Cost of care of chronic non-communicable diseases in Jamaican patients: the role of obesity

ORIGINAL RESEARCH

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ABSTRACT

OBJECTIVE: To estimate the economic cost of Chronic Non-Communicable Diseases (CNCDs) and the portion attributable to obesity among patients in Jamaica.

METHODS: The cost-of-illness approach was used to estimate the cost of care in a hospital setting in Jamaica for type 2 diabetes mellitus, hypertension, coronary heart disease, stroke, gallbladder disease, breast cancer, colon cancer, osteoarthritis, and high cholesterol. Cost and service utilization data were collected from the hospital records of all patients with these diseases who visited the University Hospital of the West Indies (UHWI) during 2006. Patients were included in the study if they were between 15 and 74 years of age and if female, were not pregnant during that year. Costs were categorized as direct or indirect. Direct costs included costs for prescription drugs, consultation visits (emergency and clinic visits), hospitalizations, allied health services, diagnostic and treatment procedures. Indirect costs included costs attributed to premature mortality, disability (permanent and temporary), and absenteeism. Indirect costs were discounted at 3% rate.

RESULTS: The sample consisted of 554 patients (40%) males (60%) females. The economic burden of the nine diseases was estimated at US$ 5,672,618 (males 37%; females 63%) and the portion attributable to obesity amounted to US$ 1,157,173 (males 23%; females 77%). Total direct cost was estimated at US$ 3,740,377 with female patients accounting for 69.9% of this cost. Total indirect cost was estimated at US$ 1,932,241 with female patients accounting for 50.6% of this cost. The greater cost among women was not found to be statistically significant. Overall, on a per capita basis, males and females accrued similar costs-of-illness (US$ 9,451.75 vs. US$ 10,758.18).

CONCLUSIONS: In a country with per capita GDP of less than US$ 5,300, a per capita annual cost of illness of US$ 10,239 for CNCDs is excessive and has detrimental implications for the health and development of Jamaica.

Keywords

Chronic non-communicable diseases; Obesity; Cost-of-illness

INTRODUCTION

The prevalence of obesity in Jamaica has been increasing over the last fifty years resulting in the main public health concern changing from a high prevalence of undernutrition and infectious diseases to a high prevalence of obesity and chronic non-communicable diseases (CNCDs). Obesity is known to be associated with several chronic diseases (including diabetes, hypertension and their sequelae) and early mortality. As a result, obesity and its associated diseases are likely to contribute significantly to health care costs burden in the Jamaican society due to increased morbidity and premature mortality. Estimating health costs associated with obesity will inform and strengthen the argument for effective intervention to reduce this burden in Jamaica.

With economic development comes the public health transition mentioned above [1- 3]. Many mid- to low-income countries undergoing this transition will at the same time manifest significant burden from both groups of diseases. In such countries, as life expectancies have increased, more persons survive, living long enough to be afflicted with CNCDs that result from unhealthy diets, obesity, low levels of physical activity as well as other risk factors. At the same time, segments of

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Disclosure
The authors have no conflicts of interest to declare.

the population are still dealing with the traditional risks to health including unsafe water, under-nutrition and poor sanitation [2-4].

Jamaica has been undergoing the epidemiological transition described above [5]. More than half of Jamaicans are overweight or obese [5] and both overweight and obesity are associated with several comorbidities [6,7]. According to Bray et al. [8], there are two physiological categories into which each disease with an increased risk as a result of the presence of overweight can be classified. The first category of disabilities is due to the physical presence of corpulence. Psychosocial function, osteoarthritis and sleep apnea belong in this category. The second category of disabilities results from the metabolic changes associated with overweight (e.g., diabetes mellitus, gallbladder disease, hypertension, cardiovascular disease, and certain cancers [8]). Also the incidence of several chronic diseases increase with degree of overweight [6,7,9]. Several studies show an association between overweight/obesity and CNCDs, e.g., diabetes mellitus [10-16], gallbladder disease [17,18], hypertension [10,19-21], coronary heart disease [22-25], stroke [26-32], and serum triglyceride levels [33,34].

Seventy percent of Jamaican women and 20% of Jamaican men have high waist circumferences (WC) [5]. Also, 70% of Jamaican women and 9% of Jamaican men have high waist-to-hip ratios (WHR) [5]. Both are associated with increased cardiovascular risk [22-24,35]. Therefore, estimating the impact of obesity is via the burden of chronic non-communicable diseases for which obesity is a major risk factor is well-founded. Especially since seven of the 10 leading causes of mortality in Jamaica in 1998 were CNCDs [36].

For Jamaica in 2001, the total economic burden of diabetes and hypertension amounted to J$ 10.18 billion (US$ 221 million at 2001 exchange rates) and J$ 12.26 billion (US$ 266 million at 2001 exchange rates) respectively [37]. Given that obesity is a risk factor for both diabetes and hypertension, obesity is therefore a significant burden on the Jamaican economy.

The foregoing suggests that CNCDs constitute an important disease burden to the Jamaican Health Sector and significant economic burden to the country. This epidemiological/economic transition is leading to increased prevalence of CNCDs, requiring more health care and increasing costs. These growing costs are unsustainable and if left unchecked could reverse health gains and hinder economic growth. To obtain a greater insight into this subject, a case study of the University

Hospital of the West Indies (UHWI) was done. There are several studies that estimate the cost of obesity [38-40]. Those studies for the most part, used prevalence data, while this study estimated the economic burden of nine CNCDs using data from hospital records.

This study aimed to estimate the economic burden of obesity and related chronic non-communicable diseases among patients in Jamaica. Health care in Jamaica is provided through a combination of public, private and quasi-public sector hospitals and healthcare facilities. The UHWI is the largest hospital in Jamaica and serves as a regional referral hospital. Therefore, patients who visited the UHWI during 2006 were deemed most suitable for this study. Data from hospital records of patients who visited UHWI during 2006 were analysed to estimate the economic burden of CNCDs. These estimations would provide important information for policy development, program planning and resource allocation in relation to CNCD management. In addition, the knowledge obtained will be useful as a benchmark of the economic cost of obesity in Jamaica and as a point of reference in the estimation of the economic burden of disease. Actual use of medical services were used to estimate the monetary value of that burden in order to strengthen our argument for intervention and guide policy makers.

