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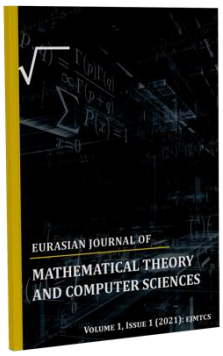

UTILIZING PREDICTION AND MONITORING TECHNIQUES WITH CORRELATION AND REGRESSION MODELS FOR THE ANALYSIS AND MANAGEMENT OF VASCULAR DISEASES

Dilafruz Nurjabova
Phd student of Tashkent University of Information Technologies,
100084, Tashkent, Uzbekistan
dilyaranur1986@gmail.com
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ABSTRACT

The increasing prevalence of vascular diseases poses significant challenges to global healthcare systems. Effective prediction and monitoring are essential for early diagnosis, personalized treatment, and improved patient outcomes. This study explores the application of prediction and monitoring techniques using correlation and regression models to analyze and manage vascular diseases. Correlation analysis identifies the relationships between key risk factors—such as age, obesity, hypertension, and lifestyle habits—and the onset of vascular conditions. Regression models, including linear, logistic, and multivariate approaches, predict disease progression, treatment efficacy, and mortality rates.

The research leverages patient data to build predictive models that assess risk levels and monitor disease trends over time. Advanced tools, such as machine learning algorithms and time-series regression, enhance accuracy and provide actionable insights. These methods enable healthcare professionals to allocate resources effectively, design targeted interventions, and reduce the burden of vascular diseases on populations.

The findings emphasize the importance of integrating predictive analytics into vascular disease management strategies, offering a scalable and data-driven framework to improve patient care and public health outcomes.

I. INTRODUCTION

According to the World Health Organization (who), 17.5 million people die each year due to cardiovascular disease. More than 75% of these deaths fall in low-and middle-income countries. According to these statistics, early heart attacks and cardiovascular diseases can be prevented at the level of 80%. It is very expensive to treat and correctly diagnose cardiovascular diseases. In Uzbekistan, coronarography, the "Golden diagnostic method", is widely used at the Scientific Research Institute of Cardiology. However, in the treatment of

cardiovascular diseases, atherosclerotic vascular problems continue, so doctors need software. Vascular diseases are one of the most pressing problems in our region today, which determines the relevance of its high mortality rate and increased economic load. Medical, epidemiological and Social Research is essential to study this topic and develop ways to eliminate it. Therefore, scientific research related to vascular diseases and the improvement of medical practice will be of fundamental importance in the further development of the region's health system.

Alexander Nikolaevich Kryukov, one of the founders of the field of Cardiology in Uzbekistan, is known as the founder of the first scientific therapeutic school in Uzbekistan. Their students were the first researchers in cardiology in the 1930s. Alexander Kryukov was a representative of the Moscow School of therapists, an academician, the founder of Hematology in the country, and also made a significant contribution to the development of emergency therapy and spas. At the first stage, the founders of therapeutic schools in Uzbekistan (M.N. Slonim, I.A. Kassirsky) studied the physics and pathology of the cardiovascular system in hot climates. Their work was particularly focused on the study of hypertension, ischemic heart disease, and other heart diseases. Between 1976 and 2002, at the second stage of Cardiology in Uzbekistan, The Scientific Research Institute of Cardiology of Uzbekistan was established. It conducted scientific research on the treatment and diagnosis of cardiovascular diseases based on the experiences of the institute, the World Health Organization and international experts. Another important stage in the development of Cardiology in Uzbekistan began after the establishment of the Scientific Department of Arterial Hypertension in 2006. In this section, genetic studies and molecular-genetic approaches have been developed, and this is of great importance in the Prevention of arterial hypertension. The Scientific Research Institute of Cardiology of Uzbekistan currently shows its success not only within the country, but also internationally. For example, in 2019, in cooperation with the European Society of Cardiology, he was involved in the development of clinical recommendations on cardiology. Also in 2018, a new high-tech Cardiological support center was opened, and in 2019, with the opening of a new administrative Corps, a new phase in the treatment of cardiovascular diseases began in Uzbekistan.These programs and scientific work are aimed at improving the early diagnosis and treatment of cardiovascular diseases, and scientific work in the field of Cardiology continues to develop in Uzbekistan, and this field is leading to a wide range of medical achievements in our country. In 2006, in the Scientific Department of Arterial Hypertension (head – professor E. M. Eliseeva, now-Hamidullaeva G.A.) a molecular-genetic research group was established. On the basis of these studies, more than 40 genetic polymorphisms were studied, and for the first time in Uzbekistan A.G. A DNA Bank of patients with (Arterial hypertension) was created. This bank was the basis for the creation of a genetic "passport", which it then used to determine the risk of hypertension.

