 mg/dL), while males have above optimal level LDL-cholesterol (within 100-129 mg/dL). Mean serum triglyceride levels can be classified as borderline high for the whole group and the males (serum triglyceride is borderline high if 150-199 mg/dL).

Table 2
Summary of Results and Comparison* of Metabolic Variables by Gender Groups

	Group	N	Mean	SD**	Mean Difference‡ (SED***)	t-value	p
Age	Female	54	43.48	11.40	-0.32 (1.97)	-0.16	.873
	Male	59	43.80	9.53			
	All	113	43.65	10.42			
Systolic Blood Pressure, mm Hg	Female	54	109.94	18.08	-4.53 (2.90)	-1.56	.122
	Male	59	114.47	11.85			
	All	113	112.31	15.25			
Total serum cholesterol, mg/dL	Female	33	206.97	47.89	4.77 (9.57)	0.50	.620
	Male	39	202.21	32.88			
	All	72	204.39	40.23			
Serum HDL-Cholesterol, mg/dL	Female	14	51.57	12.11	11.47 (3.30)	3.48	<.001
	Male	29	40.10	9.08			
	All	43	43.84	11.40			
Serum LDL-Cholesterol, mg/dL	Female	14	149.57	43.66	23.47 (11.75)	2.00	.052
	Male	29	126.10	31.99			
	All	43	133.74	37.36			
Serum triglyceride, mg/dL	Female	33	124.42	62.74	-71.73 (21.11)	-3.40	<.001
	Male	39	196.15	112.79			
	All	72	163.28	99.39			

* Comparison between gender groups was performed with independent *t*-tests. Levene's test was used to determine whether pooled or unpooled *t*-test results should be reported.
** SD = standard deviation; this is used instead of standard error of the mean to provide information about the spread of the values
*** SED = standard error of the difference
‡Mean Difference = Mean of female group – mean of male group

Figures 1 to 7 show how the two gender groups are distributed according to categories of blood pressure, fasting blood sugar, serum levels of total cholesterol, HDL-cholesterol, LDL-cholesterol, and triglycerides. The figures reveal that a substantial percentage of Filipino workers who participated in this study show signs of risk for health problems.

Figures 1 and 2 show that more males are categorized under prehypertensive systolic and prehypertensive and hypertensive diastolic blood pressure levels compared to females. Error bars in Figure 2 do not overlap for the two gender groups under the normal blood pressure category which indicates that there are significantly more females than males classified in this category.

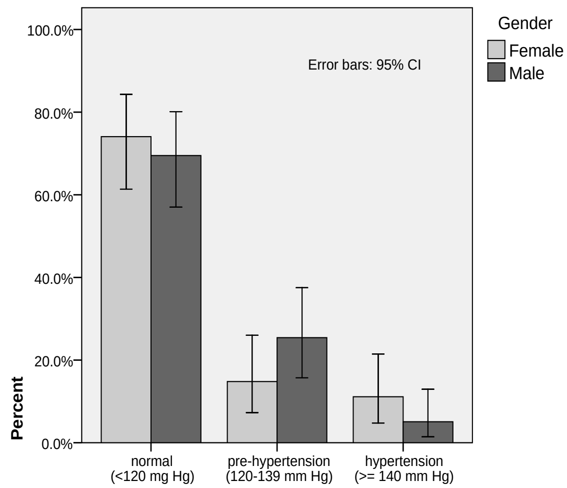

Figure 1. Distribution of gender groups according to categories of systolic blood pressure levels.

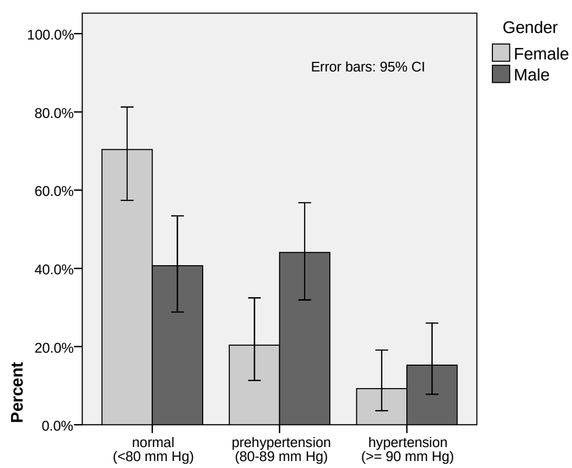

Figure 2. Distribution of gender according to diastolic blood pressure levels.

