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Economic Instability as A Primary Driver of Cardiovascular Disease Deaths in Pakistan

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ABSTRACT

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Globally, cardiovascular diseases (CVD) are the leading cause of mortality, mostly in developing countries like Pakistan. CVD is a major public health challenge in Pakistan, causing the highest number of deaths and putting substantial pressure on the healthcare system. The study examines the impact of various economic, environmental, and health-related factors on cardiovascular disease mortality rates in Pakistan. The time series data were collected over the last 23 years from the Pakistan Bureau of Statistics, the World Bank, and the Global Burden of Disease (GBD). A quantitative research approach was applied to see the relationship between population and CVD mortality rate, as well as the impact assessment was conducted using regression analysis. The trend analysis indicated that population growth is not the only factor to account for the changes in the death rates from CVD, as it has shown significant fluctuations over the years, pointing out that other factors could have contributed. Regression results revealed that CO₂ emissions, edible oil imports, and unemployment had a positive and statistically significant effect on the CVD mortality rate. While health expenditures, tobacco imports, and inflation showed an expected direct relationship but were statistically insignificant. Based on the findings, the study suggests stronger environmental regulation, reformed import policies for edible oil, and increased health expenditure may help in curbing the rising burden of mortalities caused by cardiovascular disease in Pakistan.

Introduction

Cardiovascular diseases (CVDs) have become the leading cause of death worldwide. According to estimates of the World Health Organization, about 19.8 million people died in 2022 due to CVD, accounting for 32 percent of all deaths worldwide. Out of all these fatalities, 85 percent occurred due to heart attacks and stroke (WHO, 2026), with the sharp rise seen mostly in Asian countries (Zhang et al., 2025). Historically considered an issue of developed and high-income Western countries, the landscape has changed drastically over the last several decades (Pearson, 1999; Joshi et al., 2008). Currently, more than 75 percent of CVD mortalities occur in less developed and developing countries worldwide (Siddiqi et al., 2025; Roth et al., 2020).

Within developing countries, Pakistan is facing several crises, along with rising cardiovascular diseases. Tarar et al. (2020) found CVD to be a leading cause of death in Pakistan, making up about 29 percent of all national mortalities annually. The

annual CVD death rate has sharply increased from about 170,000 in 1990 to 340,000 in 2019 (Siddiqi et al., 2025). The CVD annual mortality and absolute DALY burden in Pakistan increased approximately two-fold from 1990 to 2019, whereas globally it increased by approximately 1.5 times for the same time period (Mansoor et al., 2025).

The 2019 report of the Global Burden of Diseases, Pakistan's age-standardized incidence of CVDs at 918.18 cases per 100,000 population, and its CVD death rate at 357.88 per 1,00,000 population, were about 34 percent and 49 percent higher than the global average, respectively (Samad & Hanif, 2023). In Pakistan, over 32 million people suffer from heart disease, with more than 40 million having hypertension and 18 million having hypercholesterolemia (Tarar et al., 2020). The fiscal year 2025-26 budget of Pakistan has allocated Rs. 46.32 billion for the health sector, consisting Rs. 31.98 billion for current operations and Rs. 14.34 billion for development projects. This shows a reduction of about 16 percent in the current health budget from last year's allocation, reflecting a shift in the government's policy (GoP, 2025).

There are several interconnected risk factors, increasing the susceptibility of Pakistan to Cardiovascular diseases. The primary risk factors include unhealthy dietary habits, reduced physical activity, and increased tobacco consumption. Along with these environmental factors, specifically air pollution also plays a significant role (WHO, 2025).

