Public Health Nutrition: 23(13), 2395–2401 doi:10.1017/S1368980020001068

Health care cost of overweight-related diseases in Bangladesh

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Submitted 18 June 2019: Final revision received 12 March 2020: Accepted 19 March 2020: First published online 23 June 2020

Abstract

Objective: To estimate the economic burden of overweight in Bangladesh.
Design: We used data from Household Income and Expenditure Survey, 2010. A prevalence-based approach was used to calculate the population attributable fraction (PAF) for diseases attributable to overweight. Cost of illness methodology was used to calculate annual out of pocket (OOP) expenditure for each disease using nationally representative survey data. The cost attributable to overweight for each disease was estimated by multiplying the PAF by annual OOP expenditure. The total cost of overweight was estimated by adding PAF-weighted costs of treating the diseases.
Setting: Nationwide, covering the whole of Bangladesh.
Participants: Individuals whose BMI $\geq$ 25 kg/m^2.
Results: The total cost attributable to overweight in Bangladesh in 2010 was estimated at US$147·38 million. This represented about 0·13 % of Bangladesh's Gross Domestic Product and 3·69 % of total health care expenditure in 2010. The sensitivity analysis revealed that the total cost could be as high as US$334 million or as low as US$71 million.
Conclusions: A substantial amount of health care resource is devoted to the treatment of overweight-related diseases in Bangladesh. Effective national strategies for overweight prevention programme should be established and implemented.

Keywords
Cost
Overweight-related disease
Population attributable fraction
Bangladesh

In recent years, the prevalence of overweight has hit a plateau in high-income countries[1], whereas many low-and-middleincome countries (LMIC) are facing a paradox called nutrition transition – the overweight burden is increasing sharply[2], while the underweight burden still persists[1,3,4]. Like many LMIC in the world, Bangladesh is not an exception and is increasingly facing the burden of its growing population's overweight due to the rapid economic growth, industrialisation and urbanisation. The prevalence of overweight in Bangladesh has increased from 2·7 % in 1996[5] to 8·9 % in 2011[6]. It can be assumed that this burden will continue to increase in Bangladesh in the future as a result of inclining in per capita income. In addition, as the overweight burden is increasing, the prevalence of various chronic diseases will also increase which is a risk factor for a number of chronic medical conditions like chronic heart disease (CHD), non-insulin-dependent diabetes mellitus (NIDDM), hypertension (HPT), asthma, cancer, stroke, osteoarthritis, gallstones and kidney disease[7–9]. This increased prevalence of overweight and related non-communicable diseases threatens the health system and will create substantial health and economic burden on the country.

Despite that different studies used different methodologies in measuring cost burdens, the economic toll associated with diseases due to overweight in Asian countries varies from 1·5[10] to 9·9 %[11] of a country's total health care expenditure (THCE). In the case of Bangladesh, the cost is also expected to be huge, with the burden mainly falling on households when household members incur expenses for treatment of diseases occurring because of overweight. Out of pocket (OOP) payments are the primary means of financing health care in many low- and middle-income countries[12,13] including Bangladesh[14,15]. However, reliance on OOP payments for health services may potentially lead to a catastrophic burden for households. This may also

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be associated with the reduction of economic growth of the country as this burden adversely affects various factors of economic growth – labour supply, productivity, investment and education.

The published literature reports that globally the economic burden on the health care system due to overweight and obesity is increasing[11,16]. The increasing trend of overweight burden and related diseases in Bangladesh also implies a rising medical expenditure for Bangladeshi society. However, accurate information on the cost of overweight in Bangladesh is not available. This information is needed for health resource management by the Bangladesh government when formulating public health programmes and would be useful for policymakers for setting priorities for disease prevention. The objective of this paper is to estimate the economic burden of overweight in Bangladesh. The findings of this research will add to the current knowledge base and have implications for shaping effective public health policy.

Methods and materials

In general, there are two different methods for measuring the cost associated with overweight – methodological approach[11,17–22] and database approach[10,23–26]. As we were able to calculate the OOP expenditure from a nationally representative survey[27], we used the cross-sectional database approach for measuring the cost associated with the overweight burden. We then used a prevalence-based approach to measure population attributable fractions (PAF); and where data were available on the prevalence of the comorbidities, we calculated the proportion of disease attributable to overweight. This method allows measurement and estimation of cost across the population. The cost-of-illness methodology was used to estimate the cost of overweight. As 64 % of total health care spending in Bangladesh comes from OOP met by households[28], we considered the patient perspective to measure the cost associated with overweight.