A few of the participants had borderline high to high fasting blood sugar levels (Figure 3). A substantial percentage, however, had borderline high to high total cholesterol levels (Figure 4). In both biologic measures, the gender groups had similar percentages as indicated by the overlap in error bars.

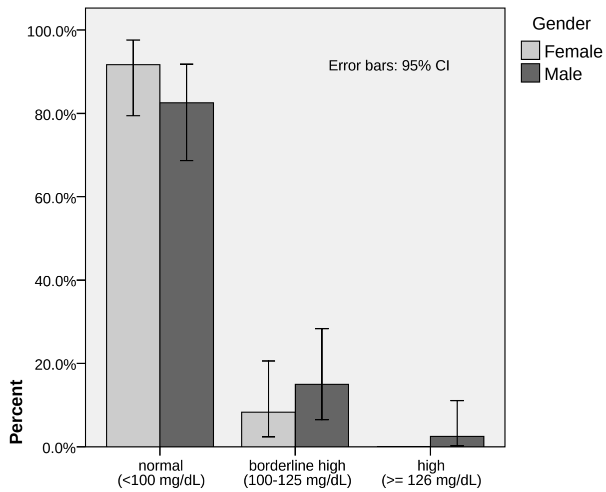

Figure 3. Distribution of gender groups according to categories of fasting blood sugar levels.

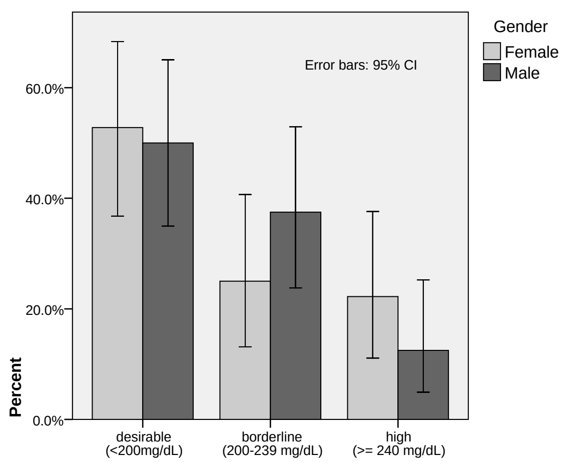

Figure 4. Distribution of gender groups according to categories of total serum cholesterol levels.

Figure 5 shows that almost the same percentage of males who had normal HDL-cholesterol levels also had low HDL-cholesterol. Although a few of the females had low HDL-cholesterol, about the same percentage had high HDL-cholesterol.

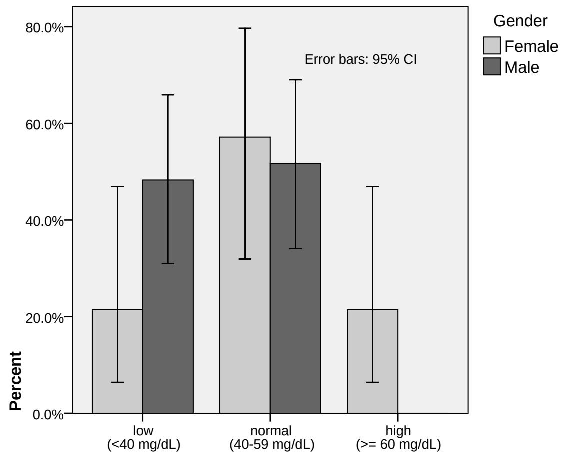

Figure 5. Distribution of the gender groups according to categories of serum HDL-cholesterol.

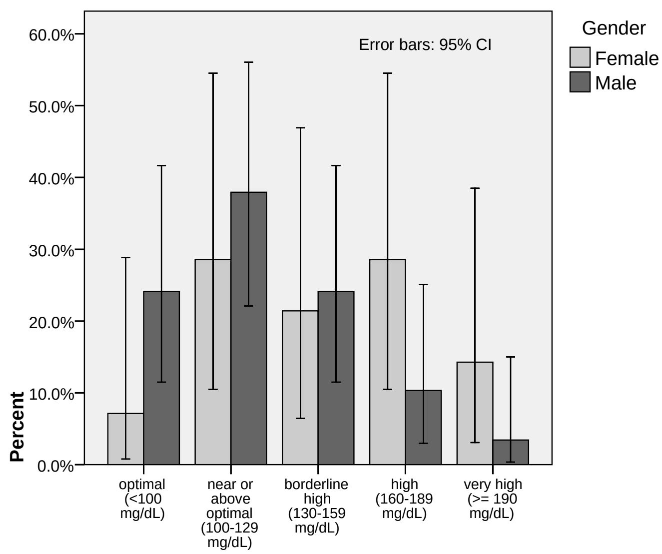

Figure 6. Distribution of gender groups according to categories of LDL-cholesterol levels.

