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Cardiovascular Disease Risk and its Association with Body Mass Index in Malaysians Based on the World Health Organization/International Society of Hypertension Risk Prediction Chart

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Abstract

Background: Malaysia has experienced an epidemiological transition, with a decrease in deaths due to communicable diseases and a marked increase in the rate of non-communicable diseases, particularly cardiovascular diseases (CVDs). This study determined the changes proportional to CVD risk and its association with body mass index (BMI) among Malaysians.

Study design: Comparative nationwide cross-sectional study.

Methods: Data from three National Health and Morbidity Survey (NHMS 2006, NHMS 2011, and NHMS 2015) were obtained and reanalysed. CVD risk was determined on the basis of the World Health Organisation/International Society of Hypertension risk prediction chart, which classifies individuals aged 40-79 years into five levels of 10-year CVD risk (Risk 1: <10%, Risk 2: 10% to <20%, Risk 3: 20% to <30%, Risk 4: 30% to <40%, and Risk 5: ≥ 40%).

Results: CVD Risk 1 decreased among men aged 40-49 years but increased in the other age groups. Among women, CVD Risk 1 increased in the age group of 70-79 years, but decreased in the other age groups. CVD risk was significantly associated with BMI in the younger age groups (40-49 and 50-59 years among men; 40-49, 50-59, and 60-69 years among women). The highest proportion of CVD Risk 5 was observed among preobese men (19.0%) and obese women (21.7%) in the oldest age group.

Conclusion: The increasing CVD risk in younger age groups is a major concern. Therefore, interventions focusing on patients with high CVD risk and overweight are warranted.

Keywords: Cardiovascular disease; CVD risk prediction chart; Body mass index; National health and morbidity survey

Introduction

Currently, cardiovascular disease (CVD) is the leading cause of death worldwide. The total number of deaths caused by CVDs increased globally from 14.4 million in 1990 to 17.5 million in 2012 [1]. In 2012, deaths due to CVDs accounted for 31% of the deaths worldwide; CVD was the single largest contributor to global mortality and is expected to continue to dominate mortality trends in the future [1,2]. Among 16 million deaths among individuals younger than 70 years caused by non-communicable diseases (NCDs), 82% were in low- and middle-income countries, and 37% were caused by CVDs [1].

Malaysia has experienced an epidemiological transition, with a decrease in deaths caused by communicable diseases [3] and a marked increase in the rate of NCDs, particularly CVDs [4,5]. A 2016 Ministry of Health of Malaysia report showed that CVDs were ranked first among the ten principal causes of death in 22.7% of government hospitals and 27.7% of private hospitals in Malaysia [6].

Generally, CVD is the result of an interaction between various genetic, sociodemographic, economic, individual, environmental and health delivery system-related factors [7,8]. Several recent studies have also reported that body mass index (BMI) is one of the strongest predictors of CVD [9,10]. Essentially, efforts to prevent CVD should address all these factors. However, because CVD involves interactions between multiple factors, using a single risk factor for predicting CVD is unreliable and can cause errors [7,9]. One of the most efficient approaches to determining CVD risk is by considering the maximum number of all probable determinants, similar to applying a risk prediction chart [9,11,12].

The World Health Organisation (WHO) and International Hypertension Society (ISH) risk prediction chart for CVD, [12] designed in 2007, provides a simplified approach for identifying people at high risk of CVD in 14 WHO epidemiological sub regions. In contrast to previous risk prediction charts, the WHO/ISH risk prediction chart considers six major determinants of CVD: age, sex, smoking status, diabetes mellitus status, systolic blood pressure, and cholesterol level. It has also been reported to be efficient for use in all 193 member states of WHO, particularly in countries that presently do not have their own prediction chart [12,13]. In addition, it is one of the five prediction charts recommended by Malaysia's Clinical Practice Guidelines for the prevention of CVD in women [14].