Impacts of Health Expenditures

Pakistan's CVD burden is further worsened by its limited expenditures on the health system, such as a lack of preventive strategies, inadequate infrastructure, and disparities in healthcare access between urban/ rural people. Pakistan has the lowest public sector spending in healthcare as compared to other developing countries. The total health expenditures were found to be only 3.2 percent of the overall GDP, and below the threshold of 5 percent mentioned by the World Health Organization (Khalid & Qayyum, 2021). Beyond the direct costs attributable to CVDs, patients and society also incur indirect costs like lost economic productivity resulting from morbidity and premature mortality, estimated at \$156 billion in 2019 (Kazi et al., 2024). The available literature found that per capita expenditures significantly impact health outcomes (Khan et al., 2025), with a 1 percent increase in health expenditures resulting in a decline of 6.31 percent in CVD mortalities per 100,000 people (Pswarai et al., 2018).

On the other hand, Pakistan has the highest out-of-pocket (OOP) expenditures, about 65 percent of total health expenditures, leading to increased financial stress on households (Rizvi, 2023). According to SECP (2025), 52.6 percent of private expenditures have been noted in Pakistan, with 89 percent of that being the households' out-of-pocket spending.

Impacts of Edible Oil Imports

Edible oil is considered one of the crucial ingredients used for cooking and preparing food. In Pakistani households, oil and ghee are widely used, exposing people to unsaturated and hydrogenated fats associated with CVD risks. The per capita consumption of edible oil has increased about 17.3 percent on a year on year basis, with the per capita consumption estimated to be about 20.3Kg/person, ranking the 8th largest edible oil consumer country (Khan & Bhatti, 2026).

In 2025, about 3.07 million tonnes of edible oil, including imports of 2.58 million tonnes (worth Rs. 764.90 billion), were available to meet the domestic demand. This highlights Pakistan's continued dependence on imports, with over the 79 percent of the demand being met by external sources (GoP, 2025). From fiscal year 2023 to 2025, Pakistan has imported 75.3 percent of edible oil to meet the domestic demand, whereas the rest was fulfilled by local production (Khan & Bhatti, 2026).

It has been seen that a higher intake of fatty acids is associated with elevated cholesterol, a major factor causing CVD. According to a report by the WHO (2002), palm oil consumption has a significant impact on rising CVD risk, mostly in developing countries. The same findings were also observed by Ismail et al. (2018) and Pradhan (2025), that higher edible oil consumption leads to a higher CVD mortality rate, specifically in developing nations.

Impacts of Tobacco

Tobacco in any form is a major cause of non-communicable diseases (NCDs) such as lung cancer and cardiovascular diseases, responsible for about 58 percent of overall deaths in Pakistan (WHO, 2018; Nayab et al., 2021). Pakistan, globally the 5th most populous country, has reported that 45 percent of its households use tobacco. A total of 23.9 million adults, with 31.8 percent men and 5.8 percent women, consume tobacco in Pakistan, with a higher prevalence in rural areas 13.9 percent compared to urban areas about 10.0 percent (PBS & WHO, 2026).

It has major impacts on the health and financial conditions in Pakistan. The World Health Organization (2026) has reported that increased tobacco consumption in Pakistan is costing 164,000 lives, with an economic loss of about PKR 1800 billion (approximately US\$6.6 billion). Major diseases attributed to tobacco consumption cost around PKR 437.76 billion approx. US\$

2.74 billion (Nayab et al., 2021), and 71 percent of the overall economic and health expenditures. Tobacco costs around 1.6 percent of the GDP, while these three diseases alone make up around 1.15 percent of the total national GDP (Memon et al., 2024).

Impacts of CO₂

Over the past decade, deaths due to heart disease caused by air pollution have increased by about 27 percent in some parts of the world. Climate change is a major source of infectious diseases (Soomro et al., 2025), similarly the Global Burden of Disease has also reported that air pollution is the 4th largest risk factor of CVD (Roth et al., 2020), causing around 7 million premature fatalities due to CVD and respiratory diseases, and has been on the rise over the last few decades (World Heart Federation, 2024; Ismail et al., 2025). It can affect the cardiovascular health of people in several ways, including systemic inflammation, inhalation, and changes in vascular function. In this era of rapid industrialization, the quality of the air has been significantly impacted by the toxins released into the air, leading to increased mortality due to respiratory and cardiovascular diseases (Jiang et al., 2023).