A substantial percentage of the participants had borderline high to very high LDL-cholesterol levels, as shown in Figure 6. Although there were no significant differences between the gender groups, a larger proportion of females compared to males are categorized under high and very high.

Figure 7 shows that a larger percentage of males compared to females have high triglyceride levels while most females are categorized under the normal level. There are significantly more males classified under the high category compared to females.

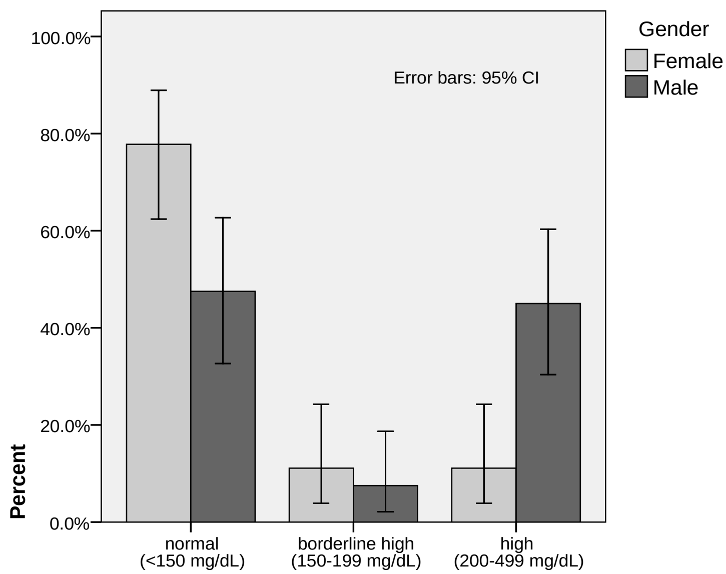

Figure 7. Distribution of gender groups according to categories of serum triglyceride levels. Error bars for the two gender groups under the high category do not overlap which indicates that there are significantly more males than females under this category.

Anthropometric Measurements: Description and Comparison by Gender Groups

A summary of the anthropometric measures and comparison analyses between the gender groups are presented in Table 3. Females have significantly smaller waist circumference and waist-to-hip ratio, and a significantly lower weight compared to males. This is expected since females are generally smaller in frame compared to males. Means of waist circumference and waist-to-hip ratio for both genders are classified under normal. Females have significantly

Table 3
Summary of Results and Comparison* of Anthropometric Variables by Gender

	Group	N	Mean	SD**	Mean Difference‡ (SED***)	t-value	p
Waist Circumference, in.	Female	54	30.01	3.14	-4.18 (0.61)	-6.82	<.001
	Male	59	34.19	3.36			
	All	113	32.20	3.86			
Hip circumference, in.	Female	54	36.65	2.48	-0.93 (0.01)	-1.93	.057
	Male	59	37.58	2.62			
	All	113	37.14	2.58			
Waist: Hip ratio	Female	54	0.82	0.05	-0.09 (0.01)	-8.45	<.001
	Male	59	0.91	0.06			
	All	113	0.87	0.07			
Weight, kg	Female	54	56.18	8.79	-12.44 (1.82)	-6.82	<.001
	Male	59	68.62	10.42			
	All	113	62.68	11.48			
BMI	Female	54	23.47	3.11	-2.18 (0.58)	-3.78	<.001
	Male	59	25.65	3.01			
	All	113	24.61	3.24			
% Body Fat	Female	54	26.05	7.50	6.14 (1.22)	5.02	<.001
	Male	59	19.91	5.17			
	All	113	22.85	7.07			
Lean Muscle, kg	Female	51	61.29	23.52	-6.72 (4.97)	-1.35	.180
	Male	57	68.01	27.69			
	All	108	64.84	25.91			
Fat Mass, kg	Female	54	23.11	12.22	4.85 (2.17)	2.23	.028
	Male	59	18.26	10.86			
	All	113	20.58	11.73			
Total Body Water, kg	Female	51	45.02	17.04	-4.76 (3.63)	-1.31	.192
	Male	57	49.78	20.26			
	All	108	47.53	18.88			

