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Medical Costs of Overweight and Obesity in Public Hospital

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ABSTRACT

Obesity and overweight are a highly prevalent problem in the recent years, resulting in a significant financial burden to the healthcare system worldwide. The increased prevalence leads to increased multiple chronic illnesses incidence. This inevitably sparks the substantial surge in medical costs for the treatment of obesity. One-part Generalized Linear Model (GLM) has been applied on the patient–level data obtained from Serdang Hospital. This finding was unexpected and suggests average obesity and overweight patients does not contribute to high personal medical cost due to the heavily subsidized programs and policies by the government, the medical cost for these burgeoning issues is lower compared to normal weight patient. Although the study has failed to highlight the actual cost of obesity and overweight, but it has provided a basic framework for better understanding of their effects, under governmental subsidiary programs.

Keywords: Obesity, Overweight, Inpatient Cost, Outpatient Cost, One-part Generalized Linear Models (GLMs)

JEL Classification: A10, I15, I19

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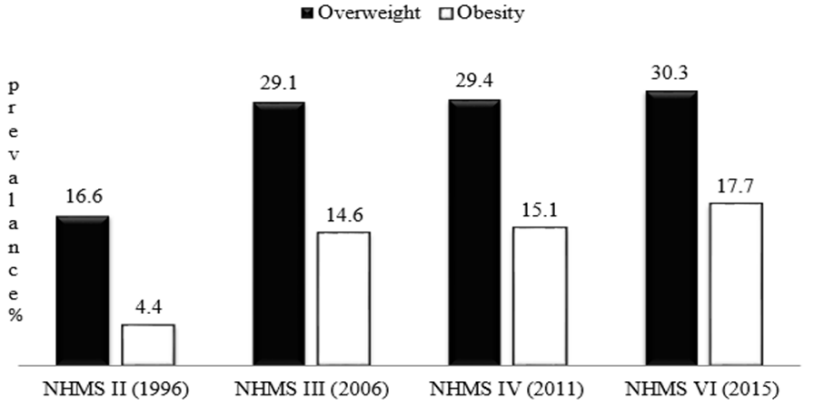
INTRODUCTION

Overweight and obesity are health conditions of abnormally high and unhealthy amount of body fats (Ministry of Health, 2004). Overweight is defined as a Body Mass Index (BMI) at or above 25 while obesity determined at a BMI of 30 or more. BMI comprises of index for a particular body weight that is grossly above the acceptable weight according to international guidelines, and may not always be associated with adverse effects on the health status. However, it is generally acknowledged that most of the patients diagnosed with non-communicable diseases are obese (Ichiho *et al*., 2013). This has attracted a lot of attention from the public recently, as it is linked with higher risks of developing non-communicable diseases, increased disability and premature death (World Health Organization, 2010). The most common screening tool currently used to detect an obese person is the Body Mass Index (BMI).

According to Malaysian National Health and Morbidity survey VI (2015), Malaysia is ranked as the fattest country in Asia, whereby 30.3 percent of the adult population are reported as overweight, while 17.7 percent are obese (refer to Figure 1). This means that almost half of Malaysian adult populations made up of 9.9 million citizens are either obese or overweight, indicating that Malaysian obesity trends are catching up with their European counterparts. Twenty years ago, only 4.4 percent Malaysians are considered as obese, and the number has escalated to an alarming figure of 17.7 percent two decades later in 2015 (Institute for Public Health, 2016).



Source: National Health and Morbidity Survey (1996, 2006, 2011, and 2015)

Figure 1: Prevalence of obesity and overweight in Malaysia (1996-2015)

This situation has spurred the Malaysian government into initiating various programs to reverse the epidemic, such as 'My Weight My Health', '10,000 Steps a Day', 'Mysihat', and 'Eat Right, Move Right: Fight Obesity (Malaysian Pharmaceutical Society, 2012; Mansor and Harun, 2014; Nutrition Month Malaysia, 2015). These campaigns, hotlines, and programs are all aimed to promote healthy lifestyle among Malaysian citizens by dispersing information on nutrition, proper dietary practices, and fitness through physical activities or exercises.

