

ORIGINAL ARTICLE

BURDEN OF DISEASE ATTRIBUTABLE TO OVERWEIGHT AND OBESITY IN MALAYSIA

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*Department of Economics, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.***ABSTRACT**

The overweight and obese population may affect the population health which can lead to economic stability and development of the countries to be compromised. Thus, this study estimates the burden of disease attributable to overweight and obesity in Malaysia for adults aged 20-59 years old. Population attribution fraction (PAF) and disability-adjusted life year (DALY) have been used to quantify years of life lost from premature death and number of years lost due to disability resulting from obesity and overweight. The burden of disease attributable to overweight was 1582 and 1146 PYs per 1000 persons for male and female, respectively. Meanwhile, the burden of disease attributable to obesity was 2951 PYs per 1000 persons with women in the lead at 1657 PYs per 1000 persons. The burden of overweight and obesity among Malaysian adults is substantial. The outcome of this study is crucial as it gives a comprehensive information on the burden of overweight and obesity in Malaysia. The information from this study also enables the authorities to develop activities and programs to combat obesity and to maintain healthy lifestyle among Malaysian.

Keywords: *obesity, relative risk, disability-adjusted life year (DALY), population attributable fraction (PAF)*

INTRODUCTION

Obesity has raised a lot of attention when World Health Organization (WHO) lists it as one of the leading global risks for mortality at world level¹. In the year 2013, American Medical Association (AMA) has officially recognized obesity as a disease in order to improve the health outcomes of the Americans². This move was due to the alarming situation that one in three American adults are obese or overweight³. However, Malaysia only views obesity as a risk factor for non-communicable diseases (NCDs) rather than a disease even though Malaysia ranked the fattest country in South - East Asia and the sixth in Asia Pacific Region⁴. Thailand is next in line with 8.8 percent. While the Timor-Leste has the lowest prevalence rate in South East Asia with only 2.2 percent. In Malaysia, the prevalence of obesity was 17.7 percent in the year 2015, almost double compared to the figures in the last two decades⁵. Despite the high prevalence of obesity, which is a core risk factor for the development of chronic diseases, people are more concerned about the potential public health challenges associated with obesity. Perhaps, the public is more concerned with the growing demand for health services under limited resources and the socioeconomic burden on the health care system which will be very significant in the near future⁶. Until today, most of the researchers only focus on mortality but tend to ignore the prolonged illness that will affect the patient daily life. In addition, the disability that arises out of the prolonged illness will further lead to productivity loss, leaves of absence from work and potential high medical cost⁷. Up to date,

research papers and studies related to the burden of obesity have been very limited due to insufficient data from the respective authorities in this country. WHO reported the burden of disease attributable to obesity in the six sub-regions, but it failed to highlight the burden of the disease attributable to obesity into country specific^{8,9}.

Indeed, obesity is proven to be a major risk factor for many non-communicable diseases such as diabetes, heart disease, stroke and certain types of cancers, but the Malaysians exhibit low awareness on the adverse impact of overweight and obesity^{10,11}. For this reason, this study aims to provide a clear picture and highlight the burden of disease attributable to overweight and obesity in Malaysia. In addition, despite this study has estimated the burden of disease by gender and age specific by applying disability-adjusted life year (DALY) and population attribution fraction (PAF), yet it offers only a basic starting point to create public awareness and to provide a better understanding for the policy makers in formulating the relevant policies to curb the problem.

METHODOLOGY

The paper is organized as follows. The next section describes the procedures on the application of PAF and DALY in estimating the burden of overweight and obesity. The third section presents the result of the burden of disease attributable to overweight and obesity across gender. In addition, the result is analyzed and reported according to four age groups in order to highlight the inclusion of age factor into the estimation. Lastly, the final

section brings the second and third sections together in a compelling conclusion.

Since the definition for obesity and overweight is too broad, this study will employ the criteria set by WHO in order to make the result comparable to similar studies in other countries. A Body Mass Index (BMI) between 25 to 29.9 kg/m² will be defined as overweight and a BMI above 30 as obese^{12, 13}. The following process is adopted from WHO and needs to be followed in estimating the burden of disease attributable to overweight and obesity.

