Prevalence of elevated body mass index condition and its associated demographic variables among adults in urban areas in Johor, Malaysia

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ABSTRACT

Introduction: The prevalence of overweight and obesity is increasing at an alarming rate. It is a major factor for many other metabolic disorders. This study aimed to determine the prevalence of increase body mass index (BMI) and obesity and their associated demographic characteristics among adults in an urban area.

Methods: A retrospective study was conducted where data was extracted from the Health Status Screening Form (BSSK) at health clinics in Johor Bahru. Using the World Health Organization (WHO), criteria for obesity, BMI≥30.0 kg/m2 was specified as obese and combination of both BMI ranges for overweight (25.0-30.0kg/m2) and obesity (≥30.0kg/m2) as elevated BMI.

Results: The overall prevalence of elevated BMI and obesity was 54.6% and 20.1% respectively. Men had a higher prevalence of elevated BMI (57.4%) with odds of 1.28 higher (95%CI: 1.04-1.58). High prevalence of elevated BMI and obesity were seen among the Indians (elevated BMI - 60.2%, obesity - 19.4%) followed by Malays (elevated BMI -57.8%, obesity - 23.1%) and Chinese showed the lowest (elevated BMI - 39.0%, obesity - 8.8%). The odds of elevated BMI and obesity were lower among younger adults as compared to older adults (≥30 years old).

Conclusion: Using WHO criteria, about one in two adults had elevated BMI while one in five were obese. Elevated BMI and obesity disparities were evident in age and ethnicity, but sex differences were encountered in elevated BMI group.

KEY WORDS:
Adult, overweight, obesity, prevalence, body mass index

INTRODUCTION

Overweight and obesity can be defined as abnormal or excessive fat accumulation to such degrees that it may impair health.[1,2] Clinically there are no perfect measures of overweight and obesity. The World Health Organization (WHO) classified bodyweight based on body mass index (BMI), calculated as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). WHO defines overweight as having a BMI ≥25.0kg/m^2 and obesity as having a BMI ≥30.0 kg/m^2. The BMI for both overweight and obesity is the same for both sexes in adults.[3]

In recent years, there were many debates on whether there is a possible need for developing different BMI cut-off points for different ethnic groups. This is due to an increasing evidence that there is difference between BMI, percentage of body fat, and body fat distribution across populations. The WHO BMI classification may not be applicable in identifying Asian individuals with a high risk of obesity-related morbidity and mortality because subjects considered by the WHO for the BMI classification were mainly Westerners. In 2000, the Western Pacific Regional Office of WHO (WPRO) proposed an alternative definition of overweight (BMI 23.0-24.9 kg/m^2) and obesity (BMI≥25.0 kg/m^2) for Asian populations.[4-6] Reducing the BMI cut-off values for action on overweight and obesity will increase the prevalence rates overnight and, therefore, increase governmental and public awareness. However, such a drastic change would be a disadvantage as it requires changes in public health policies and clinical management guidelines leading to increased costs for governments. Even though, the lower cut off points are to be added for public health action, the available data did not indicate a clear BMI cut-off point for all Asians for being overweight or obese. After much deliberation, the general consensus agreed was that the current WHO BMI cut-off points should be retained as international classifications.

Currently, overweight and obesity are considered as two very serious public health problems contributing to a number of non-communicable diseases (NCDs) such as hypertension and diabetes mellitus that are preventable, and substantially increase the risk of premature mortality and morbidity. Malaysia is not spared from the alarming rising trend in diabetes mellitus. It was found that diabetes occurrence in Malaysia has increased two-fold from 11.6 % in 2006 to 22.6 % in 2013.[7]

In the last few decades, obesity increased at an alarming rate in both developed and developing countries. Based on the WHO (2000) criteria on obesity,[4] the national prevalence of overweight has increased significantly over the past two decades. There has been a small rising trend in the prevalence of pre-obese adults in Malaysia from 20.7% reported in the 1996 Malaysian National Health and