Pakistan emitted about 2.9 tonnes of CO₂ per capita in 2025, expected to further increase up to 5.4 tonnes by 2050 (Iftikhar et al., 2024). Air pollution is a significant risk factor for causing cardiovascular diseases in Pakistan, where exposure to pollutants like PM_{2.5} from industrial emissions and vehicles is a risk factor for diseases like stroke and ischemic heart disease (Soomro, 2024).

Impacts of Unemployment

In the last few decades, many studies have been conducted to explore the relationship between unemployment and poor health, although the exact ways in which unemployment affects health problems are still not fully understood. Mostly, people in socially lower positions engage themselves in unhealthy habits with long-term exposure to stressful conditions, increasing the risks of CVD (Vodopivec et al., 2021).

The study conducted by Meneton et al. (2015) found that increasing unemployment was associated with poor cardiovascular health, leading to mortalities mostly in the middle-aged population. Roelfs et al. (2011); Brenner (2016); Karanikolos et al. (2016); Nghiem et al. (2020); Sanchez Rico et al. (2023), in their studies found that rising unemployment causes an increased CVD rate. Whereas Vodopivec et al. (2021) found that unemployment increases the hazard of cardiovascular diseases, along with other major diseases like diabetes and mental health disorders. The available published evidence on the association between unemployment and cardiovascular disease mortality in Pakistan is limited and has not been directly studied, to the best of the authors' knowledge, creating a substantial gap in health economics research in the country.

Impacts of Inflation

According to the World Bank (2024), inflation reduces households' purchasing power, which makes people choose between healthcare expenses and other necessities of life. According to the Pakistan Bureau of Statistics (2024), the healthcare component of the consumer price index (CPI) has risen by more than 21 percent during 2023 and 2024. Medical expenses have been increasing over time, with hospital costs increasing to 0.36 percent in January and by 13.09 percent compared to last year, further exacerbating the cost pressures on lower-income families using hospital services (PBS, 2025).

One of the major causes of the rise in Healthcare Inflation in Pakistan is increasing reliance on imports and a shortfall in the government's financial support, along with the lack of a regulatory mechanism in private sector pricing (Ahmed & Raza, 2023). A study conducted by Malik and Turner (2024), found that rising inflation is associated with a delay in medical consultations, decreased preventive measures, and increased charges for untreated chronic illness. About 48.4 percent of individuals reduced their visits to doctors, 40.9 percent reduced prescriptions, and 57.8 percent postponed hospitalizations because of the high cost of medical treatment (Kazmi et al., 2025). However, no substantial published literature was found that directly investigates the independent effect of inflation on cardiovascular disease outcomes in Pakistan, highlighting a critical area for future research.

Research Gap and Objectives

The existing literature has extensively documented the role of traditional risk factors such as tobacco use, unhealthy dietary habits, air pollution, and inadequate healthcare access in increasing the burden of cardiovascular diseases (CVDs). However, limited empirical evidence exists on the direct effects of unemployment and inflation on CVD mortality in Pakistan. Furthermore, no comprehensive study has examined the combined impact of health expenditure, edible oil imports, tobacco imports, CO₂ emissions, unemployment, and inflation on CVD mortality. This gap hinders a full understanding of how these factors influence cardiovascular disease mortality in the country. Thus, this study aims to examine the effects of various

macro-level variables, such as edible oil imports, tobacco consumption, health expenditures, inflation, unemployment, and CO₂ emissions, on increasing CVD mortality rate in Pakistan and provide evidence-based policy recommendations.

Significance of study

The present study will contribute to the existing literature by providing an in-depth examination of the economic, environmental, and health-related factors influencing cardiovascular disease in Pakistan. The previous literature was mostly limited to behavioral and clinical risk factors, whereas this study includes wider macroeconomic factors, such as the unemployment rate and inflation, which have not been extensively explored in the Pakistani context. The findings will be valuable for policymakers, healthcare planners, and public health practitioners in designing effective interventions aimed at reducing cardiovascular disease mortality.