Disease selection related to overweight and obesity based on relative risk assessment

The prevalence of overweight and obesity across gender was obtained from the National Health and Morbidity Survey (NHMS) IV. In order to determine the Relative Risk (RR), twenty obesity-related diseases were recommended to be included in the study by Malaysian Association for the Study of Obesity (MASO)¹². However, after applying the three selection criteria stated below, only 11 obesity related diseases were included in this study (Refer to Table 1). The selection criteria were as follow; i) the studies were published during the year 2000 to 2016, ii) the studies have applied RR to explain the differences between the two groups (overweight and obesity) in term of exposure to certain diseases; iii) the definitions of obesity and overweight have followed WHO guidelines. Most of the literature suggests that these researches are mostly done in western countries, hence; selected studies are taken almost exclusively from a western population which reports on diseases such as asthma, hypertension, osteoarthritis, gout, heart failure, breast cancer, colorectal cancer, endometrial cancer and low back pain^{14, 15, 16, 17, 18}. However, certain diseases such as diabetes mellitus and ischemic heart diseases have been proven to be persistently higher in the Asian population. Thus, RR obtained from studies on Korean population will be applied for these two diseases; diabetes mellitus and ischemic heart diseases¹⁹. Lastly, for stroke, the studies from China population were applied as none of the studies on the relative risk of stroke has been done in Malaysia yet²⁰. The RR ratios recommended in the research mentioned above were used for the calculation of the burden of disease in this study.

RRs are available in two categories which include RRs of incidence and RRs of mortality. Thus, applying RRs of mortality might lead to the underestimation of the burden of disease. Therefore, this study will use RRs of incidence to measure the burden of disease.

Burden of disease attributable to overweight & obesity

The attributable burden (AB) of a risk factor is quantified by using the population attributable fraction (PAF). The estimation of prevalence of overweight and obesity in the population (Pe) and RRs obtained from step 1 and 2, enable the PAF for 11 diseases to be computed based on equation 1.

$$PAF = \frac{Pe(RR-1)}{Pe(RR-1)+1}$$

Since obesity leads to multiple risk factors and the calculation of individual risk factors may interact with their impact on overall risk of obesity. Therefore, the estimation of the PAF (all) of the incidence or mortality attributable to obesity becomes important because it explains potential causal pathways. Thus, equation 2 represents the joint effects of multiple risk factors to obesity.

$$PAF \text{ (joint)} = 1 - \frac{1}{\sum_{i=1}^k Pe_i \times RR_i}$$

Finally, DALY corresponds to the healthy year lost due to morbidity or mortality will be computed based on equation 3.

$$DALY = YLL + YLD$$

Year of life lost (YLL) was calculated by number of death multiply to standard life expectancy at the age which death occurs. The data for number of deaths for each disease were provided by Department of Statistics, Malaysia. These data were professionally coded using the International Classification of Diseases, Ten Revision (ICD-10). Year of life lost was obtained when expected life expectancy minus the age when death occurs. Meanwhile, years lived with disability (YLD) is equal to the prevalence of obesity-related diseases (cases) multiply with disability weight. Unfortunately, the prevalence and incidence rate of obesity-related diseases are largely unavailable in Malaysia except for diabetes mellitus, hypertension and cancer^{5, 24}. For other diseases, the prevalence rate is proxy from mostly South East Asia countries, assuming that Malaysia shares similar trend with other countries in the same region²⁵. On the other hand, the disability weighting is available in Global Burden of Disease (GBD) 2004, 2010 and 2013. DALY can be obtained by adding YLL and YLD together using WHO template which is available in Microsoft Excel. Finally, the attributable burden of disease due to overweight and obesity can be estimated from the following equation 4, where each disease burden (DALY) is multiplied by PAF. Summation of all AB will give the attributable burden of disease due to overweight and obesity.

$$AB = B \times PAF$$

Table 1: Calculated RRs from various studies for obesity and overweight related diseases by gender