In addition, since 2006, the arrhythmia laboratory (head – professor R.D. Kurbanov, the main Scientific Officer-professor N.U. Zakirov) has conducted research on the detection and treatment of arrhythmias in various clinical forms. It has also been found to have high efficacy in the treatment of arrhythmias, such as antiarrhythmic drugs such as propanorm, allapinin, and aksaritmin. In 2007, he was awarded the first degree professor of the State prize of the Republic of Uzbekistan in the field of Science and technology.D. Kurbanov and academician of

the Scientific Institute of chemical plants of the Republic of Uzbekistan Yunusov S.Yu. in conjunction with," Alapinin " was a berilgn for the production and introduction into clinical practice of a new type of drug. It was used to treat arrhythmias. Scientific achievements and innovations in the field of Cardiology in Uzbekistan are recognized globally, and research in this field is important for achieving a high level in the medicine of our country as well as internationally. A number of regulatory documents, initiatives and services for the reform of the health system of Uzbekistan, prevention and treatment of cardiovascular diseases are provided and they are as follows:

1. Main regulatory documents:

- Decree of the president of the Republic of Uzbekistan of February 26, 2003 "on measures to further reform the Health System"No. 3214.
- Resolution No. 140 of the Cabinet of Ministers of March 17, 2003.

2. Improvement projects in the treatment of cardiovascular diseases:

- Initiatives carried out by the Republican Center for the development of medical education of the Ministry of health of Uzbekistan within the framework of the project" improving the Health System (Health-3)".
- A set of clinical protocols for cardiovascular diseases has been developed on the basis of Order No. 57 of the minister of health of the Republic of Uzbekistan, adopted on February 1, 2016.

3. The main purpose of cardialogical service:

- Providing qualified cardiac care at the level of international standards with the introduction of modern diagnostic and therapeutic methods.
- Expansion of preventive, early detection and effective treatment of cardiovascular diseases.
- Create favorable conditions for the population and provide the necessary resources.

4. Medical diagnostics and laboratory services:

• A number of important medical examinations are carried out at the Research Institute of Cardiology of Uzbekistan, including:

- Daily ECG monitoring.
- Test with physical loading (bicycle ergometry and treadmill).
- Ehocardiography (EhoKG), determination of cholesterol and its fractions, sugar profile and glycated hemoglobin levels.
- Platelet aggregation activity and endothelial function studies.

5. Complex diagnostics and treatment methods:

- under name Academic V.V. Vohidov in cooperation with the Traumatology Center, the following complex examination and treatment methods are carried out:

- Scintigraphy to assess the coronary circulation reserve of the coronarography and myocardium.
- Coronary angioplasty and stenting.

6. New regulatory documents:

- On January 26, 2022, the decree of the president of the Republic of Uzbekistan "on measures to improve the quality of prevention and treatment of cardiovascular diseases"was adopted PU-103. This decree sets out the following:

- Improve the quality of cardio services.
- Prevention of cardiovascular diseases and expansion of early detection.
- Improvement of applied medicine through the development of modern specialized Cardiological services.

