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Economic burden of cardiovascular diseases among elderly patients in Iran: a case from a developing country

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Abstract

Background Cardiovascular diseases (CVDs) are the leading cause of mortality and morbidity worldwide, particularly among the aging population. This study aims to evaluate the economic burden of CVDs among Iranians aged 60 years and older.

Methods A cost-of-illness study was conducted using a prevalence-based approach from a societal perspective. Cost analysis employed the bottom-up micro-costing method to assess direct medical and non-medical costs, while indirect costs were calculated using the human capital approach. Data were sourced from medical records of individuals aged 60 and older with CVDs registered in the hospital information systems of public and private hospitals in southeastern Iran. Additionally, structured face-to-face interviews were conducted with 160 caregivers or relatives serving as companions of elderly patients, using a structured questionnaire to gather data on healthcare utilization. Sensitivity analyses were performed, along with projections of the future economic burden of CVDs.

Results The annual total cost of CVDs among people aged 60 years and above in Iran was estimated at US$ 1,885,091,171.7 (about 1.88 billion), equivalent to 1.27% of the Iran's GDP in 2021. Direct medical costs accounted for 90.62% of the total, with 54.72% attributed to ambulatory care. The average cost of CVDs per patient was US$ 446.2. The results of two-way sensitivity analysis provided an estimated cost range between US$ 1.2 billion and US$ 2.7 billion. By 2030, the total cost of CVDs is projected to reach US$ 21 billion.

Conclusions The elderly population with CVDs imposes a growing economic burden on Iran's healthcare system and society. This underscores the urgent need for effective and cost-effective interventions to prevent and manage CVDs in Iran.

Keywords Economic burden, Cardiovascular diseases, Elderly, Iran

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Background

Cardiovascular diseases (CVDs) encompass a range of conditions affecting the heart and blood vessels, including coronary artery disease (CAD), cerebrovascular disease, rheumatic heart disease, and other cardiovascular conditions [1]. According to the Global Burden of Diseases (GBD) reports, nearly 612 million people globally were living with a form of CVDs in 2021, with an incidence rate of approximately 846 new cases per 100,000 people [2]. CVDs remain a major public health concern, causing approximately 19.4 million deaths and 428.3 million disability-adjusted life years (DALYs) in 2021 alone [3]. Notably, around 80% of these deaths and disabilities occur in low- and middle-income countries (LMICs) [4–6], despite a global reduction of 14.5% in CVD-related mortality from 2006 to 2016 [7].

In Iran, a lower-middle-income country, the prevalence of CVDs was 10.07% in 2021, higher than the global average [2]. CVDs accounted for 44.4% of all deaths and 18.2% of DALYs in the country [2]. Over the past four decades, Iran has experienced an increase in both the prevalence and mortality rates of CVDs. This rise can be attributed to rapid sociodemographic and economic transitions, changes in diet, inadequate physical activity, industrialization, urbanization, and longer life expectancy [8, 9].

Elderly populations are particularly vulnerable to CVDs due to age-related physiological changes and prolonged exposure to risk factors [10]. A cohort study conducted in Iran revealed that the prevalence of CVDs among individuals aged 65–70 was 27.9%, compared to 7.5% in the 35–45 age group [11]. Additionally, the proportion of elderly people (aged 60 years and older) in Iran has grown from 5.1% in 1990 to over 10% in 2022 [12]. This demographic shift poses significant challenges for the prevention and management of CVDs within this age group [13].

Beyond the health burden, CVDs impose a substantial financial burden on individuals and society. According to the American Heart Association, heart diseases in the U.S. incurred approximately $252.2 billion in costs between 2019 and 2020, including healthcare services, medications, and lost productivity [14, 15]. Globally, the economic burden of CVD is projected to increase from US$ 957 billion in 2015 to US$ 1.04 trillion by 2030, according to the World Heart Federation [16]. This trend is mirrored in Iran, where the total costs of CVDs rose from 5,571 billion Iranian Rials (IRR) in 2012 to 6,700 IRR in 2017 [17]. Similarly, in Poland, the estimated costs of CVDs increased from €8.2 billion in 2015 to €9.6 billion in 2017 [18], and in Brazil, CVD costs grew by 17% from 2010 to 2015, reaching $13.1 billion [19]. These rising costs can be attributed to population aging, the growing prevalence of chronic conditions and comorbidities, and higher healthcare utilization among older individuals [20].