METHODS

Design of the study

This is a prevalence-based cost-of-illness evaluation study using a survey of patient records and data from secondary sources. Primary data including cost and service utilization data were collected from the hospital records of patients. Secondary data included prevalence data from local [5] and other sources [6,41] which were used to calculate the population attributable risk of obesity.

Setting

Study subjects included all adult patients who visited the University Hospital of the West Indies as a result of type 2 diabetes, hypertension, coronary heart disease, stroke, gallbladder disease, breast cancer, colon cancer, osteoarthritis, and high cholesterol during 2006, and who were 15-74 years old and if female, did not give birth during the reference year. The age-range of 15-74 years was chosen because it represents approximately 70% of the Jamaican population [42] and captures predominantly the economically active population.

Medical records were used to calculate actual costs of medical care to each patient as a result of type 2 diabetes, hypertension, coronary heart disease, stroke, gallbladder disease, breast cancer, colon cancer, osteoarthritis, and high cholesterol. The human capital approach was used to calculate the cost-of-illness due to mortality and morbidity. Cost-of-illness calculations were divided into two types: direct costs and indirect costs. Direct costs included costs of drugs, consultations and hospitalizations, while indirect costs included costs attributed to morbidity, and premature mortality.

Direct costs

Drugs

The hospital records were used to generate the list of drugs prescribed to patients to manage their conditions. The usual customary and reasonable (UCR) costs suggested by pharmacies were then applied to calculate costs of drugs needed for each disease condition by multiplying the unit cost of each drug prescribed by the dosage. This gave an estimate of the amount spent on each drug for the year. The total amount spent on drugs in 2006 was determined by summing these products across all drugs.

Consultations

Consultation costs were calculated from ambulatory patients whether or not they were hospitalized at any point throughout the year. The total number of visits was multiplied by the cost of a clinic visit to arrive at the cost of consultation for each patient. The addition of the individual costs of consultation represented the total costs of consultation.

Hospitalizations

Hospitalization costs consisted of charges for medications used during hospitalization and investigative and therapeutic procedures done. These charges were retrieved from the medical records of patients and summed up to get the total cost of hospitalization in 2006.

Allied Health Services, diagnostic and treatment procedures

Records of allied health services, medical tests and other laboratory procedures, and treatment procedures carried as outpatient services were used to ascertain the types of services utilized and procedures done and their frequencies. The unit cost of each service/procedure for 2006 was obtained from the hospital's assessment office. The total cost of each service/procedure was determined as the product of its unit cost and the total number of times the service/procedure was done in 2006. The total costs of the allied health services, diagnostic procedures, and treatment procedures for 2006 were determined by summing the cost of individual items in each category.

Indirect costs

Premature mortality

Data on mortality resulting from each comorbidity were obtained from the hospital database and the number of Years of Productive Life Lost in employed patients due to premature mortality ($YPLL_M$) associated with each comorbidity was calculated based on the life expectancy for males and females in Jamaica as reported by the World Health Organization (WHO). A 3% discount rate was applied to the YPLL to convert future earnings to current value [43,44]. The cost was then calculated by multiplying YPLL by annual per capita GNP.

$$YPLL_M = \frac{N}{r}(1 - e^{-rL})$$

Where N = number of deaths; L = standard life expectancy at age of death (years), and r = discount rate

Disability

Permanent Disability

The number of years lost due to permanent disability before the age of 65 years was also calculated. This is the number of $YPLL_D$.
The patients were divided into age groups and $YPLL_D$ due to permanent disability was calculated by multiplying the number of patients in each age group by the difference between the age limit of 65 years and the median of the age group as shown in the equation below [45]:

$$YPLL_D = \sum_{i=l}^{L} [(L - i) \times d_i]$$

Where l = lower age limit established (median age), L = upper age limit established (65 years), i = median age at beginning of permanent disability, and d_i = number of patients with permanent disability at age i.

A 3% discount rate was then applied to calculate the number of discounted YPLL due to permanent disability. The cost of permanent disability was then estimated by multiplying the annual per capita GNP by $YPLL_D$.

Temporary Disability

The number of years lost due to temporary disability ($YPLL_T$) before the age of 65 years was calculated from the number of disability days for patients who did not have a permanent disability. A 3% discount rate was then applied to calculate the number of discounted $YPLL_T$. The cost of temporary disability was then estimated by multiplying the annual per capita GNP by the number of $YPLL_T$. Where the period of temporary disability was less

than one year, discounting did not apply. In such cases, the fraction of year of disability was simply calculated by dividing the number of disability days by 365.

Absenteeism

The number of absent days for employed patients was estimated as the sum of the number of days spent in consultation, in hospitalization and on sick leave from work. Thus, sick leave days were underestimated as this information was not always recorded in the clinical files. Lost salaries were then estimated. The first step was separating the employed patients according to the International Standard Classification of Occupations 2008 (ISCO-08) [46]. The major groups of the classification were: managers, professionals, technicians and associate professionals, clerical support workers, service and sales workers, skilled agricultural, forestry and fishery workers, craft and related trades workers, plant and machine operators, and assemblers, elementary occupations, and armed forces occupations [46]. The next step was to obtain the daily salaries of each category from national databases [47,48]. The salaries were then converted to U.S. dollars at 2006 US average annual rate of exchange. The cost-of-illness due to absenteeism was calculated as the product of the number of days absent and the daily salaries [49].