Unfortunately, there is no significant change seen in the present outcome. The overweight and obesity prevalence remains high and showing a dramatic increase of more than four-

folds despite these concentrated efforts by the government. This is attributable to the rising incidence of multiple chronic illnesses, resulting in substantial medical costs increasing in order to treat obesity (Mora *et al*., 2014). It has been widely documented that obesity is heavily associated with health diseases, such as high blood pressure, stroke, diabetes and heart diseases (Apovian, 2009). Therefore, in order to combat this problem, members of the public need to introduce and maintain behavioral and dietary changes in their lives without being too reliant on the government. The threat of obesity as a lifelong problem should be highlighted upon in order to create awareness among citizens regarding the need for lifestyle changes voluntarily, and engaging in healthy activities consistently. In fact, just by improving daily eating habits, exercising daily, and reducing the amount of time spent in front of the television and computers, the chances of obesity can be significantly reduced (Swinburn *et al*., 2004). Therefore, the purpose of this study is to identify the relationship between medical costs and BMI in Malaysian public hospital.

The Malaysian Public Healthcare System

Neighboring countries like Indonesia and Philippines practice decentralization system, but Malaysia is still maintaining central administration with health promotional policies and programs being formulated and funded by Ministry of Health (MOH) (Jaafar *et al*., 2013). Total Health Expenditures (THE) in year 2013 has been recorded as RM 44,748 million, which is equal to 4.53 percent of Gross Domestic Product (GDP) (Zainuddin, 2015). Despite being a highly subsidized system, the health expenditure has remained predominantly spent on public needs, at 52 percent of THE.

Table 1 shows hospital ward, inpatient and outpatient charges for Malaysian citizen. In a public hospital, medical attention and treatment are charged along with a small amount of co-payment of only 2 to 3 percent from the actual cost (Chua and Cheah, 2012). Moreover, any payment made by the patient encompasses accommodation and food costs only, as patients can choose between different types of ward accommodation during their admission. Ward charges differ slightly based on the ward type. Thus, the inpatient charges will be the sum of daily ward charges and inpatient charges, plus other selected treatment charges. Contrariwise, for outpatient visits, patients will only be charged RM 1 only per visit, and RM 5 for specialist clinic visit depending on cases as stated in Statement 2a, b, and c (refer to Table 2). If a patient has been referred by a private practitioner, a flat fee of RM 30 will be charged, which is a stark difference compared to a visit referred by government-facilitated institutions (Ministry of Health, 2013). The outpatient medical fees only include basic medications and investigation charges, and exclude other treatment charges.

Table 1: Hospital Ward and Inpatient Charges According to Different Class

	Ward charges	Inpatient treatment charges
1 bedded (1st class)	RM 80 RM 120 (new rate after 1 Jan 2017)	RM 10
2 bedded (1st class)	RM 60 RM 90 (new rate after 1 Jan 2017)	RM 10
4 bedded (1st class)	RM 40 RM 60 (new rate after 1 Jan 2017)	RM 10
2rd class	RM 20 RM 30 (new rate after 1 Jan 2017)	RM 5
3rd class	RM 3	FREE

Table 2: Public Hospital Outpatient Charges with Specialist Charges

1. Outpatient charges	RM 1
2.Specialist Clinic:	
a. Referred by Government Medical Officer	• Free for first visit. • RM 5.00 for subsequent visit excluding charges for investigation • Investigations are charged according to first class rate.
b. Referred by Private Practitioner	• RM 30.00 for first visit • RM5.00 for subsequent visit excluding investigation charges • Investigations are charged according to first class rate.
c. Clinic visit after discharged from ward.	• RM 5.00 for every visit including investigations charges

Sources: Hospital Kuala Lumpur, 2016

Furthermore, certain groups are entitled for basic services at zero charges. This incentive can be enjoyed by children aged up to 17 years old, senior citizen, civil servants and their listed responsibilities that are under 21 years old, and disabled people with mental and physical problems (Quek, 2008). Additionally, for patients diagnosed with infectious diseases or illnesses like dengue, Zika, and Hand, Foot & Mouth Disease, all medical costs will be waived (Ministry of Health, 2013). Due to these comprehensive and widely covered aspects of the national healthcare system, it has been ranked highly among the top thirty healthcare packages in the world. This list ranks each country according to three criteria: 1) life expectancy (60 percent), relative per capita cost of healthcare (30 percent), and absolute per capita cost of healthcare (10 percent) (Bloomberg, 2014). Despite these generous benefits, some still try to exploit and manipulate the nonrejection policy (everyone has the accessibility to health care) by leaving without settling their bills (Kananatu, 2002).