* Comparison between genders was performed with independent *t-test* Levene's test was used to determine if pooled or unpooled *t*-test result should be reported.
** SD = standard deviation; this is used instead of standard error of the mean to provide information about the spread of the values.
*** SED = standard error of the difference
‡Mean Difference = Mean of female group – mean of male group

lower mean BMI compared to males whose mean BMI is classified as overweight according to WHO standards (classifies BMI of 25.0-29.9 kg/m^2 as overweight). Females generally have more adipose tissue compared to males, thus, results for fat mass and % body fat are not surprising.

Distribution of anthropometric measurements are shown in Figures 8-13. For variables where undesirable and desirable limits vary according to age and gender, histograms were used (e.g., % body fat, fat mass, lean muscle, and total body water).

Participants were classified according to their BMI to determine how the gender groups are distributed. Figure 8 shows that most of the males were overweight and there were significantly more overweight males than females. While there were males who were classified as obese, there were no obese females.

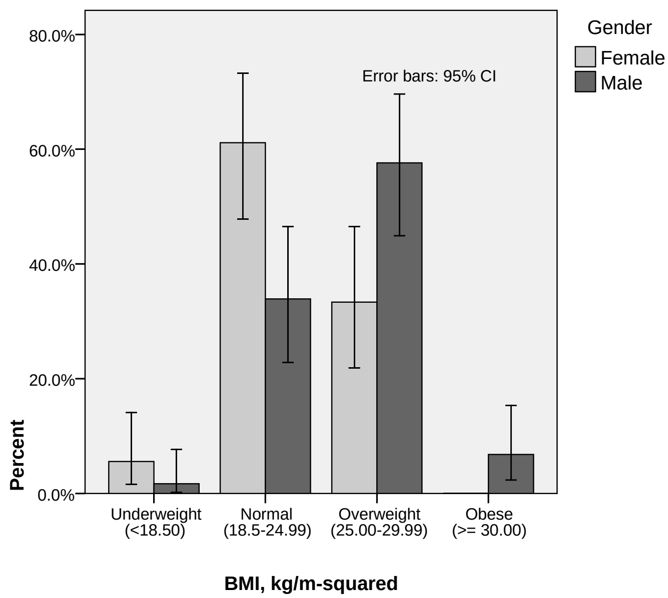

Figure 8. Distribution of gender groups according to World Health Organization (WHO) categories of body mass index (BMI). There were significantly fewer males than females in the normal weight category as shown by the gap between the error bars. The majority of the males are overweight.

Figure 9 shows the distribution of the participants according to waist categories. Note that for both gender groups, few have a waist circumference considered to predispose an individual to a higher risk for chronic diseases.

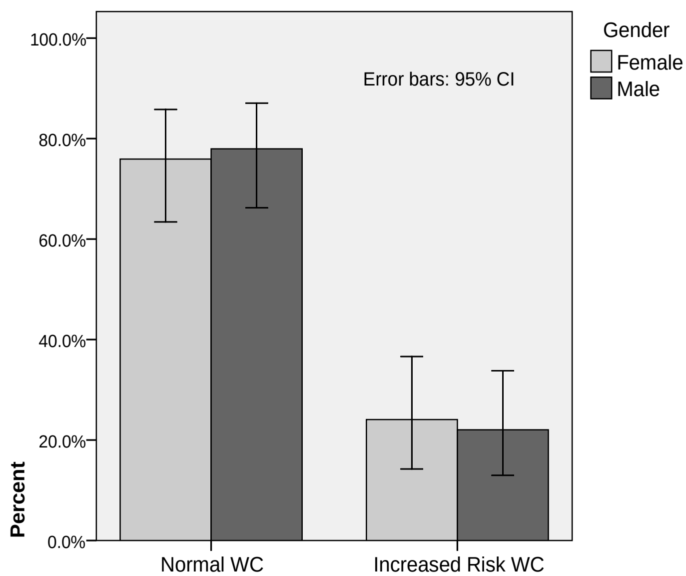

Figure 9. Distribution of gender groups according to categories of waist circumference (WC).

