Pharmaceutical Sciences Asia

Pharm Sci Asia 2021; 48(3), 285-290

DOI:10.29090/psa.2021.03.19.026

Original article

Health burden of overweight and obesity: Mortality and years of life lost (YLL) of diseases in Indonesia

Susi Ari Kristina[1*], Abdillah Ahsan[2], Faradiba Faradiba[1], Shahiroh Haulaini[1]

[1] Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia

[2] Faculty of Economics and Business, Universitas Indonesia, Jakarta, Indonesia

***Corresponding author:**
Susi Ari Kristina
susiari_k@ugm.ac.id

Keywords:
Obesity, attributable fraction, non-communicable diseases, mortality

ABSTRACT

High prevalence of obesity increased burden from non-communicable diseases. Our study aimed to estimate the number of death and years of life lost (YLL) diseases related to obesity. The Obesity attributable fraction (OAF) was used to estimate the proportion of each comorbidity attributable to obesity. The number of deaths attributable to obesity was estimated by multiplying the number of patients in each disease category and the OAF. The YLL was calculated by the number of years remaining life and the number of deaths due to overweight and obesity. The mortality attributable to overweight and obesity was estimated at 2,264,593 and 1,414,670 respectively, with the proportions of woman death were 60% and 72% of total death due to overweight and obese respectively. The YLL attributable to overweight and obesity was estimated at 67 million and 42 million person-years respectively. Diabetes mellitus and ischemic heart disease were two highest burdens both in the number of death and YLL. Obesity imposes a substantial health burden on Indonesian society especially in term of health burden. In view of a magnitude of the impact of obesity, there is a need for both further research and action at the level of health policy.

1. INTRODUCTION

The prevalence of obesity is increasing both in developed and developing countries. Epidemiology studies indicate that obesity is a major risk factor for diabetes type 2, cardiovascular diseases, and cancers[1,2]. The high prevalence of obesity, combined with other health risks, makes it a high health burden, which can lead to further incidence, mortality, and economic costs[3,4]. Global Burden of Diseases, Injuries, and Risk Factors Study (GBD Study) has quantified the health loss from diseases and injuries, by age, sex, and risk factors in worldwide population over time, covers 195 countries to project the burden magnitudes[5]. The leading three causes of disability-adjusted life years (DALYs) globally according to this study were ischemic heart disease, cerebrovascular disease, and lower respiratory infections, comprising 16.1% of all DALYs.

The health impacts associated with obesity is expected to be immense and have a greater impact on developing countries[6,7]. Obesity and its attributable comorbidities caused enormous healthcare impact ranged from an increasing number of deaths, years potential life lost, as well as healthcare costs[8,9].

According to the World Health Organization (WHO), the global prevalence of obesity has more than doubled between 1980 and 2008[10]. In 2008, Kelly et al estimated that more than 1.4 billion adults aged 20 and over were overweight (a BMI greater than or equal

to 25 kg/m^2)[4]. Of these overweight adults, 500 million were obese[4]. As a result of lifestyle changes in eating, and lower physical activity, the obesity epidemic affects populations in most countries, including in Asia[7].

The epidemiology data and burden of obesity is documented for most developed countries[11-13]. Direct healthcare costs attributable to obesity have been estimated to range from 1.5% of national health expenditure in Thailand[1] to 9.8% in Hong Kong[7]. Estimating the health burden of obesity is critical for healthcare providers, policy makers, and payers. Not only can the data estimate be used to establish priorities for research and health resource use, but it can also be used to improve public awareness of the negative health impacts of obesity.

In accordance with global projection trends, the prevalence of obesity in Indonesia increased more than 70% between 2010 and 2014[10]. According to the WHO global health observatory (GHO) database 2010, 17.3% of adult Indonesian men and 25.2% of women were classified as overweight (BMI 25-30 kg/m^2), and prevalence of obese (BMI > 30 kg/m2) were 3.1% and 6.5% in male and female respectively[10]. Despite this rapid increase in obesity over the last five years, and it is recognized that obesity-related comorbidities generate high costs[14-16], few cost analyses have been conducted for Indonesia setting. Previous study focused on healthcare costs in Indonesia noted that treatment cost of comorbidities related to smoking in Indonesia was estimated to be at least USD 2,177 million, approximately 2.5% of GDP[17]. Since no empirical study is available in Indonesia for determining obesity-related health burden, our study aims were to estimate the burden of diseases in terms of premature death and years of life lost (YLL) related to overweight and obese among Indonesian adult population.