Overweight-related diseases

BMI is an index of weight for height that is commonly used to classify nutritional statuses in adults. BMI is calculated as weight in kilograms divided by height in meters squared (kg/m^2). For this study, BMI ≥ 25 kg/m^2 is defined as overweight following the guidelines established by the WHO expert consultation meeting[29].

Initially, we consulted several review articles[16,30–32] to identify comorbidities of overweight. Finally, we identified and included diseases for which economic data were collected by the Household Income and Expenditure Survey (HIES), 2010 in Bangladesh. We selected CHD, NIDDM, HPT, asthma, gallstones and kidney disease for measuring the cost of overweight in Bangladesh. The total burden of overweight and obesity due to these six diseases is estimated to be 80–90 %. Some overweight diseases, cancers and musculoskeletal conditions were excluded because of an absence of data.

Calculation of population attributable fraction

The PAF of overweight was calculated using the formula[20]: $PAF = P \times (RR - 1)/(P \times (RR - 1) + 1)$, where P is the prevalence of overweight and RR is the relative risk (RR) of the disease for an overweight person. To identify the RR of comorbidity associated with overweight, we carried out an extensive search of the MEDLINE database using the PubMed search engine. Finally, the RR of comorbidities associated with overweight for male and female were obtained from different sources (Table 1). For example, the CHD and HPT were collected from Guh *et al.*[32]. The RR of asthma was collected from Egan *et al.*[33]. The RR of gallstones was gathered from Stender *et al.*[34]. The NIDDM and Kidney disease were collected from Lopez and Murray[35].

The prevalence of overweight-related diseases in Bangladeshi adults, both male and female, was obtained and/or calculated using data collected from different sources (Table 1). For example, the prevalence of NIDDM and HPT was obtained from the 2011 Bangladesh Demographic and Health Survey. Bangladesh Demographic and Health Survey is a nationally representative survey, and details about the survey are given elsewhere[6]. The prevalence of asthma was collected from Bartlett *et al.*[36], a study that collected self-reported data in both urban and rural areas. Using both a fasting serum sample and a urine sample, the prevalence of

Table 1 Prevalence, relative risk (RR) and population attributable fractions (PAF) of overweight-related diseases

	Prevalence (%)		RR (95 % CI)				PAF (%)	
Comorbidity	Male	Female	Male	95 % CI	Female	95 % CI	Male	Female
CHD	10·1	15·0	1·29	1·18, 1·41	1·80	1·64, 1·98	2·8	10·7
HPT	19·4	31·9	1·28	1·10, 1·50	1·65	1·24, 2·19	5·2	17·2
Asthma	4·0	3·9	1·35	1·15–1·58	1·35	1·15–1·58	1·4	1·3
NIDDM	10·7	11·2	1·46	1·21–5·23	3·35	1·21–5·23	4·7	20·8
Gallstones	3·3	7·7	1·08	1·07–1·10	1·04	1·02–1·07	0·3	0·3
Kidney disease	15·0	17·0	1·43	1·31–2·79	1·74	1·31–2·79	6·1	11·2

HPT, hypertension; NIDDM, non-insulin-dependent diabetes mellitus.

kidney disease was measured by Anand *et al.*[37]. This study reported all five stages of kidney disease; however, as Stage 1 and Stage 2 have no treatment cost, we only extracted data from the Anand *et al.*'s study to calculate the prevalence of kidney disease for stages 3, 4 and 5. Due to the lack of information on the current prevalence of CHD in Bangladesh, we calculated the prevalence of CHD based on information from the Household Income and Expenditure Survey (HIES), 2010 data. This information about the presence of CHD is self-reported and thus is less robust. The prevalence of gallstones in Bangladesh was obtained from the Dhar *et al.*'s study[38]. The survey was carried out in two villages for persons aged 15 years and older. An upper abdominal ultrasound examination identified the disease. This was the latest information we found in the literature regarding the prevalence of gallstones in Bangladesh.