Figure 10 shows the % body fat distribution of the participants by gender groups. The graphs show that females have higher values and a wider distribution for % body fat compared to males—something that is expected. However, there are a few persons in each group that are thin, and may be at risk for problems related to underweight.

The lean muscle or fat-free mass is an important determinant of basal metabolic rate. In Figure 11, a bimodal distribution is noticeable for lean muscle in the female group, while it is widely distributed in the male group. Age difference is not a reason because further analysis (not shown) reveals that lean muscle distribution is spread out over a wide range for both younger and older male and female participants. Difference in physical activity levels is the only other possible explanation for this bimodal distribution especially in the female group, but this could not be ascertained from the available data.

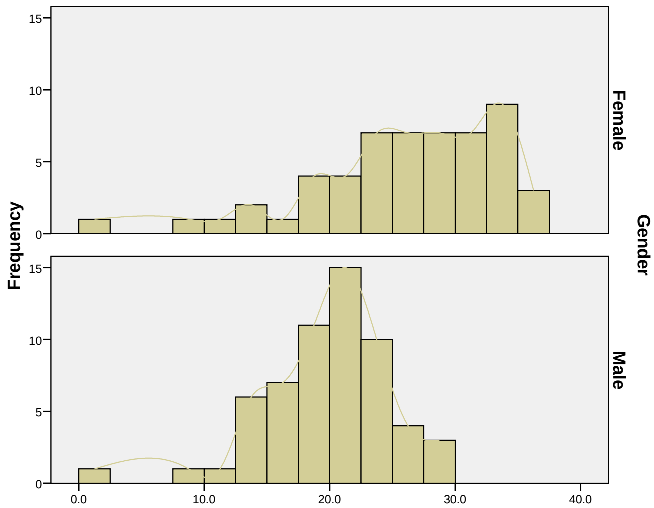

Figure 10. Distribution of % body fat according to gender groups. Generally, females have higher amounts of body fat compared to males.

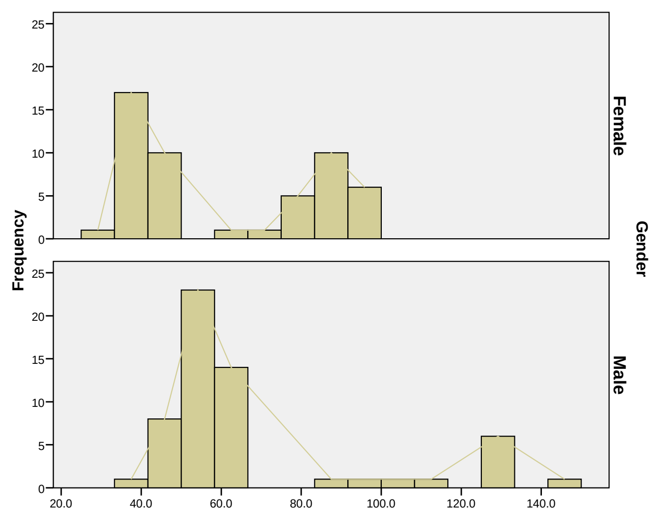

Figure 11. Distribution of fat-free mass (FFM) or lean muscle (in kg) according to gender groups.

Figure 12 shows that fat mass distribution for both genders is spread out, but there are more males who have lower fat mass compared to females as shown by the taller bars (higher frequencies). There are individuals from both gender groups who have low amounts of fat mass and a few who have large amounts.

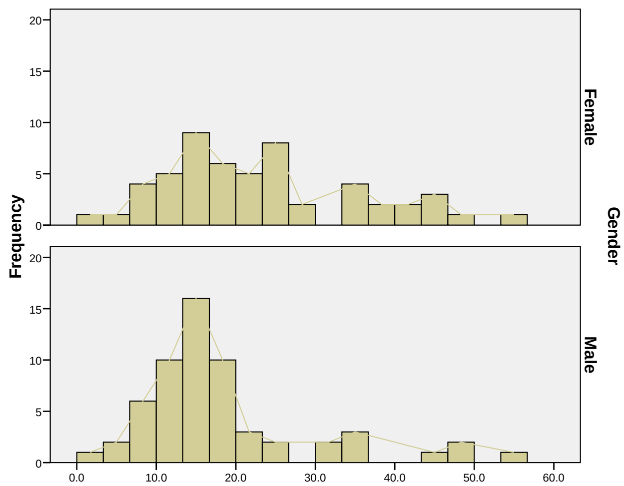

Figure 12. Distribution of fat mass (in kg) according to gender groups.