This article was accepted: 25 December 2018
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Morbidity Survey (NHMS) [8] to 30.0% reported in the 2015 NHMS.9 However, a much more dramatic rise in the levels of obesity compared with overweight levels was observed, showing a three-fold increase in obesity prevalence among adults, from 4.4% in the 1996 NHMS[8] to 14% in the 2006 NHMS[10] and 17.7% in the 2015 NHMS.[9]

Malaysia experienced rapid economic development in recent decades leading to increased urbanisation, affluence, and changes in lifestyles and nutritional status of the population. It was found that urbanisation has a strong social impact on the diet of the people.[11,12] As the society becomes more affluent, lifestyle and personal physical activity too become significant as a whole. These could be the multiple factors that resulted in Malaysia being the highest prevalence of obesity in the South East Asia region currently.[13-15]

The aims of this study were to determine the prevalence of elevated BMI (a combination of both BMI ranges for overweight (25.0-29.9kg/m^2) and obesity (≥30.0kg/m^2) and their associated demographic variables among the adult outpatients in Johor Bahru district. The findings of this study can be used as a baseline data for monitoring the effectiveness of national programs for the prevention of overweight or obesity in Johor.

METHODS AND MATERIALS

Study design

In this study, retrospective data was taken from all available Health Status Screening Form (BSSK) at the Health Clinics from 2013 to 2015 in the district of Johor Bahru. BSSK form is a health screening tool used by Family Health Development Unit of Ministry of Health Clinics in Malaysia. It contains information on health screening including demographic details, medical history of patients and family members, high risk behaviours, mental health using the Depression Anxiety and Stress Scale (DASS), biometric measurements, medication and substances intake, eating habits and physical activities. The subjects were given an option to participate in answering the self-reported screening tool, BSSK form after explanation of the tools by the paramedic officers in charge for BSSK form in Health Clinics. Only participants who had not filled up BSSK before and consented to take part in the survey were recruited. The weight of the participant was captured at the time he/she completed the BSSK form. The recruiting period was anytime within the three years period of the study. In other words, the latest entry for a participant would be taken as the final data for evaluation if the same participant had completed the BSSK form more than once. This was done through data cleaning prior analysis to remove any duplicate entries of the same participants. The BSSK forms were screened and those aged 20 years and above and with record of height and weight were selected.

Definition of Variables

a) Body mass index (BMI)

BMI was calculated as using the formula:

BMI (kg/m^2) = Weight (kg)/ Height (m^2)

As defined by WHO (2000)[4] criteria pertaining to obesity, the outcome variable, BMI was used as indicator of underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2), overweight (BMI 25.0-29.9kg/m^2) and obese (BMI ≥30.0kg/m^2)

In this study, elevated BMI is defined as the combination of both BMI ranges for overweight (25.0-29.9kg/m^2) and obesity (≥30.0kg/m^2).

b) Overall prevalence of overweight and obese

Prevalence is the actual number of cases with the disease either during a period of time or at a particular date in time The overall prevalence was calculated as follow:

i) Overall prevalence of overweight

$$\frac{\text{= total number of adults with BMI 25.0-29.9kg/m}^2\text{ (2013-2015) X 100\%}}{\text{Total number of adults from year 2013-2015}}$$

ii) Overall prevalence of obesity

$$\frac{\text{= total number of adults with BMI ≥30.0kg/m}^2\text{ (2013-2015) X 100\%}}{\text{Total number of adults from year 2013-2015}}$$

iii) Overall prevalence of elevated BMI condition

= overall prevalence of overweight + overall prevalence of obesity

Statistical Analysis

Analyses were performed with the SPSS statistical software package version 15.0. Descriptive statistics and Chi-square (χ^2) analysis were computed to express the distribution of BMI by demographic characteristics. Logistic regression analysis was conducted to determine the possible association between demographic variables and both elevated BMI and obesity using estimated adjusted odds ratio (aOR) and 95% confidence intervals (CI). The predictor variables of sex (men and women), ethnicity, age groups, marital status and education level were entered in the regression equation and the results were obtained by comparing them with the reference category. The p-value of less than 0.05 was considered as significant associated.