Studies on Selected Diseases	ICD-10	Relative Risks(RRs) by Gender	
		Male	Female
1. Diabetes mellitus ¹⁸	E10-E14	1.909 (BMI 25-29.9), 4.878 (BMI ≥30)	2.345(BMI 25-29.9), 5.188(BMI ≥30)
2. Hyperuricemia (risk of gout) ^{15,16}	E79	1.95 (BMI 25-29.9), 2.33 (BMI 30-34.9), 2.97(BMI≥ 35)	1.63 (BMI 25-29.9), 2.76(BMI 30-34.9) 3.9(BMI≥ 35)
3. Ischemic heart disease ¹⁸	I20-I25	1.374 (BMI 25-29.9), 1.585 (BMI ≥30)	1.295 (BMI 25-29.9), 1.510 (BMI ≥30)
4. Cerebrovascular disease ¹⁹	I60-I69	1.23 (BMI 25-29), 1.57(BMI≥30)	1.30 (BMI 25-29), 1.32 (BMI≥30)
5. Sleep apnea ¹⁹	G47	1.63 (BMI 25-29.9), 4.38(BMI 30-39.9) 7.11(BMI≥ 40)	1.63 (BMI 25-29.9), 4.38(BMI 30-39.9) 7.11(BMI≥ 40)
6. Congestive heart failure ¹⁴	I50	1.31(BMI 25-29.9), 1.79 (BMI ≥30)	1.27 (BMI 25-29.9),1.78(BMI ≥30)
7. Hypertension ¹⁴	I10-I15	1.28(BMI 25-29.9), 1.84(BMI ≥30)	1.65(BMI 25-29.9), 2.42(BMI ≥30)
8. Asthma ¹⁴	J45-J46	1.20(BMI 25-29.9), 1.43(BMI ≥30)	1.25(BMI 25-29.9), 1.78(BMI ≥30)
9. Osteoarthritis ¹⁴	M19	2.76(BMI 25-29.9), 4.20(BMI ≥30)	1.80(BMI 25-29.9), 1.96(BMI ≥30)
10. Low back pain ¹⁴	M54	1.59(BMI 25-29.9), 2.81(BMI ≥30)	1.59(BMI 25-29.9), 2.81(BMI ≥30)
11a. Breast cancer ¹⁴	C50		1.08(BMI 25-29.9), 1.13(BMI ≥30)
11b. Endometrial Cancer ¹⁴	C54		1.53(BMI 25-29.9), 3.22(BMI ≥30)
11c. Colorectal cancer ¹⁷	C18	1.16(BMI 25-29.9), 1.03(BMI ≥30)	1.40(BMI 25-29.9), 1.07(BMI ≥30)

RESULTS

The sum of DALY is presented in the above table. Table 2 below shows that the burden of disease attributable to overweight are 1582 and 1146 PYs per 1000 persons for male and female, respectively. Among all obesity related diseases worldwide, heart failure and hypertension has the most significant burden of disease attributable to overweight; where men were 31.7 percent and followed by 31.6 percent. The gender difference is insignificant for diabetes mellitus. On the other hand, other diseases show that the contribution of gender is significant. The sequence of disease is different across gender.

Men’s burden of diseases are ranked as follows; gout (140 PYs), sleep apnea (126 PYs), ischemic heart disease (112 PYs), cancer (91 PYs), , osteoarthritis (32 PYs), stroke (28 PYs), asthma (26 PYs), and low back pain (6 PYs). Meanwhile, the second burden of disease attributable to overweight for women are followed by cancer (405 PYs), ischemic heart disease (61PYs), heart failure (53PYs), osteoarthritis (46 PYs), gout (36 PYs), diabetes mellitus (20 PYs) and stroke (17 PYs), asthma (25 PYs), sleep apnea (10 PYs) and lastly, low back pain (9 PYs). On the other hand, the

burden of disease attributable to obesity for both genders share similar trend as in overweight.

Table 3 presented the burden of overweight related diseases by gender for each age group. Initially, DisMod II presents the output in 5-year threshold; however, to simplify it for reporting purposes, this study will summarize the result into 10-year threshold. For men, the burden of hypertension and heart failure attributable to overweight was the highest among all other diseases in all age groups. Meanwhile, the burden of diseases attributable to overweight was slightly different in the case of women.

The burden of hypertension and cancer attributable to overweight was the top two diseases contributing to the total attributable burden of disease across all age group for female. On the other hand, almost all diseases are correlated with age in both sexes unless low back pain, asthma and sleep apnea. Those diseases show that people in the high risk when their age is between 20-49, but decrease when they reach 50s because their health conditions will change to other diseases related disorder.

Table 2: Attributable Burden (AB) of diseases due to overweight and obesity by gender in Malaysia (person years /1000 persons).