A previous nationwide study estimated CVD risk among the Malaysian population [6], however, no published data are available on the time trend of the estimated CVD risk. Therefore, the present study determined the prevalence of CVD risk among the Malaysian population by using the WHO/ISH risk prediction chart and data from the National Health and Morbidity Survey (NHMS) in 2006, 2011 and 2015. In addition, the association between CVD risk and BMI status was determined for different age groups.

Methods

In this study, data from three cycles of the NHMS were used. These surveys were cross-sectional population studies aimed at obtaining community-based data on patterns of common health problems, health needs and health expenditures, the objective of which is to enable the Malaysian Ministry of Health to review priorities, plan strategies and activities and estimate the allocation of resources. These surveys were completely sponsored by the Ministry of Health and have been approved by the Medical Research and Ethics Committee, Ministry of Health, Malaysia (NHMS 2006: P42-251-170000(00500099); NHMS 2011: NMRR-10-757-6837; NHMS 2011: NMRR-14-1064-21877).

The WHO/ISH risk prediction chart indicates the 10-year risk of fatal or nonfatal major cardiovascular events such as stroke, coronary heart disease, and other atherosclerotic diseases [12]. On the basis of age, sex, smoking status, diabetes mellitus status, blood pressure, and cholesterol level, the chart classifies individuals aged 40–79 years into five risk levels (Risk 1: <10%, Risk 2: 10% to <20%, Risk 3: 20% to <30%, Risk 4: 30% to <40%, and Risk 5: ≥ 40%). According to the WHO epidemiological subregion classification, Malaysia is in the Western Pacific Region B (WPR B); therefore, the WPR B prediction chart was used in this estimation.

The original data set of sociodemographic (age and sex) and health characteristics (smoking status, diabetes mellitus status, blood pressure and cholesterol level) was obtained from the 2006, 2011 and 2015 NHMSs and recoded as follows. Age was recoded into four groups (40–49, 50–59, 60–69 and 70–79 years). Smoking status was recoded into smokers and nonsmokers, with all current smokers and those who quit smoking less than 1 year before the assessment considered as smokers. Diabetes mellitus status was recoded into two categories, diabetes and nondiabetes, by evaluating the fasting plasma glucose (diabetes: >7.0 mmol/L) and postprandial plasma glucose levels (diabetes: >11.0 mmol/L). Mean systolic blood pressure of two measurements was recoded into four categories (≤ 129, 130–149, 150–169, and ≥ 170 mmHg) and cholesterol levels were recoded into five categories (≤ 4.49, 4.50–5.49, 5.50–6.49, 6.50–7.49 and ≥ 7.50 mmol/L). BMI was recoded into four categories (underweight: <18.5 kgm^{-2}, normal: 18.5–24.9 kgm^{-2}, preobese: 25.0–29.9 kgm^{-2} and obese: ≥ 30.0 kgm^{-2}).

After participants with missing observations were excluded, the final data set contained data on 7277 men and 8720 women for the 2006 NHMS, 3874 men and 4518 women for the 2011 NHMS and 4652 men and 5355 women for the 2015 NHMS. The data were analyzed using SPSS version 19 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were computed for all categorical and continuous data. The association between CVD risk and sociodemographic characteristics and BMI status was assessed using the Pearson chi-square test; the significance level was set at $p<0.05$.

Results

In all the three NHMS cycles, the age group of 40–49 years accounted for the largest proportion of the sample, exhibiting a decreasing trend in the higher age groups **(Table 1)**. The proportion of male smokers was higher than that of female smokers, with a slight decrease with age in both sexes. Both men and women exhibited an increase in the proportion of diabetes mellitus from 2006 to 2015. Over the same period, mean systolic blood pressure decreased from 140.7 to 137.2 mmHg in men and from 142.1 to 138.7 mmHg in women, whereas mean cholesterol levels increased from 4.74 to 5.37 mmol/L in men and 4.95 to 5.84 mmol/L in women.

Table 1 Characteristics of the respondents (% (n)) in the 2006 NHMS, 2011 NHMS and 2015 NHMS.