METHODOLOGY

The patient medical record for year 2011 has been obtained from Serdang Hospital in Selangor, extracted from the Casemix system. This form of data is preferred compared to the traditional hospital discharge lists because the patient medical record is maintained according to the ICD[1] coding system (Nor Azlin *et al*., 2012). The data is unique as the healthcare information (patients' health records and data) is deemed "sensitive" data under the PDPA section 40 (Kamarudin, personal communication, 17 December, 2015). As all the authors in this research are not medical doctors, several restrictions were implemented such as components of the cost were not revealed. Furthermore, the total amount of the medical cost for a patient is remains unknown as the researchers only being disclosed to total amount of inpatient and outpatient cost paid by the patients. The total amount subsidized by the government for each patient are remains unknown. Thus, in this study, the inpatient, outpatient and total medical cost refer to the amount of medical cost paid by the patients. The comprehensive data includes the demographic characteristics, such as age, gender, diagnosis, duration of hospitalization, and patient's weight and height. Meanwhile, patient's medical cost (inpatient and outpatient) has been obtained from Revenue Unit, Serdang Hospital.

Since medical data typically contains many numerical zero values, heteroscedasticity, and right skewed patterns, most researchers have recommended two-part Generalized Linear Models (2PM) to avoid retransformation bias and smearing estimator issues (Malehi *et al*., 2015; Moran *et al*., 2007). The first part will explain the probability of hospitalization, while the second part elucidates the medical costs, conditional on hospitalization (Mora *et al*, 2014). Anyhow, the data applied for above studies are at national level which included both hospitalized and non-hospitalized patients. Therefore, two-part model is appropriate to distinguish between hospitalized (sick) and non-hospitalized patients (healthy). However, since the data used for this study was obtained from inpatient registry of a public hospital, it can be confirmed that these are sick patients requiring hospitalization; one part GLM was used. Besides, most patients did not have to pay any of the medical cost but this does not necessarily indicate that they have not been hospitalized. This is due to their costs have been subsidized by the government through the national medical funding policy. Hence, this study will focus specifically on the second part, which is factor influencing medical cost for inpatient at public hospital.

Therefore, the GLM's equation is,

$$E(Y) = \mu_i = g^{-1}(\eta_i) \quad \ldots\ldots\ldots (1)$$

In GLMs, the Gaussian distribution assumption is relaxed, allowing non-normal distribution from the exponential family of distributions like Gaussian, Binomial, Poisson or Gamma. Whereby g is a link function and Y follows a distribution within the exponential family, and the linear predictor is defined by $\eta_i = X\beta$.

[1]The International Classification of Diseases is the standard diagnostic tool for epidemiology, health management and clinical purposes. It is used to monitor the incidence and prevalence of diseases and other health problems. It has been proven as a picture of the general health situation of countries and populations.

RESULT AND DISCUSSION

Patient data from Serdang Hospital is arranged according to World Health Organization (WHO) classification scheme criteria across four age groups: underweight (BMI <18.49kg/m^2); normal weight (BMI 18.5-24.9kg/m^2); overweight (BMI 25-29.9kg/m^2); and obese (BMI>30kg/m^2).

Table 3 displays patients' data in Serdang Hospital based on their BMI categories. Medical costs for 40 percent of the entire sample size are zero, while only 1,620 patients are recorded with positive medical cost. After excluding patients with zero medical cost, the entire sample size is then summarized to their respective BMI categories. 496 patients are under overweight, while 440 patients are in obese condition. In comparison with male, female patients are majority in overweight and obese with 68.97 percent and 80.68 percent respectively. Overall, age group of 30 to 39 years old has the highest percentage of overweight and obese with 43.35 percent and 49.77 percent accordingly, compared to other age groups.