Diseases	Overweight		Obesity	
	Male	Female	Male	Female
Diabetes mellitus	21	20	22	23
Hypertension	500	465	523	524
Stroke	28	17	30	19
Heart failure	501	53	524	60
Osteoarthritis	32	46	33	52
Ischemic heart disease	112	61	117	69
Low back pain	6	9	7	10
Asthma	26	25	27	28
Cancer (colorectal, breast, endometrial)	91	405	95	458
Sleep apnea	126	10	131	12
Gout	140	36	147	40
Total	1,582	1,146	1,657	1,294

Table 3: Attributable Burden (AB) of diseases due to overweight by gender and age group in Malaysia (person years /1000 persons)

Disease	Male				Female			
	20-29	30-39	40-49	50-59	20-29	30-39	40-49	50-59
Diabetes mellitus	3	4.2	6.3	7.4	2.6	3.8	6.3	7.4
Hypertension	83.6	115.2	147.8	153	75.8	103.5	140.9	144.1
Stroke	2.6	2.7	6.4	16.6	1.4	1.7	4.9	8.9
Heart failure	83.8	115.3	148.3	153.1	19.8	14.2	11.9	6.8
Osteoarthritis	0	0.1	5.8	26.1	0	0.1	13.3	32.2
Ischemic heart disease	7.7	18.7	22.2	63	0.8	4.6	18.9	36.9
Low back pain	0.7	1.8	2.1	1.7	0.5	1.7	4	3
Asthma	6.4	10.5	6.3	2.7	4.7	9.6	6.6	3.9
Cancer (colorectal, breast, endometrial)	2.4	8.6	27.7	52.2	11.8	66.1	146.2	181.1
Sleep apnea	0.1	31.6	54.1	39.9	0	0	3.1	7
Gout	12.2	37.3	46.4	44.5	1.7	6.2	10.5	17.3
Total	202.5	346.1	473.4	560.1	119.2	211.7	366.7	448.5

Table 4 shows the burden of disease attributable to obesity by gender and age. Both male and female show that burden of disease attributable to obesity are at its highest level when they reach the age group of 50-59 and the value increases approximately by 4.5 percent for males and 11.5 percent for females. On the other hand, only a small fraction of disease burden from obesity-related diseases occurs to those between the age 20-39 for both genders.

DISCUSSION

To the best of our knowledge, this study is the first few to analyze the burden of diseases attributable

to overweight and obesity in Malaysia. Hence, issues on the availability and reliability of the data become critical in conducting this research. The mortality data for the year 2011 which were obtained from the Department of Statistics has solved the problem of misclassifications all diseases are categorized according to International Statistical Classification of Diseases and Related Health Problems 10th revision by WHO.

Table 4: Attributable Burden (AB) of diseases due to obesity by gender and age group in Malaysia (person years /1000 persons)

Disease	Male				Female			
	20-29	30-39	40-49	50-59	20-29	30-39	40-49	50-59
Diabetes mellitus	3.1	4.4	6.6	7.7	3	4.3	7.1	8.3
Hypertension	87.6	120.6	154.8	160.2	85.6	116.9	159.1	162.7
Stroke	2.8	2.8	6.7	17.3	1.5	1.9	5.5	10.1
Heart failure	87.7	120.8	155.3	160.3	22.4	16.1	13.4	7.6
Osteoarthritis	0	0.1	6.1	27.3	0	0.2	15	36.4
Ischemic heart disease	8	19.6	23.2	66	0.9	5.2	21.4	41.7
Low back pain	0.7	1.9	2.2	1.8	0.5	1.9	4.5	3.4
Asthma	6.7	11	6.6	2.8	5.3	10.9	7.5	4.4
Cancer (colorectal, breast, endometrial)	2.5	9.1	29	54.6	13.3	74.7	165.1	204.5
Sleep apnea	0.1	33.1	56.7	41.8	0	0	3.6	7.9
Gout	12.8	39	48.6	46.6	1.9	7	11.8	19.5
Total	212	362.4	495.7	586.4	134.6	239.1	414.1	506.6

Since Malaysian hospitals are less likely to perform postmortem examination, 50 percent of the causes of death are non-medical certified. In those cases, the informants such as policemen, medical assistants or other individuals took the responsibility of certifying or providing information on the cause of death³². Additionally, close relatives will be interviewed to help identify the cause of death. Due to the issues, the result of “verbal autopsy” might undermine the quality of the data. Thus, this study only employs mortality data based on medical certified. However, accepting only medically certified deaths as the only valid data for this study has the tendency to underestimate the mortality data.

