DE GRUYTER OPEN

http://www.jrdiabet.ro
Rom J Diabetes Nutr Metab Dis. **24**(3):195-201
doi: 10.1515/rjdnmd-2017-0025

OVERWEIGHT AND OBESITY IN RELATION TO CARDIOVASCULAR RISK FACTORS AMONG UNIVERSITY STUDENTS IN MALAYSIA

Chee Huei Phing ✉***, Lee Syeh Hoa, Tan Xue Hua***

Faculty of Science, Universiti Tunku Abdul Rahman, Kampar, Perak, Malaysia

received: May 31, 2017 *accepted*: July 27, 2017

available online: September 15, 2017

Abstract

Background and aims: *In light of the urbanization, industrialization and mechanized transportation, cardiovascular risk factors have been predominated. Hence, it is hypothesized that Malaysian students entering the university would not be oblivious to this reality. The study aims to investigate the cardiovascular disease risk factors stratified on genders and body weight status.* ***Material and Methods:*** *This pilot study had a cross-sectional design. Subjects were assessed for several parameters such as smoking, alcohol consumption, dietary habits, weight, height, physical activity level, waist circumference, hip circumference, blood pressure, pulse rate, glucose, uric acid and cholesterol level. Subjects were students aged 18 years and above who agreed to participate.* ***Results:*** *Males have higher mean height, weight, waist circumference, hip circumference, body mass index and waist-to-hip ratio compared to females ($p<0.05$). In addition, males have higher mean value for systolic blood pressure ($p<0.05$), diastolic blood pressure, glucose level, uric acid level and cholesterol level, but lower mean value for pulse rate. Systolic blood pressure and diastolic blood pressure correlated significantly with the three obesity indices, explicitly body mass index, waist circumference and waist-to-hip ratio($p<0.05$).* ***Conclusions:*** *It is crucial to implement intervention programs for those individuals with high risk in developing cardiovascular diseases.*

key words: *overweight, obesity, cardiovascular risk factors, glucose, uric acid, cholesterol*

Background and Aims

Overweight and obesity refers to excessive or abnormal accumulation of fat in the body. It is becoming a crucial health concern worldwide with approximately 17.1 million people dying from cardiovascular diseases in year 2004, representing 29% of all global mortalities. In addition, more than 1.9 billion adults aged 18 years and above were overweight in year 2014 [1].

Malaysia has been experiencing a rapid phase of urbanization and industrialization in recent decades. Cardiovascular diseases occupied the greatest proportion (35%) of mortality rate in Malaysia. Furthermore, National Health and Morbidity Survey 2015 demonstrated that national prevalence of overweight and obesity was 33.4% and 30.6%, respectively. An increasing trend of hospitalization and death cases due to cardiovascular diseases over past 10 years was

✉ Jalan Universiti Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia.
Tel: +605-468 8888 Extension 4526, Fax: +605-466 1676; *corresponding author e-mail*: cheehp@utar.edu.my

observed according to Ministry of Health Malaysia [2]. It is usually associated with the presence of modifiable cardiovascular risk factors. Nevertheless, in light of the urbanization, industrialization and mechanized transportation, physical inactivity has become a crucial determinant of cardiovascular risk factors and health status. Hence, it is hypothesized that Malaysian students entering the university would not be oblivious to this reality. The study aims to investigate the cardiovascular disease risk factors based on genders and body weight status.

Material and methods

Study location and duration

The study was conducted at a tertiary education institution which is located in Perak state, Malaysia. The data collection was commenced on 17th October 2016 and completed on 19th January 2017.

Study design

The study was a cross-sectional pilot study. Subjects were assessed for numerous parameters such as smoking, alcohol consumption, dietary habits, weight, height, physical activity level, waist circumference, hip circumference, blood pressure, pulse rate, glucose, uric acid and cholesterol level. Subjects were students aged 18 years and above who agreed to participate.

Data collection

(a) Health screening questionnaire

All subjects were required to complete a questionnaire which consisted of three main parts: socio-demographics; lifestyle behaviors (smoking habit, alcohol consumption, dietary habits, physical activity); family history.