The economic impact of non-communicable diseases (NCDs), including CVDs, is of great importance to policymakers. These diseases not only affect individuals and families but also strain health systems, health insurance policies, and national economies [21]. By estimating the economic burden of diseases, policymakers can better understand the societal impact and allocate resources more efficiently. This knowledge is crucial for developing and implementing interventions that prevent and manage diseases, improve health outcomes, and reduce out-of-pocket expenditures and catastrophic costs. Since many CVD-related costs are preventable [22], policymakers can implement targeted interventions to reduce these expenses and conserve resources.

While several studies have estimated the economic burden of CVDs in Iran, most focus on specific perspectives or patient age groups. For example, one study estimated the total economic burden of CVDs in Ardabil at 6700.58 billion IRR in 2017 [17], while another estimated the total costs of CAD in Tabriz at around 63 million IRR in 2020 [23]. However, there is a need for a focused analysis of the elderly population, which constitutes the majority of CVD patients in Iran and imposes substantial costs on the health system. Additionally, updated data and future cost projections are crucial for informed policy making. This study aims to estimate the economic burden of CVDs among Iranians aged 60 years and above and provides cost projections for 2030, offering insights relevant to a country with limited healthcare resources.

Methods

Study design

This study, a partial economic evaluation focusing on the cost of illness, was conducted from a societal perspective, accounting for direct medical, non-medical, and indirect costs. The analysis employed a prevalence method with a one-year timeframe. A bottom-up micro-costing approach was utilized for the cost analysis.

Study population

The study was carried out in three public hospitals and one private hospital in Kerman, the largest city in southeastern Iran. Kerman hospitals were strategically selected for several reasons: (1) they provide a wide range of services, offered by highly qualified healthcare professionals equipped with advanced medical devices and equipment, and (2) they serve as referral centers for surrounding and neighboring cities and provinces, including those in the Sistan and Baluchestan and Hormozgan provinces. Although most patients utilize public hospitals, a proportion, based on socioeconomic factors, seek care in private hospitals. To capture a comprehensive representation

of patient demographics and healthcare utilization, we included both public and private hospitals in the study.

The study population comprised elderly individuals aged 60 and above diagnosed with CVDs. All patients diagnosed with CVDs in public hospitals during the study period (2019 and 2020) were included. However, due to limitations in the Hospital Information System (HIS), a number of 50 patients admitted to the private hospital were included in the study.

To address the variation in cost data and medical tariffs between public and private hospitals and ensure an accurate calculation of the average cost, we adjusted costs by a survey set reflecting the proportional distribution of patients across both hospital types. The cost ratio of private to public hospitals was 3.3:1.

Patients were identified using the International Classification of Diseases, 10th revision (ICD-10) codes, encompassing categories including acute rheumatic fever (I00-I01), chronic rheumatic heart diseases (I05-I09), hypertensive diseases (I10-I15), Ischemic heart diseases (I20-I25), pulmonary heart disease and diseases of pulmonary circulation (I26-I28), other forms of heart disease (I30-I52), diseases of arteries, arterioles and capillaries (I70-I79), diseases of veins, lymphatic vessels and lymph nodes, not elsewhere classified (I80-I89), and other and unspecified disorders of the circulatory system (I95-I99).

Data sources

Data were extracted from multiple sources. Demographic information, admission and discharge dates, length of stay, and hospitalization costs (i.e., medications, tests, radiology and imaging, surgery, consumable materials and other costs) were gathered. A face-to-face structured interview survey was also conducted to collect data on health utilization, direct non-medical costs, and indirect costs. Trained interviewers conducted structured, face-to-face interviews with caregivers, companions or relatives of elderly patients at hospitals and ambulatory clinics where patients with CVDs were treated (see Additional file 1). The questionnaire consisted of three main parts: (1) patient demographic information, (2) caregiver demographics, and (3) health services utilization and cost data. The primary draft of the questionnaire was developed based on national surveys on health services utilization and medical costing and economic burden in Iran. Then, the primary questionnaire was critically reviewed and validated by a panel of experts in health policy, health economics, epidemiology, and gerontology. Additionally, it was tested for clarity and understandability among individuals with limited reading skills.