Cost of obesity

The economic burden of obesity was then estimated from the calculated direct and indirect costs of type 2 diabetes, hypertension, coronary heart disease, stroke, gallbladder disease, breast cancer, colon cancer, osteoarthritis, and high cholesterol. The analysis of the proportion of the cost of each case which was attributable to obesity was based on the population attributable risk of obesity. The population attributable risk (PAR) is also referred to as the "etiologic fraction" or "population attributable fraction". It is a measure of the proportion of cases of a given disease (e.g., type 2 diabetes) that is due to a risk factor of interest (e.g., obesity). The population attributable risk of obesity was applied to the direct and indirect costs of each of the disease. The sum of the costs gave an estimate of the economic burden of obesity. There are several studies that support the use of PAR for the estimation of the fraction of a disease that is attributable to obesity [50-53].

$$PAR = \frac{P(RR-1)}{P(RR-1)+1}$$

Where PAR = population attributable risk, RR = relative risk (estimated by the odds ratio, OR), and P = prevalence rate of disease/mortality.

However in order to estimate the PAR, the relative risk of each obesity comorbidity was obtained from other studies.

Since relative risks were not available for Jamaica on all of the comorbidities of interest (except for diabetes mellitus, hypertension and high cholesterol), relative risks for the remaining comorbidities were obtained from studies from other countries. In order to decide which source(s) of relative risks to use, the relative risks obtained were compared with those available for Jamaica. The countries for which relative risks could be found that were comparable with those available for Jamaica were used as the sources for the other relative risk values (Table I).

The PAR for obesity and the 95% confidence intervals (CIs) were then computed for each comorbidity. The PAR for each of the 9 comorbidities studied was multiplied by the cost of the corresponding comorbidity and then summed to represent the corresponding estimate of the cost of obesity. A sensitivity analysis was also done on both the estimated costs and the PARs to provide a range of values for the cost estimates.

Sensitivity analysis

One-way sensitivity analyses was performed to assess the robustness of the total cost estimates. In a one-way sensitivity analysis, the value of one variable is changed at a time in the estimation of cost, and the impact that the change has on the results examined. In this study, the cost of illness was estimated at the 3% discount rate. It was then analyzed at 95% and 97.5% confidence intervals for the population attributable risks for obesity.

RESULTS

All 554 patients (except females who gave birth during 2006) between the ages of 15-74 years of age who visited the hospital during 2006 for the diseases being studied were included in the study. The mean age was 56.9 years. Of the patients studied, 220 (40%) were males and 334 (60%) were females.

Direct costs

Drugs

The total cost of prescription drugs was US$ 2,245,245.10, averaging US$ 4,052.79 per patient during 2006. The greatest proportion of the payment was on drugs for the management of diabetes mellitus (US$ 1,531,885.30; 68.2%), followed by coronary heart disease (US$ 296,634.72; 13.2%), hypertension (US$ 186,821.16; 8.3%) and breast cancer (US$ 75,246.04; 3.4%). The least amount spent on drugs was for gallbladder disease (US$ 6.90)

Disease	RR (95%CI)		PAR [% (95%CI)]		PAR [% (97.5%CI)]	
	Males	Females	Males	Females	Males	Females
DM [7]	2.05 (1.20-3.49)	2.14 (1.32-3.47)	0.11 (0.0687-0.151)	0.30 (0.259-0.341)	0.11 (0.0625-0.157)	0.30 (0.253-0.347)
HTN [7]	2.36 (1.47-3.78)	2.76 (1.85-4.11)	0.14 (0.0989-0.181)	0.40 (0.359-0.441)	0.14 (0.0928-0.187)	0.40 (0.353-0.447)
CHD [43]	1.40 (1.17-1.68)	1.32 (1.07-1.62)	0.05 (8.40×10^{-3}-0.0916)	0.11 (0.0684-0.152)	0.05 (2.24×10^{-3}-0.0978)	0.11 (0.0622-0.158)
S [8]						
• Overweight	1.23 (1.13-1.34)	1.15 (1.00-1.32)	0.03 (0.0116-0.0716)	0.05 (0.0488-0.0512)	0.03 (0.0177-0.0777)	0.05 (0.0486-0.0514)
• Obesity	1.51 (1.33-1.72)	1.49 (1.27-1.74)	0.06 (0.0184-0.1016)	0.16 (0.118-0.202)	0.06 (0.0123-0.1077)	0.16 (0.112-0.2077)
GD [8]						
• Overweight	1.09 (0.87-1.37)	1.44 (1.05-1.98)	0.01 (-0.0292-0.0492)	0.14 (0.100-0.179)	0.01 (-0.0349-0.0549)	0.14 (0.0951-0.185)
• Obesity	1.43 (1.04-1.96)	2.32 (1.17-4.57)	0.05 (0.01084-0.0892)	0.33 (0.291-0.369)	0.05 (5.05×10^{-3}-0.0949)	0.33 (0.285-0.375)
BC [8]						
Overweight	-	1.08 (1.03-1.14)		0.03 (0.0265-0.0335)		0.03 (0.0259-0.0341)
Obesity	-	1.13 (1.05-1.22)		0.05 (0.0333-0.133)		0.05 (0.0456-0.146)
CC [8]						
• Overweight	1.51 (1.37-1.67)	1.45 (1.30-1.62)	0.06 (0.0200-0.100)	0.15 (0.110-0.190)	0.06 (0.0141-0.1059)	0.15 (0.1041-0.196)
• Obesity	1.95 (1.59-2.39)	1.66 (1.52-1.81)	0.10 (0.0600-0.140)	0.20 (0.160-0.240)	0.10 (0.0541-0.146)	0.20 (0.154-0.246)
OA [8]						
Overweight	2.76 (2.05-3.70)	1.80 (1.75-1.85)	0.17 (0.144-0.196)	0.23 (0.204-0.256)	0.17 (0.140-0.200)	0.23 (0.200-0.260)
Obesity	4.20 (2.76-6.41)	1.96 (1.88-2.04)	0.28 (0.254-0.306)	0.27 (0.254-0.296)	0.28 (0.250-0.310)	0.27 (0.240-0.300)
HC [7]	2.89 (2.04-4.10)	3.57 (1.91-6.68)	0.18 (0.139-0.221)	0.49 (0.449-0.531)	0.18 (0.133-0.227)	0.49 (0.443-0.537)
Obesity prevalence (%) [7]	12	38	-	-	-	-

