

Original Article

The national and subnational trend of ischemic heart disease in Iran from 1990-2021, with projections for 2040: a modelling study

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Abstract: Background: Ischemic heart disease (IHD) is a leading cause of death in Iran, and monitoring its trends is essential for disease management and achieving Sustainable Development Goal 3.4. Methods: This study examines the prevalence of IHD in Iran at national and subnational levels and projects future trends to 2040. We retrieved sex-specific IHD data for Iran and its provinces from 1990 to 2021 from the Global Burden of Disease (GBD) Study 2021 and applied the illness-death model (IDM) to estimate age-standardized prevalence rates (ASPRs) by 2040. Results: In Iran, the ASPR of IHD decreased until 2009 but began to rise again by 2021. By 2040, prevalence is projected to increase by 16% to 7,336.1 per 100,000 (95% CI: 7,163.9-7,512.4). In 2021, the highest provincial ASPRs were observed in Khuzestan, Yazd, and Alborz; by 2040, Yazd, Khuzestan, and North Khorasan are expected to have the highest rates. Conversely, Hamadan, Sistan and Baluchistan, and West Azarbayegan had the lowest ASPRs in both 2021 and 2040. A similar pattern was observed in both males and females. Conclusion: These findings indicate an upward trend in IHD nationwide and across all provinces by 2040. To lessen the future impact of IHD in Iran, it is crucial to tackle modifiable risk factors, strengthen the healthcare system, and improve prevention efforts.

Keywords: Ischemic heart disease (IHD), Iran, global burden of disease (GBD), illness death model (IDM)

Introduction

Cardiovascular diseases (CVDs) have remained the leading cause of death in most regions of the world over the past decades [1]. While high-income countries have experienced a decrease in cardiovascular disease (CVD) mortality, low- and middle-income countries, particularly in the Eastern Mediterranean Region (EMR), continue to face high CVD mortality rates. On the other hand, ischemic heart disease (IHD) is the most common type of CVD, responsible for approximately 16% of global deaths in 2019, equivalent to approximately 9.14 million deaths [2]. In this setting, highest burdens of CVD have been reported in the North Africa and Middle East (NAME) region [2, 3], with Iran reporting the highest age-standardized prevalence rate (ASPR) in 2019 [4]. So that in that year, Iran's age-adjusted mortality, disability-adjusted life

years (DALYs), and prevalence rates of IHD were 163.6, 2842.7, and 6198.5 per 100,000 people, respectively [5]. Hence, understanding the epidemiology of cardiovascular diseases, including the current status and future picture, is crucial for health planning.

On the other hand, IHD imposes lifelong costs on health systems due to its chronic nature [6, 7], making it essential for countries, including Iran, to monitor and forecast its burden as the leading cause of non-communicable disease (NCD) mortality. This aligns with Sustainable Development Goal 3.4, which aims to reduce premature mortality from NCDs by one-third by 2030 [8]. Moreover, epidemiological evidence have demonstrated the substantial influence of some demographic factors on IHD, such that men exhibit a higher incidence than women, particularly in younger age groups [9], which is

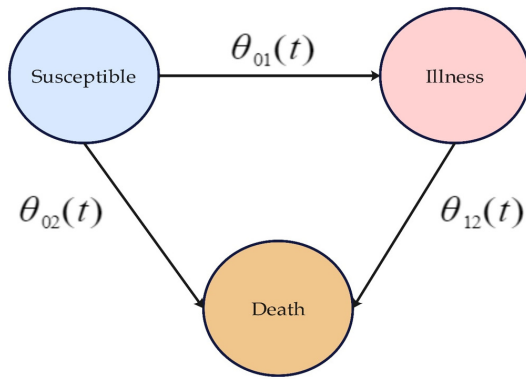


Figure 1. Illness-death model for ischemic heart disease.

linked to biological factors, such as estrogen's protective effect in premenopausal women, as well as behavioral and environmental factors, such as higher smoking, alcohol consumption, and physical inactivity [10]. The risk for women significantly increases after menopause, often surpassing that for men [11]. Age also plays a crucial role in IHD development and progression [12], with incidence rates generally rising due to cumulative risk factors, such as hypertension, diabetes, hyperlipidemia, smoking, and sedentary lifestyles [13]. Therefore, a comprehensive understanding of IHD epidemiology must consider sex and age differences.

Overall, accurate assessment and prediction of the burden of CVD at national and regional levels is crucial for effective implementation of health policies and reduction of healthcare costs. In this context, we aim to report the ASPR of IHD in Iran and its provinces from 1990 to 2021 and to predict its prevalence until 2040 using the illness-death model (IDM) (IDM) stratified by sex and age.

Materials and methods

Data source

To forecast the future prevalence of ischemic heart disease (IHD) in Iran and its provinces, we employed a dynamic simulation model, IDM. We sourced epidemiological metrics, including prevalence, incidence, and mortality rates, from the Global Health Data Exchange (GHDx) query tool for the years 1990 to 2021, stratified by sex at both national and subnational level at <https://vizhub.healthdata.org/gbd-results/>. Additionally, we obtained population

forecast data from <https://amar.org.ir/population-and-migration>. These comprehensive datasets provide the crucial parameters required to develop predictive models for IHD's future prevalence of IHD in Iran. In other words, the data used in this study is based on GBD methodology which is updated after each GBD report. Briefly, GBD for each disease applies a systematic review to collect disease-related health metrics by considering multiple sources of data, such as vital data, verbal autopsy, registries, population-based surveys, and literature. Accordingly, all identified data are assessed for quality. Studies were eligible if they provided age- and sex-specific estimates using clearly defined and standardized case definitions and ICD-coded cause-of-death data, while sources with non-representative sampling, data without age, sex, and location information, inadequate sample size, duplicate data, or unclear or non-validated diagnostic criteria or case definitions were excluded.

Statistical analysis

Modeling

Modeling framework and projection methodology: To forecast the future prevalence of IHD across Iran and its provinces, we implemented a discrete-time illness-death model (IDM). This compartmental model stratifies the population into three mutually exclusive states: (1) Susceptible (S), individuals at risk without IHD; (2) Ill (I), individuals with active IHD; and (3) Dead (D), an absorbing state. The structure and permitted transitions between these states are illustrated in **Figure 1**. While a comprehensive technical exposition of the IDM framework is available elsewhere [14], we provide a concise description of our specific implementation below.

Discrete-time model equations: The core dynamics of the model are defined by the following system of discrete-time difference equations, which govern the annual transition of individuals between health states from year t to $t+1$:

$$S_{t+1} = -\theta_{01}S_t - \theta_{02}S_t$$

$$I_{t+1} = +\theta_{01}S_t - \theta_{12}I_t$$

Here, S_t and I_t represent the number of individuals in the Susceptible and Ill states at the begin-

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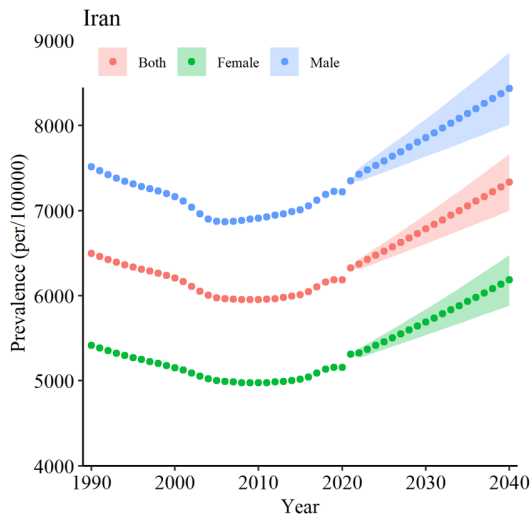


Figure 2. Age-standardized prevalence rates (ASPR) of ischemic heart disease (IHD) per 100,000 population in Iran, reported for males, females, and the overall population, were analyzed for the period 1990-2021 and projected for 2021-2040. The halo effect in each scatter plot illustrates the 95% confidence intervals surrounding the estimated values.

ning of year t . Our model parameters are defined as annual transition rates: θ_{01} : The incidence rate, representing the rates that a susceptible individual develops IHD within one year. θ_{02} : The background mortality rate, representing the probability that a susceptible individual dies from a cause other than IHD within one year. θ_{12} : The excess mortality rate, representing the probability that an individual with IHD dies from any cause within one year.

Demographic stratification and model calibration: To account for essential epidemiological heterogeneity, the model was stratified and calibrated independently for each combination of sex, age group (<45 and ≥ 45 years), and geographic unit (national and provincial levels). This allows for distinct sets of transition probabilities across key demographic and regional subgroups. To estimate the time-varying parameters θ_{01} , θ_{02} , and θ_{12} for each demographic and geographic stratum, we fitted cubic spline regressions to the corresponding historical GBD data from 1990 to 2021. The optimal spline for each parameter was determined by minimizing the sum of least squares between the smoothed curve and the annual GBD estimates over the 32-year calibration period, yielding a complete annual series for each transition probability. These fitted splines were

then extrapolated to provide parameter estimates through 2040. The projected annual parameters were subsequently integrated into the discrete-time model equations to simulate IHD prevalence from 2022 to 2040. The complete technical details and R code for this spline fitting and model integration process are provided in the referenced methodological paper [14]. All analyses and projections were conducted using R statistical software (version 4.3.1). Data are presented as ASPRs per 100,000 population with corresponding 95% confidence intervals (95% CIs). The study employed a descriptive epidemiological modeling approach based on the IDM. Temporal trends were summarized by calculating percentage changes in ASPRs for the periods 1990-2021 and 2021-2040. As the primary objective was to describe and project disease burden rather than test predefined hypotheses, no formal inferential statistical comparisons were performed; consequently, p -values and significance thresholds were not applicable.