Table 3: Patient Data in Serdang Hospital by BMI Categories

	Underweight (<18.5)	Normal (18.5-24.9)	Overweight (25-29.9)	Obesity (>30)	Total
Sample size (N)	79	605	496	440	1620
Age					
20-29	36(45.57%)	155(25.62%)	66(13.31%)	44(10%)	301(18.58%)
30-39	23(29.11%)	255(42.15%)	215(43.35%)	219(49.77%)	712(43.95%)
40-49	12(15.19%)	86(14.21%)	120(24.19%)	117(26.60%)	335(20.68%)
50-59	8 (10.13%)	109(18.02%)	96(19.35%)	60(13.63%)	273(16.79%)
Gender					
Male	40(50.63%)	215(35.64%)	147(31.03%)	85(19.32%)	494(30.49%)
Female	39(49.37%)	390(64.36%)	349(68.97%)	355(80.68%)	1126(69.51%)

Descriptive statistics for the dependent variables used in the empirical exercise are presented in Table 4. Total observation available for the total inpatient cost is 1,614, while the mean of total inpatient cost is RM 235.60 and standard deviation of 348.70. The highest total inpatient cost is RM 4,492 and contrariwise, the lowest is RM 5. The median of total inpatient cost (the 50th percentile) is RM 120 per patient. In contrast, the total observation for outpatient cost is only 261 patients. The mean of total outpatient cost is RM 19.85 and standard deviation of 46.72. The median of total outpatient cost (the 50th percentile) is RM 3 per patient. The highest total inpatient cost is RM 510, whereas the lowest is RM 1. Additionally, 1,620 total medical cost observations have been extracted in year 2011. The mean value is slightly higher as the total medical cost is a sum of total inpatient and outpatient patients combined. The lowest total medical cost is RM 1, and the highest is RM 4,682. The skewness and kurtosis of the distribution of all three types of medical cost are bigger compared to 0 for symmetric data, and 3 for normal data. Since all of the coefficients are positive, the mean value is greater than the median. Thus, all of the distribution is skewed to the right and does not follow a normal distribution.

Table 4: Mean for Inpatient, Outpatient and Total Medical Costs per Patient in year 2011

	Total Inpatient costs (RM)	Total Outpatient costs (RM)	Total medical costs (RM)
Mean	235.6	19.85	238
Median	120	3	121
Standard Deviation	348.7	46.72	353.78
Skewness	3.84	6.3	3.89
Kurtosis	25.94	56.66	27.28
N (Number of obs)	1614	261	1620

Table 5 shows the marginal effect of several variables like underweight, overweight, obesity, gender and age on the three types of medical cost by when GLMs is applied on them. The choices for optimal family and link function are tested through Modified Park test, Pregibon Link test, Pearson Correlation test, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) test. The results obtained from Modified Park test have suggested a Gamma distribution, whereby the variance is proportional to the square of mean. Meanwhile, Pregibon Link test and Pearson Correlation tests yield non-significant p-values, whereas the value from AIC test is relatively smaller to indicate that the model fits very well.

The results from Model 1, 2 and 3 in Table 5 show significant incremental effects in all three types of medical cost (obese patients). The total inpatient, outpatient and medical cost for obese patients are RM1.97, RM0.13, and RM1.96 respectively compared to normal weight patients. Total inpatient and outpatient cost for obese patient are significant at a lower value in Table 5. It encompasses approximately 38 percent inpatient medical cost (below RM100). Inpatient charges were waived for third-class ward patients. Moreover, a maximum of RM 500 charge per admission for third class ward further justifies the lower costs incurred (Sivanandam and Rahim, 2016). The value for total outpatient cost for obese patients is also significant at a lower number due to the charges for basic outpatient care at RM 1 and RM 5 only. As the Malaysian public hospital does not share universal patient data over the country, if the patient went to other health care center for further follow up, the patient's total outpatient cost will be omitted. Thus, the outpatient medical cost only reflexes the patient who went back to the Serdang Hospital.