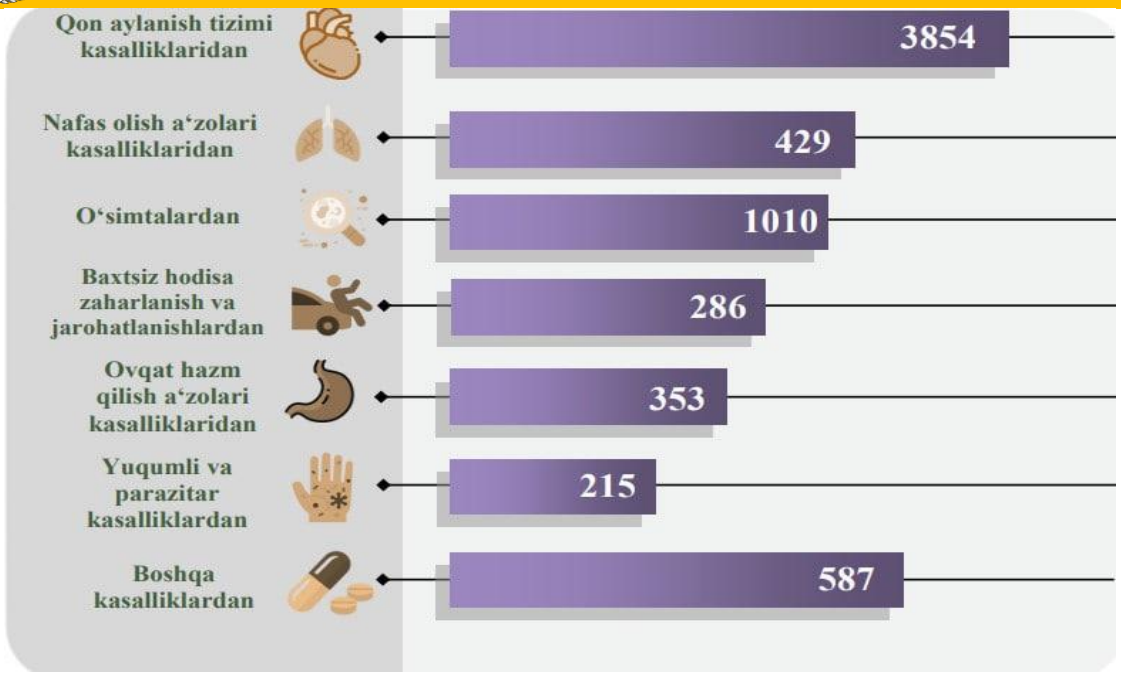
II. METHODS

Vascular diseases currently remain one of the pressing problems all over the world, in particular in the countries of Central Asia. The relevance of this topic is based on several factors, which can be explained as follows using scientific concepts and the language of scientific literature:

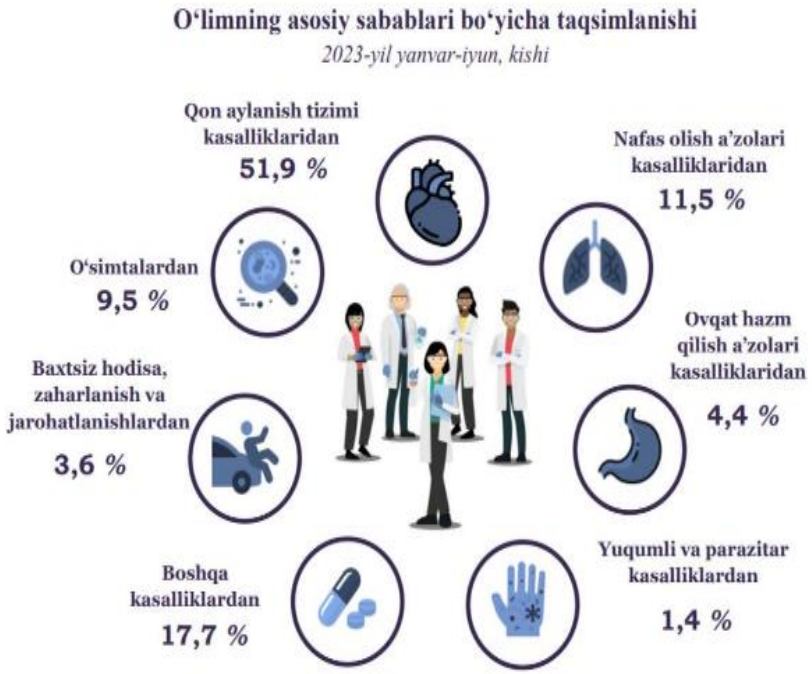
1. High mortality: vascular diseases (ischemic heart disease, arterial hypertension, etc.) account for 30-40% of the causes of death in the world. According to the World Health Organization (who), these diseases are noted as the most common cause of death in our region. [Global Burden of Disease Study (GBD), 2023]
2. Prevalence of risk factors: factors such as rational malnutrition, high blood pressure, obesity, smoking, and low physical activity significantly increase the risk of these diseases. These factors are common in the countries of Central Asia and stand before the health system as an urgent task. [Lancet Public Health Journal]
3. Socio-economic burden: vascular diseases cause not only an increase in the mortality rate, but also an increase in the economic burden. This results in a higher incidence rate among the working population, which reduces productivity and increases health care costs. [European Journal of Preventive Cardiology, 2022]
4. Limited regional health services: the lack of medical centers in Central Asia with advanced diagnostic and therapeutic methods limits the chances of detecting the disease at an early stage and effective treatment. [World Health Organization (WHO) Regional Office for Europe] This figure shows the distribution of the main causes of death from January to June 2023. According to statistics, the largest percentage indicator was caused by diseases of the circulatory system (51.9%).