The cost data included annual hospitalization costs, outpatient medical visit expenses, rehabilitation costs, out-of-pocket medication costs, paraclinical and diagnosis services (e.g., laboratory, imaging, and radiology tests), and transportation and accommodation costs for inpatient and outpatient services. Moreover, data on patients and their caregivers' jobs and employment, monthly income, and absenteeism (the number of days absent from work) due to caregiving responsibilities were also collected. In total, data from 160 patients with diverse socio-economic backgrounds from both public and private hospitals and ambulatory clinics were collected and analyzed.

Population data for individuals aged 60 and above were obtained from the United Nations population [24], and the prevalence of CVDs (44.24%) among the elderly people (44.24%) was sourced from the Global Burden of Disease (GBD) study 2019 [2].

Cost estimation

From a societal perspective, costs were categorized as direct (medical and non-medical) and indirect.

Medical costs

Direct medical costs included expenses for hospitalization, outpatient visits, rehabilitation, medical tests, diagnosis and imaging tests, and medications.

Direct medical cost = Hospitalization Costs + Ambulatory Care Costs.

Hospitalization = Materials and Consumables + Surgery + Lab Test, Diagnostic Test and Radiology + Medication + Hospital Stay and Daily Bed.

Ambulatory care cost = [monthly unit cost of services (including outpatient visits, monthly rehabilitation, monthly lab test, diagnostic test and radiology, monthly out-of-pocket medication) × (quantity of services used) × 12]

Non-medical costs

Direct non-medical costs included transportation, food, accommodation, and other expenses incurred by patients and their caregivers.

Direct non-medical costs = $\sum$ [monthly unit cost of services (such as transportation, food, accommodation and other non-medical cost) × (quantity of services used) × 12]

Indirect costs

Using the human capital approach, we calculated the income lost (productivity loss) due to work disability and caregiving responsibilities. In 2020, the retirement age for men and women were 60 and 55, respectively [25]. To calculate the productivity loss for patients, we considered only 13.5% of Iranians aged 60 and above who continued working after retirement [26]. However, all of patients' caregivers were eligible for the calculation of productivity loss, provided they were employed. The number of days the elderly and caregivers were absent from work was

multiplied by their average daily wages. Productivity loss due to premature death was not considered in this study because our study population was aged 60 and above.

Indirect costs = ∑ [(daily patients wage × workdays lost per month) + (daily caregiver wage × workdays lost per month) × 12]

The overall economic burden was calculated as:

Economic burden = total costs [direct medical + direct non-medical + (patients' productivity loss × 13.5%) + caregivers' productivity loss] × prevalence of CVD for elderly people × elderly population.

All healthcare costs were adjusted to 2020 prices using the healthcare inflation index from the Central Bank of Iran. Non-healthcare costs in 2020 were adjusted using general inflation index [27]. All values were converted to USD (US $) at an exchange rate of 448,210 IRR per US dollar [28].

Sensitivity analysis

We performed one-way sensitivity analyses with a ±20% variation in each cost component, visualizing the results with a tornado diagram. Additionally, a two-way sensitivity analysis was conducted by varying the CVD prevalence and elderly population size by ±20% to evaluate their effects on total costs.

Estimating the future economic burden of CVDs

To predict the economic burden of CVDs among elderly patients in 2030, we followed these steps:

(1) Population and prevalence rates projection: Using 2020 data, we projected the number of individuals aged 60 and above with CVDs in 2030. (2) Cost prediction: Future costs were estimated by applying constant inflation rates for healthcare and non-healthcare sectors derived from the Statistical Centre of Iran [29]. The formula used is:

$$Average\ cost\ \ in\ 2030 = Cost_M \times (1 + r_h)^n + Cost_N \times (1 + r_g)^n$$

Where n is the number of years, r_h is the healthcare inflation rate, and r_g is the general inflation rate,

In addition, $Cost_M$ represents the average medical costs of the population aged 60 and above with CVDs in 2020, and CostN is the average non-medical and indirect costs of the population aged 60 and above with CVDs in 2020.

3. Total cost estimation: We applied the projected average cost in 2030 to the projected population and CVD prevalence for that year.

Total cost of population age 60 and above with CVDs in 2030 = average cost in 2030 × population in 2030 × prevalence of CVDs among this group in 2030.

Data manipulation and analysis

Before analysis, missing data from hospitals and surveys were reviewed and removed. Descriptive statistics were calculated for demographic and cost data. All analyses were performed using STATA version 17.0 and Excel.