Materials and methods

Research Design: To achieve the study's aim, a quantitative research approach has been employed. Analysis was conducted in two stages: first, a trend analysis was conducted to examine the relationship between cardiovascular disease mortality rates and the population of Pakistan. Second, a multiple-input regression analysis was conducted to estimate the impact of independent variables on the CVD mortality rate.

Data Collection: An annual time series of data spanning from 2001 to 2023 was collected from different national and international databases. Data on the Cardiovascular Disease mortality rate (per 100,000 people) were obtained from the Global Burden of Disease Report published by the Institute for Health Metrics and Evaluation (IHME, 2025). It is the most reliable and methodologically strong source for providing yearly estimates of Pakistan's disease burden.

Additionally, data on other variables were collected from various sources. The independent variables included edible oil imports, tobacco imports, health expenditures (percent of GDP), unemployment, inflation, and CO₂ emissions. Zhang et al. (2025) Used three different criteria in their study to investigate the CVD burden in Asia. First, the behavioral factors (diet, tobacco consumption, and less physical activity), second, the environmental factors (air pollution and unfavorable temperatures), and lastly, the metabolic factors (high blood pressure, body mass index, and kidney dysfunction). Thus, the Table-1 below shows the sources of data from which the data were obtained for the above mentioned variables.

Table 1: Description and sources of study variables:

Variable Name	Unit	Source
CVD mortality rate	per 100,000 people	GBD 2025, IHME
Health Expenditures	percent of GDP	World Bank
Edible Oil Imports	ooo tonnes	Pakistan Bureau of Statistics
Tobacco Imports	Kg	Pakistan Bureau of Statistics
CO ₂ Emissions	Mt	World Bank
Unemployment	percent	Pakistan Bureau of Statistics
Inflation	percent	Pakistan Bureau of Statistics

Model Specification: As the study is based on time series data, a natural logarithm was applied to improve consistency and normalize the data. The estimated, log-transformed regression model is specified as follows:

$$\ln(CVD_t) = \beta_0 + \beta_1 \ln(H.Exp) + \beta_2 \ln(Oil Imports) + \beta_3 \ln(Tobacco Imports) + \beta_4 \ln(CO_2) + \beta_5 \ln(Unemployment) + \beta_6 \ln(Inflation) + \mu_t$$

Here, the t represents the year, β_0 is the intercept of the model, and from β_1 to β_6 are the coefficients of regression. Coefficients show the effects of each independent variable on the CVD rate, whereas μ_t is the error term to capture the left-out or unobserved variations. The analysis was performed using the ToolPak data analysis tool of Microsoft Office. Overall

model fit was evaluated using the coefficient of determination (R^2), adjusted R^2 , and the overall F-statistic.