Other causes include:

- Respiratory organ diseases-11.5%;
- Diseases of the digestive organs-4,4%;
- Infectious and parasitic diseases – 1,4%;
- Tumors-9.5%;
- Accidents, poisoning and injuries-3.6%;
- Other diseases-17.7%.



Pic.1. Distribution of major causes of death by January-June 2023(Uz Axa)



Pic. 2. The main causes of death in the first half of 2023 (Uz Axa)

This diagram describes the main causes of death and their quantitative distribution in the first half of 2023. This information is expressed as follows:

- Diseases of the circulatory system: leading with 3854 cases.
- Respiratory organ diseases: 429 cases.
- Tumors: 10-10 cases.
- Accident, poisoning and injuries: 286 cases.
- Diseases of the digestive organs: 353 cases.
- Infectious and parasitic diseases: 215 cases.
- Other diseases: 587 cases.

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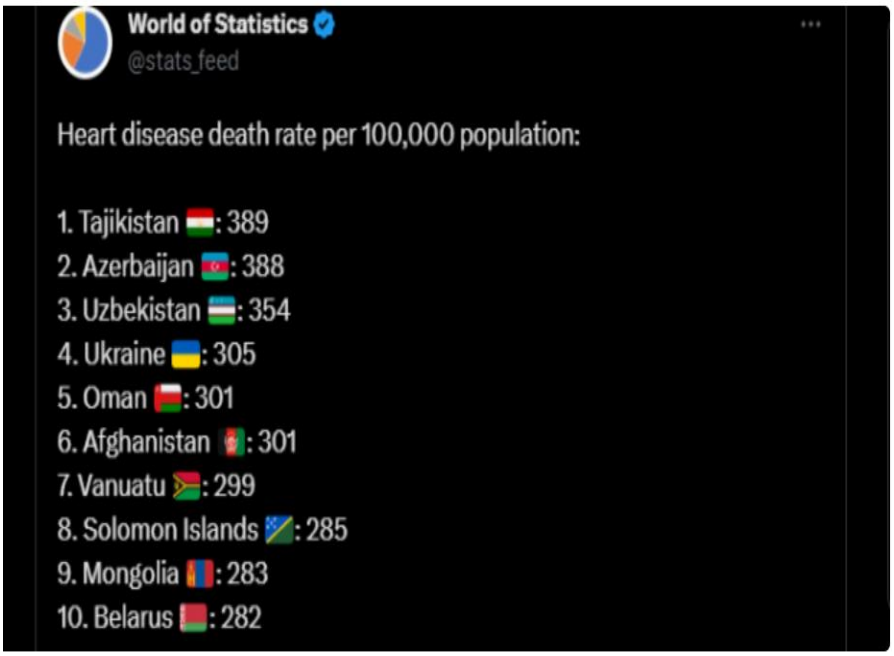
Uzbekistan has been among the top five countries in terms of cardiovascular mortality, according to world of Statistics ' latest Twitter data. This ranking focuses on the severity of heart and vascular disorders, including ischemic heart disease, cerebral vascular disease, rheumatic heart disease, and other related pathologies. Statistically, Tajikistan was the number one death toll, with 389 deaths per 100,000 residents. In second place is Azerbaijan (388 cases). Uzbekistan ranked third with 354 deaths per 100,000 residents. Notably, in 2022, there were 172.1 thousand cardiovascular deaths in Uzbekistan alone. This reaffirms how common cardiovascular diseases are in the country and the need to fight them [. https://upl.uz/obshestvo/34534-news.html, 23-06-2023, 17:09].