Item	NHMS 2006		NHMS 2011		NHMS 2015	
	Men (n=7277)	Women (n=8720)	Men (n=3874)	Women (n=4518)	Men (n=4652)	Women (n=5355)
Age (years)						
40–49	40.3(2934)	43.8(3815)	38.8(1502)	39.2(1770)	33.8(1571)	34.3(1837)
50–59	32.7(2381)	31.6(2757)	33.5(1296)	34.6(1561)	33.3(1550)	33.7(1805)

60–69	19.0(1382)	16.9(1478)	19.4(753)	16.7(755)	22.4(1043)	21.7(1161)
70–79	8.0(580)	7.7(670)	8.3(323)	9.6(432)	10.5(488)	10.3(552)
Smoking status						
Smoker	43.2(3142)	2.4(206)	40.8(1579)	1.7(77)	40.1(1864)	1.0(55)
Diabetes status						
Diabetes	18.8(1371)	19.2(1678)	29.8(1156)	27.3(1232)	30.2(1405)	32.8(1756)
Systolic blood pressure status						
Systolic hypertensive (>140 mmHg)	44.0(3184)	46.5(4032)	38.2(1464)	39.9(1791)	33.2(1628)	36.2(2110)
Cholesterol level status						
High cholesterol (>6.2 mmol/L)	6.4(460)	10.3(884)	11.5(446)	21.6(976)	20.8(1042)	33.9(1887)
Body Mass Index (BMI)						
Underweight (<18.5kgm^{-2})	4.7(410)	5.0(428)	4.9(182)	4.0(170)	3.7(170)	3.1(148)
Normal (18.5–24.9 kgm^{-2})	48.5(3470)	38.4(3270)	45.7(1698)	37.9(1631)	42.2(1903)	37.2(1791)
Pre-obese (25.0-29.9kgm^{-2})	35.0(2505)	35.7(3041)	37.0(1374)	35.8(1541)	38.5(1733)	35.5(1935)
Obese (≥ 30.0 kgm^{-2})	10.8(770)	20.9(1783)	12.5(464)	22.3(957)	15.7(710)	24.2(1340)

In all the three surveys, the proportion of CVD Risk 1 was lower in the older age groups in both sexes, whereas the proportions of CVD Risks 2-5 were higher in the higher age groups **(Table 2)**. A comparison between the 2006 and 2015 surveys revealed that the proportion of CVD Risk 1 decreased among men in the age group of 40–49 years, but increased in the other age groups. Among women, the proportion of CVD Risk 1 increased in the age group of 70–79 years but decreased in the other age groups. From 2006 to 2015, the proportion of CVD Risk 5 increased markedly in women aged 70–79 years (11.1% vs. 15.3%), whereas men in the same age group exhibited a decreasing trend (23.3% vs. 18.4%).

Table 2 Proportions of CVD risk (% (n)) in the 2006 NHMS, 2011 NHMS, and 2015 NHMS stratified by age group and sex.

Age group	Gender									
	Male					Female				
	Risk 1	Risk 2	Risk 3	Risk 4	Risk 5	Risk 1	Risk 2	Risk 3	Risk 4	Risk 5
40 - 49 years										
NHMS 2006	2657(90.7)	132(4.4)	59(2.0)	31(1.1)	55(1.8)	3510(92.2)	122(3.1)	90(2.3)	37(0.9)	56(1.5)
NHMS 2011	1338(88.3)	84(6.1)	33(2.3)	13(1.1)	34(2.2)	1609(90.4)	51(3.2)	49(2.8)	21(1.4)	40(2.2)
NHMS 2015	1368(88.9)	101(5.5)	42(2.5)	18(0.9)	42(2.1)	1638(90.1)	86(4.4)	37(1.6)	24(1.0)	52(3.0)
50 - 59 years										
NHMS 2006	1744(73.4)	316(13.1)	111(4.7)	89(3.7)	121(5.1)	2159(78.8)	234(8.3)	130(4.7)	99(3.6)	135(4.7)
NHMS 2011	940(73.2)	166(11.6)	63(5.7)	52(3.7)	75(5.8)	1208(76.9)	152(9.9)	72(4.6)	33(2.3)	96(6.3)
NHMS 2015	1124(74.3)	225(12.6)	62(4.1)	55(2.9)	84(6.1)	1303(75.1)	213(10.6)	128(6.0)	35(2.0)	126(6.4)
60 - 69 years										