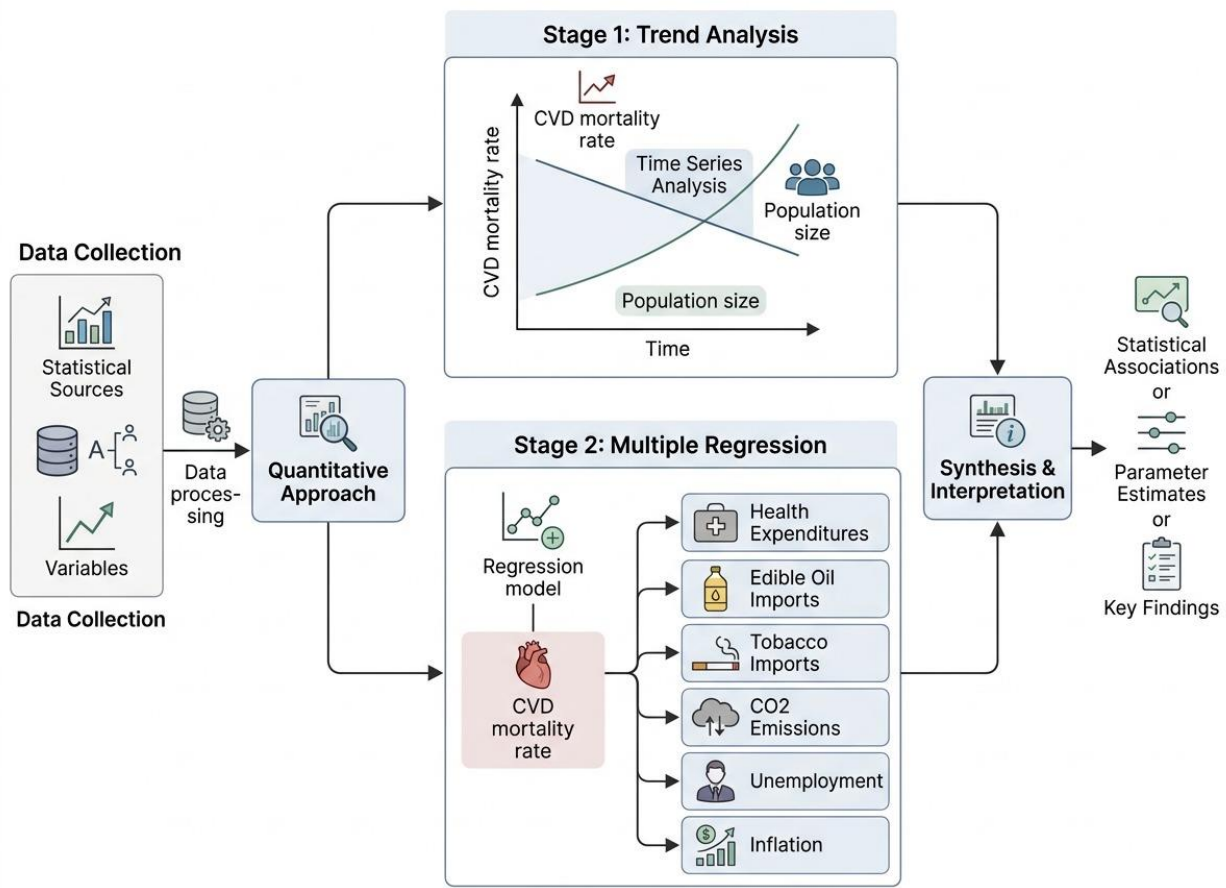


Figure 1: Schematic diagram of analytical framework

The above given Figure 1 shows the detailed pictorial representation of the methodology used in the study.

Results and Discussions

Trend Analysis: Population and Cardiovascular Disease Rate (CVD)

Figure 2 depicts a trend between Pakistan's population and the CVD mortality rate. It shows that over the past 23 years, the population has shown a continuously rising trend. On the other hand, deaths due to cardiovascular diseases have also seen an upward trend, but with major fluctuations. The graph reveals that population growth alone does not explain the variations in CVD mortality. Even though the population has increased over time, the mortality rate due to cardiovascular diseases has not increased at the same rate like population. These findings indicate that other factors, like economic, environmental, or health-related factors, might have a role in increasing CVD-related mortality.