Table I. *Relative Risk (RR) due to obesity and Population Attributable Risk (PAR) due to obesity for the diseases studied*
BC = Breast Cancer, CC = Colon Cancer, CHD = Coronary Heart Disease, DM = Diabetes Mellitus, GD = Gallbladder Disease, HC = High Cholesterol, HTN = hypertension, OA = osteoarthritis, S = Stroke

which accounted for < 0.01% of the total amount spent on drugs by patients (Table II). Women accounted for about 62% of the overall cost of drug therapy. This amounted to US$ 1,388,280.79. Being a woman was not found to be statistically associated with greater drug costs (p = 0.63; CI = 95%). The average costs per males and females were US$ 3,895.29 and US$ 4,156.53 respectively.

Payment on drugs accounted for a major proportion of the cost of treatment. For high cholesterol, approximately 100% of the total expenditure for treatment was on drugs. In addition, the proportion of the cost of treatment that was due to drug cost expenditure was at least about half of the cost or greater for diabetes mellitus (89%), hypertension (66%), stroke (64%), coronary heart disease (61%), and osteoarthritis (49%). The diseases for which drugs contributed the least towards total overall treatment were colon cancer and gallbladder disease at 6% and 0.1% respectively (Table III).

Consultations

The total cost of consultations (out-patient + emergency visits) for 2006 for these patients was US$23,811.20. Females accounted for 72.6% of this cost, however, women were not found to have statistically higher consultations costs (P-value = 0.17; CI = 95%) (Table II). Breast cancer, diabetes mellitus, hypertension, and coronary heart disease ac-

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counted for the greater proportion of the overall consultation cost: US$ 6,920.13 (29.1%); US$6,218.55 (26.1%); US$ 4,188.22 (17.6%) and US$ 4,007.51 (16.8%) respectively (Table II).

Females accounted for 61.3% of the cost of consultations when the cost of breast cancer was removed from the results. Again, women were not found to have statistically greater consultations costs even without the inclusion

	Prescription drugs (US$)	Consultation (US$)	Drugs used during hospita-lization (US$)	Allied health services (US$)	Diagnostic services (US$)	Treatment services (US$)	Total direct cost [US$ (%)]
DM							
• Males	575,149.75	2,636.67	6,673.64	242.83	10,323.33	47,927.19	642,953.41 (37.5)
• Females	956,735.55	3,581.88	12,634.53	537.25	35,221.25	62,950.40	1,071,660.86 (62.5)
• Total	1,531,885.30	6,218.55	19,308.17	780.08	45,544.58	110,877.59	1,714,614.27 (100)
HTN							
• Males	87,293.87	1,604.09	1,783.50	7,719.62	24,220.18	6,613.51	129,234.77 (45.7)
• Female	99,527.29	2,584.13	2,193.63	801.41	43,242.60	5,065.25	153,414.31 (54.3)
• Total	186,821.16	4,188.22	3,977.13	8,521.03	67,462.78	11,678.76	282,649.08 (100)
CHD							
• Males	135,802.18	1,518.85	2,778.74	443.18	28,166.29	84,743.50	253,452.74 (52.1)
• Females	160,832.54	2,488.66	4,738.14	270.16	40,655.74	24,337.84	233,323.08 (47.9)
• Total	296,634.72	4,007.51	7,516.88	713.34	68,822.03	109,081.34	486,775.82 (100)
S							
• Males	26,079.27	393.10	851.76	267.09	9,876.49	601.10	38,068.81 (46.2)
• Females	26,546.44	521.08	2,212.09	421.87	14,361.64	337.00	44,400.12 (53.8)
• Total	52,625.71	914.18	3,063.85	688.96	24,238.13	938.10	82,468.93 (100)
GD							
• Males	0.00	42.48	0.00	0.00	721.77	0.00	764.25 (7.1)
• Females	6.90	244.53	407.60	18.21	1,838.51	7,554.34	10,070.09 (92.9)
• Total	6.90	287.01	407.60	18.21	2,560.28	7,554.34	10,834.34 (100)
BC							
• Males	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (0)
• Females	75,246.04	6,920.13	2,595.82	124.44	96,134.23	771,977.99	952,998.65 (100)
• Total	75,246.04	6,920.13	2,595.82	124.44	96,134.23	771,977.99	952,998.65 (100)
CC							
• Males	66.12	180.75	173.11	27.32	3,840.33	14,875.73	19,163.36 (33.2)
• Females	3,577.98	372.01	329.68	6.07	3,983.75	30,366.08	38,635.57 (66.8)
• Total	3,644.10	552.76	502.79	33.39	7,824.08	45,241.81	57,798.93 (100)
OA							
• Males	11,799.03	127.24	0.18	36.42	165.41	7,554.34	19,682.62 (18.8)
• Females	39,256.69	542.45	88.06	133.54	894.83	44,237.91	85,153.48 (81.2)
• Total	51,055.72	669.69	88.24	169.96	1,060.24	51,792.25	104,836.10 (100)
HC							
• Males	20,774.09	31.89	7.12	0.00	0.00	0.00	20,813.10 (43.9)
• Females	26,551.36	21.26	0.00	0.00	15.18	0.00	26,587.80 (56.1)
• Total	47,325.45	53.15	7.12	0.00	15.18	0.00	47,400.90 (100)
Economic burden							
• Males	856,964.31	6,535.07	12,268.05	8,736.46	77,313.80	162,315.37	1,124,133.06 (30.1)
• Females	1,388,280.79	17,276.13	25,199.55	2,312.95	236,347.73	946,826.81	2,616,243.96 (69.9)
• Total	2,245,245.10	23,811.20	37,467.60	11,049.41	313,661.53	1,109,142.18	3,740,377.02 (100)