2. MATERIALS AND METHODS

This study was a prevalence-based burden of diseases study. Epidemiological data used in this study were taken from the literature and official Indonesia publications as described below.

2.1. Obesity and comorbidities

Obesity was categorized into two categories, as overweight (having a BMI of 25-30 kg/m^2) and obese (having a BMI of 30 kg/m^2 or higher). Criteria of comorbidities included in this study were selected based on the degree of disease associated with obesity, the availability of existing information and its relevance to the Indonesia context. The following 10 comorbidities were included in our study: colon and colorectal cancer, pancreas cancer, breast cancer, ovarian cancer, endometrial cancer, diabetes mellitus, hypertension, ischemic heart disease, asthma, and stroke. The number of mortality for each disease was estimated from the Obesity Attributable Fraction (OAF). The attribution of the mortality of comorbidity in the population that is related to obesity[18], was calculated for each comorbidity using the following formula:

$$OAF_{ij} = \frac{P\,(RRij-1)}{P(RRij-1)+1}$$

OAFij = Obesity Attributable Fraction, for Body Mass Index (BMI) level (i: BMI =25.0-29.9 kg/m^2 and j: BMI >=30 kg/m^2)
Pij = Prevalence of obesity at BMI level i or j of comorbidity
RRij = Relative Risk of comorbidity associated with BMI level i or j

In this study, obesity prevalence (P) was obtained from the WHO global health observatory (GHO) database by country in 2010, where overweight among male and female 17.3% and 25.2% respectively. Prevalence of obese were 3.1% and 6.5% in male and female respectively[10] while the Relative Risks (RR) were derived from meta-analyses[2] which consisted of a prospective cohort study of the general population of countries in Europe or North America, Australia or New Zealand.

2.2. Mortality and Years Life Lost (YLL) attributable to obesity

The number of mortality of comorbidities related to obesity was estimated by multiplying sex-and age-specific cancer mortality and OAF. The number of deaths from each comorbidity was obtained from the 2011 WHO mortality data. These mortality rates were estimated based on updated regional data inputs which take into account the greater availability of national death registration data. Projections based on the historically observed relationships of mortality with cause-specific mortality rates as well as economic and social development[19].

To estimate years life lost (YLL)[20], we used epidemiological data inputs include the number of deaths that could be attributed to obesity and life expectancy by age group. The data on the total number of deaths from each comorbidity were obtained from the 2011 WHO mortality by specific causes. Obesity attributable

risk was used to estimate the number of deaths attributable to obesity. We use WHO standard expected years of life in 2011[21] to calculate the years of premature death. The number of years remaining to live was derived from subtracting age of death from "life expectancy". Life expectancy was obtained from the WHO standard expected years of life in 2011. To estimate age-specific YLL each comorbidity we applied the YLL formula as number of obesity attributable deaths multiply by number of years remaining to live.

Table 1. Relative risks for selected comorbidities in obese subjects and Obesity Attributable Fraction (OAF).

Comorbidities	RR*				OAF (%)			
	Overweight		Obese		Overweight		Obese	
	Male	Female	Male	Female	Male	Female	Male	Female
Colon and colorectal cancer	1.51	1.45	1.95	1.66	8.11	10.19	2.32	3.87
Pancreas cancer	1.28	1.24	2.29	1.6	4.62	5.70	3.12	3.53
Breast cancer		1.08		1.13		1.98		0.79
Ovarian cancer		1.18		1.28		4.34		1.68
Endometrial cancer		1.53		3.22		11.78		11.93
Diabetes Mellitus	2.4	3.92	6.74	12.41	19.50	42.39	12.55	41.04
Hypertension	1.28	1.65	1.84	2.42	4.62	14.07	2.06	7.97
Ischemic heart disease	1.29	1.8	1.72	3.1	4.78	16.78	1.77	11.36
Asthma	1.2	1.25	1.43	1.78	3.34	5.93	1.06	4.54
Stroke	1.23	1.15	1.51	1.49	3.83	3.64	1.26	2.90

**RR was retrieved from Guh DP, Zhang W, Bansback N, Amarsi Z, L B, Anis AH. The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis. BMC Public Health. 2009;9(88):1-20.*

3. RESULTS

The overall relative risk estimates and OAFs for obesity and the 10 comorbidities, disaggregated by gender, are presented in Table 1. OAF estimates indicate that about 12.55% to 42.39% of all deaths of diabetes mellitus, 1.77% to 16.78% of all deaths of ischemic heart disease, and 11.78% to 11.93% of all deaths of endometrial cancer in Indonesia were attributable to obesity.