RESULTS

Characteristics of participants

A total of 1,885 (83.3%) of all the BSSK forms (N=2,262) with complete records of height and weight of adults of age 20 years and above were analysed. The prevalence of underweight, normal, overweight, and obesity which were seen among the adults for year 2013 to 2015 according to the WHO BMI classification is depicted in Figure 1. The demographic profiles of the adult participants are shown in Table I.

Prevalence of overweight, elevated BMI and obesity and their associated factors

The mean BMI of men and women was 26.2±5.0kg/m^2 and 26.0±5.5kg/m^2 respectively. The distribution of BMI by demographic variables of the participants is shown in Table I. The overall prevalence of overweight and obese were 34.5% and 20.1% respectively.

Only sex, ethnicity and age were found to influence prevalence of elevated BMI as displayed in Table II. Men had a higher prevalence of elevated BMI (57.4%) with odds ratio of 1.28 higher (95% CI: 1.04-1.58) compared to women. The

Table I: Distribution of BMI class by demographic variables

	Variables		n(%*)	
	Underweight	Normal	Overweight	Obesity
Overall	82(4.4)	774(41.1)	651(34.5)	378(20.1)
Sex				
Women	51(4.7)	460(42.8)	340(31.6)	224(20.8)
Men	31(3.8)	314(38.8)	311(38.4)	154(19.0)
Ethnicity				
Chinese	15(4.6)	185(56.4)	99 (30.2)	29(8.8)
Malay	56(4.4)	480(37.8)	441(34.7)	293(23.1)
Indian	10(4.9)	72(35.0)	84(40.8)	40(19.4)
Others	1(1.5)	31(47.7)	22(33.9)	11(16.9)
Age group (years)				
20.0-29.9	37(9.1)	222(54.4)	89 (21.6)	61(14.9)
30.0-39.9	18(3.9)	170(37.0)	161(35.1)	110(24.0)
40.0-49.9	5(1.3)	148(39.3)	137(36.3)	87 (23.1)
50.0-59.9	4(1.3)	100(32.4)	137(44.3)	68 (22.0)
≥60.0	13(4.1)	129(40.6)	126(39.6)	50 (15.7)
Marital status				
Single	44(11.3)	189(48.3)	92(23.5)	66(16.9)
Married	22(1.8)	458(38.3)	451(37.7)	264(22.1)
Widow/Widower				
Divorcee	4 (3.6)	45 (40.9)	42(38.2)	19(17.3)
Education attainment				
Primary & none	6(2.3)	109(42.4)	99(38.5)	43(16.7)
Secondary	45(4.5)	383(38.6)	355(35.8)	210(21.1)
Tertiary	22(4.8)	221(47.8)	130(28.1)	89 (19.3)

%* percentage of row total
Note: underweight (BMI <18.5 kg/m2), normal weight (BMI 18.5-24.9 kg/m2), overweight (BMI 25.0-29.9kg/m2) and obese (BMI ≥30.0kg/m2)