Results

Historical trend: 1990 to 2021

In Iran, the Age-Standardized Prevalence Rate (ASPR) of IHD has shown a decreasing trend until 2009, followed by an increase by 2021. However, the ASPR in 1990 was higher than that in 2021 (6496.75 per 100,000 individuals vs. 6327.23 per 100,000 individuals) (**Figure 2**). Furthermore, a distinct geographic pattern emerged, with the highest IHD burdens consistently concentrated in the southern and central provinces - such as Khuzestan, Yazd, and Kerman - while the western and northwestern regions, including Hamadan and West Azarbayejan, recorded the lowest rates. This spatial disparity persisted over the three decades; for instance, while Kerman and Isfahan led in prevalence in 1990, Khuzestan assumed the highest burden by 2021 (6,915.60 per 100,000), followed by Yazd and Alborz. Conversely, Hamadan, West Azarbayejan, and Sistan and Baluchistan remained the provinces with the lowest prevalence in 2021 (**Table 1; Figures 3-5**). Additionally, beyond static burden, the rate of change varied significantly by region. Central and southern provinces experienced the most rapid increases, with Yazd (4.86%), Semnan (3.79%), and Khuzestan (3.23%) showing the highest percentage growth, suggesting

a worsening epidemiological transition in these areas. In contrast, provinces like Isfahan, Tehran, and Sistan and Baluchistan demonstrated more stable trends (**Table 1**). These geographic and temporal patterns were consistent across both sexes, with females and males reflecting similar regional distributions of high and low ASPRs, and experiencing the most significant increases in Khuzestan, Yazd, and Semnan (**Tables 2, 3; Figures 3-5**). Consequently, effective IHD management in Iran requires moving away from uniform national policies. Strategies must instead be localized to tackle regional disparities and the rising burden in high-risk provinces.

Future perspective: 2021 to 2040

Both

Looking ahead to 2040, Iran faces a significant escalation in its IHD burden, with the national ASPR projected to rise by 16% to reach 7,336.1 per 100,000 (**Figure 2**). However, this increase will not be evenly distributed. The geographic disparities observed in recent years are expected to persist, with central and northern provinces like Yazd, Khuzestan, and North Khorasan continuing to shoulder the highest absolute burdens. Meanwhile, provinces in the west and southeast, such as Hamadan and Sistan and Baluchistan, are likely to maintain lower prevalence rates. More concerning is the uneven speed of this rise. Provinces like Yazd and Khorasan-e-Razavi are projected to see their ASPR surge by over 20%, indicating a rapid and worsening epidemiological transition in these specific regions. In contrast, areas like Zanjan and Alborz are expected to experience much slower growth, suggesting more stable disease dynamics (**Table 1; Figures 3-5**). This divergence highlights that a uniform national strategy will likely fail; instead, public health resources must be strategically allocated to target the high-risk provinces where the burden is growing most rapidly.

Female

Similarly, the national ASPR for women is expected to climb by 16.36%, reaching 6,184.2 per 100,000 by 2040. This rise will be marked by pronounced geographic inequalities. Central and northern provinces, particularly Khuzestan, Yazd, and Golestan, are projected to shoulder

the heaviest burdens, with rates exceeding 6,600 per 100,000. In contrast, western and southeastern regions such as Hamadan, Sistan and Baluchistan, and West Azarbajejan are likely to maintain lower prevalence, staying below 5,700 per 100,000. Crucially, the speed of this increase varies significantly: Khorasan-e-Razavi, Yazd, and Kohgiluyeh and Boyer-Ahmad are anticipated to witness the sharpest spikes in female ASPR, reflecting a rapid deterioration in cardiovascular health markers in these areas. Conversely, provinces like Zanjan, Semnan, and Chahar Mahaal and Bakhtiari are expected to show more modest growth, indicating relatively stable risk profiles for women there (**Table 2; Figures 3-5**). This divergence underscores the necessity of moving away from generic national health policies toward gender-sensitive and region-specific interventions. Prioritizing preventive care and lifestyle modifications in high-growth provinces like Yazd and Khorasan-e-Razavi is essential to mitigate the escalating burden of IHD among Iranian women in the coming decades.

Male

By 2040, the national ASPR for males is projected to increase by 14.73%, reaching 8,436.8 per 100,000 (95% CI: 8,218.6-8,661.0). As with the total population and females, this burden will be unevenly distributed geographically. Yazd, Khuzestan, and Golestan are anticipated to face the highest male IHD rates, while Hamadan, West Azarbajejan, and Sistan and Baluchistan are expected to maintain the lowest. However, the pace of this increase varies significantly across regions. Yazd is projected to experience the most dramatic rise in male ASPR at 20.17%, indicating a rapid worsening of cardiovascular risk factors in this province. In contrast, Zanjan is expected to see the smallest increase (9.50%), suggesting more effective risk management or stable demographics among men in that area (**Table 3; Figures 3-5**). This suggests that current preventive strategies may be insufficient in high-growth regions, necessitating targeted male-specific health interventions in provinces like Yazd to curb the escalating prevalence of IHD.

Age groups

To better understand the shifting epidemiology of IHD, we analyzed trends across two key age

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Table 1. Estimated age-standardized prevalence rates (ASPR) of ischemic heart disease (IHD) per 100,000 population, with 95% confidence intervals, reported every 5 years from 2022 to 2040, alongside the percentage changes in ASPR for 1990-2021 and 2021-2040, across Iran and its 31 provinces for the overall population

	ASPR, 2022	ASPR, 2025	ASPR, 2030	ASPR, 2035	ASPR, 2040	Percentage change (1990-2021)	Percentage change (2021-2040)
Iran (Islamic Republic of)	6373.613 (6340.376-6407.025)	6524.621 (6471.473-6578.207)	6784.428 (6694.736-6875.329)	7054.764 (6925.356-7186.61)	7336.073 (7163.913-7512.41)	-2.60931	15.94454
Alborz	6767.493 (6723.916-6811.352)	6883.73 (6814.594-6953.568)	7083.143 (6967.925-7200.264)	7289.549 (7125.285-7457.587)	7502.887 (7286.863-7725.285)	1.925215	11.19603
Ardebil	6570.965 (6535.93-6606.189)	6687.877 (6632.217-6744.004)	6887.43 (6794.465-6981.666)	7093.016 (6960.239-7228.325)	7304.823 (7129.957-7483.976)	1.539665	11.82165
Bushehr	6603.665 (6566.924-6640.612)	6734.773 (6676.322-6793.734)	6959.135 (6861.224-7058.435)	7191.022 (7050.743-7334.071)	7430.689 (7245.353-7620.727)	0.514821	13.46218
Chahar Mahaal and Bakhtiari	6378.137 (6351.593-6404.793)	6486.142 (6443.97-6528.59)	6670.233 (6599.83-6741.387)	6859.553 (6759.068-6961.533)	7054.25 (6922.011-7189.019)	-2.29716	11.40743
East Azarbayejan	6402.331 (6371.255-6433.559)	6579.469 (6529.613-6629.706)	6885.767 (6801.118-6971.467)	7206.472 (7083.57-7331.5)	7542.276 (7377.731-7710.478)	-0.72256	18.96262
Fars	6189.095 (6157.303-6221.052)	6342.45 (6291.49-6393.825)	6606.572 (6520.354-6693.941)	6881.744 (6757.1-7008.715)	7168.432 (7002.313-7338.545)	-5.35197	16.91089
Gilan	6470.922 (6432.567-6509.508)	6609.557 (6548.526-6671.165)	6847.793 (6745.604-6951.539)	7095.235 (6948.832-7244.687)	7352.169 (7158.631-7550.779)	-0.5813	14.29488
Golestan	6685.005 (6647.428-6722.795)	6847.903 (6787.777-6908.563)	7128.346 (7026.784-7231.38)	7420.376 (7273.714-7570.007)	7724.479 (7529.202-7924.845)	-0.09862	16.37833
Hamadan	5900.589 (5872.9-5928.409)	6016.967 (5972.857-6061.403)	6216.116 (6142.15-6290.976)	6421.943 (6315.907-6529.766)	6634.676 (6494.517-6777.872)	-1.89924	13.81666
Hormozgan	6496.689 (6463.47-6530.079)	6657.276 (6604.113-6710.867)	6933.383 (6843.529-7024.416)	7220.536 (7090.699-7352.749)	7519.281 (7346.306-7696.328)	-0.03759	16.87608
Ilam	6399.007 (6367.126-6431.048)	6538.935 (6487.965-6590.312)	6779.185 (6693.407-6866.089)	7028.508 (6905.185-7154.093)	7287.235 (7123.781-7454.539)	-0.91784	14.84848
Isfahan	6377.553 (6336.711-6418.659)	6503.737 (6438.772-6569.354)	6719.786 (6611.009-6830.343)	6943.23 (6787.45-7102.563)	7174.325 (6968.591-7386.091)	-6.80102	12.98597
Kerman	6480.044 (6435.602-6524.795)	6661.075 (6589.71-6733.224)	6974.119 (6852.935-7097.495)	7301.903 (7126.019-7482.243)	7645.125 (7409.776-7888.161)	-5.59442	18.85504
Kermanshah	6392.143 (6352.394-6432.14)	6519.501 (6456.189-6583.433)	6737.393 (6631.272-6845.213)	6962.536 (6810.474-7117.995)	7195.184 (6994.288-7401.856)	-1.26709	13.12082
Khorasan-e-Razavi	6440.079 (6401.547-6478.843)	6636.391 (6574.472-6698.892)	6977.362 (6871.906-7084.427)	7336.368 (7182.742-7493.251)	7714.384 (7507.983-7926.397)	-4.39661	20.73708
Khuzestan	6969.218 (6929.177-7009.49)	7152.457 (7088.293-7217.201)	7468.754 (7360.081-7579.031)	7799.193 (7641.824-7959.802)	8144.4 (7934.275-8360.089)	3.227561	17.7685