Figure 13 shows the total body water distribution of the gender groups. Total body water is related to lean muscle. It can be noted that the female group has a bimodal distribution of total body water, similar to the distribution of lean muscle (compare Figure 13 with Figure 11). The same pattern can be seen in the male group. Since males have generally more muscles than females, a wider distribution of total body water and eventually, a higher mean can be expected for males.

Participants were classified further into two categories of BMI (normal and overweight) and under each category, those with normal waist circumference were compared to those with high waist circumference. Table 4 shows a summary of the results for this analysis.

Due to the very small number of individuals with normal BMI but with high waist circumference, *t*-test was not done to compare this group with those of normal BMI with normal waist circumference. Comparison was only done between the two WC groupings of the high BMI individuals. Results showed that although those with high WC have relatively higher values than the normal

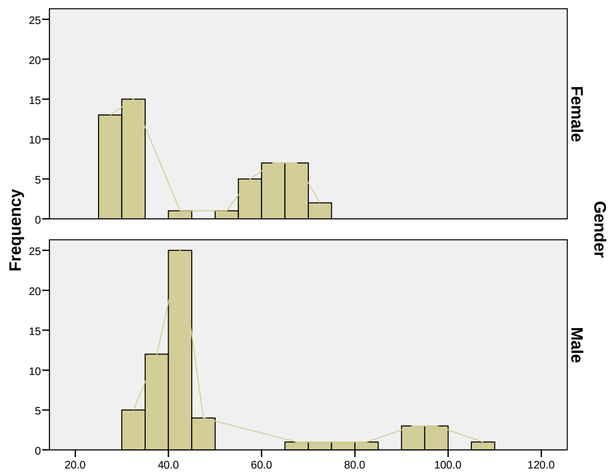

Figure 13. Distribution of total body water (in kg) according to gender groups.
Biologic and Anthropometric Measures by Categories of BMI and WC

WC group for all metabolic measures (except for serum triglycerides), there were no significant differences. Of the anthropometric measures, only % body fat and fat mass are significantly different between those who had normal WC and high WC. Mean % body fat and fat-mass were within desirable limits for both gender groups, however.

Correlations between Anthropometric and Biologic Measures

Correlation analyses were done to determine if there were relationships between the biologic and anthropometric measures. Fat mass and percent body fat are highly correlated so only fat mass was included in the analysis. Total body water, likewise, is highly associated with fat-free mass or lean muscle so only fat-free mass was included in the analysis. Previous analyses show that there are significant differences between the two gender groups in most of the variables under study (refer to Tables 2 and 3); thus, it was necessary to control for the effects of gender.

Table 5 shows a summary of the correlation analyses with and without controlling for the effects of gender. Systolic blood pressure was positively correlated with all the anthropometric variables except WHR, while diastolic blood pressure was positively correlated with all the anthropometric variables.

Table 4
Comparison of Metabolic and Anthropometric Measures in Respondents with Normal and High Waist Circumferences within Different Categories of Body Mass Index (BMI)

	Categories of BMI							
	Normal BMI (BMI < 25.0 kg/m^2)				High BMI (BMI ≥ 25.0 kg/m^2)			
	Normal WC		High WC		Normal WC		High WC	
	N	Mean (SEM*)	N	Mean (SEM*)	N	Mean (SEM*)	N	Mean (SEM*)
Metabolic measures								
Systolic BP, mm Hg	54	108.7 (2.2)	3	121.3 (2.7)	33	114.4 (2.3)	23	116.5 (3.3)
Diastolic BP, mm Hg	54	72.9 (1.4)	3	79.0 (2.1)	33	77.6 (1.9)	23	79.4 (2.1)
Fasting Blood Sugar, mg/dL	35	84.0 (1.9)	1	119.0 (-)	21	89.2 (3.2)	15	93.1 (2.0)
Serum Total Chol, mg/dL	35	201.1 (7.4)	1	298.0 (-)	21	201.7 (8.0)	15	209.6 (8.3)
Serum HDL Chol, mg/dL	16	45.1 (3.7)	1	48.0 (-)	17	43.2 (2.2)	9	42.2 (3.2)
Serum LDL Chol, mg/dL	16	149 (10.2)	1	189.0 (-)	17	120.5 (7.7)	9	125.4 (10.1)
Serum triglycerides, mg/dL	35	124.6 (11.2)	1	304.0 ( )	21	215.2 (24.9)	15	171.4 (27.7)
Anthropometric measures								
Weight, kg	54	54.4 (1.1)	3	66.0 (6.2)	33	69.9 (1.2)	23	71.2 (2.1)
% Body Fat	54	19.7 (1.0)	3	26.2 (4.1)	33	23.5 (0.8)‡	23	28.7 (1.1)‡
Lean Muscle, kg	53	63.4 (3.3)	3	66.0 (16.7)	32	61.6 (4.1)	20	73.6 (7.6)
Fat Mass, kg	54	16.7 (1.4)	3	26.4 (10.8)	33	19.4 (1.5)‡	23	30.5 (2.8)‡
Total Body Water, kg	53	46.6 (2.4)	3	48.3 (12.2)	32	45.1 (3.0)	20	53.8 (5.5)
Age, years	54	42.2 (1.5)	3	51.0 (8.2)	23	43.5 (9.4)	23	46.4 (2.0)