Estimates of the overall number of deaths of obesity, disaggregated by types of comorbidities, gender, and BMI level are displayed in Table 2. With regard to total death, the three conditions that were found to incur the highest deaths were ischemic heart disease (1,488,714), diabetes mellitus (1,270,377) and stroke (280,000).

As shown in Table 2, the estimated number of deaths attributable to obesity is 3.7 million deaths. The death attributable to obesity was accounted for 1.48% of total deaths in 2015. Obesity-related deaths for women were about 2 times higher than for men (2,392,111 in women vs 1,287,152 in men).

Table 2. Number of deaths of comorbidities related to obesity.

Comorbidities	Number of deaths of comorbidities related to obesity					
	Overweight			Obese		
	Male	Female	**Total**	Male	Female	**Total**
Colon and colorectal cancer	53,323	66,827	120,150	15,258	25,393	40,651
Pancreas cancer	8,634	7,553	16,188	5,839	4,676	10,515
Breast cancer	0	44,210	44,210	0	17,601	17,601
Ovarian cancer	0	31,800	31,800	0	12,307	12,307
Endometrial cancer	0	15,648	15,648	0	15,840	15,840
Diabetes Mellitus	248,433	438,012	686,446	159,898	424,033	583,931
Hypertension	60,597	95,579	156,176	26,976	54,134	81,110
Ischemic heart disease	379,626	577,632	957,257	140,506	390,951	531,457
Asthma	23,095	26,911	50,006	7,345	20,623	27,968
Stroke	118,602	68,110	186,711	39,019	54,271	93,289
Total	892,311	1,372,282	2,264,593	394,841	1,019,829	1,414,670

Table 3. Years of life lost (YLL) of comorbidities related to obesity.

Comorbidities	YLL					
	Overweight			Obese		
	Male	Female	**Total**	Male	Female	**Total**
Colon and colorectal cancer	1,529,594	2,131,380	3,660,974	437,670	809,899	1,247,570
Pancreas cancer	255,549	239,787	495,336	172,806	148,452	321,258
Breast cancer		1,504,068	1,504,068		598,809	598,809
Ovarian cancer	0	1,077,940	1,077,940	0	417,177	417,177
Endometrial cancer	0	513,222	513,222	0	519,517	519,517
Diabetes Mellitus	7,188,856	13,381,399	20,570,255	4,626,930	12,954,328	17,581,258
Hypertension	1,749,632	2,819,332	4,568,964	778,897	1,596,802	2,375,699
Ischemic heart disease	10,961,988	17,121,552	28,083,540	4,057,229	11,588,149	15,645,378
Asthma	692,797	893,854	1,586,651	220,327	685,010	905,336
Stroke	3,317,203	1,903,921	5,221,124	1,091,319	1,517,071	2,608,390
Total	25,695,619	41,586,457	67,282,076	11,385,178	30,835,214	42,220,392

The three conditions that incur the highest YLL were ischemic heart disease (43,728,918 person-years), diabetes mellitus (38,151,513 person-years), and stroke (7,829,514 person-years). The estimated YLL as a result of obesity-related conditions was 109 million person-years. The YLL incurred by women was 2 times higher than it is in men (72,421,671 vs 37,080,797 person-years) (Table 3).

4. DISCUSSION

This was the first analysis of health burden related obesity in the Indonesian context, where obesity-attributable mortality was found to be substantial, accounting for 1.48% of national death in the year 2011[22]. Many studies have shown that obesity exerts a significant health and cost burden on a country's health system and productivity[8,14]. In addition, the analysis revealed that YLL associated with obesity were broadly similar, which are in line with the findings of previous studies[7,23,24].