NHMS 2006	483(35.3)	398(28.8)	169(12.3)	108(7.7)	224(15.8)	757(51.5)	238(16.3)	230(15.6)	82(5.5)	171(11.1)
NHMS 2011	270(38.0)	220(28.5)	85(11.8)	66(8.6)	112(13.2)	379(48.2)	156(20.1)	87(12.4)	45(7.0)	88(12.3)
NHMS 2015	413(40.7)	295(29.8)	114(9.6)	89(7.0)	132(12.9)	539(48.1)	278(24.2)	120(11.5)	76(6.2)	148(10.0)
70 - 79 years										
NHMS 2006	73(12.6)	199(34.7)	99(17.4)	71(12.0)	138(23.3)	213(31.9)	196(29.3)	96(14.5)	91(13.3)	74(11.1)
NHMS 2011	33(10.1)	121(40.8)	68(20.5)	38(10.4)	63(18.3)	158(36.6)	144(36.0)	40(8.4)	48(10.1)	42(8.9)
NHMS 2015	53(14.7)	165(30.9)	107(23.6)	69(12.5)	94(18.4)	196(38.1)	165(25.4)	71(14.8)	42(6.5)	78(15.3)

CVD risk levels were significantly associated with BMI in men aged 40–49 and 50–59 years and in women aged 40–49, 50–59, and 60–69 years **(Table 3)**. The highest proportion of CVD Risk 5 was observed among preobese men (21.8%) and obese women (22.1%) in the oldest age group (70–79 years).

Table 3 Proportions of CVD risk (n (%)) in 2015 stratified by BMI status, age group and sex.

Gender	Age group	BMI status	Risk level					p-value*
			Risk 1	Risk 2	Risk 3	Risk 4	Risk 5	
Male	40 – 49 years	Underweight	58(90.6)	4(6.3)	1(1.6)	0(0)	1(1.6)	0.001
		Normal	543(91.3)	26(4.4)	11(1.8)	5(0.8)	10(1.7)	
		Pre-obese	541(86.7)	43(6.9)	14(2.2)	8(1.3)	18(2.8)	
		Obese	208(77.9)	28(10.5)	14(5.2)	4(1.5)	13(4.9)	
	50 – 59 years	Underweight	32(88.9)	3(8.3)	0(0)	1(2.8)	0(0)	0.001
		Normal	479(78.5)	74(12.1)	19(3.1)	17(2.8)	21(3.4)	
		Pre-obese	404(67.6)	97(16.2)	28(4.7)	21(3.5)	48(8.0)	
		Obese	186(67.9)	49(17.9)	13(4.7)	13(4.7)	13(4.7)	
	60 – 69 years	Underweight	22(64.7)	7(20.6)	3(8.8)	1(2.9)	1(2.9)	0.05
		Normal	197(42.7)	125(27.1)	50(10.8)	36(7.8)	53(11.5)	
		Pre-obese	128(35.2)	112(30.8)	43(11.8)	30(8.2)	51(14.0)	
		Obese	53(38.4)	35(25.4)	11(8.0)	18(13.0)	21(15.2)	
	70 – 79 years	Underweight	6(16.7)	19(52.8)	4(11.1)	4(11.1)	3(8.3)	0.057
		Normal	29(12.2)	86(36.3)	50(21.1)	27(11.4)	45(19.0)	
		Pre-obese	13(8.8)	38(25.9)	34(23.1)	30(20.4)	32(21.8)	
		Obese	3(9.7)	8(25.8)	9(29.0)	5(16.1)	6(19.4)	
Female	40 – 49 years	Underweight	40(97.6)	1(2.4)	0(0)	0(0)	0(0)	0.001
		Normal	575(93.5)	22(3.6)	5(0.8)	1(0.2)	12(2.0)	
		Pre-obese	600(88.8)	33(4.9)	11(1.6)	12(1.8)	20(3.0)	
		Obese	410(83.8)	29(5.9)	21(4.3)	11(2.2)	18(3.7)	
	50 – 59 years	Underweight	31(91.2)	2(5.9)	0(0)	0(0)	1(2.9)	0.005
		Normal	437(78.9)	54(9.7)	30(5.4)	7(1.3)	26(4.7)	
		Pre-obese	477(69.5)	89(13.0)	55(8.0)	16(2.3)	49(7.1)	