(b) Anthropometric measurement

Waist and hip circumferences were measured by using an inelastic measuring tape. Waist circumference was measured at midway level between the lowest rib margin and the iliac crest. On the other hand, hip circumference was assessed at the maximal protrusion of the buttocks with the feet together.

(c) Blood pressure measurement

Blood pressure and pulse rate measurements were measured triplicate via a validated automated digital blood pressure monitor (Omron, Japan). Subjects were advised not to consume coffee, perform vigorous exercise or smoke 30 minutes prior to data collection. Blood pressure measurement was taken after the subjects had rested in a seated position for five minutes.

(d) Biochemical analysis

Finger pricking was conducted on the subjects who had fasted for at least eight hours. Their blood glucose, cholesterol and uric acid were measured by using EasyTouch®GCU Monitoring System (Bioptik Technology, Taiwan). A drop of blood (2.3 µL for glucose and uric acid; 22 µL for cholesterol) was added to the test strip, and the result was displayed on the screen in 10 seconds for glucose, 150 seconds for cholesterol, and 20 seconds for uric acid.

(e) Physical activity measurements

The International Physical Activity Questionnaire - short form (IPAQ-SF)

Subjects were probed about time spent for physical activity in the last seven days. The IPAQ-SF [3] estimates the physical activity level in MET-minutes/ week by ascertaining how frequent (number of days in a week) and how long (in minutes) an individual engages in three specific types of activity - walking, moderate-intensity and high-intensity activities on weekdays and weekend days.

Pedometer

Omron HJ-321 pedometer (Omron, Japan) was employed to measure step count. Subjects were asked to wear the pedometer for two weekdays and one weekend day at their waist [4].

Ethical Considerations

Written informed consent was collected from the subjects involved in the study. Ethical approval was obtained from UTAR Scientific and Ethical Review Committee (U/SERC/69/2016).

Data Analysis

Statistical analyses were preformed using IBM SPSS 22 (SPSS Inc., Chicago, IL, USA). Pearson correlation coefficient was used to assess the relationship between two continuous variables, whereas chi-square test was used to assess the association between two categorical variables. Independent sample *t*-test was used to compare means between males and females. The level of significance was set at $p<0.05$.

Results

The demographic characteristics of the study subjects were as presented in Table 1. There were 35 subjects involved in the pilot study. A total of 62.9% (n=22) of the subjects were females and 37.1% (n=13) were males. Majority of the subjects were Buddhist (77.1%), and followed by Christian (14.3%), Muslim (5.7%) and Hindus (2.9%).

Approximately half of the subjects consumed fried food three to five times per week. There were 60% of the subjects consumed two servings of carbohydrates and vegetables daily whereas 48.6% of the subjects did not consume fruits in a day. Males have higher mean height, weight, waist circumference, hip circumference, body mass index and waist-to-hip ratio compared to females ($p<0.05$). In addition, males have higher mean value for systolic blood pressure ($p<0.05$), diastolic blood pressure, glucose level, uric acid level and cholesterol level, but lower mean value for pulse rate.

Table 1. Distribution of subjects based on demographic characteristics, anthropometric, biochemical and clinical indices.

Characteristics	Frequency (n=35)	Percentage (%)
Gender		
Male	13	37.1
Female	22	62.9
Religion		
Buddhism	27	77.1
Christian	5	14.3
Hinduism	1	2.9
Islam	2	5.7
Smoking habit		
Never smoked	34	97.1
Current smoker more than 20 cigarettes/ day	1	2.9
Alcohol consumption		
Average 0 drink daily	34	97.1
Average 1 drink daily or 7 units per week	1	2.9
Frequency of fried food consumption		
Less than once a week	3	8.6
1 to 2 times a week	15	42.9
3 to 5 times a week	17	48.6
Servings of starchy carbohydrates		
0 to1 serving daily	2	5.7
2 servings daily	24	68.6
3 servings daily	6	17.1
4 or more servings daily	3	8.6
Servings of sweet food such as cakes, biscuits or chocolate do you consume a day		
Usually none	15	42.9
1 to 2 servings daily	19	54.3
More than 2 servings daily	1	2.9
Amount of sugar consumption daily in hot drinks/ added to food		
0 to 3 teaspoons	28	80.0
4 to 6 teaspoons	6	17.1
7 to 9 teaspoons	1	2.9
Frequency of fish consumption		
Rarely	21	60.0
1 to 2 times daily	11	31.4
3 to 6 times daily	2	5.7
Every day	1	2.9
Servings of fruit		
Usually none	17	48.6