According to the WHO report, overweight and obese account for 44% of diabetes mellitus cases, 23% of coronary heart disease cases, and 7-14% of cancer cases[25]. These data in accordance with our findings, which estimated that about 40.5% of ischemic heart deaths, 34.5% of diabetes mellitus deaths, 7.5% of hypertension deaths, and 5.5% cancers deaths in Indonesia were associated with obesity. Similar findings were previously observed in Mexico populations, revealed that type 2 diabetes mellitus was the main cause of premature death[24]. In accordance with western countries, our study found that cardiovascular disease related to obesity to be the primary leading cause of economic and mortality burden. In line with a previous study in Thailand[14], considering recent updates on the epidemic of cardiovascular diseases and type 2 diabetes in Asia[7], we found that ischemic heart disease is the first leading cause of obesity premature death, followed diabetes mellitus, and stroke associated with obesity.

Furthermore, we found that years of life lost attributable to obesity was substantial. These burden had a health impact equal that of smoking, our results indicate that health burden attributable to obesity are the same as those attributable to smoking, which was estimated at 1,207,845 YLL[26]. A substantial burden both in mortality rate and YLL was largely concentrated in the overweight population, which possible explanation is the higher prevalence of overweight rather than obese population. Given the rise of obesity in Asia, and the prevalence of related conditions, particularly cardiovascular disease and diabetes mellitus, community intervention programs aimed at changing lifestyle and eating habits to control obesity clearly deserve more attention.

In summary, our findings clearly explain that the effect of obesity on the Indonesia's health burden is substantial, and it potentially affects in escalating health care costs, which are since 2014 all Indonesian people are covered by universal health insurance, and paid by government in Indonesia. It is needed that, a public health campaign targeting obesity epidemic should place emphasis on the impact of obesity on society as well as social responsibility, to effectively tackle obesity in Indonesia.

Some potential limitations of our analysis should be noted. First, we used BMI cut off levels for overweight and obesity that are valid for a Caucasian population and the BMI cut off levels of an Asian population used might be lower for overweight and obesity. This might result in underestimating the burden of disease in Indonesia. Second, we used data from the International Database

estimation in 2011 to estimate the prevalence of obesity by gender and BMI categories (25 - 30 and ≥ 30 kg/m^2). The prevalences of each comorbidity are derived from the WHO mortality report 2011. In this study, the prevalence of obesity in 2011 was used to calculate the OAF. As lag times for chronic diseases may differ across persons and diseases and are not exactly known, we might have overestimated the mortality from the impact of obesity as the induction time need for developing comorbidity as well as duration of obesity were not taken into account. We also note that there is some evidence that the risks of selected diseases not included in our analysis including osteoarthritis, gallbladder disease, sleep apnea, and depression may be higher among persons who are obese. Furthermore, due to the unavailability of incidence of disease data in Indonesia, the incidence of non-communicable diseases associated with obesity was not included in the analysis.

5. CONCLUSIONS

Our analysis confirmed that obesity imposes a substantial health burden on Indonesia society. In light of the rapid and continuous increase in obesity prevalence in Indonesia, large-scale research focusing on economic cost of obesity, including health care costs and premature mortality costs would be beneficial. Comprehensive interventions for the healthy lifestyle and prevention of obesity should be regarded as public health concerns in Indonesia.

6. ACKNOWLEDGMENTS

The Indonesian Universal Health Coverage is acknowledged for providing raw data needed for analysis. Faculty of Pharmacy Universitas Gadjah Mada is acknowledged for support and local administration.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Ethics approval

This study was approved by Medical and Health Research Ethics Committee (MHREC) Universitas Gadjah Mada with reference number UGM/MHREC/314/REF/2017.