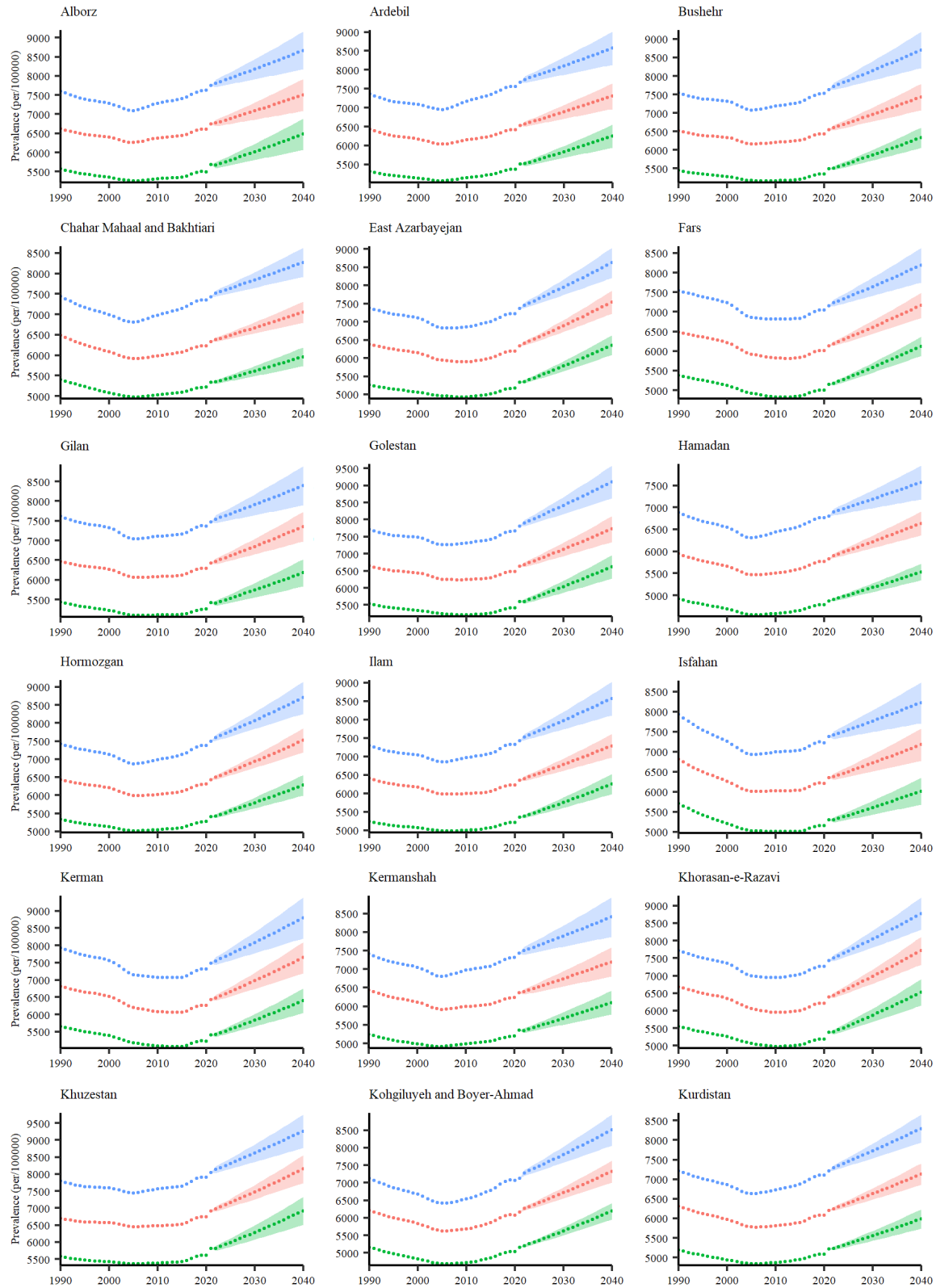
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Kohgiluyeh and Boyer-Ahmad	6264.774 (6233.878-6295.824)	6429.402 (6379.86-6479.33)	6713.486 (6629.519-6798.524)	7010.17 (6888.51-7133.995)	7320.012 (7157.489-7486.259)	-0.66424	18.76956
Kurdistan	6248.461 (6220.575-6276.471)	6387.427 (6342.99-6432.17)	6626.066 (6551.357-6701.605)	6873.799 (6766.33-6982.92)	7130.997 (6988.415-7276.38)	-1.75291	15.10266
Lorestan	6375.667 (6344.284-6407.204)	6507.408 (6457.521-6557.674)	6733.127 (6649.524-6817.757)	6966.778 (6846.861-7088.734)	7208.647 (7049.995-7370.755)	-2.51558	14.10948
Markazi	6512.917 (6478.156-6547.865)	6679.576 (6623.914-6735.705)	6967.051 (6872.865-7062.527)	7267.144 (7130.864-7406.023)	7580.43 (7398.605-7766.717)	0.404911	17.34133
Mazandaran	6623.342 (6584.956-6661.951)	6749.713 (6688.625-6811.359)	6964.891 (6862.62-7068.685)	7186.167 (7039.81-7335.569)	7413.957 (7220.862-7612.217)	-0.20043	12.36564
North Khorasan	6648.754 (6615.095-6682.584)	6818.992 (6765.077-6873.34)	7112.64 (7021.402-7205.073)	7419.163 (7287.16-7553.578)	7739.141 (7563.038-7919.377)	2.01188	17.44535
Qazvin	6118.917 (6090.06-6147.91)	6241.877 (6195.886-6288.21)	6452.347 (6375.174-6530.457)	6669.947 (6559.242-6782.528)	6894.927 (6748.505-7044.539)	0.511746	13.71537
Qom	6391.913 (6361.614-6422.357)	6557.455 (6508.802-6606.476)	6846.06 (6763.261-6929.898)	7153.466 (7032.623-7276.481)	7484.653 (7321.247-7651.987)	-0.14941	18.65778
Semnan	6686.683 (6646.404-6727.207)	6807.065 (6743.078-6871.659)	7012.603 (6905.74-7121.116)	7224.437 (7071.826-7380.33)	7442.765 (7241.799-7649.284)	3.789485	11.91153
Sistan and Baluchistan	5910.885 (5879.695-5942.241)	6031.392 (5981.706-6081.491)	6237.872 (6154.522-6322.351)	6451.625 (6332.063-6573.442)	6672.924 (6514.778-6834.904)	-5.9446	13.68662
South Khorasan	6241.607 (6214.438-6268.894)	6389.199 (6345.777-6432.918)	6643.242 (6569.966-6717.333)	6907.57 (6801.813-7014.964)	7182.511 (7041.76-7326.063)	-3.70091	16.42857
Tehran	6177.975 (6145.194-6210.931)	6336.055 (6283.569-6388.978)	6608.81 (6520.007-6698.819)	6893.655 (6765.174-7024.568)	7191.166 (7019.753-7366.753)	-5.94462	17.20625
West Azarbayejan	5922.308 (5896.328-5948.401)	6056.613 (6015.157-6098.352)	6287.32 (6217.526-6357.891)	6526.902 (6426.397-6628.961)	6775.707 (6642.241-6911.82)	-3.30175	15.56726
Yazd	6887.31 (6851.527-6923.28)	7115.303 (7057.659-7173.415)	7511.404 (7412.881-7611.219)	7928.241 (7784.318-8074.767)	8366.393 (8172.678-8564.56)	4.856239	23.0966
Zanjan	6265.947 (6233.869-6298.192)	6360.743 (6309.865-6412.044)	6521.888 (6437.24-6607.7)	6687.072 (6566.688-6809.769)	6856.412 (6698.556-7018.162)	-2.8401	10.14064

groups: those under 45 years and those over 45. The data reveals a concerning acceleration in disease burden among younger populations. For individuals under 45, the ASPR rose by 13.20% from 1990 (698.75 per 100,000) to 2021 (790.98 per 100,000) and is projected to surge by a further 23.01% by 2040, reaching 972.97 per 100,000 ([Table S1](#)). This rapid escalation suggests a worsening of early-onset risk factors. In contrast, the over-45 group, which bears the absolute highest burden (14,133.06 per 100,000 in 2021), has seen a more modest historical increase of 5.48% from

1990 to 2021. However, this group is also projected to see a significant rise of 16.44% by 2040, reaching 16,457.45 per 100,000 ([Table S2](#)). While the older population remains the most affected overall, the rate of change is disproportionately higher in the younger demographic, signaling a critical need for preventive strategies targeting early adulthood ([Tables S1, S2](#)). This highlights an urgent need for targeted interventions focused on lifestyle modifications and early screening for young Iranians to prevent a future surge in early-onset cardiovascular disease.