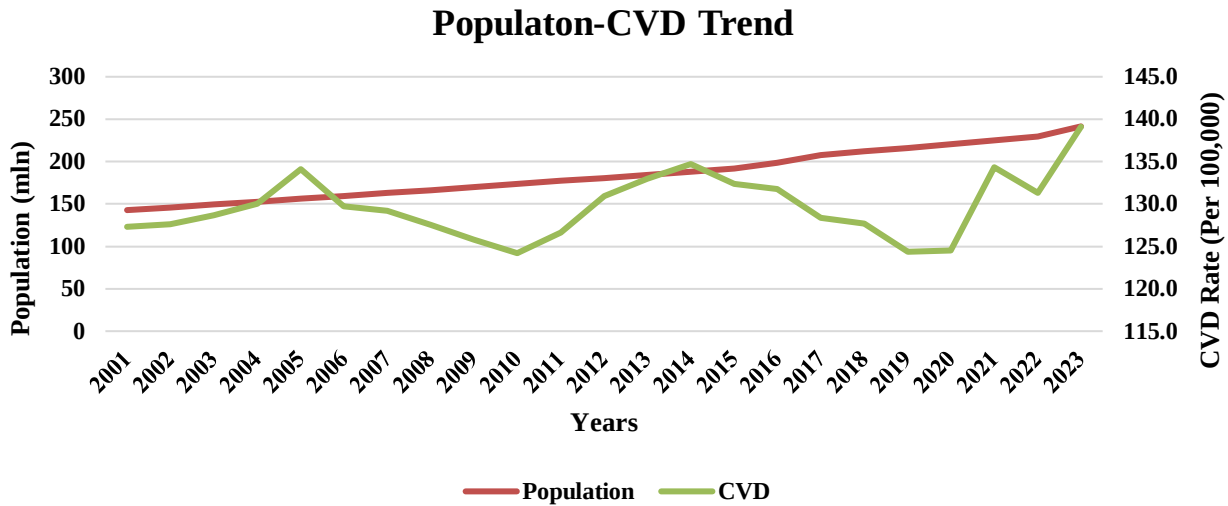


Figure 2: Pakistan Population and CVD Mortality Rate Trend, 2001–2023

Therefore, to confirm this, a robust regression was employed to analyze and identify the impacts of various variables on CVD-related mortality rate.

Regression Results

Overall Model Fit: Table 2 below shows the overall strong performance of the regression model. The value of R-square indicates that approximately 97 percent of the variation in the cardiovascular disease mortality rate was explained by the independent variables of the study. The Adjusted R^2 value of 0.965 further reinforced the model's strong explanatory capability after accounting for the number of explanatory variables.

Table 2: Overall Model Fit Statistics

Statistics	Value	Statistics	Value
Multiple R	0.987	F-statistics	101.490
R Square	0.974	Prob (F-stat)	7.93E-12
Adjusted R^2	0.964	Observations (n)	23
Standard Error	0.003	Regression df	6

Independent Variables Results: Table 3 presents the regression result with estimated coefficients, standard error, t-statistics, and p-values for all the variables of the study.

Table 3: Regression Result

Variable	Coefficient	Std. Error	P-value
Intercept	5.4307	0.0216	3.29E-30
Health Exp. (ln)	-0.00518	0.01606	0.75127
Edible Oil Imp. (ln)	0.02374	0.00679	0.00298
Tobacco Imp. (ln)	0.00072	0.00072	0.33372
CO ₂ (ln)	0.04721	0.01246	0.00161
Unemployment (ln)	0.00306	0.00094	0.0048
Inflation (ln)	-0.00021	0.00136	0.87935

Impact of Health Expenditures on Cardiovascular Disease Mortality Rate: The estimated coefficient of the health expenditures showed a negative relationship between expenditures and CVD rates. According to the findings, a 1 percent increase in health expenditures results in a decrease of about 0.0051 percent in CVD mortality, similar to findings by Magsi et al. (2021). The results confirm the theoretical expectations that increased spending on the healthcare system is linked to a decrease in cardiovascular diseases.

However, the results are statistically insignificant as the p-value stands at 0.751, stating no precise relationship between health expenditures and CVD mortality rates in Pakistan. This reflects Pakistan's health budget, which has always been

historically low. It spends only 5 percent of its total government expenditure, making up only 1 percent of its GDP and US\$16 per capita on primary healthcare (WHO, 2023; 2025).

Impact of Edible Oil Imports on Cardiovascular Disease Mortality Rate: The results indicate that the coefficient for imports of edible oil was both positive and statistically significant. A 1 percent increase in imports of edible oil causes a 0.023 percent rise in the CVD mortality rate, confirming that higher imports significantly increase the number of mortalities caused by cardiovascular disease.

The increasing consumption of edible oils filled with high in fat and the changing dietary patterns are contributing to rising cholesterol, resulting in an increase in cardiovascular diseases in Pakistan. The United States Department of Agriculture has forecasted that Pakistan's edible oil consumption to reach 5.23 million tons by 2027, with a 3 percent increase from 2026. The continuous incline is seen mainly due to rising demand at household and commercial levels (USDA, 2026).