Results

Patient characteristics

Data from a total of 11,341 CVD patients were included in our study, conducted between 2019 and 2020, with 51.35% of the patients being male. The average hospital length of stay was 5.02 days, ranging from 4.83 to 5.20 days. The majority of patients (56.37%) were aged between 60 and 70 years. Table 1 presents the demographic distribution of the CVD patients. Most of the individuals who participated in the interviews were female (53%), aged between 60 and 70 (58%), and residing in Kerman province (93%). Additionally, 44% were housekeepers, 99% had basic health insurance, 53% had complementary health insurance, and 80% had one caregiver (see Additional file 2).

In 2020, the estimated annual total costs for elderly patients with CVDs in Iran amounted to US$ 1,885,091,171.7 (approximately US$ 1.89 billion). Of this, direct medical costs represented 90.62% (US$ 1,708,248,063.0), totaling around US$ 1.71 billion. Among these direct medical costs, annual ambulatory care costs contributed 54.72% (US$ 934,827,866.7 or approximately US$ 934.83 million), while annual hospitalization costs accounted for 45.28% (US$ 773,420,196.3 or approximately US$ 773.42 million) (Table 2).

The total non-medical costs, which made up only 2.28% (US$ 42,956,952.3 or around US$ 42.96 million) of the total, were primarily driven by food expenses (48.37%). Total productivity losses were estimated at US$ 133,886,156.4 or around 133.89 million, with 99.2% of this attributed to caregivers' lost productivity (Table 2).

Table 1 Demographic characteristics of hospitalized patients with CVDs in Kerman, 2019–2020

Characteristics	2019 Frequency (%)	2020 Frequency (%)	Total Frequency (%)
Age:			
60–70 years	3740 (56.32)	2653 (56.45)	6383 (56.37)
71–80 years	1853 (27.90)	1298 (27.62)	3151 (27.78)
81–90 years	920 (13.85)	658 (14.00)	1578 (13.91)
≥ 91 years	128 (1.93)	91 (1.94)	219 (1.93)
Sex			
Male	3316 (49.93)	2508 (53.36)	5824 (51.35)
Female	3325 (50.07)	2192 (46.64)	5517 (48.65)
	2019 Mean	**2020 Mean**	**Total Mean**
Hospital length of stay (per day)	4.94	5.12	5.02

Table 2 Direct medical, direct non-medical, and indirect costs of Iranian elderly patients with CVDs in 2020

Cost category		Annual average costs (US$)	Annual total costs (US$)	Percentage of total costs
Direct medical costs				
Hospitalization	Materials and Consumables	30.4	128,619,523.0	
	Surgery	39.2	165,583,619.5	
	Lab Test, Diagnostic Test and Radiology	6.1	25,737,505.0	
	Medication	19.2	81,056,772.7	
	Hospital Stay and Daily Bed	88.1	372,422,776.0	
Subtotal		183.1	773,420,196.3	
Ambulatory care	Visit	2.6	11,020,130.0	
	Rehabilitation	207.7	877,704,534.4	
	Lab test, diagnostic test and radiology	5.4	22,737,736.7	
	Medication	5.5	23,365,465.6	
Subtotal		221.3	934,827,866.7	
Total direct medical costs		404.3	1,708,248,063.0	90.62
Direct non-medical costs				
	Transportation	1.2	4,882,193.8	
	Food	4.9	20,777,042.1	
	Accommodation	0.6	2,614,595.8	
	Other non-medical costs	3.5	14,683,120.6	
Total direct non-medical costs		10.2	42,956,952.3	2.28
Indirect costs				
	Patient's productivity loss	0.3	1,107,303.0	
	Caregivers' productivity loss	31.4	132,778,853.4	
Total indirect costs		31.7	133,886,156.4	7.10
Total		446.2	1,885,091,171.7	100

On average, the annual cost of CVDs per elderly patient in Iran was US$ 446.2, of which US$ 404.3 was for direct medical expenses. Direct non-medical costs averaged US$ 10.2, and indirect costs, primarily related to productivity losses, averaged US$ 31.7 (Table 2).