Table II: Prevalence of elevated BMI by demographic variables

Variables	Elevated BMI (BMI >25kg/m²)			
	n	Prevalence (%)	OR (95% CI)	aOR$^{\Delta}$ (95% CI)
Sex	1029	54.6		
Women	564	52.5	reference	
Men	465	57.4	1.22(1.02-1.47)	1.28 (1.04-1.58)
Ethnicity	1019	54.0		
Chinese	128	39.0	reference	
Malay	734	57.8	2.14(1.67-2.74)	2.69(1.99-3.62)
Indian	124	60.2	2.36(1.65-3.38)	2.67(1.78-4.02)
Others	33	50.7	1.61(0.94-2.75)	1.89(1.05-3.42)
Age group (years)	1026	54.8		
20.0-29.9	150	36.7	reference	
30.0-39.9	271	59.0	2.49(1.89-3.27)	2.38(1.73-3.28)
40.0-49.9	224	59.4	2.53(1.90-3.37)	2.44(1.71-3.48)
50.0-59.9	205	66.3	3.40(2.50-4.64)	3.34(2.27-4.91)
≥60.0	176	55.3	2.14(1.59-2.89)	2.71(1.68-4.36)
Marital status	934	55.1		
Single	158	40.4	reference	
Married	715	59.8	2.20(1.74-2.77)	1.33(0.99-1.79)
Widow/Widower/Divorcee	61	55.5	1.84(1.20-2.81)	1.10(0.67-1.81)
Education attainment	926	54.1		
Primary & none	142	55.3	(1.01-1.86)	1.07(0.73-1.57)
Secondary	565	56.9	1.47(1.17-1.83)	1.20(0.93-1.53)
Tertiary	219	47.4	reference	

OR-odds ratio, aOR-adjusted odds ratio, ΔAdjusted for sex, ethnicity, age group, marital status and education, Negelkerke R Square, R2N for overweight = 0.112, N=1641

Table III: Prevalence of obesity (BMI ≥30.0kg/m2) by demographic variables

Variables	Obesity			
	n	Prevalence(%)	OR(95% CI)	aORΔ(95% CI)
Sex	378	20.1		
Women	224	20.8	reference	
Men	154	19.0	0.89(0.72-1.12)	
Ethnicity	373	20.0		
Chinese	29	8.8	reference	
Malay	293	23.1	3.09(2.07-4.63)	3.46(2.19-5.47)
Indian	40	19.4	2.48(1.49-4.16)	2.39(1.34-4.23)
Others	11	16.9	2.10(0.49-4.46)	2.08(0.92-4.69)
Age group (years)	376	20.1		
20.0-29.9	61	14.9	reference	
30.0-39.9	110	24.0	1.80(1.27-2.54)	1.87(1.26-2.79)
40.0-49.9	87	23.1	1.71(1.19-2.46)	1.92(1.24-2.98)
50.0-59.9	68	22.0	1.61(1.10-2.36)	1.75(1.11-2.77)
≥60.0	50	15.7	1.06(0.71-1.60)	1.51(0.88-2.61)
Marital status	349	20.6		
Single	66	16.9	reference	
Married	264	22.1	1.40(1.04-1.89)	1.05(0.73-1.53)
Widow/Widower/Divorcee	19	17.3	1.03(0.59-1.80)	0.79(0.42-1.48)
Education attainment	342	20.0		
Primary & None	43	16.7	0.84(0.56-1.26)	
Secondary	210	21.1	1.12(0.85-1.48)	
Tertiary	89	19.3	reference	

OR-odds ratio, aOR-adjusted odds ratio, ΔAdjusted for ethnicity, age group and marital status, Negelkerke R Square, R2N for obese =0 .051, N=1676

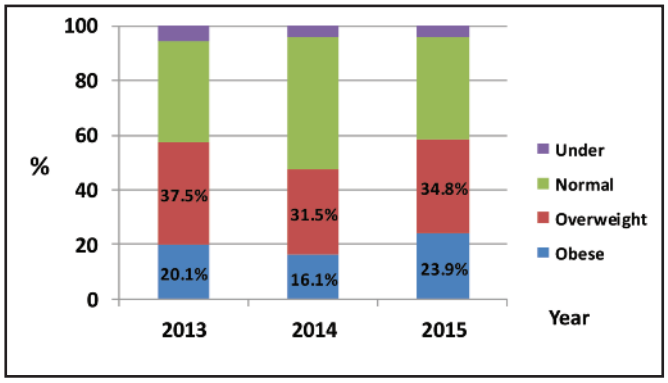

Fig. 1: Distribuion of BMI class among the adults in urban areas in Johor by year.
Note: underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2), overweight (BMI 25.0-29.9kg/m^2) and obese (BMI ≥30.0kg/m^2)

odds of elevated BMI among the Chinese was lower as compared to Malays, Indians and other races. It was noted that the prevalence of elevated BMI increased with advancing age until the sixth decade. The odds of elevated BMI among elder group (≥60 years old) were 2.71 times more as compared to younger adult group (<30 years old).