1 to 3 servings daily	17	48.6
4 or more servings daily	1	2.9
Servings of vegetables		
Usually none	3	8.6
1 to 2 servings daily	21	60.0
3 to 4 servings daily	9	25.7
5 or more servings daily	2	5.7
Cups of coffee		
Usually none	25	71.4
1 to 2 cups daily	9	25.7
3 to 4 cups daily	1	2.9
Soft drinks consumption		
Less than 500 mL per week	28	80.0
1 to 2 liters per week	7	20.0
Volume of plain water consumption		
0 to 500 mL	5	14.3
0.51 L to 1.25 L	17	48.6
More than 1.25 L	13	37.1
Body mass index		
Underweight	7	20.0
Normal	10	28.6
Overweight	13	37.1
Obese	5	14.3
Waist circumference		
Normal	20	57.1
Obese	15	42.9

Waist-to-hip ratio		
Normal	22	62.9
Obese	13	37.1
Systolic blood pressure		
Normal	34	97.1
Hypertension	1	2.9
Diastolic blood pressure		
Normal	34	97.1
Hypertension	1	2.9
Pulse rate		
Normal	32	91.4
Bradycardia	1	2.9
Tachycardia	2	5.7
Glucose level		
Normal	35	100.0
Uric acid level		
Normal	20	57.1
Hyperuricemia	15	42.9
Cholesterol level		
Normal	32	91.4
Hypercholesterolemia	3	8.6
Family history of cardiovascular disease		
Yes	9	25.7
No	26	74.3

Table 2. Comparison of anthropometric, biochemical and clinical indices between genders.

Measures	Males	Females	t-value	p-value
Height (m)	1.73±0.07	1.61±0.07	5.05	<0.001
Weight (kg)	70.77±13.01	57.59±13.88	2.78	0.009
Waist circumference (cm)	87.12±11.37	79.05±13.02	1.86	0.720
Hip circumference (cm)	99.71±8.46	99.07±10.93	1.18	0.858
Body mass index (kg/m^2)	23.69±3.94	22.27±4.78	0.90	0.372
Waist-to-hip ratio	0.87±0.06	0.79±0.06	3.71	0.001
Systolic blood pressure (mmHg)	121.56±10.79	105.15±13.59	3.71	0.001
Diastolic blood pressure (mmHg)	73.26±6.36	69.46±11.15	1.12	0.270
Pulse rate (beats per minute)	78.15±13.05	83.86±13.07	-1.25	0.220
Glucose level (mmol/L)	3.95±0.88	3.54±0.60	1.65	0.109
Uric acid level (µmol/L)	423.39±145.62	361.09±110.18	1.43	0.161
Cholesterol level (mmol/L)	3.49±2.35	1.66±1.92	2.49	0.180

Systolic blood pressure and diastolic blood pressure demonstrated an increasing trend across the four body mass index categories. The correlation between anthropometric parameters and cardiovascular risk factors is illustrated in Table 3. Systolic blood pressure and diastolic blood pressure correlated significantly with the three obesity indices ($p<0.05$). Waist circumference correlated best with the cardiovascular risk factors, in which it was significantly correlated with three out of the six cardiovascular risk factors (systolic blood pressure, diastolic blood pressure, cholesterol level).

Table 3. Relationship between obesity indices and cardiovascular risk factors.