Estimation of cost

Out of pocket expenditure

The OOP expenditure related to all of the selected diseases, except NIDDM, was derived from the HIES, 2010 in Bangladesh. The sampling method, study design, survey tools and quality control of the HIES have been described elsewhere[27]. A total of 668 (288 males and 380 females) individuals who spent money to receive health care services for one or more of the diseases being examined were considered for this study. Total OOP expenditure was estimated for medical and non-medical categories under the following cost categories: consultation fee for the health care provider, hospital charge, and expenditure related to medicine, investigation cost, travel cost to and from hospital/clinics, informal payments like tips, and other costs such as food. Total OOP per person per year was then calculated by multiplying twelve with total OOP per month per person which was derived by summing up the expenditure related to the above-stated categories. The direct cost of treatment for diabetes was extracted from diabetes sources[39].

Total cost

Total cost per person per year due to overweight-related diseases was calculated by multiplying the total cost per person per year with the PAF. Total cost among the population of the different diseases due to overweight was then calculated by multiplying the total population with the total cost per person per year due to overweight. The total population was obtained from the Bangladesh Bureau of Statistics census data[40]. In 2011, the total population in Bangladesh was 142 319 000 (71 255 000 men and 71 064 000 women). Finally, the grand total cost due to overweight-related diseases was calculated by summing the cost related to males and females. A percentage of gross domestic product (GDP) and THCE was measured using the GDP[41] and THCE in Bangladesh in 2010[41]. Total cost per person per year was presented in US dollars applying the exchange rate (US$ 1 = 69·65 BDT)[42].

Sensitivity analysis

Considering the similar approach used by Birmingham *et al.*[21], a two-way sensitivity analysis was performed using ±20 % of OOP expenditure and 95 % CI of RR of comorbidities due to overweight. Another sensitivity analysis was conducted using 95 % CI of health care expenditure.

Results

The estimated prevalence, RR and PAF by gender for each of the six comorbidities are presented in Table 1. The prevalence of comorbidity for males ranged from 3·3 % for gallstones to 19·4 % for HPT; and for females, it ranged from 4·0 % for asthma to 31·9 % for HPT. The influence of overweight in selected comorbidities is huge. For males, the RR ranged from 1·08 for gallstones to 1·46 for NIDDM, and for females, it ranged from 1·04 for gallstones to 3·35 for NIDDM. The PAF estimates indicate that more than 20 % of NIDDM in Bangladesh was attributable to overweight.

The direct medical and non-medical costs per person per month of the individual comorbidities due to overweight in 2010 are shown in Tables 2 and 3, respectively. Both medical and nonmedical costs were higher for males for all diseases, except kidney disease, though PAF was higher for females for all diseases except asthma.

The annual medical cost of six comorbidities attributable to overweight was estimated to be over US$147·38 million and is displayed in Table 4. The analysis stratified by disease showed that the largest costs were due to kidney disease (US$72 million), followed by overweight-related

Table 2 Direct medical cost per person per month in US dollars

Comorbidity	Consultation fee		Hospital charge		Medicine		Investigation		Total cost	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
CHD	2·24	2·27	3·40	0·21	22·44	17·77	5·54	5·20	33·42	25·45
HPT	1·12	10·9	0·86	0·03	6·98	7·86	1·74	1·68	10·70	10·65
Asthma	1·35	1·14	0·89	0·00	9·37	8·52	1·96	1·63	13·57	11·29
Gallstones	1·24	0·72	0·00	0·72	7·89	8·61	3·35	0·00	12·48	10·05
Kidney	2·67	2·83	2·67	2·47	19·42	28·29	8·11	15·67	32·87	49·27

HPT, hypertension.

Table 3 Direct non-medical cost per person per month in US dollars

	Transport		Tips		Others		Total cost	
Comorbidity	Male	Female	Male	Female	Male	Female	Male	Female
CHD	3·69	2·83	0·00	0·00	1·36	2·04	5·06	4·87
HPT	0·72	0·76	0·72	0·00	0·36	0·46	1·80	1·23
Asthma	0·99	0·58	0·07	0·00	0·24	0·25	1·30	0·83
Gallstones	1·44	0·29	0·00	0·29	0·36	0·29	1·79	0·86
Kidney disease	1·77	4·64	0·00	0·00	1·19	2·41	2·96	7·05

HPT, hypertension.