Table II. *Breakdown of the total direct costs of the diseases studied by gender (US$)*
BC =Breast Cancer, CC = Colon Cancer, CHD = Coronary Heart Disease, DM = Diabetes Mellitus, GD = Gallbladder Disease, HC = High Cholesterol, HTN = hypertension, OA = osteoarthritis, S = Stroke

Disease	Prescription drugs	Consultation visits		Procedures and services used during consultations			Procedures and services used during hospitalizations				Hospitalization
		Outpatient	Emergency	Diagnostic procedures	Treatment procedures	Allied health services	Drugs	Diagnostic procedures	Treatment services	Allied health services	
DM	1,531,885.30 (89)	4,379.56 (0.3)	1,838.99 (0.1)	10,995.39 (0.6)	48.64 (0.003)	36.43 (0.002)	19,308.17 (1)	34,549.19 (2)	110,828.95 (6)	743.65 (0.04)	165,429.96 (10)
HTN	186,821.16 (66)	2,933.88 (1)	1,254.34 (0.5)	4,037.62 (1)	12.16 (0.004)	7,877.56 (3)	3,977.13 (1)	63,425.16 (22)	11,666.60 (4)	643.47 (0.2)	79,712.36 (28)
CHD	296,634.72 (61)	2,359.86 (0.5)	1,647.65 (0.3)	4,970.97 (1)	1,405.62 (0.3)	15.18 (0.003)	7,516.88 (2)	63,851.06 (13)	107,675.72 (22)	698.16 (0.1)	179,741.82 (37)
S	52,625.71 (64)	297.64 (0.4)	616.54 (0.7)	5,552.10 (7)	27.36 (0.03)	21.25 (0.03)	3,063.85 (4)	18,686.03 (23)	910.74 (1)	667.71 (0.8)	23,328.33 (28)
GD	6.90	233.86 (2)	53.15 (0.5)	791.89 (7)	0.00 (0)	0.00 (0)	407.60 (4)	1,768.39 (16)	7,554.34 (70)	18.21 (0.2)	9,749.54 (90)
BC	75,246.04 (8)	6,654.38 (0.7)	265.75 (0.03)	2,121.75 (0.2)	537,977.14 (56)	0.00 (0)	2,595.82 (0.3)	94,012.48 (10)	234,000.85 (25)	124.44 (0.01)	330,733.59 (35)
CC	3,644.10 (6)	499.61 (1)	53.15 (0.1)	2,012.47 (3)	27,383.07 (47)	9.11 (0.02)	502.79 (0.9)	5,811.61 (10)	17,858.74 (31)	24.28 (0.04)	24,197.42 (42)
OA	51,055.72 (49)	637.80 (0.6)	31.89 (0.03)	22.77 (0.02)	0.00 (0)	6.07 (0.006)	88.24 (0.08)	1,037.47 (1)	51,792.25 (49)	163.89 (0.2)	53,081.85 (51)
HC	47,325.45 (99.8)	53.15 (0.1)	-	0.00 (0)	0.00 (0)	0.00 (0)	7.12 (0.02)	15.18 (0.03)	0.00 (0)	0.00 (0)	22.30 (0.05)
Total	2,245,245.10	18,049.74	5,761.46	30,504.96	566,853.99	7,965.60	37,467.60	283,156.57	542,288.19	3,083.81	865,996.17

Table III. *Breakdown of the costs of consultation visits and hospitalizations and the contribution of costs of procedures and services used during consultations and hospitalizations to the overall direct costs by disease (US$)*

BC =Breast Cancer, CC = Colon Cancer, CHD = Coronary Heart Disease, DM = Diabetes Mellitus, GD = Gallbladder Disease, HC = High Cholesterol, HTN = hypertension, OA = osteoarthritis, S = Stroke

of breast cancer cost (p = 0.44; CI = 95%). Outpatient consultations accounted for 75.8% of the overall cost of consultations (Table III).

Hospitalization

The greatest cost accrued during hospitalizations was for breast cancer at US$ 330,758.56, followed by coronary heart disease, diabetes mellitus, and hypertension at US$ 179,741.83; US$ 162,124.54, and US$ 79,712.36, respectively (Table II). With respect to the procedures and services used during hospitalization, the greatest contributors were treatment services at US$ 542,288.19 and diagnostic procedures at US$ 283,156.57 (Table III).

Allied health services

The total cost of allied health services (e.g., dietician visit and physiotherapy), was US$ 11,049.41, which accounted for 0.1% of the overall cost, and 0.3% of the total direct cost. Most of the cost of these services (72%) accrued during consultation visits (US$ 7,965.60), with the remaining services occurring during hospitalization (Table II and III). Hypertension was responsible for the greatest cost for allied health services at US$ 8,521.03. No allied health services were employed by patients who visited the hospital due to high cholesterol (Table II and III).

Amount spent on diagnostic and treatment services

The participants used several diagnostic services during 2006 and spent a total of US$ 313,661.53 (3% of total overall cost, 8% of total direct cost). The greatest costs accrued were for breast cancer, coronary heart disease, hypertension and diabetes mellitus at US$ 96,134.23, US$ 68,822.03, US$ 67,462.78, and US$ 42,239.03, respectively. High cholesterol was responsible for the least cost accrued due to diagnostic services at US$ 15.18 (Table II). Most (90.3%) of the cost of diagnostic procedures was accrued during hospitalization (Table III).

Treatment services accrued a cost of US$ 1,109,142.18 (12% of total overall cost and 30% of total direct cost). The greatest costs accrued were for breast cancer, diabetes mellitus, coronary heart disease, and colon cancer at US$ 771,977.99, US$ 110,877.59, US$ 109,081.34, and US$ 45,241.81, respectively (Table II). Treatment services were divided almost equally between consultations and hospitalizations (51% and 49%, respectively) (Table III).