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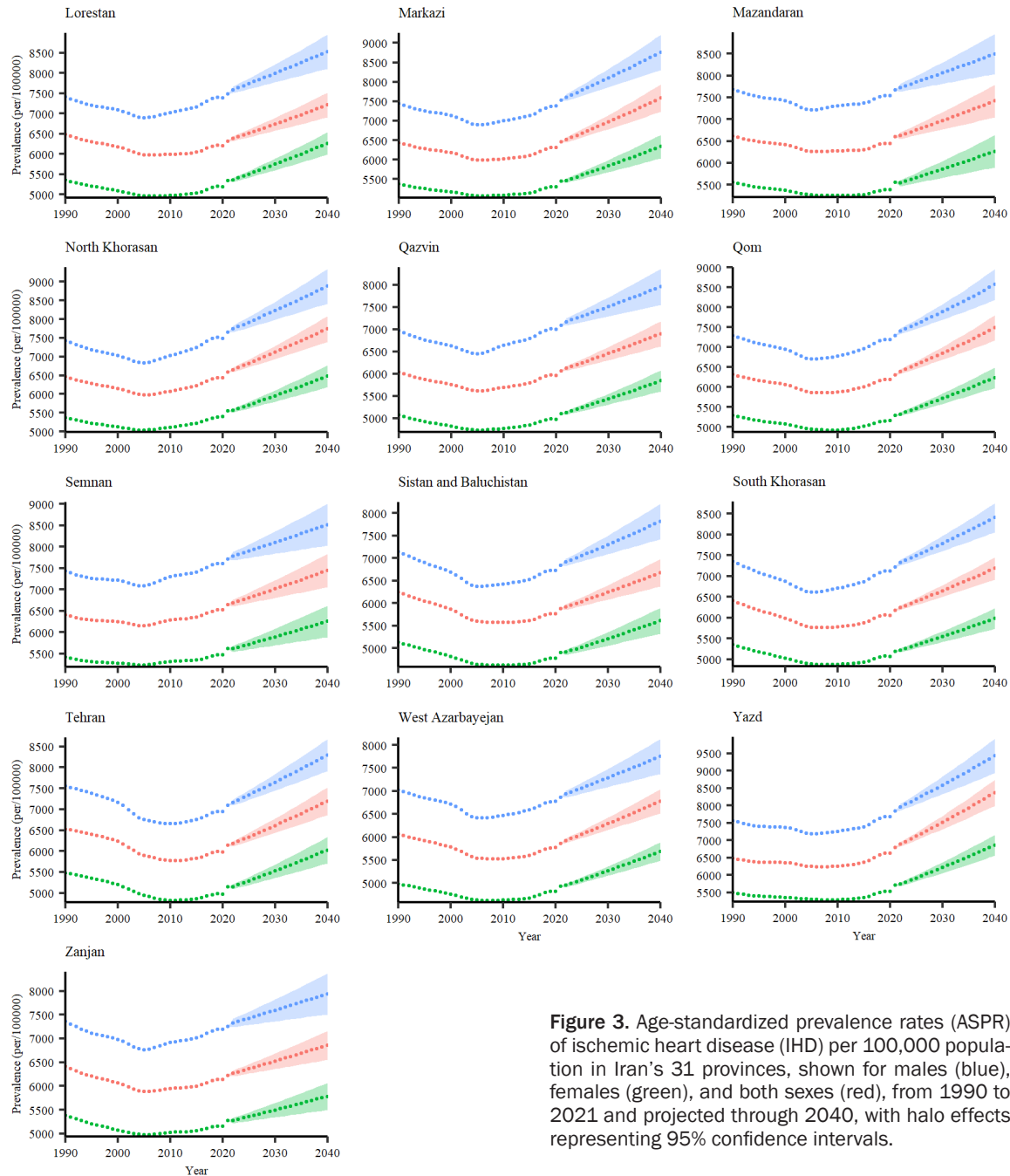


Figure 3. Age-standardized prevalence rates (ASPR) of ischemic heart disease (IHD) per 100,000 population in Iran's 31 provinces, shown for males (blue), females (green), and both sexes (red), from 1990 to 2021 and projected through 2040, with halo effects representing 95% confidence intervals.

Discussion

Our study opens an important perspective into the future trends of IHD in Iran and serves as critical information for health policy makers by describing the current and future epidemiological picture of the disease. In fact, this information can provide a guide for health stakeholders and other decision-makers to make the right decisions to achieve Sustainable Development Goal 3.4 (SDG 3.4) in the country.

Our findings showed an upward trend in cardiovascular disease across the country and in all provinces by 2040, affecting both men and women. This trend can imply a need for urgent action to effectively address this growing problem.

The historical trend of IHD in Iran show a decrease in ASPRs from 1990 to 2009, followed by an increase until 2021, with a continuing upward trend expected through 2040. We

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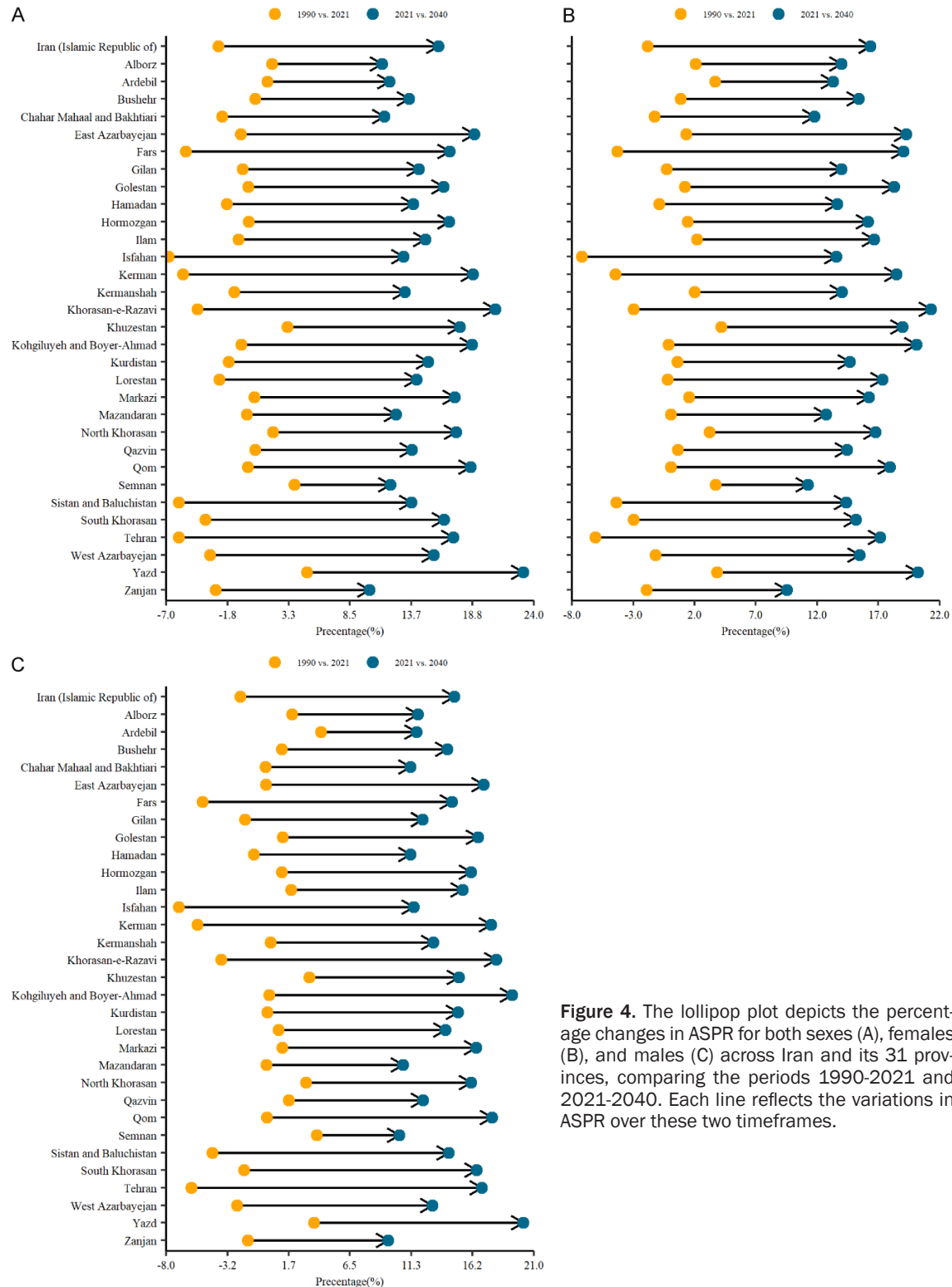


Figure 4. The lollipop plot depicts the percentage changes in ASPR for both sexes (A), females (B), and males (C) across Iran and its 31 provinces, comparing the periods 1990-2021 and 2021-2040. Each line reflects the variations in ASPR over these two timeframes.

will first examine historical trends and then discuss future projections to elucidate the epidemiology of IHD in Iran. Considering historical trends, one study [5] noted an insignificant

change in the ASPR of IHD from 1990 to 2019, which aligns with the observed decreasing and subsequent increasing trends of IHD. However, this national pattern may reflect moderate

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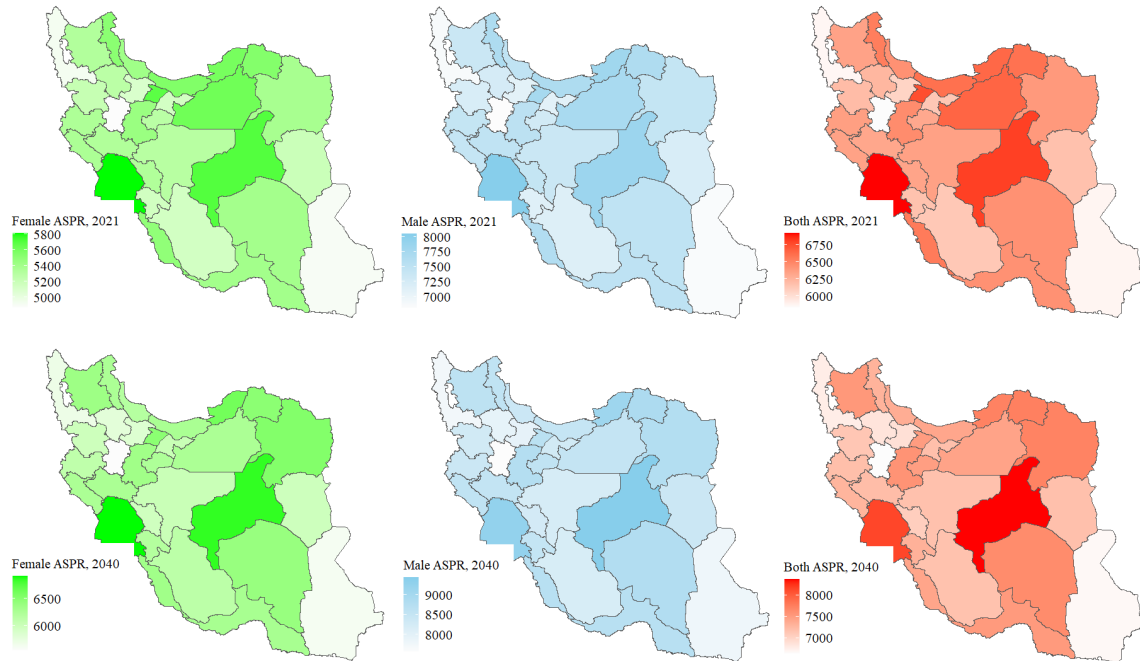


Figure 5. Map of age-standardized prevalence rates (ASPR) of ischemic heart disease (IHD) in 2021 and 2040 across 31 provinces of Iran.