Table 4 Annual medical cost of six overweight-related comorbidities (in million US dollars)

Comorbidity	Male	Female	Total	% of GDP	% of THCE
CHD	9·36	27·70	37·07	0·032	0·93
HPT	5·51	17·40	22·91	0·020	0·57
Asthma	1·76	1·39	3·15	0·003	0·08
NIDDM	3·95	7·46	11·41	0·010	0·29
Gallstones	0·32	0·29	0·61	0·001	0·02
Kidney disease	18·56	53·67	72·23	0·063	1·81
Total	39·46	107·91	147·38	0·128	3·69

GDP, gross domestic product; THCE, total health care expenditure; HPT, hypertension; NIDDM, non-insulin-dependent diabetes mellitus.

CHD (US$37 million), HPT (US$23 million) and diabetes (US$11 million). With the total GDP in Bangladesh in 2010 being US$115 billion and the calculated THCE as around US$4 billion, the proportion attributable to overweight is therefore 0·13 % of GDP and 3·69 % of THCE.

A two-way sensitivity analysis revealed that the total cost could be as low as US$71 million or as high as US $334 million. For lower limits, this corresponds to 0·062 and 1·73 %, respectively, for GDP and THCE; for higher limits, this corresponds to 0·29 and 8·34 %, respectively, for GDP and THCE. Considering 95 % CI of health care expenditure, the annual medical cost of six comorbidities attributable to overweight for the higher limits counted US$176·61 million, and for lower limit, it counted US$117·62 million.

Discussion

This study is the first of its kind in Bangladesh, and probably in the Indian subcontinent. The estimation of these six overweight-related diseases is huge (US$147·38 million) with a proportion of 3·69 % of THCE. Due to the lack of data availability, we could not estimate some important overweight-related diseases like cancers, musculoskeletal conditions, stroke and arthritis. This is undoubtedly an underestimation. Despite this and many other limitations, our findings are comparable to a Korean study[23] (proportion of THCE 3·7 %), where overweight was defined as BMI $\geq$ 23 kg/m^2, and a study conducted in China[43] where proportion of cost to THCE was 3·7 % and the definition of overweight was BMI $\geq$ 24 kg/m^2. However, the Korean study[43] estimated socio-economic costs including both direct and indirect costs.

The Chinese study[43] considered four diseases only. Our estimate is somewhat higher than the proportion in Thailand[10] (1·5 %, overweight defined as BMI $\geq$ 25 kg/m^2) and Taiwan[24] (2·9 %, overweight defined as BMI $\geq$ 24 kg/m^2). On the other hand, our estimate is lower than the proportion in New Zealand[18] (5·98 %, overweight defined as BMI $\geq$ 25 kg/m^2) and Hong Kong[11] (5·98 %, overweight defined as BMI $\geq$ 25 kg/m^2). The New Zealand study considered both direct and indirect costs, whereas the Hong Kong study collected data about hospital costs, thus including a provider perspective. The estimated cost of overweight-related diseases was equivalent to 0·13 % of the Bangladesh GDP in 2010. This amount is comparable to Thailand's[10] in 2009 (0·13 %), Brazil's[44] in 2010 (0·09 %) and Korea's[23] in 2005 (0·22 %). Though costs associated with overweight have been estimated as huge in some countries in Asia[10,23], due to methodological differences between studies, it is difficult to make comparisons. Moreover, the definition of BMI as well as the cut-off levels varies from country to country. However, we used the WHO-defined BMI cut-off[29] as studies conducted in Bangladesh in general used WHO criteria to define overweight[5,6,45–47].

The cost for overweight-related kidney disease is high compared with other obesity-related diseases. In our study, half of the total cost for overweight-related diseases was due to kidney disease. This may be due to the higher cost

of dialysis, kidney transplants and related drug costs. If the cost of overweight-related kidney disease is dropped from the analysis, the total cost of overweight-related diseases is reduced to US$75 million which was 0·06 % of GDP and 1·88 % of THCE in 2010. There is a positive association between obesity and chronic kidney disease. There is new accumulating evidence to suggest that chronic kidney disease is more common in overweight or obese patients[48]. The second highest economic burden (25 %) for overweight-related diseases is for CHD. The findings are supported by Alexander[49]. The author concluded that there is a strong association of obesity particularly central obesity and traditional risk factor for CHD such as HPT, type 2 diabetes mellitus and dyslipidaemia. Obesity is commonly cited as a risk factor for the development of CHD. The main cost item for CHD and kidney disease is investigation and medicine. Though the prevalence of HPT was highest among the comorbidities, the total cost of HPT due to overweight was low, which may be due to low hospital admissions and high dependency on low-cost drugs. In a Korean study, Kang *et al.*[23] showed that HPT was a significant part of total cost of obesity-related diseases. Overweight-related health care costs were higher for females compared with males, mainly due to the higher prevalence rate among Bangladeshi females for most of the selected comorbidities. This finding is also consistent with the Pitayatinanan *et al.* study[10]. However, for both direct medical and non-medical costs, males had higher OOP expenditure compared with their female counterparts for all of the specified diseases, except kidney disease. In most countries, diabetes features higher up in the list of costs[50]. However, in Bangladesh, it is not the case. This may be related to lack of diabetes awareness and or proper records. The most trusted data in HIES do not have a breakdown of NIDDM.