Sensitivity analysis

The tornado diagram illustrates the most influential cost components affecting the total average costs associated with CVDs among the elderly population in Iran (Fig. 1). The average costs of CVDs are most sensitive to fluctuations in rehabilitation and hospital stay costs, while they exhibit the least sensitivity to variations in patient productivity loss and accommodation costs.

Figure 2 displays the findings of a two-way sensitivity analysis examining the prevalence rate of CVDs and the size of elderly population. We considered a 20% variation in both parameters, resulting in an estimated cost range from US$1.2 billion dollars to US$2.7 billion.

Prediction of economic burden of CVDs in 2030

Table 3 presents the predicted cost of CVDs in Iran for the elderly population in 2030. The average cost per individual aged 60 and above with CVDs is estimated to be US$ 3,285.2, with the total cost for this group expected to reach US$ 21 billion in 2030.

Discussion

This study estimated the economic burden of CVDs among elderly patients aged 60 and above in Iran in 2020, employing a bottom-up micro-costing approach. The results indicate that CVDs impose a substantial financial burden on the health system and society, with direct medical costs comprising the majority of the total costs. This study is the first to provide a societal perspective estimate of the economic burden of CVDs among the elderly in Iran, accounting for both public and private sectors. These data are crucial for informing health policy decisions regarding resource allocation for CVDs management in Iran.

Our findings revealed that direct medical costs accounted for 90.62% of total costs, with 54.72% attributed to ambulatory care costs, including visits, rehabilitation, medications, and paraclinical costs. This result aligns with another study conducted in Iran by Sheikhgholami et al. [30], which estimated the economic costs of patients with acute coronary syndrome. However, it diverges from the findings of Darba et al. (2020), which indicated that direct costs constituted only 56% of total costs [23]. This discrepancy can be explained by the demographic characteristics of our participants, who were predominantly elderly individuals aged 60 and above. Most of these participants were retired, resulting in minimal productivity losses.