Physical activity and body weight measures	SBP (mmHg)	DBP (mmHg)	Pulse rate (beats/ min)	Glucose level (mmol/L)	Uric acid level (μmol/L)	Cholesterol level (mmol/L)
Body mass index						
Underweight	96.57 ± 10.56	63.14 ± 8.30	83.38 ± 5.26	3.37 ± 0.39	331.57 ± 79.43	2.73 ± 2.08
Normal	107.83 ± 12.33	70.23 ± 7.71	77.37 ± 14.06	3.43 ± 0.81	410.10 ± 162.70	0.81 ± 1.71
Overweight	116.49 ± 11.56	73.85 ± 10.33	83.05 ± 16.02	4.13 ± 0.60	351.08 ± 90.50	2.80 ± 2.15
Obese	125.00 ± 15.05	75.20 ± 9.41	84.80 ± 12.15	3.50 ± 0.85	492.40 ± 130.22	3.60 ± 2.63
r (p-value)	0.643 (<0.001)	0.434 (0.009)	0.167 (0.337)	0.253 (0.143)	0.150 (0.388)	0.254 (0.142)
Waist circumference						
Normal	107.12 ± 14.27	68.30 ± 8.30	78.67 ± 9.68	3.71 ± 0.80	394.20±127.46	2.37 ± 2.10
Obese	116.76 ± 14.17	74.29 ± 10.68	85.84 ± 16.20	3.66 ± 0.66	370.93±127.55	2.31 ± 2.49
r (p-value)	0.693 (<0.001)	0.470 (0.004)	0.083 (0.637)	0.215 (0.214)	0.120 (0.491)	0.333 (0.051)
Waist-to-hip ratio						
Normal	110.79 ± 15.05	70.49 ± 11.01	79.73 ± 13.37	3.71 ± 0.81	368.46±128.39	2.42 ± 2.21
Obese	112.03 ± 15.01	71.51 ± 7.42	85.15 ± 12.59	3.65 ± 0.59	410.92±122.54	2.20 ± 2.38
r (p-value)	0.590 (<0.001)	0.338 (0.047)	0.085 (0.628)	0.196 (0.258)	0.253 (0.142)	0.304 (0.076)
IPAQ category						
Low	113.28±14.05	73.61±8.43	78.89±12.54	4.00±0.74	373.08±108.52	2.35±2.22
Moderate	108.84±15.90	68.87±6.72	82.64±11.50	3.53±0.62	402.93±132.80	2.11±2.57
Highly active	112.71±15.16	70.50±15.34	84.33±17.53	3.53±0.83	365.88±148.92	2.76±1.77
Chi-square (p-value)	0.305 (0.959)	16.985 (0.001)	35.243 (<0.001)	Not relevant*	7.778 (0.051)	1.161 (0.762)
Steps category						
<5,000 steps						
5,000 to 7,499 steps	87.67	57.33	66.00	3.60	255.00	2.59
7,500 to 9999 steps	125.67±16.03	88.33±22.63	113.50±11.55	4.30±0.42	344.00±2.83	1.85±2.62
10,000 to 12,499 steps	112.33±12.32	67.47±9.37	80.67±9.39	3.50±0.44	293.20±84.57	2.48±2.56
≥12,500 steps	110.85±14.71	70.70±7.59	80.17±10.87	3.68±0.79	408.85±129.31	2.44±2.25
r (p-value)	0.008 (0.963)	0.109 (0.532)	0.194 (0.264)	0.082 (0.638)	-0.338 (0.047)	-0.081 (0.645)

**Note: ***All subjects under normal blood glucose category

Discussions

More females were overweight and obese compared to males. The finding was consistent with the study conducted by Chang and colleagues [5], in which higher prevalence of obesity were observed in females. It may be due to the reason that females tend to gain weight during childbearing years and more likely to consume high calorie diet [6].

Males had higher mean systolic and diastolic blood pressure (SBP: 121.56±10.79 mmHg; DBP: 73.26±6.36 mmHg) compared to females (SBP: 105.15 mmHg±13.59; DBP=69.46±11.15 mmHg). This was in line with the study of Maranon and Reckelhoff [7] which demonstrated that males typically have higher blood pressure and develop cardiovascular disease earlier. The incidence of high blood pressure was more common among males compared to pre-menopausal females. Androgen hormone of males stimulates the synthesis of angiotensinogen leading to an elevation in Angiotensin II. Androgen can also elevate

sodium re-absorption in the proximal tubule via both androgen receptors and AT1 receptors. Furthermore, there was a lot of AT1 receptors in males that enables angiotensin II to cause indirect negative impacts on blood pressure [8]. All of these factors lead to earlier development of high blood pressure in males. High blood pressure is the chief killer in males aged 45 years and above, and females aged 65 years and above [6,9].