		Obese	345(67.9)	65(12.8)	40(7.9)	12(2.4)	46(9.1)	
	60 – 69 years	Underweight	24(64.9)	6(16.2)	4(10.8)	0(0)	3(8.1)	0.003
		Normal	209(53.6)	90(23.1)	31(7.9)	24(6.2)	36(9.2)	
		Pre-obese	183(43.9)	107(25.7)	43(10.3)	31(7.4)	53(12.7)	
		Obese	106(38.5)	67(24.4)	36(13.1)	17(6.2)	49(17.8)	
	70 – 79 years	Underweight	15(41.7)	8(22.2)	7(19.4)	4(11.1)	2(5.6)	0.05
		Normal	89(38.4)	75(32.3)	26(11.2)	16(6.9)	26(11.2)	
		Pre-obese	44(28.2)	52(33.3)	25(16.0)	8(5.1)	27(17.3)	
		Obese	25(36.8)	12(17.6)	9(13.2)	7(10.3)	15(22.1)	

*Pearson chi-square test

Underweight: <18.5 kgm^{-2}, normal: 18.5–24.9 kgm^{-2}, preobese: 25.0–29.9 kgm^{-2}, and obese: ≥30.0 kgm^{-2}

Discussion

According to our review of relevant literature, this is the first report on the time trend of estimated CVD risk and its association with BMI status by age group. Both men and women exhibited an increase in the proportion of diabetes mellitus from 2006 to 2015 and CVD Risk 1 decreased in the younger age groups (40–49 years among men and 40–49, 50–59 and 60–69 years among women). CVD risk levels were significantly associated with BMI status in the younger age groups. Thus, the increase in CVD risk as well as the prevalence of diabetes is alarming, and more efficient CVD prevention and control strategies are warranted in Malaysia.

From 2006 to 2015, mean systolic blood pressure declined, whereas cholesterol levels increased. The decline in systolic blood pressure is consistent with the change in the prevalence of hypertension in Malaysia, which was reported to have decreased from 47.0% in 2006 to 43.5% in 2011 and then 39.8% in 2015 in both men and women older than 30 years [15]. A previous survey also reported improvements in the proportion of awareness and control of hypertension in Malaysia [16]. From the 1996 NHMS to the 2015 NHMS, the prevalence of hypercholesterolemia among Malaysians aged ≥30 years increased drastically; it was 11.7% in 1996, 28.2% in 2006, 43.9% in 2011 and 56.8% in 2015 [13]. A review on hypercholesterolemia in Asia reported that fatty and spicy diet and an unhealthy lifestyle contribute to hypercholesterolemia and was positively related to CVD [17].

Older age groups exhibit higher risks of CVD according to the WHO/ISH risk prediction chart, which is consistent with our findings for all the three national surveys. Many studies have reported that CVD prevalence increases with age [18-20]. Ageing is an inevitable part of life and the largest risk factor for CVD, which remains the leading cause of death in many countries [20].