Indirect costs

Premature mortality

The estimated cost of premature mortality was US$ 95,309.00. Although deaths occur-red for both genders, this cost was estimated from the YPLL, and could only be computed for women because the mortality observed for males occurred beyond the age of 65 years. The diseases responsible for this cost were breast cancer at US$ 72,355.00 (75.9% cost of premature mortality) and hypertension at US$ 22,954.00 (24.1% cost of premature mortality) (Table IV).

Permanent disability

The total discounted cost of permanent disability was based on 38 patients and accrued a cost of US$ 1,908,176.00 (28% of total cost and 81% of total indirect cost). The comorbidities responsible for permanent disabilities were diabetes mellitus, hypertension, stroke and osteoarthritis, accruing discounted costs of US$ 867,761.00, US$ 206,087.00, US$144,211.00, and US$ 349,799.00, respectively (Table IV).

Cost of temporary disability

The total discounted cost of temporary disability in patients under 65 years who were not permanently disabled amounted to US$ 39,899.10 in lost productivity. Fifty-three percent of this loss was as a result of temporary disability in men. Temporary disability was responsible for 2% of the indirect cost and 0.7% of the total cost of the diseases studied (Table IV).

Coronary heart diseases accrued the greatest cost due to temporary disability followed by diabetes, hypertension, and colon cancer at US$ 17,987.40 (45%), US$ 13,457.91 (34%), US$ 3,575.38 (9%), and US$ 2,859.76 (9%), respectively (Table IV).

Cost of absenteeism

The total cost of absentee days was US$ 229,175.56. Women were responsible for 55.5% of overall losses due to absenteeism. The diseases that contributed the most to this cost were diabetes mellitus, hypertension, breast cancer and coronary heart disease at US$ 70,505.28 (31%), US$ 54,819.30 (24%), US$ 40,174.64 (18%), and US$ 38,573.68 (17%), respectively (Table IV).

Overall costs

The sum of the costs attributable to the diseases studied was US$ 5,672,617.68. The four main contributors were diabetes mellitus (47.0%), breast cancer (18.8%), hypertension (10.0%), and coronary heart disease (9.6%). Female patients were responsible for 63.3% of the overall costs attributable to the diseases covered. However, being a woman was not found to be statistically associated with greater overall costs (p = 0.44; CI = 95%). Female patients also accrued more than half

Disease	Indirect cost (US$)				
	Premature mortality	Permanent disability	Temporary disability	Absenteeism	Total [US$ (%)]
DM					
• Males	-	583,331.00	11,498.32	36,565.14	631,394.46 (66.3)
• Females	-	284,430.00	1,959.59	33,940.14	320,329.73 (33.7)
• Total	-	867,761.00	13,457.91	70,505.28	951,724.19 (100)
HTN					
• Males	0.00	65,369.00	1,922.30	28,447.05	95,738.35 (33.3)
• Females	22,954.00	140,718.00	1,653.08	26,372.25	191,697.33 (66.7)
• Total	22,954.00	206,087.00	3,575.38	54,819.30	287,435.68 (100)
CHD					
• Males	-	-	6,180.19	19,225.19	25,405.38 (44.9)
• Females	-	-	11,807.21	19,348.49	31,155.70 (55.1)
• Total	-	-	17,987.40	38,573.68	56,561.08 (100)
S					
• Males	-	50,399.00	328.07	8,656.35	59,383.42 (38.2)
• Females	-	93,812.00	423.70	1,641.60	95,877.30 (61.8)
• Total	-	144,211.00	751.77	10,297.95	155,260.72 (100)
GD					
• Males	-	-	-	1,560.20	1,560.20 (58.3)
• Females	-	-	-	1,114.80	1,114.80 (41.7)
• Total	-	-	-	2,675.00	2,675.00 (100)
BC					
• Males	0.00	-	0.00	0.00	0.00(0)
• Females	72,355.00	-	27.34	40,174.64	112,556.98 (100)
• Total	72,355.00	-	27.34	40,174.64	112,556.98 (100)
CC					
• Males	-	-	0.00	7,135.54	7,135.54(60.6)
• Females	-	-	2,859.76	1,777.30	4,637.06 (39.4)
• Total	-	-	2,859.76	8,912.84	11,772.60 (100)
OA					
• Males	-	133,233.00	1,225.87	163.08	134,621.95 (38.0)
• Females	-	216,566.00	0.00	2,845.27	219,411.27 (62.0)
• Total	-	349,799.00	1,225.87	3,008.35	354,033.22 (100)
HC					
• Males	-	-	13.67	0.00	13.67 (6.2)
• Females	-	-	0.00	207.52	207.52(93.8)
• Total	-	-	13.67	207.52	221.19 (100)
Economic burden					
• Males	0.00	832,332.00	21,168.42	101,752.55	955,252.97 (49.4)
• Females	95,309.00	735,526.00	18,730.68	127,422.01	976,987.69 (50.6)
• Total	95,309.00	1,567,858.00	39,899.10	229,175.56	1,932,240.66 (100)

Table IV. *Breakdown of the total indirect costs of the diseases studied by gender (US$)*
BC =Breast Cancer, CC = Colon Cancer, CHD = Coronary Heart Disease, DM = Diabetes Mellitus, GD = Gallbladder Disease, HC = High Cholesterol, HTN = hypertension, OA = osteoarthritis, S = Stroke

of the cost of all conditions studied except coronary heart disease (Table V). Total direct cost of the total burden of disease was US$ 3,740,377.02 (65.9% of total cost). About 70% of direct cost was accrued by females (Table II and V). Women were not found to be statistically associated with greater direct costs (p = 0. 30; CI = 95%). Total indirect