There was an increase in systolic blood pressure and diastolic blood pressure with increasing body mass index observed in the present study. On the other hand, a J-shaped trend was observed in pulse rate with increasing body mass index. Overweight and obese individuals tend to have higher blood pressure and pulse rate compared to normal weight individuals (body mass index < 23 kg/m^2). As illustrated in study of Hu and colleagues [10], women with a greater body mass index had approximately six times higher risk of developing high blood pressure. This scenario may be due to the contribution of greater body weight to an increase in arterial pressure. Obesity always lead to an adverse effect on diastolic and systolic function of the heart [11]. In addition, high pulse rate was observed to be associated with increased body mass index. Tachycardia is a risk factor for cardiovascular disease morbidity and mortality, and frequently associated with development of high blood pressure [12].

The analyses could not be stratified based on the ethnicity due to a small number of Malay- and Indian-subjects in the study. Random measurement of glucose, cholesterol and uric acid only offered initial information about the subjects.

Conclusions

There were more overweight and obese females compared to males. Males had higher systolic and diastolic blood pressure than females. Among the three body weight indices (body mass index, waist circumference, waist-to-hip ratio), waist circumference correlated best with most of the cardiovascular risk factors (systolic blood pressure, diastolic blood pressure, cholesterol level). A comprehensive diagnostic measure would be required to confirm the rising level of these parameters if the results obtained were not in the normal range. It is pivotal to implement intervention programs for those individuals with high risk in developing cardiovascular diseases.

Conflict of Interests. Authors declare that there is no conflict of interest.

REFERENCES

1. World Health Organization. Obesity and overweight. [online] Available at: http://www.who.int/ediacentre/factsheets/fs311/en/ [Accessed 2nd Nov 2016].

2. Aniza I, Nurmawati A, Hanizah Y, Ahmad Taufik J. Modifiable risk factors of cardiovascular disease among adults in rural community of Malaysia: a cross sectional study. *Malaysian Journal of Public Health Medicine* 16: 53-61, 2016.

3. Sjostrom M., Ainsworth B, Bauman A, Bull F, Craig C, Sallis J. *General info*. Retrieved October 22, 2011, from http://www.ipaq.ki.se/scoring.htm, 2011.

4. Park W, Lee VJ, Ku B, Tanaka H. Effect of walking speed and placement position interactions in determining the accuracy of various newer pedometers. *Journal of Exercise Science & Fitness* 12: 31-37, 2014.

5. Chang CT, Lee PY, Cheah WL. The prevalence of cardiovascular risk factors in the young and middle-aged rural population in Sarawak, Malaysia. *Malays J Med Sci* 19: 27-34, 2012.

6. Yunus AM, Sherina M, Nor Afiah M, Rampal L, Tiew K. Prevalence of cardiovascular risk factors in a rural community in Mukim Dengkil, Selangor. *Malays J Nutr* 10: 5-11, 2014.

7. Maranon R, Reckelhoff JF. Sex and gender differences in control of blood pressure. *Clin Sci (Lond)*, 125: 311-318, 2013.

8. Medical College of Georgia. Cause of gender differences in blood pressure, kidney damage under study. [online]. Retrieved March 29, 2017, from https://www.sciencedaily.com/releases/2007/05/070502111521.htm, 2007.

9. Akter SFU, Fauzi ARM, Nordin MS, et al. Prevalence of cardiovascular risk factors in a selected community at Kuantan, Pahang, Malaysia. *International Journal of Medicine and Medical Sciences* 2: 322-328, 2010.

10. Hu FB, Wang B, Chen C, el al. Body mass index and cardiovascular risk factors in a rural Chinese population. *Am J Epidermol* 151: 88-97, 2000.

11. Lavie CJ, Milani RV, Ventura HO. Obesity and cardiovascular disease. *J Am Coll Cardiol* 53: 1925-1932, 2009.

12. Palatini P. Role of elevated heart rate in the development of cardiovascular disease in hypertension. *Hypertension* 58: 745-750, 2011.