Impact of Tobacco Imports on Cardiovascular Disease Mortality Rate: Results demonstrated a direct relation between the tobacco imports and CVD mortality rates. The analysis revealed that rising imports lead to a 0.00072 percent increase in mortality rates, suggesting that this positive relationship is theoretically correct but statistically insignificant. This insignificance mostly reflects limitations and volatilities in data quality rather than an actual absence of the effects. Khan et al. (2025) have found that smoking has a profound role in elevating CVD in Pakistan, with smokers having a high chance of getting affected, and it needs to be addressed by cardiologists.

Impact of Carbon Dioxide Emissions on Cardiovascular Disease Mortality Rate: The results of the CO₂ emissions analysis showed a positive and significant relationship, with an estimated coefficient explaining 0.047 percent of the variation in the variable. These findings indicate that the worsening quality of the environment and increasing pollution are major contributors to cardiovascular diseases. CO₂ emissions were taken as an aggregate-level proxy for overall pollution-related combustion released from various sectors of Pakistan. The major sectors contributing to rising pollution include Energy, Industry, Transport, Agriculture, etc. According to Roser (2021), around 6.7 million deaths occurred in 2019, of which more than 50 percent were associated with CVD. Whereas the experts claim that the number may be higher, as the CVD is more severely impacted by pollution (World Health Federation, 2024;).

Impact of Unemployment on Cardiovascular Disease Mortality Rate: The increasing unemployment trend in Pakistan has always shown severe effects on public health. The study results found that a 1 percent rise in unemployment is associated with a 0.003 percent rise in CVD-caused mortalities, with a statistically significant P-value of 0.005 percent. The magnitude might appear low, but it must be taken seriously in the case of Pakistan due to a significant increase in its unemployment rate. Higher unemployment raises numerous concerns, including financial insecurity, poor living standards, stress, anxiety, and reduced health expenditures. These factors ultimately contribute to many psychological diseases and also severely affect the cardiovascular health of the public. Similar results were mentioned by Meneton et al. (2015) and Nghiem et al. (2020), that both fatal and non-fatal cardiovascular risks were higher for the unemployed middle-aged population, as compared to the employed.

Impact of Inflation on Cardiovascular Disease Mortality Rate: Theoretically, increasing inflation should negatively affect human health through various factors. The factors can be inadequate living standards, decreased purchasing power, food insecurity, and restricting people's power to access better health facilities. But the regression results showed a negative and insignificant association of inflation and CVD mortality rate in Pakistan.

According to the findings, as inflation increases, CVD mortalities decrease by approximately 0.00021 percent. In contrast, previous studies have reported that rising inflation severely affects public health by reducing access to nutritious food and better health facilities (Akram et al., 2025; PBS, 2025). However, no literature was explicitly found mentioning the direct impact of inflation on cardiovascular mortalities.

Conclusion and suggestions

The study has analyzed the impact of various factors on the CVD mortality rate in Pakistan. The study has concluded that increasing CO₂ emissions, edible oil imports, and rising unemployment significantly contribute to the cardiovascular disease-related mortality burden in Pakistan. In contrast, health expenditure, tobacco imports, and inflation did not exhibit statistically significant effects; however, their estimated coefficients were broadly in line with theoretical expectations.

Based on the findings, the study suggests taking strict actions and implementing policies to reduce CVD mortalities in Pakistan. Improved environmental conditions should be promoted by using cleaner and renewable energy alternatives to reduce CO₂ emissions. The government should make suitable import policies for edible oil to reduce its consumption and promote healthy diet choices. Furthermore, more employment opportunities must be generated, along with creating

unemployment support programs, to mitigate the adverse impacts of joblessness on health. At last, the Govt of Pakistan should increase its health budget to ensure access to prevention and treatment.

Finding

No financial funding was received for conducting this research.

Conflict of interest

The authors declare no conflict of interest.

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