Moreover, the presence of data gap for mortality in Malaysia has imposed some limitation on this study. A complete report on mortality data according to cause of death for the year 2011 was only published in December 2015 which implied that the data were not up-to-date. Part of the reason is caused by the complex organization and management of data system in Malaysia. Any death of Malaysians must be reported to the National Registration Department, while the compilation of the death data according to ICD coding is under the responsibility of the Department of Statistics. Being managed by two different authorities, the whole process is relatively time-consuming. However, the Department of Statistics, Malaysia is the sole information provider for total death in Malaysia so the data provided have been very useful for this study.

As there are twenty obesity related diseases were identified by the MASO but this study only take into consideration of eleven obesity related

diseases which might indicate underestimation of the impact of obesity and overweight. However, the diseases excluded in this study mostly has low prevalence in Malaysia. Furthermore, the consistent in selection criteria is crucial to ensure the study is comparable with others. Rather than letting the inconsistency in selection criteria to influence the result, the authors choose to remain the current selection criteria.

Likewise, it is important to realize that the RR, incidence and prevalence rate is largely not available in Malaysia. Most of the literature suggested that these research studies for RR are mostly done in Western countries. Hence, selected studies are taken almost exclusively from a Western population, which reports on diseases such as asthma, hypertension, osteoarthritis, gout, heart failure, breast cancer, colorectal cancer, endometrial cancer and low back pain. Similarly, for prevalence and incidence rates, only limited sources of data are available. Under those circumstances, the results obtained by applying DALY are unable to reflect the real consequence of being obese in Malaysia.

Comparatively, the disability weights applied to this study were taken from the Global Burden of Disease (GBD) for 2004, 2010 and 2013. As a result, it might fail to highlight the real patient morbidity conditions in Malaysia specifically. A patient who has multiple disease conditions might suffer from a high level of disability, as compared to those who have only one disease. In this case, the patient’s disability weight should be close to one if the multiple diseases condition was taken into consideration. In addition, obesity is likely to be linked with the incidence of obesity co-morbidity

rather than resulting patients to lose their lives²¹. Nevertheless, in some extreme cases, for example, morbid obesity has been confirmed to bring substantial mortality consequences to the patient due to multiple health complications^{22, 23}. Meanwhile, for those who are overweight and mildly obese, applying the RRs of incidence will raise the reliability of the result. This is because RRs of mortality will be lower since obesity is less likely to cause death.

Among all obesity related diseases worldwide, heart failure has the most significant burden of disease attributable to being obesity, where men were 524 PYs per 1000 persons and followed by hypertension 523 PYs per 1000 persons. Gender difference is insignificant for diabetes mellitus. Chronic diseases such as osteoarthritis, low back pain, and gout may not lead to loss of patients' life but the diseases tend to be associated with disability such as activity limitation and emotional stress where the patient will take distance from social contact and avoid leisure activities²⁷. In Malaysia, the incidence of getting cancer for women is much earlier than women in western countries²⁸. Approximately 50 percent of the cancer patients are being diagnosed before the age of 50²⁹. Meanwhile, men are at higher risk of getting stroke, heart failure and ischemic heart disease as compared with women^{30, 31}. The chances of full recovery from the disease are relatively lower thus it will cause a higher mortality rate for these diseases. Unless, the people in the age group of 20-39 under a morbidly obese condition which can lead to premature death at an early age, otherwise, obesity will only act as risk factor and the speed of developing the diseases are accelerated with age.

CONCLUSIONS

Although there are still many related work that need to be done in this area, this study has produced among the first and important findings by applying DALY to estimate the burden of disease attributable to overweight and obesity in Malaysia for the year 2011. The key finding of this study is that gender is significant for both burden of the disease attributable to overweight and obesity. The burden of disease attributable to overweight was 1582 (men) and 1146 PYs for (women). Meanwhile, the burden of disease attributable to obesity was 1657 (men) and 1294 PYs for (women). Even the prevalence of overweight is higher than prevalence of obesity, but the relative risks for obesity-related diseases across gender are higher compared to relative risk of overweight related diseases. The outcome of this study is crucial as it gives vital information on the burden of disease attributable to overweight and obesity in Malaysia. This study gives a clear

indication to the relevant authority on the need to develop activities and programs to fight obesity and promote healthy lifestyles among the Malaysian public at an early stage.

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