Article info:
Received April 1, 2019
Received in revised form January 15, 2020
Accepted June 28, 2020

REFERENCES

1. Seidell JC, Halberstadt J. The global burden of obesity and thechallenges of prevention. Ann Nutr Metab. 2015;66(suppl 2):7-12.
2. Guh DP, Zhang W, Bansback N, Amarsi Z, L B, Anis AH. The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis. BMC Pub Health. 2009;9(88):1-20.
3. Nguyen DM, El-Serag HB. The big burden of obesity. Gastro Endoscopy. 2009;70(4):752-7.
4. Kelly T, Yang W, Chen CS, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. Intl J of Obesity. 2008;32:1431-7.
5. GBD 2016 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017;390: 1269-344.
6. Monteiro CA, Moura EC, Conde WL, Popki BM. Socioeconomic status and obesity in adult populations of developing countries: a review. Bull World Health Org. 2004;82:940-6.
7. Hoque ME, Mannan M, Long KZ, Al Mamun A. Economic burden of underweight and overweight among adults in the Asia-Pacific region: a systematic review. Trop Med Intl Health 2016;21(4):458-69.
8. Allender S, Rayner M. The burden of overweight and obesity-related ill health in the UK. Obesity Rev. 2007; 8:467-73.
9. Jia H, Lubetkin EI. The statewide burden of obesity, smoking, low income and chronic diseases in the United States. J Pub Health. 2009;31(4):496-505
10. World Health Organization. Global Health Observatory (GHO) Data: Overweight and Obesity by Country Geneva: World Health Organization; 2015 [cited 2016 February 15]; Available from: http://www.who.int/gho/ncd/risk_factors/overweight/en/.
11. Sander B, Bergemann R. Economic burden of obesity and its complications in Germany. Eur J Health Econ. 2013;4(4):248-53.
12. Wang YC, McPherson K, Marsh T, Gortmaker SL, Brown M. Health and economic burden of the projected obesity trends in the USA and the UK. Lancet. 2011; 378:815-25.
13. Luo W, Morrison H, de Groh M, Waters C, DesMeules M, Jones-McLean E, et al. The burden of adult obesity in Canada. Chronic Diseases Canada. 2007;27(4):135-44.
14. Pitayatienanan P, Butchon R, Yothasamut J, Aekplakorn W, Teerawattananon Y, Suksomboon N, et al. Economic

costs of obesity in Thailand: a retrospective cost- of-illness study. BMC Health Services Res. 2014; 14(146):1-7.
15. Finkelstein EA, Trogdon JG, Brown DS, Allaire BT, Kamal-Bahl SJ. The lifetime medical cost burden of overweight and obesity: Implications for obesity prevention. Obesity. 2008;18:1843-8.
16. Rtveladze K, Tim Marsh T, Webber L, Kilpi F, Levy D, McPherson K, et al. Health and economic burden of obesity in Brazil. PLoS ONE. 2013;8(7):e68785.
17. Kristina SA, Endarti D, Wiedyaningsih C, Fahamsya A, Faizah N. Health Care Cost of Noncommunicable Diseases Related to Smoking in Indonesia, 2015. Asia Pac J Pub Health. 2018;1-7.
18. Flegal KM, Panagiotou OA, Graubard BI. Estimating population attributable fractions to quantify the health burden of obesity. Ann Epidemiol. 2015;25(3):201-7.
19. World Health Organization. Global Burden of Disease. Geneva: World Health Organization, 2017.
20. Gardner JW, Sanborn JS. Years of Potential Life Lost (YPLL) What Does it Measure? Epidemiology. 1990; 1(4):322-9.
21. World Health Organization. Life Tables 2015. 2016 [cited 2016 24 November]; Available from: http://apps.who.int/gho/data/view.main.60750?lang=en.
22. Ministry of Health. Basic Health Survey Report. Jakarta: Ministry of Health, 2015.
23. Muennig P, Lubetkin E, Jia H, Franks P. Gender and the burden of disease attributable to obesity Am J Pub Health. 2006;96(9):1662-8.
24. Murillo-Zamora E, Raúl García-Ceballos R, Delgado-Enciso I, Garza-Guajardo R, Barboza-Quintana O, Rodríguez-Sánchez IP, et al. Regional-level estimation of expected years of life lost attributable to overweight and obesity among Mexican adults. Glob Health Action. 2016;9:31642.
25. Ng M. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: A systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384:766-81.
26. Kristina SA, Endarti D, Prabandari YS, Ahsan A, Thavorncharoensap M. Burden of Cancers Related to Smoking among the Indonesian Population: Premature Mortality Costs and Years of Potential Life Lost. Asian Pac J Cancer Prev. 2015;16(16):6903-8.