Pic.3. Uzbekistan is among the top five countries in terms of mortality associated with cardiovascular diseases. [https://upl.uz/obshestvo/34534-news.html, 23-06-2023, 17:09].

To be sure of this site, I actually came across the following statistics on this site:

Pic.4.In addition to cardiovascular diseases, it is important to pay attention to the main causes of death in Uzbekistan. Below is a general classification of the main causes of deaths, calculated for every 100,000 inhabitants.

Causes of death (TOP 50)

1. Cardiovascular diseases (ischemia of the heart, stroke, etc.
2. Respiratory diseases (pneumonia, chronic obstructive pulmonary diseases).
3. Diabetes and its complications.
4. Oncological diseases (cancer).
5. Injuries and accidents.
6. Infectious diseases (tuberculosis, hepatitis, etc.).
7. Diseases associated with hypertension and blood pressure.
8. Impaired cerebral circulation.
9. Heart failure.
10. Diseases of the digestive system (ulcers and cirrhosis of the liver).
11. Complications of pregnancy and childbirth.
12. Psychological disorders (depression and stress-related deaths).

Standard mortality rates:

- Cardiovascular disease: 354 deaths per 100,000 residents.
- Infectious diseases: about 50-80 deaths.
- Oncological diseases: an average of 80-100 deaths.
- Injuries and accidents: 70-90 deaths per 100,000 residents.

These indicators determine the problems facing the health sector in the country and the measures to be taken to eliminate them. Let's now turn to other sources namely [https://www.statista.com/outlook/hmo/hospitals/inpatient-care/treatment-of-cardiovascular-diseases/uzbekistan] let's focus on the statistics of this site:

Development of the Uzbek market for the treatment of cardiovascular diseases

Key indicators:

1. Market size:

-In 2024, the total revenue of the cardiovascular disease treatment market is projected to reach US $ 243 million in Uzbekistan.

-By 2029, this figure is expected to reach US $ 460.3 million, which means an average increase of 13.63% per year (CAGR 2024-2029).

2. Global comparison:

-The United States is expected to receive the largest revenue from cardiovascular disease treatment in the world at US $ 136 billion (for 2024).

3. Trends in Uzbekistan:

- The number of specialized health institutions is increasing to meet the needs of the population. -The demand for the introduction of modern and advanced methods for the treatment of cardiovascular diseases is growing.

- The application of innovative technologies and diagnostic tools is expanding.

These data highlight the importance of the cardiovascular disease treatment sector, which is an important component of the health market in Uzbekistan. The growth of the

market is aimed at providing high-quality medical services and expanding programs for the Prevention of these diseases.

Michelle Lui , Saeid Safiri , Alibek Mereke , Kairat Davletov , Nana Mebonia , Akbope Myrkassymova , Timur Aripov , Erkin Mirrakhimov, SargisA. Aghayan, Amiran Gamkrelidze, Mohsen Naghavi, Jacek A. Kopec, Nizal Sarrafzadegan in their paper's about "Burden of Ischemic Heart Disease in Central Asian Countries, 1990-2017" and published in this journal IJC Heart & Vasculature Volume 33, April 2021, 1007-26 and cited the following sources:

The Global Burden of Disease Project (GBD) is a large – scale research initiative aimed at improving the health care system and addressing inequalities, measuring global health loss rates.