Table 5: Summary of Regression Analysis for Variables Predicting Medical Cost

	Model 1		Model 2		Model 3	
Variable	M.E	S.E	M.E	S.E	M.E	S.E
Underweight	90.54***	2.23	1.33***	0.26	92.56***	2.25
Overweight	-6.55***	0.49	-0.93***	0.65	-7.40***	0.50
Obesity	1.97***	0.18	0.13***	0.65	1.96***	0.18
Gender	-151.63***	28.82	-2.48	1.15	-153.94***	29.37
Age	1.80	1.22	-0.12	0.62	1.72	.24

For the overweight category, the patients paid a relatively small amount of medical cost for all types (RM6.55, RM0.93 and RM7.40) compared to the normal weight patients. This

indicates that by being overweight lowers all types of medical cost which is contradicted with the existing literature. The heavily subsidized health care system does take place in explaining the lower medical cost. Suppose overweight patient are require paying high medical cost as the prevalence rate of chronic diseases raise, however; due to the government subsidized program, the cost were transferred to the government rather than the patient.

In men's category, the high medical cost of RM151.63 for inpatient cost and RM2.48 for the outpatient cost when compared with women category are consistent with Serdang Hospital's role as a reference center for cardiology, cardiothoracic, urology and nephrology surgery. The national cardiovascular diseases database indicates that among 14,763 patients registered in 2011 to 2013, 78.8 percent is made up of male patients (Ahmad and Sim, 2015). Therefore, a patient who suffers from the related diseases may be transferred to the hospital for further health inspections. However, the marginal effect of age is insignificant, which is contradictory with previous literature stating that as people grow older, medical cost also increases (Pan *et al*., 2008; Gray, 2005). Despite the samples in this study being limited to observation in people aged between 20 to 59 years old, this may potentially explain for insignificance in age factor.

Table 6 shows the conditions that hold other characteristics like age and gender constant. Compared with the normal weight group, the underweight patients pay an average of relatively higher medical cost by 76 percent for inpatient cost, 13.6 percent for outpatient cost, and 76.1 percent for total medical cost. This is because underweight patients usually associated with multiple morbidity which resulting longer hospital stay, higher treatment cost and higher risk of mortality (Barker *et al*., 2011). On the other hand, both overweight and obese patients paid an average of lower medical cost compared to normal weight patients, however; the gap between overweight patients and normal weight patients is smaller. Overweight patients paid an average RM7.90, RM5.13 and RM9.79 lower in term of inpatient cost, outpatient cost and total medical cost. A slightly high BMI (overweight) are significant acts as protective effect as they are having better survivor rate particularly patients who have been diagnosed with cardiovascular disease (Doehner *et al*., 2015). Furthermore, overweight is associated with lower all-cause mortality compared to normal weight patients (Wang *et al*., 2016).

Table 6: Average Predicted Cost Differences according to BMI

	Inpatient cost (RM)	Outpatient cost (RM)	Total medical cost (RM)
Underweight	418	20.7	424
Normal	236.27	18.23	240.79
Overweight	228.37	3.1	231
Obesity	205.82	8.1	207

On the other hand, the gap between obese patients and normal weight patients is bigger compared to overweight patients. Obese patients are in risk of multiple medical conditions which lead to further morbidity and mortality (Guh *et al*., 2009). Suppose the medical cost paid by the obese patients should be higher, however; as the government's heavily subsidized program took place, eventually the patients paid lower medical cost. Since the subsidized policy is unrevised since 1982, revenue collection estimated is around 2 percent against its spending (Chua and Cheah, 2012). Furthermore, patients are admitted to first and second-

class ward upon request, otherwise, patients will be warded into a third-class ward. As about 88 percent of the hospital wards in Malaysia are third-class ward, patients have little choices to be upgraded to a better environment (Sivanandam and Rahim, 2016). In addition, patients who required close monitor are allocated to the third-class ward since the floor design is strategically located and easily accessible by nurses and doctors as it is located middle of the floor or near to nurse counter (Fairuzah, personal communication, 17 December, 2015). This could be potential explanation for lower medical cost for overweight and obese patients as the cost components was not accessible by the non-medical background researcher due to the Data Protection Act 2010.