Disease	Direct costs (US$)	Indirect costs (US$)	Total costs [US$ (%)]
DM			
• Males	642,953.41	631,394.46	1,274,347.87 (47.8)
• Females	1,071,660.86	320,329.73	1,391,990.59 (52.2)
• Total	1,714,614.27	951,724.19	2,666,338.46 (100)
HTN			
• Males	129,234.77	95,738.35	224,973.12 (39.5)
• Females	153,414.31	191,697.33	345,111.64 (60.5)
• Total	282,649.08	287,435.68	570,084.76 (100)
CHD			
• Males	253,452.74	25,405.38	278,858.12 (51.3)
• Females	233,323.08	31,155.70	264,478.78 (48.7)
• Total	486,775.82	56,561.08	543,336.90 (100)
S			
• Males	38,068.81	59,383.42	97,452.23 (41.0)
• Females	44,400.12	95,877.30	140,277.42 (59.0)
• Total	82,468.93	155,260.72	237,729.65 (100)
GD			
• Males	764.25	1,560.20	2,324.45 (17.2)
• Females	10,070.09	1,114.80	11,184.89 (82.8)
• Total	10,834.34	2,675.00	13,509.34 (100)
BC			
• Males	0.00	0.00	0.00 (0)
• Females	952,998.65	112,556.98	1,065,555.63 (100)
• Total	952,998.65	112,556.98	1,065,555.63 (100)
CC			
• Males	19,163.36	7,135.54	26,298.90 (37.8)
• Females	38,635.57	4,637.06	43,272.63 (62.2)
• Total	57,798.93	11,772.60	69,571.53 (100)
OA			
• Males	19,682.62	134,621.95	154,304.57 (33.6)
• Females	85,153.48	219,411.27	304,564.75 (66.4)
• Total	104,836.10	354,033.22	458,869.32 (100)
HC			
• Males	20,813.10	13.67	20,826.77 (43.7)
• Females	26,587.80	207.52	26,795.32 (56.3)
• Total	47,400.90	221.19	47,622.09 (100)
Economic burden			
• Males	1,124,133.06	955,252.97	2,079,386.03 (36.7)
• Females	2,616,243.96	976,987.69	3,593,231.65 (63.3)
• Total	3,740,377.02	1,932,240.66	5,672,617.68 (100)

Table V. *Total cost of care for the diseases studied by gender (US$)*
BC = Breast Cancer, CC = Colon Cancer, CHD = Coronary Heart Disease, DM = Diabetes Mellitus, GD = Gallbladder Disease, HC = High Cholesterol, HTN = hypertension, OA = osteoarthritis, S = Stroke

cost amounted to US$ 1,932,240.66 (34.1% of total cost). About 51% of indirect cost was accrued by females (Table IV and V). When the cost of breast cancer was removed from direct and indirect costs, females accrued

59.7% and 47.5% of the total direct and indirect costs, respectively.

Total costs attributable to obesity

In order to arrive at the costs attributable to obesity, the population attributable risk (PAR) for each disease due to obesity was calculated as outlined in the methodology (Table I). The resulting values were then applied to the cost of each disease.

The overall costs attributable to obesity for males and females were estimated at US$ 271,921.28 and US$ 885,251.61, respectively, giving a total estimate of US$ 1,157,172.89. This figure does not include premature mortality since the level of premature mortality was very low and perhaps did not reflect the true mortality rate of the patients. Therefore, males and females contributed 23.5% and 76.5%, respectively to the cost of obesity (Table VI). Women were not found to be statistically associated with greater obesity costs (p = 0.16; CI = 95%). When the cost of breast cancer was removed from the cost of obesity, females accrued 74.6% of the cost (p = 0.23; CI = 95%). Also, when both breast cancer and colon cancer costs were removed from the cost of obesity, females accrued 74.6% of the cost (p = 0.23; CI = 95%).

DISCUSSION

This is a cost-of-illness study in which data analysed were collected from the hospital records of 554 patients who were treated at the University Hospital of the West Indies during 2006 for obesity-related diseases, thereby arriving at an estimate of the direct and indirect costs of obesity. This method is considered more accurate than using prevalence data for the estimation of cost because, in such methodologies, all patients with the same malady are treated as a homogenous group while patients with similar diagnoses may have vastly different treatment experiences and costs. The present study did not include the costs of pain and suffering [54], or presenteeism (reduced performance while at work due to ill health) [55].

This study estimated the economic burden attributable to the nine diseases of interest to be US$ 5,672,617.68 for the patients studied. The three main contributors were diabetes mellitus, breast cancer and hypertension, with female patients being responsible for 63.3% of the overall costs. However, there is a potential for bias towards females due to the failure to include a principal male cancer (e.g., prostate cancer), where there is growing evidence of a relationship with obesity [56].

Female patients also accrued more than half of the cost of all diseases studied except for coronary heart disease. This is contrary to expectation given that females accounted for 60% of the cases studied. The higher direct cost for female patients is due to their unique presentation in breast cancers which also bore the highest direct cost.

Total direct and indirect costs attributable to the nine diseases of interest were estimated at US$ 3,740,377.02 and US $1,932,240.66, respectively for men and women. Women accrued 70% of direct costs and 51% of indirect costs but also represented 60% of the study population. The total per capita direct costs for men and women were US$ 5,109.70 and US $7,833.07, respectively. The total per capita indirect costs for men and women were US$ 4,342.06 and US$ 2,925.11, respectively. Given the higher prevalence of obesity among Jamaican women [5], they seemed to have been managing their conditions better than the men, with lower indirect costs. Their conditions could have been more easily managed with drugs while the men needed more diagnostic and treatment interventions. When breast cancer cases were excluded, women accrued 60% of direct and 48% of indirect costs. The greatest contributors to direct cost were prescription drugs followed by treatment services at US$ 2,245,245.10 and US$ 1,109,142.18, respectively. The greatest contributors to indirect cost were permanent disability followed by the absenteeism at US$ 1,567,858.00 and US$ 229,175.56, respectively.