Basic information:

1. GBD project Mission:

- Develops standardized indicators to assess the health damage caused by various diseases, injuries and risk factors.

- Helps to identify health trends and problems around the world.

2. History of the project:

-The GBD program began in 1990 with a project directed by the World Bank. It has analyzed the health effects of more than 100 diseases and injuries in 8 regions.

-The program introduced a new unit of measurement – disability life years (DALY). This indicator made it possible to quantitatively assess the damage of disease, injury and Risk Factors and compare between regions.

3. Current state and expansion:

-GBD 2021, published in 2024, includes the impact of the COVID-19 pandemic and Forecasts up to 2050.

-In this study, more than 12,000 scientists from more than 160 countries took part, 288 cases of deaths were analyzed for the cause.

4. The main causes of the burden of diseases on a global scale (2019):

- Cardiovascular diseases.
- Cancer.
- Neonatal (related to newborns) diseases.
- Musculoskeletal (muscle and bone) diseases.
- Respiratory infections.
- Disorders related to mental health and substance abuse.

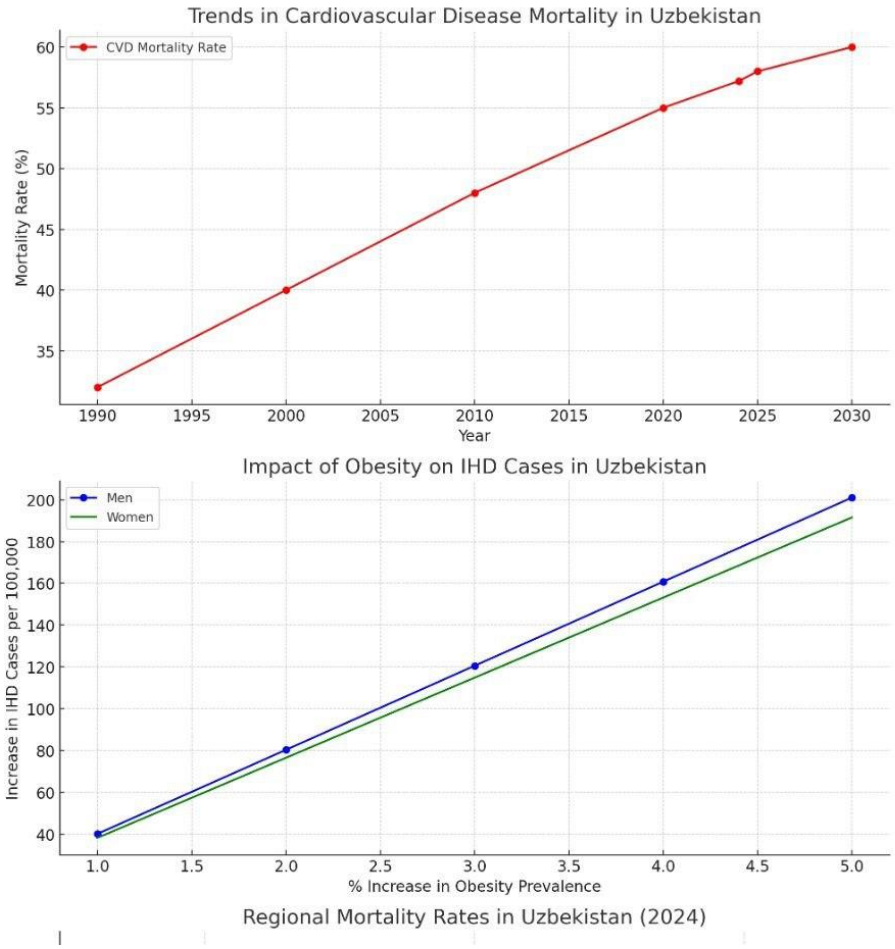
5. World Health Organization(WHO: - WHO provides comprehensive analyses of the underlying causes of death and disease in its Global Health Estimates report.

III. DISCUSSION AND RESULTS

Based on the links and silks below, we have come to this using the graph correlation and regression methods.