As to our knowledge, this study is the first study to examine the impact of overweight and obesity to multiple levels of medical cost via patient-level data in Malaysia. We found out that there are lots of challenges and obstacles to overcome. This study is not comprehensive but the findings are significant issue on the potential problem beyond obesity, which is often being swept into obscurity and ignored.

This study demonstrates the several types of medical costs of overweight and obese patients when they were admitted to the public hospital. The findings were consistent with the literature where there is slightly additional effect for inpatient, outpatient and total medical cost for obese patients. The unexpected significant at lower value medical cost paid by the patients might be due to the choices of ward (third-class ward). Meanwhile, for overweight patients, they paid a relatively small amount for all types of medical costs compared to the normal weight patients. As the BMI might failed to explain other weight factor components, such as fat, bones, muscle and fluids, a slightly high BMI (overweight) might not lead to adverse health consequences. On the other hand, the average predicted cost across BMI levels suggest that underweight and obesity patients paid average lower cost compared to normal weight patients. The differences might be due to the choices of ward and government subsidized program. Since the data for component cost is not accessible, further discussions on the reasons remain unknown.

The above analysis does not enable us to determine the actual medical cost for overweight and obese patients due to a number of possible limitations. Firstly, a longer processing time has been required as the data for this study is composite multilevel data from various departments. Next, as the data is kept separately by different departments, they have been stored and maintained in different types of software and following different styles. Due to MOH restrictions and guidelines, some information is only available in hard copy form, which adds to the difficulties in data analysis. Furthermore, Personal Data Protection Act (PDA) 2010 has restricted the access for the components of medical cost by non-medical background researchers. Therefore, the various components of medical cost and its drivers such as type of ward admitted, type of treatment received, and the total amounts of governmental subsidies received by each patient could not be accessed. Thus, the analysis is inadequate due to data weakness, and subsequently failed to pinpoint the real cost of being obese and overweight in Malaysia.

Additionally, the unavailability of a universal patient's medical record introduces the risk of underestimated medical cost. There are no standardized approaches to identify patients among different facilities within the health-care system. Since different hospital relies on the different patient record systems, databases are kept internal only, and it is not disclosed to any

third parties. Therefore, a patient will be treated as a newly registered patient if they transfer to a different hospital as they will be given a new registration number upon admission. This complicates the process of summarization and electronic data combination.

Another point is that the practice of measuring the patient's weight and height when visiting the doctor is not commonly adhered to. The hospital is recommended to take the measurement but it is not required to take record of these details during admission. Thus, this data is mostly incomplete. To overcome this problem, the sample population is restricted to patients who recorded at least one-time weight and height measurement. For patients who have more than one record for weight and height, the first measurement was selected.

In addition, Malaysian public hospitals are heavily subsidized by the government. For citizens who are either issued cards by Social Welfare or National Islamic Council (MAIK), or are Retired Government Servants or Persons with Disabilities (PWD), the medical cost will be waived. Citizens earning less than RM300 per month, students, and governments servants will also enjoy the exemption benefits. Approximately 40 percent of the total samples collected from Serdang Hospital are eligible for these criteria thus resulting large amount of zero medical cost, therefore; patients fall under these categories will be excluded for the analysis.

CONCLUSION

This study is pioneering the country's researches on obesity and overweight medical cost by using patient-level data. It has revealed the potential of financial burden that can be faced by these patients if the numbers of overweight and obese patients keep rising. Since overweight and obesity is now prevalent and statistically increased, the incidence of multiple chronic illnesses has subsequently risen too, culminating in substantially increased medical costs of the treatments. Even though this study has found significant additional increase of medical cost due to obesity, the actual cost that a patient must pay is noncalculable due to heavily subsidized government policies. Thus, this study would like to propose for further research if the actual medical cost is accessible by non-medical background researchers. Future studies should also include national level samples by evaluating adults of all ages and reports on all components of medical costs.

ETHICAL APPROVAL

This study had been reviewed and approved by the Clinical Research Center, Serdang Hospital and National Medical Research Register (NMRR) (NMRR-15-1941-28594).

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