* SEM = standard error of the mean
‡ Significantly different means between normal HC and high WC groups at $p < .05$.

Although the correlations are considered weak, the results indicate that blood pressure is influenced by body size. However, after controlling for gender, the significant correlations disappeared. Fasting blood sugar was positively correlated with waist and hip circumferences and WHR, although correlations were weak. Significance disappeared after controlling for gender. Total cholesterol, HDL-cholesterol, and LDL-cholesterol were all inversely, or negatively, correlated with fat-free mass. This indicates that as lean muscle or fat-free mass increases, cholesterol levels decrease. HDL-cholesterol is also inversely correlated with WHR, while LDL-cholesterol was inversely correlated with both waist and hip circumferences and BMI. Although controlling for gender resulted in the disappearance of significant associations between total cholesterol, HDL-cholesterol, and triglycerides for all the anthropometric

Table 5
Correlations Between Metabolic and Anthropometric Variables Before Controlling (A) and After Controlling (B) for the Effects of Gender

	Correlation coefficients (r) ‡					
	WC	HC	WHR	BMI	Lean Mass	Fat Mass
Systolic BP	A 0.26** B 0.10	A 0.27** B 0.04	A 0.16 B 0.13	A 0.29** B 0.11	A 0.30** B 0.06	A 0.32** B 0.16
Diastolic BP	A 0.34** B - 0.04	A 0.28** B -0.14	A 0.25** B 0.10	A 0.33** B -0.10	A 0.20* B -0.11	A 0.20* B -0.03
Fasting Blood Sugar	A 0.34** B 0.20	A 0.29* B 0.25	A 0.25* B 0.06	A 0.20 B -0.01	A -0.15 B -0.07	A 0.01 B 0.19
Total Cholesterol	A 0.11 B -0.04	A 0.01 B -0.13	A 0.16 B 0.07	A 0.01 B -0.25	A -0.44** B -0.30	A -0.18 B -0.20
HDL-Cholesterol	A -0.17 B 0.17	A 0.10 B 0.23	A -0.33* B 0.03	A -0.09 B 0.08	A -0.40** B 0.02	A 0.15 B 0.04
LDL-Cholesterol	A -0.36* B -0.24	A -0.38* B -0.34*	A -0.23 B -0.02	A -0.36* B -0.29	A -0.42** B -0.33*	A -0.24 B -0.34*
Triglycerides	A 0.39** B 0.28	A 0.23 B 0.29	A 0.40** B 0.15	A 0.19 B 0.01	A -0.43** B 0.01	A -0.32** B 0.24

‡ Pearson's Product-Moment correlations; A is the correlation coefficient before controlling for the effects of gender while B is the correlation coefficient after controlling for the effect of gender
* Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

variables, the significant associations persisted between LDL-cholesterol and HC, LDL-cholesterol and lean mass, and LDL-cholesterol and fat mass.

Discussion

The main purpose of this study was to investigate the health status of SDA Filipino workers from selected SDA institutions in the Philippines using biologic and anthropometric methods of health assessment. To determine the health status of the workers, their measurements were compared with existing standards. Presentation of the results was simplified by classifying workers as either low, normal, borderline high, or high for most of the variables in the study.

