

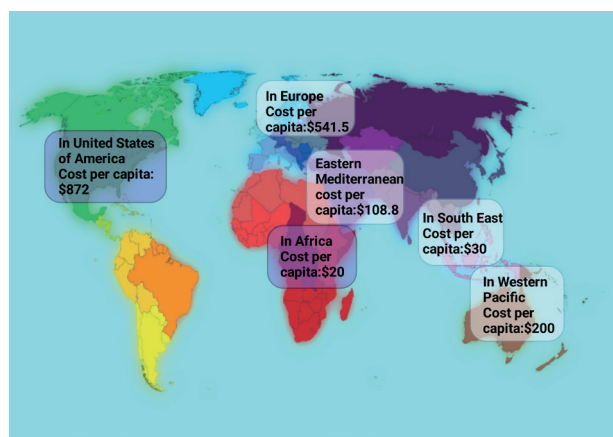


obesity rates. The low and middle-income countries (LMICs) are facing an annual rise in Overweight and obesity, which is more than two times that of high-income countries noted from 2000 to 2016<sup>1</sup>. Annually, there are about 5 million deaths worldwide due to NCDs resulting from overweight and obesity and 77% of such demises take place in LMICs<sup>6</sup>. With the advent of COVID-19, it became evident that obese and overweight individuals were prone to a more severe form of the disease and had a more significant risk of being hospitalized and demise<sup>7</sup>.

A body mass index (BMI) from 25 to 29.9 is considered overweight. Individuals with a BMI of 30 and above are obese<sup>1</sup>. Overweight and obesity may develop under the influence of multiple factors that include stress, nutrition which is high in energy density, little physical activity, poor access to healthcare, and genetic factors<sup>5,8</sup>. The rising prevalence of this chronic, progressing, and relapsing condition with multiple influencing factors and many disease outcomes places a heavy economic burden on countries around the globe<sup>9</sup>. They know about the economic impact that aids in allocating and prioritizing resources. It also helps create awareness at a national and international level so that policies may be developed to combat overweight and obesity<sup>10</sup>. Analyzing the impact of obesity and overweight on the economy can help better understand causes, prevalence, and possible means to lower the development of obesity and overweight<sup>11</sup>.

### Obesity and Economic Impact on the Gross Domestic Product (GDP) of Countries Globally

In certain countries, the economic effect of obesity has been noted to be substantial; the gross domestic product (GDP) of Thailand and the USA of 0.13% and 9.3%, respectively, needed to be allocated to expenses for medical care and productivity reduction<sup>12,13</sup>. In 2019, Okunogbe *et al.*, used the cost-of-illness approach to estimate the impact of obesity on the economy of 161 countries. They found that the economy's effects on GDP globally were 2.19%. In Africa, the average expenditure was US\$ 20 per capita; in America, it was US\$ 872 per capita [Figure 2]. The economic impact ranged from US\$ 6 in low-income countries to US\$ 1110 in high-income countries. They also remarked that continuing such a trend would increase the economic obesity-related effects on GDP globally to 3.29%, and the most significant increase observed in low-income countries by 2060. Also, in high-income countries, expenses are expected to rise 4 times, while in low and middle-income countries income countries, the rise would be 12 to 25 folds<sup>11</sup>.



**Figure 2:** Exhibiting the Global Cost Per Capita of Obesity in 2019. This figure has been developed by utilizing the premium version of Bio Render (<https://biorender.com/>) with License No.: CS2590KMOE. Image Credit: Rahnuma Ahmad.

### Direct Costs of Overweight and Obesity

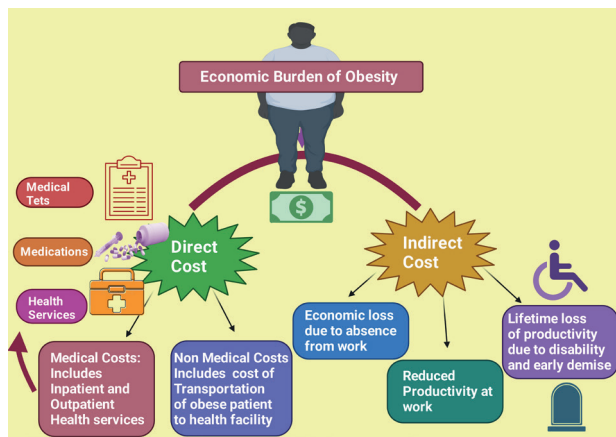
Direct costs incurred by obesity are influenced by race, age, and gender<sup>14-16</sup>. Such factors may be targeted for intervention. Direct medical costs are the expenses due to inpatient and outpatient health services, including surgery, drug therapy, and radiological and laboratory tests<sup>17</sup>. Direct nonmedical payments are transporting an individual to the health care provider<sup>18</sup>. Several studies have been performed on the direct costs of obesity<sup>19-30</sup>. Most of the studies for estimating direct cost were done from a healthcare perspective, and one survey by Andreyeva *et al.*, was done from a societal perspective<sup>23</sup>. The factors included while studying the direct costs of obesity vary in different studies. For example, de Oliveira *et al.*, had the costs of medication, orthotics, bariatric surgery, medical consultation, diagnostic procedures, and prosthetics showing the annual cost to be US\$ 269.6 million for obese and US\$ 64.2 million for morbidly obese subjects.