Table 2. The estimated age-standardized prevalence rates (ASPR) of ischemic heart disease (IHD) per 100,000 population in females, including 95% confidence intervals, are presented at 5-year intervals from 2022 to 2040, alongside the percentage changes in IHD prevalence for the periods 1990-2021 and 2021-2040 across Iran and its 31 provinces

	ASPR, 2022	ASPR, 2025	ASPR, 2030	ASPR, 2035	ASPR, 2040	Percentage change (1990-2021)	Percentage change (2021-2040)
Iran (Islamic Republic of)	5325.38 (5296.014-5354.909)	5459.615 (5412.622-5507.016)	5691.023 (5611.578-5771.594)	5932.407 (5817.553-6049.529)	6184.214 (6031.1-6341.217)	-1.82931	16.36103
Alborz	5672.703 (5631.709-5713.995)	5799.565 (5734.178-5865.698)	6017.429 (5907.516-6129.389)	6243.594 (6085.613-6405.678)	6478.378 (6268.997-6694.753)	2.057556	13.97336
Ardebil	5521.654 (5490.964-5552.515)	5636.665 (5587.814-5685.941)	5833.771 (5751.842-5916.856)	6037.866 (5920.332-6157.707)	6249.209 (6093.714-6408.619)	3.680954	13.2987
Bushehr	5509.921 (5482.208-5537.774)	5639.064 (5594.822-5683.655)	5861.126 (5786.571-5936.636)	6092.016 (5984.553-6201.395)	6332.091 (6189.247-6478.206)	0.842005	15.38693
Chahar Mahaal and Bakhtiari	5346.313 (5322.44-5370.292)	5444.273 (5406.339-5482.473)	5611.566 (5548.148-5675.706)	5784.027 (5693.349-5876.139)	5961.816 (5842.254-6083.806)	-1.26143	11.7634
East Azarbayejan	5353.298 (5327.19-5379.535)	5508.408 (5466.494-5550.642)	5777.094 (5705.813-5849.261)	6059.05 (5955.364-6164.531)	6354.949 (6215.862-6497.129)	1.302673	19.28034
Fars	5174.29 (5150.462-5198.229)	5321.588 (5283.304-5360.151)	5576.54 (5511.419-5642.434)	5843.811 (5749.11-5940.081)	6124.006 (5997.024-6253.695)	-4.30557	19.04605
Gilan	5413.594 (5378.304-5449.119)	5533.971 (5477.782-5590.754)	5740.848 (5646.657-5836.655)	5955.781 (5820.695-6094.041)	6179.066 (6000.327-6363.093)	-0.28677	14.00202

Burden of ischemic heart disease in Iran

Golestan	5606.508 (5572.956-5640.262)	5763.74 (5709.879-5818.11)	6035.749 (5944.259-6128.65)	6320.722 (6187.853-6456.452)	6619.288 (6441.365-6802.141)	1.193803	18.28123
Hamadan	4904.075 (4884.816-4923.409)	5003.691 (4973.018-5034.552)	5174.299 (5122.827-5226.286)	5350.813 (5276.94-5425.715)	5533.442 (5435.672-5632.96)	-0.91001	13.63226
Hormozgan	5428.484 (5399.989-5457.129)	5561.812 (5516.226-5607.776)	5791.359 (5714.354-5869.403)	6030.406 (5919.19-6143.717)	6279.357 (6131.248-6431.053)	1.422088	16.15656
Ilam	5378.727 (5351.68-5405.911)	5514.871 (5471.581-5558.506)	5749.657 (5676.479-5823.784)	5994.659 (5888.886-6102.34)	6250.313 (6109.331-6394.561)	2.2008	16.638
Isfahan	5300.619 (5266.918-5334.535)	5413.576 (5359.911-5467.777)	5607.342 (5517.277-5698.867)	5808.214 (5678.914-5940.432)	6016.464 (5845.275-6192.618)	-7.21468	13.57455
Kerman	5414.551 (5380.17-5449.155)	5566.808 (5511.564-5622.625)	5830.203 (5736.335-5925.696)	6106.145 (5969.838-6245.773)	6395.24 (6212.761-6583.464)	-4.48997	18.46854
Kermanshah	5349.208 (5317.047-5381.564)	5467.633 (5416.318-5519.433)	5670.877 (5584.571-5758.517)	5881.704 (5757.586-6008.498)	6100.405 (5935.82-6269.553)	1.980797	14.03243
Khorasan-e-Razavi	5393.87 (5357.627-5430.358)	5567.837 (5509.495-5626.795)	5870.539 (5770.874-5971.914)	6189.976 (6044.354-6339.081)	6527.112 (6330.893-6729.363)	-2.98144	21.27361
Khuzestan	5816.868 (5777.028-5856.981)	5986.664 (5922.689-6051.331)	6280.898 (6172.115-6391.598)	6589.795 (6431.619-6751.858)	6914.099 (6702.015-7132.888)	4.173722	18.9854
Kohgiluyeh and Boyer-Ahmad	5205.577 (5182.977-5228.276)	5357.801 (5321.54-5394.308)	5621.5 (5559.846-5683.828)	5898.225 (5808.542-5989.268)	6188.623 (6068.314-6311.268)	-0.15202	20.11071
Kurdistan	5234.562 (5209.801-5259.44)	5352.606 (5313.116-5392.388)	5555.378 (5488.93-5622.622)	5765.951 (5670.306-5863.188)	5984.642 (5857.677-6114.316)	0.607713	14.68221
Lorestan	5358.533 (5331.15-5386.055)	5498.827 (5455.066-5542.934)	5740.979 (5666.981-5815.915)	5993.957 (5886.863-6102.93)	6258.262 (6115.297-6404.437)	-0.21388	17.31599
Markazi	5464.488 (5434.316-5494.828)	5600.678 (5552.423-5649.351)	5835.375 (5753.843-5918.058)	6080.084 (5962.268-6200.217)	6335.249 (6178.254-6496.215)	1.52566	16.24101
Mazandaran	5542.262 (5504.939-5579.838)	5656.573 (5597.156-5716.618)	5852.412 (5752.772-5953.773)	6055.103 (5912.19-6201.457)	6264.886 (6075.872-6459.758)	0.047805	12.73382
North Khorasan	5561.607 (5532.742-5590.623)	5703.929 (5657.699-5750.54)	5949.396 (5871.182-6028.663)	6205.589 (6092.454-6320.848)	6472.983 (6322.089-6627.519)	3.232083	16.75059
Qazvin	5121.154 (5097.486-5144.933)	5234.21 (5196.436-5272.258)	5428.239 (5364.666-5492.567)	5629.515 (5538.023-5722.52)	5838.324 (5716.913-5962.316)	0.628199	14.45469
Qom	5322.135 (5296.991-5347.398)	5463.877 (5423.544-5504.51)	5708.867 (5640.421-5778.146)	5965.287 (5865.96-6066.307)	6233.738 (6100.807-6369.59)	0.038829	17.9425
Semnan	5614.434 (5576.557-5652.569)	5716.035 (5655.868-5776.842)	5889.569 (5789.099-5991.781)	6068.503 (5925.038-6215.437)	6253.015 (6064.113-6447.792)	3.708804	11.25173
Sistan and Baluchistan	4909.304 (4880.446-4938.333)	5019.075 (4972.984-5065.594)	5207.573 (5129.955-5286.373)	5403.248 (5291.504-5517.371)	5606.391 (5458.063-5758.79)	-4.40444	14.37747
South Khorasan	5221.15 (5196.36-5246.057)	5340.265 (5300.684-5380.142)	5545.033 (5478.355-5612.521)	5757.771 (5661.707-5855.463)	5978.737 (5851.107-6109.145)	-2.99579	15.16734

Burden of ischemic heart disease in Iran

Tehran	5149.525 (5118.5- 5180.738)	5285.277 (5235.561- 5335.466)	5519.774 (5435.566- 5605.288)	5765.019 (5643.068- 5889.611)	6021.554 (5858.698- 6188.947)	-6.09309	17.15239
West Azarbayejan	4948.377 (4928.492- 4968.342)	5064.001 (5032.279- 5095.92)	5262.789 (5209.361- 5316.755)	5469.447 (5392.453- 5547.514)	5684.292 (5581.963- 5788.443)	-1.20725	15.46377
Yazd	5739.583 (5710.29- 5769.026)	5913.387 (5866.334- 5960.816)	6214.217 (6134.161- 6295.304)	6529.319 (6412.894- 6647.816)	6858.981 (6702.963- 7018.532)	3.825884	20.22722
Zanjan	5274.881 (5245.111- 5304.824)	5356.134 (5308.897- 5403.814)	5494.328 (5415.724- 5574.16)	5636.083 (5524.294- 5750.32)	5781.511 (5634.927- 5932.215)	-1.90888	9.544048