The strength of the present study is that the OOP expenditure information was collected from a nationally representative sample. Some limitations on the methods used, data collection and disease identification in this study need to be mentioned. First, as we used secondary sources for cost and prevalence data, the accuracy of cost and prevalence data was difficult to assess. Moreover, some of the information was incomplete, and we estimated total cost based on a number of assumptions. For example, the cost of NIDDM was considered equal for both males and females due to lack of sex-specific OOP expenditure for NIDDM treatment. However, for most of the cases, we tried to the best of our ability to make the assumptions as realistic as possible.

Second, the PAF calculation relied on RR that were based on meta-analysis[32] and not on Bangladesh populations. We used RR data from meta-analysis due to lack of information of RR measurement in Bangladesh. Third, the cost variables used for calculating OOP expenditure are self-reported which might lead to measurement bias or recall bias in our results. For example, inflated reporting of direct costs would lead to an inflated assessment of costs. Again, respondents relied on recalling the expenditure rather than counting. This may have resulted in either under or over reporting of the total expenditure; thus, the result is less robust. The breakdown of NIDDM was not available in the HIES. Fourth, the indirect costs, such as loss of production and intangible costs, were not included in the study. If such costs were included, the total cost would be higher than the current estimate. Finally, the study did not assess other overweight-related diseases such as stroke, arthritis, musculoskeletal conditions and cancer due to lack of OOP expenditure data related to these diseases. Inclusion of these diseases would increase the total cost estimates substantially. In addition, the cost of treating overweight itself was not included in the analysis. However, such treatment facilities are rare in Bangladesh. Finally, for this study, we included people with BMI higher than 25 kg/m^2 which includes obese people whose BMI is higher than 30 kg/m^2. The RR of comorbidities due to obesity was higher than that of overweight. So considering the RR for obese people and summing this into the current estimation would increase the total cost. However, only 2·9 % of the females and 0·7 % of the males are obese[6] in Bangladesh, as the country is now at the early stage of nutritional transition from underweight to overweight.

Conclusion

Our study provides evidence that overweight once not considered a dominant problem in Bangladesh is now a predominant problem. Despite many limitations of this study, the findings are very useful for planners and policymakers in estimating the burden of overweight in a wider sense and economic burden of overweight-related diseases in a specific sense. The results indicate the magnitude of the issue. A detailed study is warranted to estimate the burden of overweight-related diseases. The study provides a picture of the estimated costs of overweight in Bangladesh in one specific year. The findings thus indicate the magnitude of the economic burden and the possibilities for reducing the economic loss through the reduction of the prevalence of overweight. With the increasing trend of overweight burden in Bangladesh, the future economic burden of overweight will be enormous. The information about the costs may have a role in the future economic analysis of public health interventions to prevent an increase in the prevalence of overweight in Bangladesh.

Acknowledgements

Acknowledgement: We would like to acknowledge the Bangladesh Bureau of Statistics for providing access to the Bangladesh Household Income and Expenditure Survey (HIES), 2010 data. *Financial support:* This research received no specific grant from any funding agency in the

public, commercial or not-for-profit sectors. Conflict of interest: None of the authors had a conflict of interest. *Authorship:* M.E.H. and A.A.M.[5] developed the study concept and participated in the data analysis and discussion. M.E.H. wrote the first draft. A.A.M.[2] edited first draft. M.E.H., A.A.M.[2] and D.M.E.H. prepared the final draft. All authors critically reviewed the drafts. All authors have seen and approved the final draft of the study. *Ethics of human subject participation:* HIES obtained informed consent from each participant before starting the interview.

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