1. https://world-heart-federation.org/world-heart-observatory/countries/uzbekistan/
2. https://world-heart-federation.org/wp-content/uploads/World-Heart-Report-2023.pdf
3. https://worldpopulationreview.com/country-rankings/heart-disease-rates-by-country
4. https://m.kun.uz/en/news/2024/10/25/cardiovascular-disease-leads-death-causes-in-uzbekistans-2024-mortality-data

5. https://www.mdpi.com/1660-4601/19/16/10447.



Pic.5.Summary of Cardiovascular Disease (CVD) in Uzbekistan

1. Trends in Cardiovascular Disease Mortality (1990–2030):

- **Historical Data**:

-In 1990, CVD accounted for ~32% of deaths in Uzbekistan.

-By 2024, this figure rose to **57.2%**, making it the leading cause of mortality.

- **Future Projections**:

-If the trend continues, CVD could reach **60% of total deaths by 2030** without intervention.

Graph:

-Displays mortality rates increasing over time with projections from 2024 to 2030.

2. Impact of Obesity on Ischemic Heart Disease (IHD):

- Obesity is a primary risk factor driving CVD cases.
- A **1% increase in obesity prevalence** results in:

-40.2 new IHD cases per 100,000 men.

-38.3 new IHD cases per 100,000 women.

Graph:

-A line chart correlating obesity prevalence and new IHD cases, with separate trends for men and women.

3. Regional Cardiovascular Mortality in Uzbekistan (2024):

-Tashkent City has the highest mortality rate at **5.5 per 1,000 population**, followed by **Tashkent Region (5.4)** and **Jizzakh (4.2)**.

Cardiovascular Disease in Uzbekistan:

1. **Leading Cause of Death**:

-Cardiovascular diseases (CVDs) account for 57.2% of all deaths in Uzbekistan as of 2024, making them the top cause of mortality. Ischemic heart diseases are a significant contributor to this percentage.

2. **Historical Trends**:

-Between 1990 and 2017, the death rate due to ischemic heart disease (IHD) in Uzbekistan increased by 77.2%, the highest globally for that period. This trend is influenced by factors such as rising obesity rates, aging population, and lifestyle changes.

3. **Risk Factors**:

-Obesity is a critical risk factor in Uzbekistan, showing a strong positive correlation with the incidence and mortality of IHD. A 1% rise in obesity prevalence results in an increase of 40.2 cases of IHD per 100,000 men and 38.3 per 100,000 women.

-Other contributors include hypertension, diabetes, tobacco use, and poor diet.

4. **Regional Variations**:

-Urban regions like Tashkent city have higher mortality rates (5.5 per 1,000 population), while regions like Jizzakh report the lowest (4.2 per 1,000).

Analysis with Graphics and Tables:

Trends in CVD Mortality (1990-2024):

Year	Deaths from CVD (%)	Global Rank in IHD Increase
1990	~32%	-
2017	~50%	1st
2024	57.2%	-

Impact of Obesity on CVD:

Obesity Prevalence (%)	Increase in IHD Cases per 100,000 (Men)	Increase in IHD Cases per 100,000 (Women)
1%	+40.2	+38.3

Regional Mortality Rates (2024):

Region	Mortality Rate (per 1,000)
Tashkent City	5.5
Tashkent Region	5.4
Jizzakh	4.2

Future Predictions (2025-2030):

- Without intervention, obesity rates are expected to rise further, driving up IHD incidences. If trends continue:

-By 2030, CVD could account for nearly 60% of all deaths.

-Targeted public health campaigns could reduce these rates by promoting healthier lifestyles and better access to medical care.

Projected CVD Mortality (2020-2030):

Year	Predicted Mortality Rate (%)
2020	55%
2025	58%
2030	60%

These insights highlight the urgent need for focused healthcare policies in Uzbekistan to address cardiovascular risks through preventative measures and improved treatments.