Table 3. The estimated age-standardized prevalence rates (ASPR) of ischemic heart disease (IHD) per 100,000 population in males, including 95% confidence intervals, are presented at 5-year intervals from 2022 to 2040, alongside the percentage changes in IHD prevalence for the periods 1990-2021 and 2021-2040 across Iran and its 31 provinces

	ASPR, 2022	ASPR, 2025	ASPR, 2030	ASPR, 2035	ASPR, 2040	Percentage change (1990-2021)	Percentage change (2021-2040)
Iran (Islamic Republic of)	7426.43 (7383.687- 7469.421)	7585.857 (7517.673- 7654.659)	7859.353 (7744.742- 7975.665)	8142.903 (7978.185- 8311.037)	8436.891 (8218.608- 8661.006)	-2.15141	14.73827
Alborz	7806.973 (7756.012- 7858.268)	7942.881 (7862.001- 8024.59)	8175.461 (8040.543- 8312.633)	8415.495 (8222.976- 8612.497)	8662.946 (8409.59- 8923.891)	1.907101	11.85004
Ardebil	7745.466 (7700.163- 7791.035)	7877.326 (7805.357- 7949.96)	8102.13 (7982.037- 8224.035)	8333.389 (8162.081- 8508.304)	8571.289 (8345.986- 8802.695)	4.187685	11.75213
Bushehr	7719.671 (7669.367- 7770.303)	7875.834 (7795.755- 7956.732)	8143.184 (8008.978- 8279.632)	8419.645 (8227.31- 8616.461)	8705.529 (8451.359- 8967.312)	1.113403	14.16074
Chahar Mahaal and Bakhtiari	7516.466 (7479.162- 7553.955)	7637.316 (7578.1- 7696.995)	7843.07 (7744.372- 7943.026)	8054.37 (7913.743- 8197.5)	8271.367 (8086.626- 8460.338)	-0.19157	11.28079
East Azarbayejan	7454.212 (7413.042- 7495.611)	7637.21 (7571.338- 7703.655)	7952.347 (7841.068- 8065.204)	8280.626 (8119.903- 8444.528)	8622.606 (8408.562- 8842.092)	-0.14868	17.03288
Fars	7230.214 (7185.312- 7275.398)	7381.998 (7310.32- 7454.381)	7642.112 (7521.664- 7764.5)	7911.427 (7738.471- 8088.278)	8190.271 (7961.318- 8425.863)	-5.15568	14.52507
Gilan	7542.951 (7491.105- 7595.158)	7677.361 (7595.082- 7760.542)	7907.663 (7770.612- 8047.152)	8145.892 (7950.632- 8345.952)	8392.158 (8135.505- 8656.847)	-1.80203	12.23844
Golestan	7899.983 (7852.322- 7947.934)	8088.898 (8012.676- 8165.846)	8413.957 (8285.32- 8544.597)	8752.222 (8566.623- 8941.858)	9104.239 (8857.333- 9358.058)	1.167663	16.60212
Hamadan	6895.304 (6855.167- 6935.677)	7003.05 (6939.388- 7067.297)	7186.421 (7080.443- 7293.987)	7374.646 (7223.819- 7528.627)	7567.857 (7369.939- 7771.101)	-1.10138	11.2499
Hormozgan	7590.366 (7546.018- 7634.975)	7766.165 (7695.287- 7837.697)	8066.95 (7947.483- 8188.213)	8378.239 (8206.133- 8553.957)	8700.818 (8472.248- 8935.556)	1.117082	16.03031
Ilam	7523.521 (7477.73- 7569.592)	7688.215 (7615.012- 7762.13)	7970.882 (7847.696- 8096.034)	8264.097 (8087.015- 8445.131)	8568.25 (8333.591- 8809.647)	1.838081	15.36585
Isfahan	7413 (7360.08- 7466.301)	7541.682 (7457.699- 7626.607)	7761.354 (7621.316- 7903.955)	7987.695 (7787.999- 8192.488)	8220.901 (7958.299- 8492.123)	-7.02068	11.5312

Burden of ischemic heart disease in Iran

Kerman	7551.281 (7492.774- 7610.248)	7746.296 (7652.493- 7841.263)	8082.562 (7923.842- 8244.528)	8433.414 (8203.942- 8669.458)	8799.488 (8493.651- 9116.614)	-5.55926	17.61926
Kermanshah	7495.529 (7441.043- 7550.414)	7639.758 (7553.025- 7727.488)	7886.27 (7741.103- 8034.164)	8140.674 (7933.001- 8353.795)	8403.243 (8129.335- 8686.399)	0.227663	13.06709
Khorasan-e-Razavi	7506.135 (7460.406- 7552.144)	7702.897 (7629.667- 7776.831)	8043.456 (7919.562- 8169.287)	8400.339 (8221.08- 8583.498)	8774.22 (8535.002- 9020.118)	-3.68153	18.0374
Khuzestan	8129.691 (8080.091- 8179.596)	8307.552 (8228.379- 8387.487)	8612.836 (8479.7- 8748.066)	8929.51 (8738.133- 9125.083)	9257.965 (9004.324- 9518.759)	3.269808	15.08424
Kohgiluyeh and Boyer-Ahmad	7283.036 (7239.526- 7326.808)	7473.836 (7404.108- 7544.222)	7803.063 (7684.979- 7922.967)	8146.866 (7975.907- 8321.503)	8505.892 (8277.684- 8740.418)	0.10546	19.29039
Kurdistan	7295.281 (7258.814- 7331.931)	7452.555 (7394.461- 7511.101)	7722.452 (7624.868- 7821.261)	8002.407 (7862.18- 8145.078)	8292.834 (8106.99- 8482.827)	-0.04367	15.01564
Lorestan	7586.293 (7543.38- 7629.45)	7735.769 (7667.412- 7804.737)	7991.515 (7876.917- 8107.787)	8255.776 (8091.537- 8423.372)	8528.843 (8311.811- 8751.588)	0.869362	14.03905
Markazi	7601.83 (7556.578- 7647.354)	7783.135 (7710.782- 7856.167)	8095.18 (7973.102- 8219.125)	8420.019 (8243.917- 8599.882)	8758.203 (8523.966- 8998.875)	1.15081	16.46043
Mazandaran	7721.806 (7674.027- 7769.882)	7845.291 (7769.486- 7921.836)	8054.807 (7928.565- 8183.06)	8269.24 (8089.527- 8452.948)	8488.883 (8253.021- 8731.488)	-0.09436	10.67728
North Khorasan	7736.689 (7690.338- 7783.319)	7916.115 (7842.076- 7990.854)	8224.634 (8099.884- 8351.307)	8545.415 (8365.691- 8729.002)	8878.961 (8640.21- 9124.31)	3.011093	16.04013
Qazvin	7166.775 (7125.145- 7208.648)	7292.024 (7225.839- 7358.817)	7505.687 (7395.142- 7617.89)	7725.651 (7567.838- 7886.771)	7952.106 (7744.394- 8165.417)	1.668808	12.25773
Qom	7404.619 (7367.478- 7441.947)	7579.399 (7519.862- 7639.413)	7885.137 (7783.986- 7987.655)	8213.961 (8066.225- 8364.618)	8575.147 (8374.394- 8781.405)	-0.05907	17.70441
Semnan	7780.69 (7729.347- 7832.373)	7898.844 (7817.505- 7981.028)	8099.777 (7964.592- 8237.251)	8305.832 (8113.729- 8502.47)	8517.139 (8265.431- 8776.487)	3.86397	10.37179
Sistan and Baluchistan	6906.901 (6866.883- 6947.153)	7049.658 (6985.886- 7114.011)	7294.336 (7187.307- 7402.958)	7547.73 (7394.14- 7704.508)	7810.169 (7606.934- 8018.83)	-4.35092	14.29495
South Khorasan	7320.839 (7285.796- 7356.05)	7490.288 (7434.298- 7546.7)	7781.821 (7687.427- 7877.373)	8084.972 (7948.885- 8223.384)	8400.089 (8219.171- 8584.98)	-1.87544	16.49119
Tehran	7163.211 (7125.316- 7201.308)	7340.206 (7279.581- 7401.334)	7645.093 (7542.67- 7748.902)	7962.812 (7814.851- 8113.564)	8293.915 (8096.82- 8495.788)	-6.03696	16.90092
West Azarbayejan	6933.353 (6894.618- 6972.306)	7062.954 (7001.389- 7125.059)	7284.439 (7181.493- 7388.853)	7512.973 (7365.749- 7663.119)	7748.787 (7554.632- 7947.891)	-2.4086	13.00491
Yazd	7954.766 (7906.399- 8003.427)	8183.733 (8106.108- 8262.098)	8579.355 (8447.545- 8713.208)	8992.915 (8801.614- 9188.331)	9424.822 (9168.947- 9687.733)	3.652666	20.17193
Zanjan	7326.618 (7281.001- 7372.52)	7425.109 (7352.924- 7498.009)	7592.14 (7472.444- 7713.777)	7762.847 (7593.167- 7936.368)	7937.322 (7715.538- 8165.558)	-1.58106	9.499161

progress in mitigating IHD risk factors from 1990 to 2009 and in improving healthcare access, although the likelihood remains low and may be influenced by unobservable factors. Moreover, this may be related to the implementation of a specific program that was later suspended or scaled back for various reasons. In another scenario this biphasic trend is likely linked to population aging, increasing metabolic risk factors, urbanization-driven lifestyle changes, longer patient survival, and enhanced disease detection through improved registration systems.

We observed a significant increase in the national prevalence of IHD, reaching 7336.1 per 100,000 population by 2040. This finding is supported by the Shi et al. [15] study, which showed a global increase in the prevalence and incidence of coronary heart disease by 2050, as IHD is a common type of CVSs. This trend may be due to individual aging, urbanization, and lifestyle changes such as increased consumption of unhealthy foods (fast foods), low physical inactivity, and more exposure to stress. Farzadfar et al. [16] predicted that by 2030, physical inactivity would increase to 36.2% in Iranian men and 26.7% in women, along with an increase in other risk factors such as obesity, diabetes, and hypertension.