Table III shows that the odds of obesity among the Malays [aOR: 3.46 (95% CI: 2.19-5.47)] and Indian [aOR: 2.39 (95% CI: 1.34-4.23)] were higher as compared to the Chinese. The younger adults (<30 years old) were having lower odds of being obese. There were no differences of overweight or obesity between men and women.

DISCUSSION

Nearly one in two of the adults were found to have elevated BMI and one in five were obese. Women were less likely to have high BMI (≥25.0kg/m^2). Similar findings were also encountered in some of the local studies reported in a review by Lim KG[16] on adult obesity research in Malaysia. In the review, it was reported that consistently in all the studies, more men were overweight compared with women and more women were obese than men. The disparity in elevated BMI could be due to aesthetic reasons, stigma and weight-based discrimination as well as different self-perception of body weight among men and women. There is a possibility that the women in this study population were more concerned about physical appearance than men. However, this claim needs to be further explored especially through research focusing specifically on the interrelationships among body image, excessive body weight, and psychological outcomes among overweight or obese adults. Interestingly, in this study comparison with men, the prevalence of obesity among women was about 2% higher but did not reach significant level. Several studies have shown the prevalence of obesity was found to be more pronounced in women such as in the Cameroons (3.2% for men, and 28.8% for women) and Saudi Arabia (16% for men, and 24% for women).[4,17] The increase in BMI especially married women could be possibly be associated with parity, since child bearing has been suggested to be an important contributor to the development of obesity.[18,19] Another study revealed that the weight gain by women during pregnancy leads to retaining the gained weight.[20] More investigation on certain factors influencing sex disparities in overweight and obesity such as physical activity cultural values, biological factors (e.g., menopause),

body image concerns and urbanization need to be further explored and substantiated.

Difference in obesity or disparity in elevated BMI among ethnic groups was observed. The finding showed that Indians had the highest prevalence of elevated BMI followed by Malays, other indigenous race and lastly Chinese. Similar trend was also seen in both Malaysia's National Health and Morbidity Survey of 1996[8] and study by Wan Nazaimoon and his colleagues.[21] However, obesity was also reported to be significantly associated with ethnicity.[22] In this study, it was observed that the prevalence of elevated BMI and obesity among the Malays were 2.7 times and 3.5 times more likely than the Chinese. This observation of associated ethnicity and BMI was also reported by Paeratakul and his colleagues, where the prevalence of high BMI was found to be higher in the ethnic minority population especially in black women compared to whites.[23] There is no straight forward association between overweight or obesity and ethnicity. As such, further research, especially on the ethnic, sex differences and the complex interplay of factors affecting overweight or obesity should be looked into. This is crucial especially in developing targeted obesity prevention interventions and health promotion activities in order to eliminate health disparities and help to achieve health equity over time.

The odds of elevated BMI condition were 2.7 times more likely among elderly group (≥60 years old) as compared to younger adult group (<30 years old). The prevalence of this high BMI increased with advancing age. This is in line with findings from a review of data on the prevalence of adult overweight or obesity from the WHO's Global Database on BMI which showed an increasing trend of prevalence of adult obesity with advance of age. The peak of this trend is estimated to be 40-50 years in many developing countries in contrast to 50-60 years in most developed countries.[24] Age is reported as one of the strongest risk factors that predispose an individual to the development of overweight or obese in most populations.[25] The possible reasons could be due to considerable changes in body composition of fat-free mass and fat mass and an increase in energy intake, a decrease in energy expenditure, or both and hormonal changes that occur during aging.