In contrast, Bahia *et al.*, included only outpatient and inpatient expenses and found the yearly cost was US\$ 1.1 billion<sup>23,25</sup>. A non-linear association exists between obesity and rising prices. The medical costs are about 2 to 3-fold higher for morbidly obese patients than regular BMI patients<sup>31</sup>. In the United States of America, it was noted that obesity increased expenditure in all significant medical healthcare categories. Prescription drugs and inpatient services incurred the higher cost among the categories. 88.5% of the expenditure rise constituted of third-party payers in the case of adult obesity<sup>32</sup>. Here the third-party payers include employers, insurance companies, and government agencies<sup>18</sup>. Thus, it is economically

rational that governments intervene to lower and prevent obesity<sup>33</sup>. Here it was found that public insurance expenditures were more significant than private health insurance and suggested the possible cause to be worse health cases were covered under public health insurance causing more utilization of medical care<sup>32,34</sup>.

### Indirect Costs of Obesity

The increasing overweight and obesity prevalence is related to both direct and indirect costs [Figure 3]<sup>35</sup>. The indirect cost is due to mortality and morbidity<sup>36-38</sup>. The indirect costs are losses due to decreased productivity at work owing to long-term and short-term working inability. Obesity is mainly linked to a higher risk of temporary work loss, like sick leave, absenteeism, and lower productivity during work, that is, presenteeism. Premature death and disability pension expenditures are included in indirect costs<sup>36,37</sup>.



**Figure 3:** Displaying the Different Types of Costs Inflicted by Obesity on the Global Economy. This figure has been developed by utilizing the premium version of Bio Render (<https://biorender.com/>) with License No.: CA258V5VMG. Image Credit: Rahnuma Ahmad.

### Economic Burden of Absenteeism in Overweight and Obese Individuals

Several studies have been carried out to assess short-term sick leave annual expenditure. In these studies, average-weight employees' sick leave from work was compared with that of obese and overweight employees. The excess incurred cost by obese employees was between US\$ 89 and US\$ 1586, while that of overweight workers was between US\$ 54 and US\$ 161<sup>14,39-42</sup>. Durden *et al.*, noted a significantly greater cost for obese and overweight employees<sup>43</sup>. Calculations of total annual cost resulting from absenteeism for obese, normal, and

overweight individuals were done in other studies. The expenditure for obese employees ranged between US\$ 57 and US\$ 6759; for overweight subjects, it went from US\$ 29 to US\$ 5132<sup>44-53</sup>. The expenses in the case of males and females were assessed in other studies, and it was reported that the costs of obese men (US\$ 89-1130) were lower than that of obese women (US\$ 170-1391)<sup>14,39,40</sup>.

### Presenteeism and Economic Cost for Overweight and Obese Subjects

A fall in productivity of employees (presenteeism) at work due to obesity and overweight were studied by several researchers using a survey of employee<sup>41,42,46,49,54-56</sup>. Expenditures due to obesity ranged from US\$ 11-4175, and that incurred by overweight individuals were between US\$ 611 and US\$ 1669,<sup>42,53,55</sup>. However, Finkelstein *et al.*, and Peake's study noted that the cost of overweight subjects was lower than that of typical employees<sup>42,47</sup>. In the case of gender-specific presenteeism costs, it was pointed out that the expenditure in women was between US\$ 927 and US\$ 3341, while that for men ranged from US\$ 429 to 4175<sup>42</sup>. The expenses of morbid and moderate obesity were found to be US\$ 2414, US\$ 1990, US\$ 1684, US\$ 699<sup>41,46,50,53</sup>. The cost of presenteeism and absenteeism was studied in one research work which showed US\$ 6402-9104 prices for obese subjects, and for overweight individuals, it was US\$ 5515<sup>57</sup>.