III. CONCLUSION

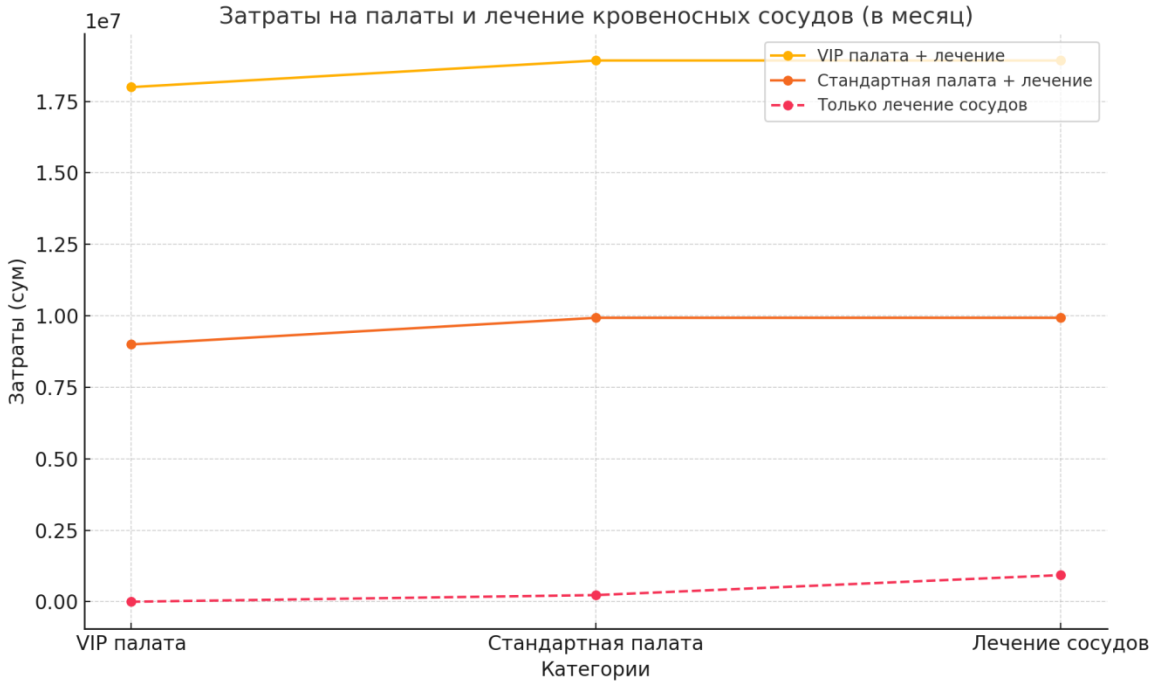
The provided data highlights the increasing mortality rates from cardiovascular diseases (CVD) in Uzbekistan over several decades, as well as regional disparities and the influence of obesity on ischemic heart disease (IHD).

In 1990, cardiovascular diseases accounted for approximately 32% of deaths in Uzbekistan. This figure has significantly increased, reaching 57.2% by 2024, making CVD the leading cause of mortality. Projections suggest that without intervention, this percentage could rise to 60% by 2030. The steady upward trend is clearly illustrated in a line graph showing CVD mortality from 1990 to 2030.

Obesity, a critical risk factor, has a direct impact on ischemic heart disease. For every 1% increase in obesity prevalence, there are 40.2 additional cases of IHD per 100,000 men and 38.3 per 100,000 women. A line chart comparing obesity prevalence and new IHD cases demonstrates a stronger effect on men compared to women.

Regionally, urban areas like Tashkent City exhibit the highest mortality rates at 5.5 per 1,000 population in 2024, followed by Tashkent Region (5.4) and Jizzakh (4.2). These disparities emphasize the influence of urbanization and lifestyle factors on CVD rates.

In summary, the data underscores the alarming rise in CVD mortality in Uzbekistan, driven largely by obesity and regional inequalities. It highlights the urgent need for public health initiatives focused on obesity reduction, healthier lifestyles, and improved access to healthcare to mitigate these trends.



Pic.6. Real the price of the Clinic

All these expenses were received in real from the price of the American hospital Clinic. In addition, its separate VIP chamber and standards' were counted separately.

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