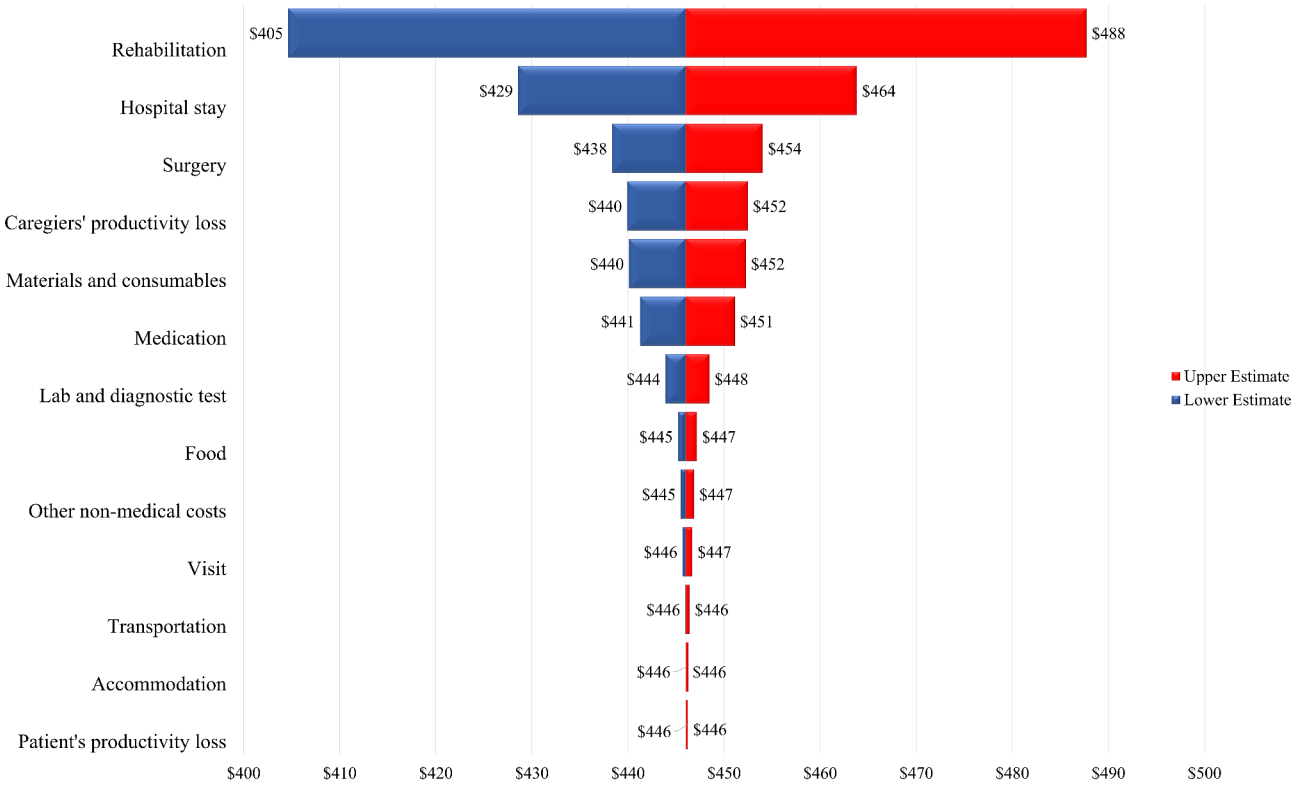

Fig. 1 Tornado diagram of one-way sensitivity analysis of the cost components

Our study also demonstrated that ambulatory care costs were higher than hospitalization costs, attributable to specific CVD interventions such as angioplasty, stenting, pacemaker implantation and rehabilitation, which are typically conducted on an ambulatory basis [31–33]. Cardiac rehabilitation, a non-pharmacological treatment essential for patients with CVDs, can enhance physical function, reduce their risk of complications, and improve quality of life. While cardiac rehabilitation is considered cost-effective in many countries, it remains underutilized [34]. In fact, patients in 55% of countries face out-of-pocket expenses for some or all rehabilitation services [35]. The participants in our study often had to travel significant distances to access these services, leading to increased financial burdens. This study primarily considered productivity losses for patient caregivers and a small group of individuals aged 60 and above who continued to work post-retirement (13.5% of all individuals aged 60 and above). In Iran, as in many countries [25], the typical retirement age is 60 or after 30 years of service. Global retirement ages vary, with Libya having the highest at 70 and Sri Lanka the lowest at 55 [25]. Notably, a portion of the elderly population in Iran continues to work due to financial constraints [36]. Despite accounting for productivity losses among working elders, the proportion of indirect costs, particularly those related to absenteeism, was smaller than in other economic burden studies. For instance, indirect costs accounted for approximately 10% of the total costs in Poland and 15% in Brazil [19].

The results indicate that the total costs of CVDs for the elderly in 2020 amounted to US$ 1.8 billion, representing 1.27% of the GDP and 21.93% of total health expenditure in Iran (as of 2021). Additionally, the average cost per individual with CVDs was estimated at US$ 446.2, constituting 26.33% of GDP per capita in 2021. This underscores the significant public health and economic challenge CVDs present for Iran, particularly for its aging population. Similar findings have been reported in various countries; for example, the percentage of GDP associated with CVDs was 1.78% in Serbia [37], 2.8% in Russia [38], 1.89% in Poland [18], and 2% in the European Union countries [39]. Given the substantial costs associated with CVDs, it is not surprising that they consume a significant portion of Iran's GDP and health expenditure, potentially limiting resources available for addressing other health issues. This situation may exacerbate the challenges faced by patients who cannot afford out-of-pocket medical expenses, leading to a broader cost-of-living crisis.

According to the GBD Study 2019, the age-standardized prevalence of CVDs in Iran was 9,117.9 cases per 100,000 people, surpassing the global average of 6,459.6 cases per 100,000 people [2]. However, the prevalence of CVDs varies significantly by age, with the highest rates