### Productivity Loss, Economic Costs, and Obesity

Loss of productivity due to short-term and long-term disability was studied by several researchers<sup>41,55, 58,59</sup>. Disability-related costs for obese subjects ranged from US\$ 21-439; for overweight employees, it was between US\$ 30 and US\$ 41<sup>41,58</sup>. Depending on the methodology of the studies, the cost resulting from disability through the lifetime and disability pension varied. When cost estimation was done using the human capital approach (HCA), the price was found to be US\$ 32668 for obese and US\$ 31037 for overweight, and when the friction cost method (FCM) was used, the cost came to US\$ 3115 for obese and US\$ 2649 for overweight<sup>35,59</sup>.

### Early Demise and Lifetime Productivity Loss in Obesity and Economic Burden

Early demise-related loss of work was studied, and it was observed that excess productivity costs were between US\$ 212 and US\$ 1170 for obese subjects and US\$ 29 for overweight<sup>41</sup>. Lifetime loss of productivity was reported to be US\$ 23070 (FCM) or US\$ 114626 (HCA) for obese employees and US\$ 20066 (FCM) or US\$ 87 184 (HCA) for overweight subjects<sup>59</sup>. Several studies have focused

on the macroeconomic cost of obesity and overweight annually and reported the expenditure varied from the price in New Zealand (US\$ 79 million) to that of the United States of America (US\$ 41 billion)<sup>56,60</sup>. Lightwood *et al.*, after studying the costs for adolescent obesity in the USA, have concluded that the expenditure is likely to increase from that found for the year 2020 (US\$ 954 million) to US\$ 36 billion in the year 2050<sup>50</sup>.

### **Economic Burden of Non-communicable Diseases Resulting from Obesity**

There are several studies in which the expenditure due to various non-communicable diseases developing from obesity have been included while estimating the cost of obesity<sup>12,19,20,23,25,30,61-66</sup>. Konnopka *et al.*, found the direct cost of obesity to be 4,854 million EUR and the indirect cost to be 5,019 million EUR. The direct price included 43% due to endocrine diseases like obesity and diabetes, 38% due to cardiovascular diseases, 14% due to neoplasm, and 6% from digestive diseases suffered by overweight and obese populations. In this study, neoplasms included liver, pancreas, gallbladder, cervix, postmenopausal breast, ovary, uterus, kidney, prostate, multiple myeloma, leukemia, esophagus, colon, and stomach<sup>61</sup>. Musculoskeletal disease<sup>12,19,20,23,25,63,64</sup>, digestive disease<sup>12,61,63-65</sup>, and respiratory disorders<sup>12,23,25,30,63,64</sup> were included while trying to find the cost of obesity in some studies. Thompson *et al.*, found that the price for management of common conditions related to obesity like coronary artery disease, diabetes, raised cholesterol, stroke, and hypertension in the obese population was about US\$ 9,000 to US\$ 17,000 more than that for normal BMI individuals<sup>67</sup>.

To improve the cost estimations of obesity, more studies need to include diseases related to obesity, and income on the individual level need to be taken into consideration. Economic calculations should consist of obesity in childhood to understand the lifetime loss of productivity. Also, long-term studies with more than one year should be carried out to see the long-term economic burden of obesity. A better

comprehension of expenditure related to obesity is likely to be the development of more extensive and immediate programs to manage and prevent obesity. Preventive programs like the 'Let's Move' initiative and Community Putting Prevention to Work are in the USA<sup>17</sup>. There is an urgent need for a more united effort by national and local governments, nonprofit and health-related organizations, advertisers, and companies concerned with food and individuals to promote a healthy way of life and, thus, reduce the economic burden and save valuable global resources.

### **Consent for Publication**

All authors reviewed and approved the final version and have agreed to be accountable for all aspects of the work, including any accuracy or integrity issues.

### **Disclosure**

The author declares that they do not have any financial involvement or affiliations with any organization, association, or entity directly or indirectly with the subject matter or materials presented in this article. This includes honoraria, expert testimony, employment, ownership of stocks or options, patents or grants received or pending, or royalties.

### **Funding**

This study received no funding.

### **Data Availability**

Information is taken from freely available sources for this editorial.

### **Authorship Contribution**

All authors contributed significantly to the work, whether in the conception, design, utilization, collection, analysis, and interpretation of data or all these areas. They also participated in the article's drafting, revision, or critical review, gave their final approval for the version that would be published, decided on the journal to which the paper would be submitted, and made the responsible decision to be held accountable for all aspects of the work.

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