Additionally, we observed a significant change in the ASPR between 1990-2021 and 2021-2040 across provinces. These differences in IHD prevalence trends can be linked to regional (provincial) disparities in socioeconomic development, healthcare infrastructure, and the prevalence of modifiable and non-modifiable risk factors, such as diabetes, obesity, lifestyle, tobacco use and hypertension [17-19]. Provinces with higher ASPRs, such as Khuzestan and Yazd, may face greater exposure to these risk factors owing to unhealthy diets, physical inactivity, and limited access to preventive services. Thus, evidence [20] shows that Yazd province has the highest prevalence of insufficient physical activity in Iran at 63.45%, followed by Khuzestan at 53.38%, which is higher than in most other provinces [21]. This underscores the need for interventions to modify lifestyle and/or control modifiable risk factors. Moreover, the highest ASPR in provinces such as Yazd, Khuzestan, and North Khorasan by 2040 can be attributed to a higher rate of hypertension and consumption of much higher amounts of salt by 2030 [16]. In contrast to the

decreasing predicted trend in Iran, Yazd and North Khorasan experienced an increasing trend in salt intake. North Khorasan has also been predicted to have higher rates of obesity and diabetes than the overall rate in Iran [16].

This once again emphasizes the need for interventions to change lifestyle and manage modifiable risk factors, as a significant portion of the burden of these diseases is rooted in modifiable risk factors. In contrast, provinces such as Hamedan, West Azerbaijan, and Sistan and Baluchestan had the lowest ASPR rates in 2021 and are expected to maintain this status until 2040, likely due to effective public health measures and education, improved healthcare delivery, and better risk factor management [22], which is likely more related to the ethnic and cultural makeup of the people of these provinces through adherence to a healthy and traditional lifestyle.

Furthermore, we observed higher ASPR for men than women at the national and provincial levels, which is consistent with global evidence in this regard [23]. This discrepancy has been attributed in part to the regulatory role of estrogen in cardiovascular disease [24, 25]. Furthermore, some evidence suggests that heavy social responsibilities and higher psychological stress in men may be triggers for men to not adhere to a healthy lifestyle, ultimately leading to excessive alcohol consumption, late night waking, smoking, high-fat diets, sedentary behavior, etc. [26-28].

Our study is the first in Iran to provide a comprehensive roadmap for IHD by 2040 using GBD data and a robust IDM model that considers the interrelationships of epidemiological indicators, including prevalence, incidence, and mortality. As a result, the findings of this study can provide valuable information for policymakers and public health professionals for future planning and resource allocation. By knowing the differences between provinces, while allocating resources, healthy lifestyle patterns or contributing factors in areas with lower prevalence rates can be used. In addition, we attempted to provide sex- and age-specific data to better understand the epidemiology of IHD in Iran. Similar to other studies, we faced some limitations: Reliance on GBD data may lead to bias due to incomplete or poor-quality health records in certain provinces, potentially affecting accuracy. However, these effects appear to be mini-

mal due to generally consistent registration systems across provinces.

Conclusion

Our study shows the increasing burden of IHD in Iran and its provinces. Our results revealed significant provincial and gender disparities in the prevalence trend, and further studies are needed to more precisely explain the origins of these inter-provincial differences by focusing on modifiable risk factors and lifestyle. It is hoped that these studies can provide a glimmer of hope for better prevention, treatment, and management of this disease in the country. On the other hand, the projected increase in IHD cases by 2040 indicates the urgent need for comprehensive public health strategies and targeted policies to control the burden of this disease, especially in high-burden and deprived provinces. This can further highlight the importance of focusing on modifiable risk factors.

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Disclosure of conflict of interest

None.

Ethical considerations

This project was approved by the Ethics Committee of Qom University of Medical Sciences, Qom, Iran (Approval No: IR.MUQ.REC.1403.196).

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Burden of ischemic heart disease in Iran

Table S1. Prevalence of ischemic heart disease (IHD) per 100,000 people under 45 years old, with 95% confidence intervals, from 2022 to 2040, along with percentage changes in age-standardized prevalence rates (ASPR) for 1990-2021 and 2021-2040 across Iran and its 31 provinces for the overall population

Location	2022	2025	2030	2035	2040	Percentage change (1990-2021)	Percentage change (2021-2040)
Iran (Islamic Republic of)	798.78 (796.47-801.1)	825.48 (821.75-829.23)	871.97 (865.57-878.42)	921.09 (911.7-930.57)	972.97 (960.27-985.83)	13.199	23.007
Alborz	854.55 (850.61-858.5)	877.92 (871.61-884.28)	918.3 (907.59-929.14)	960.54 (945-976.35)	1004.73 (983.92-1025.98)	18.416	17.924
Ardebil	829.72 (826.83-832.62)	854.6 (849.96-859.27)	897.75 (889.83-905.74)	943.08 (931.53-954.77)	990.7 (975.17-1006.47)	22.375	20.048
Bushehr	809.42 (805.8-813.06)	824.1 (818.35-829.9)	849.17 (839.55-858.9)	875 (861.24-888.97)	901.61 (883.48-920.12)	15.378	11.276
Chahar Mahaal and Bakhtiari	783.85 (780.64-787.07)	808.83 (803.66-814.04)	852.25 (843.4-861.19)	898 (885.07-911.13)	946.21 (928.77-963.98)	13.850	21.298
East Azarbayejan	802.09 (799.28-804.92)	826.47 (821.94-831.02)	868.55 (860.87-876.29)	912.29 (901.21-923.48)	957.19 (942.64-971.84)	18.949	20.350
Fars	770.37 (767.17-773.58)	804.27 (799.06-809.52)	864.13 (855.04-873.33)	928.45 (914.88-942.21)	997.54 (978.9-1016.55)	12.452	31.678
Gilan	811.25 (807.84-814.68)	835.65 (830.16-841.18)	877.96 (868.6-887.43)	922.41 (908.76-936.27)	969.11 (950.76-987.82)	16.606	19.759
Golestan	846.91 (843.55-850.29)	878.15 (872.7-883.63)	932.79 (923.4-942.27)	990.81 (976.97-1004.85)	1052.43 (1033.61-1071.59)	17.734	25.254
Hamadan	708.06 (706.2-709.92)	731.36 (728.37-734.37)	771.92 (766.79-777.09)	814.74 (807.21-822.33)	859.92 (849.75-870.21)	15.285	23.145
Hormozgan	806.88 (804.75-809.01)	835.92 (832.48-839.38)	886.66 (880.73-892.62)	940.46 (931.73-949.27)	997.51 (985.65-1009.51)	17.065	24.738
Ilam	797.69 (792.3-803.12)	831.1 (822.34-839.96)	889.93 (874.72-905.41)	952.93 (930.35-976.04)	1020.38 (989.49-1052.23)	19.346	29.358
Isfahan	797.9 (794.57-801.24)	824.3 (818.93-829.7)	870.19 (860.99-879.49)	918.59 (905.11-932.27)	969.65 (951.44-988.2)	4.950	22.343
Kerman	815.41 (812.41-818.41)	849.94 (845.07-854.85)	910.79 (902.3-919.35)	975.98 (963.36-988.76)	1045.83 (1028.52-1063.43)	10.456	29.633
Kermanshah	795.72 (792.67-798.79)	825.65 (820.71-830.63)	878.03 (869.49-886.65)	933.7 (921.09-946.48)	992.87 (975.71-1010.33)	19.119	25.622
Khorasan-e-Razavi	818.15 (814.9-821.41)	847.98 (842.72-853.28)	900.14 (891.07-909.3)	955.5 (942.15-969.05)	1014.28 (996.13-1032.75)	12.108	25.378
Khuzestan	894.53 (890.16-898.92)	933.75 (926.63-940.93)	1003 (990.59-1015.56)	1077.37 (1058.88-1096.18)	1157.26 (1131.86-1183.23)	22.577	30.386

Burden of ischemic heart disease in Iran

Kohgiluyeh and Boyer-Ahmad	749.99 (747.35-752.64)	782.16 (777.87-786.49)	838.89 (831.41-846.44)	899.73 (888.59-911.02)	965 (949.69-980.56)	13.811	30.764
Kurdistan	771.83 (768.78-774.89)	798.17 (793.26-803.11)	843.85 (835.48-852.3)	891.6 (879.47-903.85)	940.9 (924.92-956.99)	16.148	22.860
Lorestan	795.62 (791.74-799.52)	827.56 (821.25-833.9)	883.65 (872.74-894.7)	943.56 (927.4-960)	1007.53 (985.45-1030.09)	15.920	27.894
Markazi	813.68 (810.68-816.69)	837.83 (833.01-842.68)	879.68 (871.47-887.98)	923.63 (911.66-935.76)	969.77 (953.69-986.13)	19.948	19.539
Mazandaran	849.59 (846.87-852.32)	874.29 (869.92-878.68)	917.06 (909.62-924.56)	961.93 (951.09-972.89)	1008.99 (994.44-1023.75)	18.163	19.347
North Khorasan	826.46 (822.4-830.54)	857.39 (850.81-864.02)	911.52 (900.17-923.01)	969.04 (952.31-986.07)	1030.18 (1007.42-1053.45)	18.493	25.478
Qazvin	755.49 (752.62-758.38)	779.86 (775.23-784.52)	822.18 (814.25-830.18)	866.75 (855.14-878.51)	913.72 (898.06-929.65)	16.823	22.645
Qom	784.61 (779.32-789.94)	813.35 (804.79-822.01)	863.63 (848.88-878.63)	917.04 (895.32-939.28)	973.79 (944.31-1004.19)	14.084	25.984
Semnan	835.87 (831.65-840.11)	856.28 (849.54-863.08)	891.42 (880.04-902.95)	928 (911.56-944.73)	966.08 (944.2-988.47)	19.398	15.771
Sistan and Baluchistan	695.56 (693.37-697.75)	712.61 (709.12-716.13)	741.98 (736.07-747.94)	772.56 (764.01-781.2)	804.4 (793.01-815.95)	5.130	16.668
South Khorasan	753.54 (751.13-755.97)	776.24 (772.36-780.15)	815.61 (808.98-822.29)	856.97 (847.3-866.76)	900.43 (887.42-913.63)	8.210	20.471
Tehran	786.89 (782.62-791.17)	811.94 (805.07-818.87)	855.49 (843.75-867.39)	901.37 (884.22-918.85)	949.71 (926.61-973.39)	5.144	22.693
West Azarbayejan	716.68 (714.24-719.14)	736.78 (732.86-740.73)	771.53 (764.86-778.26)	807.89 (798.21-817.69)	845.94 (832.98-859.1)	14.686	19.253
Yazd	869.98 (864.85-875.15)	904.16 (895.83-912.56)	964.12 (949.73-978.73)	1028.07 (1006.79-1049.79)	1096.25 (1067.25-1126.05)	20.650	27.723
Zanjan	773.41 (771.03-775.8)	792.54 (788.73-796.36)	825.47 (819.04-831.95)	859.77 (850.47-869.18)	895.5 (883.1-908.08)	15.110	16.288