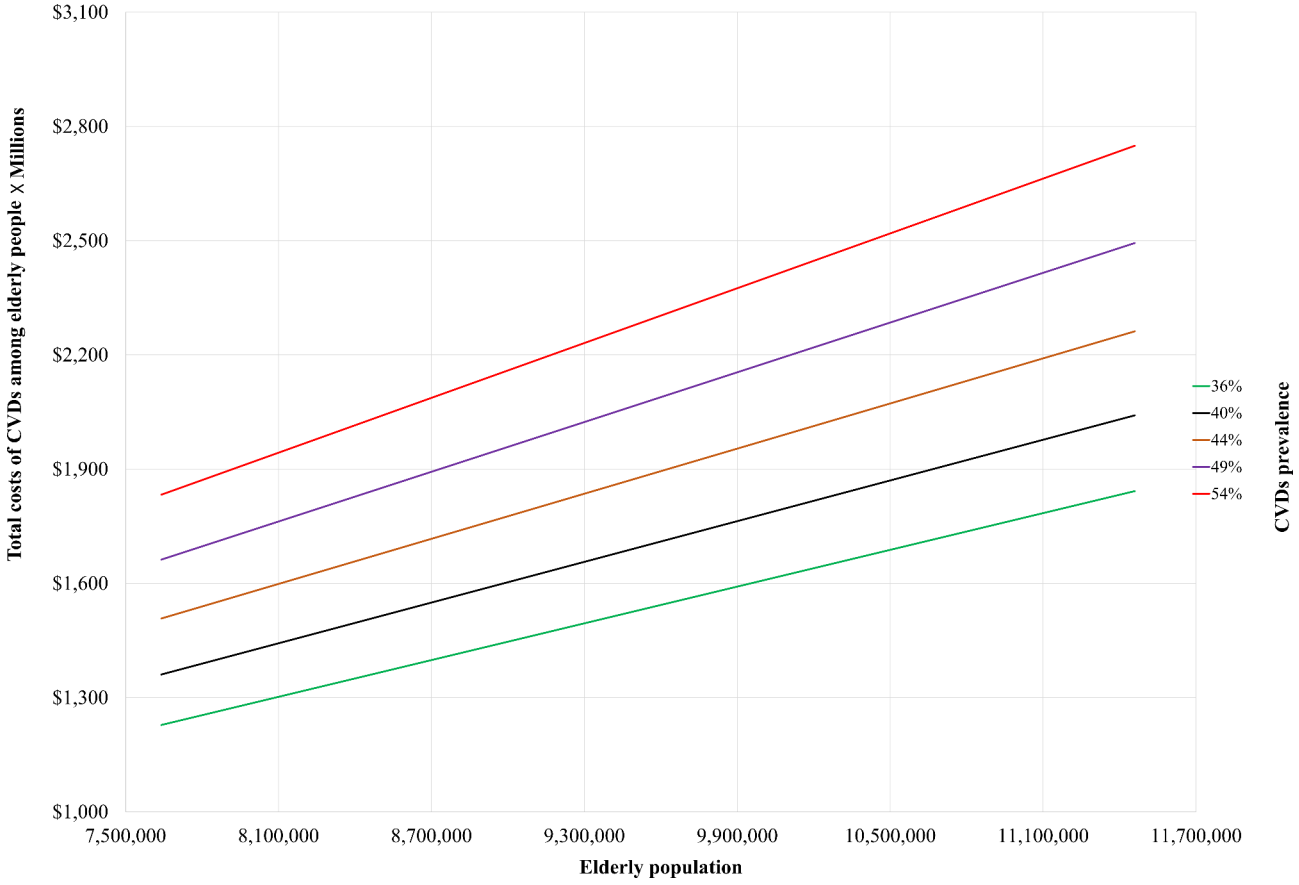

Fig. 2 Two-way sensitivity analysis on CVDs prevalence rate and elderly population size

among the elderly population (aged 60 and above) and the lowest among younger individuals (under 50 years). A study by Saki et al. (2022) reported a prevalence of 22.5% for individuals under 55 and 52% for those over 55 in Iran [11]. These data emphasize the substantial impact of the aging population on CVDs management policies. As people age, their likelihood of developing CVDs increases, leading to greater healthcare utilization and a significant economic burden on the health system.

The sensitivity analysis indicated that rehabilitation and hospital stay costs are significant factors affecting the average total cost of CVDs, although their overall impact is relatively small, accounting for less than 9% of the total average cost. Additionally, findings from the two-way sensitivity analysis demonstrated that a 20% change in both the prevalence of CVDs and the population size of individuals aged 60 and above could lead to significant cost fluctuations ranging from −35 to 46%.

Predictions regarding the economic burden of CVDs among individuals aged 60 and above in Iran suggest that by 2030, total costs are expected to rise 11-fold, reaching approximately US$ 21 billion. This trend underscores the urgent need for implementing effective and cost-effective interventions to prevent the onset of CVDs among middle-aged and younger populations, who are at risk of developing these conditions in the future, thereby mitigating associated costs. Proposed interventions include promoting physical activity, moderating alcohol intake [40], reducing salt consumption [41], and clinically managing hypertension [42], diabetes [43], and dyslipidemia [44].