The overall cost of obesity was estimated at US$ 1,157,172.89 (20% of total overall cost for the diseases studied), with females contributing 77% of the overall cost of obesity. Excluding breast cancer, the female contribution to the cost of obesity falls to 75%. This estimate did not include premature mortality due to the inadequacy of data: although mortality occurred for both genders, the mortality observed for males occurred beyond the age of 65 years and thus could not be included in the calculation of YPLL. Thus, YPLL could only be computed for women. For all diseases, females contributed more than 50% to the cost of obesity. In a previous study of 8 diseases (not including breast and colon cancer), females contributed to 55% of the overall cost of obesity [57], which is lower compared to our data when these two cancers are excluded.

Diabetes contributed the most to the cost of obesity at US$ 557,775.44 (48%), followed by osteoarthritis, hypertension, and breast cancer at US$ 221,719.43 (19%), US$ 169,540.90 (15%), and US$ 85,244.45 (7%),

Diseases	Cost (US$)		
	Males	Females	Total [US$ (%)]
DM	140,178.27	417,597.18	557,775.44 (48.2)
HTN	31,496.24	138,044.66	169,540.90 (14.7)
CHD	13,942.91	29,092.67	43,035.58 (3.7)
S	8,770.70	29,458.26	38,228.96 (3.2)
GD	139.46	5,256.89	5,396.35 (0.5)
BC	-	85,244.45	85,244.45 (7.4)
CC	4,207.82	15,145.42	19,353.24 (1.7)
OA	69,437.06	152,282.37	221,719.43 (19.2)
HC	3,748.82	13,129.71	16,878.53 (1.4)
Economic burden [US$ (%)]	271,921.28 (23.5)	885,251.61 (76.5)	1,157,172.89 (100)

Table VI. *Cost attributable to obesity for the diseases studied*
BC =Breast Cancer, CC = Colon Cancer, CHD = Coronary Heart Disease, DM = Diabetes Mellitus, GD = Gallbladder Disease, HC = High Cholesterol, HTN = hypertension, OA = osteoarthritis, S = Stroke

respectively. The PAR of obesity in diabetes is not disproportionate when compared to the PAR of obesity in the other diseases. In a study that estimated direct costs of obesity for a group of diseases that did not include osteoarthritis, the 3 largest contributors to the costs were hypertension, type 2 diabetes mellitus and coronary artery disease [51]. In another study that estimated costs of obesity for a group of diseases (osteoarthritis excluded), coronary artery disease, type 2 diabetes mellitus and hypertension were among the 4 largest contributors to the costs [38]. Therefore, the results are comparable with type 2 diabetes mellitus and hypertension being among the top 4 contributors.

Cardiovascular disease has been predicted to be the leading cause of death and disability worldwide by 2020 [58]. However, the leading cause of permanent disability in this study was diabetes mellitus. In this study, the two contributors to mortality were hypertension and breast cancer, with an estimated cost of US$ 22,954.00 and US$ 72,355.00 respectively. Mortality is however projected to increase dramatically from ischemic heart disease in developing countries by 2020 [59]. In previous studies, cerebrovascular diseases, heart diseases, hypertensive diseases, diabetes mellitus, and malignant neoplasms have been found to be among the ten leading causes of death in Jamaica [36,60].

CONCLUSIONS

This study has shown the high cost of CNCDs, with diabetes accruing the highest cost overall as well as the highest cost attributable to obesity. On a per capita basis,

females accrued greater costs of illness for gallbladder disease (US$ 33.49 vs. US$ 10.57 about three times that of the males) and osteoarthritis (US$ 911.87 vs. US$ 701.38). On a per capita basis, males accrued higher costs of illness for diabetes mellitus (US$ 5,792.49 vs. US$ 4,167.64), coronary heart disease (US$ 1,267.54 vs. US$ 791.85) and high cholesterol (US$ 94.67 vs. US$ 80.23). On a per capita basis, males and females accrued similar costs of illness for hypertension (US$ 1,022.61 vs. US$ 1,033.27), stroke (US$ 442.96 vs. US$ 419.99), and colon cancer (US$ 119.54 vs. US$ 129.56). Overall, on a per capita basis, males and females accrued similar costs of illness (US$ 9,451.75 vs. US$ 10,758.18).

Obesity was responsible for 20.4% of total overall cost of the diseases studied. With respect to the cost of illness due to obesity, on a per capita basis, females accrued greater costs of illness for all of the diseases studied: diabetes mellitus (US$ 1,250.29 vs. US$ 637.17, twice than males), hypertension (US$ 413.31 vs. US$ 143.16, about three times than males), coronary heart disease (US$ 87.10 vs. US$ 63.38), stroke (US$ 88.20 vs. US$ 39.87, more than twice than males), gallbladder disease (US$ 15.74 vs. US$ 0.63, twenty-five times than males), colon cancer (US$ 45.35 vs. US$ 19.13, more than twi-

ce than males), osteoarthritis (US$ 455.94 vs. US$ 315.62), and hypercholesterolemia (US$ 39.31 vs. US$ 17.04, more than twice than males). In addition, females accrued 77% of the cost of illness due to obesity with them accruing a higher per capita cost than males (US$ 2,650.45 vs. US$ 1,236.01 twice than males).

This study showed that although Jamaica is not an affluent country, obesity and its comorbidities are important sources of economic burden. This is therefore further argument that chronic non-communicable diseases are not necessarily diseases of affluence. In addition, this study indicated that although Jamaica is in a public health transition, obesity is already showing a strong impact on medical and economic costs to the country. In general, policies to control and prevent CNCDs should seek to improve lifestyle behavior activities (diet and physical activity) of both men and women, if these indicators are to improve. Jamaica could include in its planning for the future, the training of health personnel (particularly physicians, dieticians and nutritionists) in the management and prevention of obesity. As the demographic transition continues and the population ages, the economic costs will become unsurmountable if efforts to arrest this trend do not begin.

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