Burden of ischemic heart disease in Iran

Table S2. Prevalence of ischemic heart disease (IHD) per 100,000 people over 45 years old, with 95% confidence intervals, from 2022 to 2040, along with percentage changes in age-standardized prevalence rates (ASPR) for 1990-2021 and 2021-2040 across Iran and its 31 provinces for the overall population

Location	2022	2025	2030	2035	2040	Percentage change (1990-2021)	Percentage change (2021-2040)
Iran (Islamic Republic of)	14372.07 (14271.84-14473.02)	14699.71 (14539.83-14861.34)	15262.99 (14994-15536.77)	15848.6 (15461.5-16245.3)	16457.46 (15943.72-16987.57)	5.481	16.447
Alborz	14629.02 (14507.38-14751.69)	15018.57 (14823.68-15216.01)	15691.73 (15361.63-16028.9)	16396.07 (15917.93-16888.56)	17133.12 (16494.45-17796.52)	3.712	18.943
Ardebil	14865.01 (14749.95-14980.97)	14956.69 (14776.14-15139.43)	15110.96 (14815.53-15412.26)	15267.13 (14853.71-15691.99)	15425.23 (14891.75-15977.7)	14.434	5.034
Bushehr	14575.47 (14463.62-14688.17)	14876.03 (14697.87-15056.34)	15390.84 (15092.13-15695.44)	15923.51 (15495.32-16363.47)	16474.65 (15908.74-17060.6)	8.974	15.014
Chahar Mahaal and Bakhtiari	14334.62 (14222.38-14447.74)	14538.7 (14361.06-14718.54)	14885.27 (14590.55-15185.93)	15240.04 (14822-15669.83)	15603.2 (15056.49-16169.71)	6.874	10.240
East Azarbayegan	14260.23 (14160.16-14361)	14587.09 (14427.44-14748.49)	15148.94 (14880.35-15422.36)	15732.91 (15346.43-16129.06)	16339.88 (15827.08-16869.18)	10.879	16.651
Fars	13885.74 (13775.92-13996.44)	14295.64 (14119.18-14474.31)	15005.93 (14705.78-15312.2)	15751.56 (15315.13-16200.4)	16534.28 (15949.19-17140.76)	4.213	21.397
Gilan	14395.97 (14272.07-14520.95)	14600.51 (14404.3-14799.43)	14947.78 (14622.4-15280.5)	15303.14 (14842.08-15778.78)	15666.77 (15064.5-16293.59)	7.810	10.068
Golestan	14627.89 (14506.03-14750.77)	14923.56 (14729.5-15120.17)	15429.78 (15104.65-15761.91)	15953.31 (15487.64-16432.97)	16494.73 (15879.82-17133.43)	6.951	14.322
Hamadan	13623.35 (13517.23-13730.31)	13774.32 (13606.87-13943.82)	14030.51 (13754.21-14312.36)	14292.39 (13902.56-14693.12)	14559.91 (14052.76-15085.32)	8.664	8.645
Hormozgan	14556.7 (14424-14690.62)	14979.66 (14766.54-15195.84)	15700.2 (15338.06-16070.86)	16444.48 (15918.92-16987.33)	17216.54 (16513.89-17948.96)	6.459	20.831
Ilam	14487.47 (14368.48-14607.45)	14848.59 (14658.4-15041.24)	15470 (15149.03-15797.72)	16116.72 (15653.56-16593.5)	16789.81 (16173.56-17429.38)	7.444	17.950
Isfahan	14259.02 (14130.55-14388.65)	14440.29 (14237.16-14646.31)	14747.66 (14411.54-15091.64)	15061.75 (14586.37-15552.66)	15382.71 (14762.86-16028.65)	-1.288	8.963
Kerman	14412.76 (14286.22-14540.42)	14881.71 (14677.9-15088.36)	15696.76 (15348.67-16052.8)	16555.66 (16047.4-17080.11)	17460.84 (16776.58-18173.1)	-0.344	23.145
Kermanshah	14516.53 (14384.09-14650.2)	14869.57 (14658.26-15083.91)	15477.14 (15121.24-15841.33)	16109.51 (15596.75-16638.95)	16767.72 (16086.43-17477.53)	8.231	17.398
Khorasan-e-Razavi	14559.89 (14462.8-14657.64)	14932.73 (14777.57-15089.5)	15577.8 (15315.82-15844.21)	16253.53 (15875.03-16640.93)	16961.17 (16456.74-17480.81)	4.099	18.500
Khuzestan	15650.47 (15512-15790.17)	16069.76 (15847.93-16294.68)	16793.91 (16418.5-17177.88)	17550.99 (17007.85-18111.4)	18342.45 (17617.95-19096.62)	7.126	19.134

Burden of ischemic heart disease in Iran

Kohgiluyeh and Boyer-Ahmad	14374.78 (14263.35-14487.08)	14684.36 (14506.67-14864.23)	15215.43 (14917.05-15519.8)	15766.01 (15337.68-16206.34)	16336.81 (15769.92-16924.16)	12.571	16.713
Kurdistan	14450.82 (14338.75-14563.75)	14831.46 (14652.25-15012.86)	15488.54 (15185.61-15797.46)	16175.06 (15737.05-16625.12)	16892.34 (16308.3-17497.05)	9.200	19.074
Lorestan	14495.81 (14393.6-14598.75)	14939.38 (14774.91-15105.69)	15709.11 (15428.7-15994.6)	16518.57 (16109.9-16937.58)	17369.8 (16820.67-17936.82)	5.637	22.525
Markazi	15295.1 (15182.37-15408.67)	15564.07 (15385.03-15745.19)	16024.27 (15725.6-16328.59)	16499.74 (16073.8-16936.94)	16990.98 (16430.82-17570.15)	14.870	13.042
Mazandaran	14771.24 (14637.86-14905.83)	14942 (14731.39-15155.63)	15230.66 (14882.94-15586.51)	15524.53 (15033.88-16031.18)	15823.77 (15185.49-16488.84)	7.432	7.992
North Khorasan	15094.76 (14979.92-15210.47)	15469.25 (15285.72-15654.96)	16114.47 (15804.8-16430.16)	16787.02 (16340.17-17246)	17488.09 (16893.49-18103.44)	14.541	18.074
Qazvin	13553.9 (13462.46-13645.96)	13698.21 (13553.83-13844.12)	13942.5 (13704.11-14185.03)	14191.62 (13855.16-14536.24)	14445.7 (14007.88-14897.18)	6.277	8.171
Qom	14233.52 (14137.27-14330.42)	14643.92 (14489.31-14800.18)	15354.47 (15091.64-15621.88)	16099.58 (15717.61-16490.82)	16880.91 (16369.11-17408.69)	6.694	21.538
Semnan	15128.8 (15005.35-15253.25)	15319.03 (15124.18-15516.38)	15639.38 (15317.52-15967.95)	15963.29 (15508.85-16430.93)	16289.97 (15698.61-16903.38)	9.492	8.923
Sistan and Baluchistan	13560.76 (13477.23-13644.82)	13822.25 (13689.22-13956.57)	14269.81 (14047.01-14496.15)	14732.53 (14413.56-15058.59)	15210.97 (14789.93-15644.05)	3.067	14.309
South Khorasan	14599.66 (14510.2-14689.66)	14715.5 (14574.68-14857.68)	14910.82 (14679.38-15145.9)	15109 (14783.84-15441.29)	15310.08 (14888.89-15743.16)	8.244	6.551
Tehran	14176.46 (14091.92-14261.51)	14623.42 (14487.22-14760.9)	15400.8 (15168.12-15637.03)	16220.75 (15880.95-16567.81)	17085.73 (16628.15-17555.86)	0.355	23.093
West Azarbayejan	12816.5 (12713.44-12920.39)	13019.34 (12855.97-13184.79)	13364.83 (13093.15-13642.13)	13719.81 (13333.58-14117.21)	14084.57 (13578.29-14609.69)	6.818	11.751
Yazd	15725.24 (15621.02-15830.15)	16171.78 (16004.05-16341.27)	16946.28 (16660.53-17237.03)	17760.8 (17344.62-18187.26)	18618.05 (18058.95-19195.12)	12.803	21.151
Zanjan	14463.01 (14355.79-14571.03)	14621.83 (14452.55-14793.1)	14893.65 (14613.58-15179.13)	15175.44 (14778.76-15582.95)	15468.72 (14950.01-16005.94)	9.691	8.650