Our data can guide CVD management policies by identifying areas for cost reduction, such as rehabilitation programs, making clinical care more affordable for patients and enabling policymakers to allocate resources more efficiently. Furthermore, implementing preventive strategies, including hypertension and diabetes management and expanding health insurance coverage for elderly patients, can significantly diminish the long-term economic burden of CVDs.

This study has several limitations. Firstly, we did not differentiate between types of CVDs, such as CAD and ischemic heart diseases, which may incur different costs. Consequently, our results may under- or over-estimate the economic burden of specific CVDs among Iran's elderly population. Secondly, our data were collected exclusively from one city in Iran, encompassing various sources, including retrospective hospital records and

Table 3 Prediction of the forthcoming economic burden of CVDs among the population aged 60 years and above in 2030

Variable	Value	Source
Population aged 60 and above in Iran in 2030	13,260,000	Calculated using data from United Nations Population [24]
Prevalence of CVDs among individuals aged 60 and above in Iran in 2030	0.483	Calculated using data from GBD [2]
Healthcare Inflation Index in Iran in 2030	0.22	Calculated using the data from Statistical Centre of Iran [29]
General Inflation Index in Iran in 2030	0.23	Calculated using the data from Statistical Centre of Iran [29]
Direct medical costs of CVDs per patient in Iran in 2020	US$ 404.3	Current study
Direct non-medical costs and indirect costs of CVDs per patient in Iran in 2020	US$ 41.9	Current study
Total costs of CVDs per patient in Iran in 2020	US$ 446.2	Current study
Total costs of CVDs per patient in Iran in 2030	US$ 3,285.2	Calculated
Total costs of CVDs for the population aged 60 and above in Iran in 2030	US$ 21,040,423,581.4	Calculated

face-to-face interviews. Despite this geographical limitation, the city's extensive range of services and accessibility for nearby residents strengthen its representativeness of Iran's healthcare landscape. This representation may alleviate concerns regarding the generalizability and applicability of our findings. Thirdly, our analysis did not account for presenteeism when calculating productivity loss. Additionally, potential recall biases could arise from interviews conducted with companions of the elderly people, despite our efforts to ensure that we interviewed those most knowledgeable about the elder's health and care. To address these limitations, we performed sensitivity analyses to assess the impact of different cost components on the average and total costs of CVDs.

Conclusions

This study demonstrates that CVDs among the elderly impose a significant financial burden on Iran's health system and society. The majority of these costs stem from direct medical expenses, including rehabilitation and hospitalization. Our data also indicate that CVDs costs constitute a considerable portion of health expenditure per capita and GDP per capita, suggesting reduced funding for other health issues. Given the high costs associated with CVDs, there is an urgent need for effective and cost-effective interventions to prevent their onset among middle-aged and younger populations. Furthermore, regular monitoring of individuals and investment in prevention programs can substantially mitigate these high costs. The projected increase in total costs by 2030 further underscores this necessity. These data can inform health policy decisions and resource allocation for CVDs management in Iran, highlighting the importance of increasing subsidies for affected patients.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-024-11808-0.

Supplementary Material 1.

Supplementary Material 2.

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Authors' contributions

Conceptualization: Mohammad Tasavon Gholamhoseini, Vahid Yazdi-Feyzabadi, Reza Goudarzi; Data Collection: Mohammad Tasavon Gholamhoseini, Sepideh Arjomand Kermani; Formal analysis: Mohammad Tasavon Gholamhoseini, Sepideh Arjomand Kermani, Vahid Yazdi-Feyzabadi, Reza Goudarzi; Visualization: Mohammad Tasavon Gholamhoseini, Sepideh Arjomand Kermani; Writing - Original Draft: Mohammad Tasavon Gholamhoseini; Writing - Review & Editing: all authors.

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Data availability

The datasets utilized and/or examined in the present study can be obtained from the corresponding author upon a reasonable request.

Declarations

Ethics approval and consent to participate

This study received ethical approval (IR.KMU.REC.1401.191) from the ethical committee of Kerman University of Medical Sciences. All participants provided informed consent prior to participating in the interview, and received a comprehensive explanation of the study's objectives. Participation was entirely voluntary, and individuals were free to withdraw at any time. All data were collected and analyzed with the utmost attention to accuracy and integrity.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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