In this study there was no significant association between the prevalence of either elevated BMI condition or obesity and marital status after adjusting for other variables. However, findings from a Spanish cross-sectional study reported that 1.69 odds of obesity comparing married to single people.[26] This finding is also supported by Jeffery (2002) who found that marriage was associated with a significant two-year weight gain and divorce with a significant two-year weight loss.[27] The effects of marriage and divorce on weight may be due to the influence of marriage on financial and material resources, social support, and health related behaviour.[27,28] However, it is not clear how marital status is associated with obesity and the role of marriage since there were several conflicting reports or studies about relationship between marital status and obesity.[29-32]

Though, there was no significant association between prevalence of elevated BMI and attainment of education after adjusting for other variables in this study, it is difficult to interpret the direction of the causal link between obesity and education when exploring the cross-sectional relationship between these two variables. Nevertheless, a study done by Parkes, found that respondents with no schooling and no formal education had significantly higher BMI than those with qualifications.[33] Similar finding was also reported in a cross-sectional study that employed data from national health interview surveys from nineteen European countries which reported higher prevalence of obesity and overweight among people with lower educational status.[34] Study done by Hoffmann revealed that level of education influenced health behaviour, providing better knowledge and access to information about health risks and healthy behaviours, as well as the cognitive ability to deal with such information.[35] Thus, the higher educational level provides material resources and facilitates to the implementation of health-promoting behaviours.[35] Despite that, a recent systematic review by Cohen AK et al., on the relationship between educational attainment and obesity studies conducted in 91 countries showed that obesity and education level are not straight forward.[36] These two association are influenced in turn by both gender and economic development level the country. Where an inverse association was more common in studies of higher-income countries and a positive association was more common in lower-income countries, stronger social patterning among women prevailed.[36]

This abnormally high prevalence of elevated BMI condition is of great concern. It is very likely that the rate will increase further if effective approaches not implemented to controlling them. Obesity and overweight are known to be modifiable risk factors to several NCDs, highlighting the need to reduce the prevalence rates and the rising level of NCDs. In order to reverse the increase in overweight and obesity, efforts should focus on promoting healthy diets and increasing levels of physical activity, or both. A community based nutrition and physical activity intervention conducted by Xu et al., among children who were overweight or obese and their caregivers found to have a reduced BMI over a two-years following the intervention.[37] Similar finding was observed in a local study where there was a reduction of BMI, waist circumferences and fat free mass among the obese adults enrolled in a 12-week weight loss program consisting of dietary and exercise interventions.[38] Such findings also calls for the involvement of health services, community, food industry and mass media, to play a key role in the modification of environment in a way which does not support the increase of body weight.

LIMITATION

It was not feasible to compare the prevalence of overweight or obesity between this study and NHMS of 2015.This is due to the difference in the study population age of the adults in the study (≥20 years old) and those in NHMS studies (≥18 years old). By virtue of being facility based, BSSK can be used as a supplement to NHMS which is a national population survey in Malaysia. BSSK can serve as an extension or even as a check/confirm finding especially when conducted with different study populations and settings. Furthermore, both these surveys provided data and information useful for planning of future health programmes. The results in this study did not show statistically significant differences

between educational attainment or marital status with either elevated BMI condition or obesity. This could be because the sample size was insufficient to detect the differences. Another possible limitation of this study is the lack of information on household incomes, the size of the family and closely related occupation as it may be related to variations in behaviours which change energy consumption, energy expenditure and metabolism.[39]

CONCLUSION

From the study, the prevalence of adults with elevated BMI condition was one in two while obesity showed one in five. Elevated BMI condition and obesity disparities were evident in age and ethnicity but males and females were encountered in elevated BMI group.

ETHICAL CONSIDERATION

This study was conducted with the approval from National Medical Research and Ethics Committee (MREC) of the Ministry of Health (MOH), Malaysia via the National Medical Research Registry (NMRR) with assigned number NMRR-16-376-29133.

CONFLICT OF INTEREST

None

ACKNOWLEDGEMENTS

The authors wish to thank the Director-General of Health, Malaysia for his permission to publish this article. The authors are very grateful to the Public Health Clinics of Johor Bahru for providing the data that enabled this study to be completed.

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