Although the proportion of CVD Risk 1 was generally lower in women compared with men, a decreasing trend was observed in women. In addition, a marked increase in the proportion of CVD Risk 5 was observed among women aged 70–79 years, whereas men in the same age group exhibited a decreasing trend. According to several studies conducted in Malaysia, women in Malaysia have a longer life expectancy than do men (men-72.5 years and women-77.4 years as of 2015), which further increases the concern of CVD [16,21,22]. In addition, poor social support, lower quality of life and lower mental health among women compared with men makes women more vulnerable to NCDs, and CVD is one of the main NCDs [21].

In middle-aged adults, BMI was significantly associated with CVD risk in both sexes. However, in older age groups, BMI was no longer significantly associated with CVD risk. Most related studies have suggested that BMI per se is not the most appropriate predictor of morbidity and mortality in elderly people because of its inability to discern or detect age-related body fat redistribution [23]. An increase in BMI was associated with an increase in CVD in the young and middle-aged groups but not in the older groups. No sex difference was observed in the association between BMI and CVD [24].

We used the WHO/ISH risk prediction chart instead of the Framingham Risk Score (FRS) or Systematic Coronary Risk Evaluation (SCORE) as the prediction chart because the WHO/ISH risk prediction chart considers all possible determinants of CVD available in the NHMS data. The FRS and SCORE use equation models derived from samples in other countries and thus might be inapplicable for the Malaysian population. Moreover, the FRS model requires readings for high-density lipoprotein cholesterol, which is unavailable in the NHMS data. Furthermore, the SCORE model does not consider diabetes status, and this is a critical determinant of CVD [14,25].

The present study used data from a national survey and applied multistage random sampling to ensure that the sample data are nationally representative. However, some methodological problems remain. First, because we aggregated the data into age groups and stratified them by sex, smoking status, diabetes mellitus status, systolic blood pressure and cholesterol level, the coefficients of variation might have increased. Second, misclassification of diabetes mellitus status might have occurred when a single occasion postprandial plasma glucose level was used in the absence of

fasting plasma glucose data. However, the possible overestimation of risk in people with newly diagnosed diabetes may have balanced the underestimation risk in people with undetected diabetes [26].

Conclusion

The trend of decreasing systolic blood pressure and increasing cholesterol levels shows that the CVD risk in Malaysia is increasing, particularly among women. The trend of increasing preobesity and obesity was also associated with elevated CVD risk. This is an alarming indication of the health situation in Malaysia because the prevalence of preobesity and obesity is increasing annually. Therefore, the implementation of effective intervention strategies is urgently required, and such strategies must focus on groups who are overweight, have a high BMI and are at high risk of CVD, and also preventing individuals who are at low risk of CVD from progressing to high risk.