Blood sugar levels are within normal levels for most of the participants. However, results for blood lipids (triglycerides, total cholesterol, HDL-cholesterol, and LDL-cholesterol) indicate that a considerable number of the workers are at risk for cardiovascular problems. Total cholesterol level is borderline high for both genders and the group as a whole. It should be noted that a substantial percentage of the workers also have low HDL-cholesterol for both gender groups, and more than half of the gender groups have borderline high to very high levels of LDL-cholesterol. Such a scenario predisposes individuals to cardiovascular problems (Wannamethee, et al., 2000; Linn, et al., 1991). Increased levels of serum total cholesterol and LDL-cholesterol, and decreased levels of HDL-cholesterol have been found to increase the risk for ischemic cardiovascular disease among individuals who have coronary heart disease (Koren-Morag, Tanne, Graff, & Goldbourt, 2002). Increased serum levels of LDL-cholesterol means more cholesterol is exposed in the blood stream, which then increases the chances of cholesterol oxidation that could result to atherosclerosis. Additionally, low levels of HDL-cholesterol mean less cholesterol from the blood stream is transported back to the liver for processing into other useful substances, e.g., hormones, bile, etc. In a prospective study among men, low serum HDL-cholesterol regardless of normal total cholesterol was identified as a risk factor for coronary heart disease (Goldbourt, Yaari, & Medalie, 1997). In addition, it is noteworthy that about 40% of the males and 10% of the females have elevated serum triglyceride levels. This condition, in combination with low HDL-cholesterol, increases one’s risk for ischemic heart disease (Jeppesen, Hein, Suadicani, & Gyntelberg, 2001).

Using the WHO standards, results for BMI reveal that the majority of the males (64%) are overweight to obese, while a third of the females (33%) are overweight. If the BMI is classified according to what has been recommended for Asians by the WPRO, more of these workers will be classified as overweight and/or obese—22% overweight and 33% obese (a total of 55% overweight to obese) for females and 17% overweight and 64% obese (a total of 81%

overweight to obese) for males. As Table 4 shows, very few of the normal BMI individuals (n = 3) have central adiposity (that is, waist circumference that is considered at risk for chronic problems). Among the high BMI group, though, 40% (22 out of 55) have central adiposity. These individuals are at a higher risk for metabolic problems, such as type 2 diabetes mellitus, and cardiovascular diseases and certain cancers (Farin, et al., 2006; Zhu, et al., 2006; Hu, et al., 2004; Borugian, et al., 2003; Seidell, et al., 2001; Iwao, et al., 2001).

A bimodal distribution is noticeable for fat-free mass or lean muscle especially in the female group. It has been mentioned earlier that this bimodal distribution could be explained by differences in physical activity level, with the active individuals having more lean muscle compared to those who have low physical activity levels; however, this could not be ascertained from the available data. Thus, this warrants further investigation.

Increasing body size was shown in this report to significantly correlate with increasing blood pressure, which can be considered consistent with what literature says (Davy & Hall, 2004). However, this could be attributed to differences between the genders since the significance disappeared after controlling for gender. Weak but significant positive correlations have also been found between fasting blood sugar and WC and WHR, a finding that has been substantiated by studies (Snijder, van Dam, Visser, & Seidell, 2006). Again, gender differences could have resulted to this since the significance disappeared after controlling for gender. It is interesting to note that serum total cholesterol, HDL-cholesterol, LDL-cholesterol, and serum triglycerides are all inversely, or negatively, correlated with fat-free mass but that all of these significant findings disappeared and only persisted for LDL-cholesterol after adjusting for the effects of gender. Lack of power due to small sample size for this set of variables (LDL-cholesterol and HDL-cholesterol) limits further interpretation of these findings.

Findings from this study suggest that this group of Filipino workers are at risk for chronic problems, as indicated by the anthropometric and biologic indicators of health status. The males in this group of study participants seem to be at greater risk compared to the females. It is necessary that members of this group who are at increased risk for lifestyle diseases receive intervention to prevent progression of their condition, while those who are at reduced risk should continue to practice a healthy lifestyle to maintain their health status. Further study is needed to determine what lifestyle factors, such as dietary and sleeping habits, and stress and physical activity levels, contribute significantly to these health outcomes.

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Gina Segovia-Siapco, DrPH, MPH
Associate Professor of Nutrition and Public Health
Chair, Department of Public Health, School of Graduate Studies
Adventist International Institute of Advanced Studies
Silang, Cavite Philippines