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Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. World Health Organization (2016) Cardiovascular Disease (CVDs) Fact Sheet. WHO, Geneva.
2. Lu H, Pan WZ, Wan Q, Cheng LL, Shu XH, et al. (2016) Trends in the prevalence of heart diseases over a ten-year period from single-center observations based on a large echocardiographic database. J Zhejiang University Sci 17: 54-59.
3. Arokiasamy JT (1990) Communicable diseases: a continuing threat in Malaysia. Med J Malaysia 45: 181-186.
4. Dans A, Ng N, Varghese C, Tai ES, Firestone R, et al. (2011) The rise of chronic non-communicable diseases in southeast Asia: time for action. The Lancet 377: 680-689.
5. Khoo KL, Tan H, Khoo TH (1991) Cardiovascular mortality in peninsular Malaysia: 1950-1989. Med J Malaysia 46: 7-20.
6. http://www.moh.gov.my/images/gallery/publications/.pdf
7. Akter SFU, Fauzi ARM, Nordin MS, Satwi S, Mohamed A, et al. (2010) Prevalence of cardiovascular risk factors in a selected community at Kuantan, Pahang, Malaysia. Int J Med Med Sci 2: 322-328.
8. Otgontuya D, Oum S, Buckley BS, Bonita R (2013) Assessment of total cardiovascular risk using WHO/ISH risk prediction charts in three low and middle income countries in Asia. BMC Public Health 13: 1.
9. Ghorpade AG, Shrivastava SR, Kar SS, Sarkar S, Majgi SM, et al. (2015) Estimation of the cardiovascular risk using World Health Organization/International Society of Hypertension (WHO/ISH) risk prediction charts in a rural population of South India. Int J Health Policy Manag 4: 531-536
10. Chen Y, Copeland WK, Vedanthan R, Grant E, Lee JE, et al. (2013) Association between body mass index and cardiovascular disease mortality in east Asians and south Asians: pooled analysis of prospective data from the Asia Cohort Consortium. Br Med J 347: 5446.
11. Al-Lawati JA, Barakat MN, Al-Lawati NA, Al-Maskari MY, Elsayed MK, et al. (2013) Cardiovascular risk assessment in diabetes mellitus comparison of the general framingham risk profile versus the World Health Organization/International Society of hypertension risk prediction charts in arabs clinical implications. Angiology 64: 336-342.
12. Mendis S, Lindholm LH, Mancia G, Whitworth J, Alderman M, et al. (2007) World Health Organization (WHO) and International Society of Hypertension (ISH) risk prediction charts: assessment of cardiovascular risk for prevention and control of cardiovascular disease in low and middle-income countries. J Hypertens 25: 1578-1582.
13. World Health Organization, UNAIDS (2007) Prevention of cardiovascular disease. WHO, Geneva.
14. Ministry of Health (2008) Clinical practice guidelines (CPG) in prevention CVD in women, Ministry of Health, Malaysia.
15. Fadhli MY (2016) The National Health and Morbidity Survey 2015: NCD risk factors. Presentation in 31st Nutrition Society Malaysia Scientific Conference.
16. Naing C, Yeoh PN, Wai VN, Win NN, Kuan LP, et al. (2016) Hypertension in Malaysia: an analysis of trends from the national surveys 1996 to 2011. Medicine (Baltimore) 95: e2417.
17. Livy A, Lye SH (2011) Familial hypercholesterolemia in Asia: A review. J Omics Res 1: 22-31.
18. Shomad MBA, Rahman NAA, Rahman NIA, Haque M (2016) The prevalence of cardiovascular disease risk factors among students of international Islamic University Malaysia, Kuantan Campus. J Applied Pharmaceut Sci 6: 51-57.
19. Al-Alwan I, Badri M, Al-Ghamdi M, Aljarbou A, Alotaibi H, et al. (2013) Prevalence of self-reported cardiovascular risk factors among saudi physicians: A comparative study. Int J Health Sci (Qassim) 7: 3-13.
20. North BJ, Sinclair DA (2012) The intersection between aging and cardiovascular disease. Circulation Research 110: 1097-1108.
21. Sazlina SG, Zaiton A, Afiah MN, Hayati KS (2012) Predictors of health related quality of life in older people with non-communicable diseases attending three primary care clinics in Malaysia. J Nutr, Health Aging 16: 498-502.
22. No Authors Listed (2015) Abridge life table, Malaysia 2012–2015. Department of Statistics, Malaysia.
23. Chang SH, Beason TS, Hunleth JM, Colditz GA (2012) A systematic review of body fat distribution and mortality in older people. Maturitas 72: 175-191.
24. Canning KL, Brown RE, Jamnik VK, Kuk JL (2013) Relationship between obesity and obesity-related morbidities weakens with aging. J Gerontology Series A: Biol Sci Med Sci 026.
25. Selvarajah S, Kaur G, Haniff J, Cheong KC, Hiong TG, et al. (2014) Comparison of the Framingham Risk Score, SCORE and WHO/ISH cardiovascular risk prediction models in an Asian population. Int J Cardiol 176: 211-218.

26. Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, et al. (2012) European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). European Heart J 33: 1635-1701.