Assessing and predicting the trend of cardiovascular risk factors in 40—80-year population based on the Ira-PEN program as an integrated service in primary health care

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Abstract:

BACKGROUND: In Iran, half of all mortalities and 79% of those induced by noncommunicable diseases are attributed to cardiovascular diseases. In Iran, due to the high rate of noncommunicable diseases, a modified program (PEN) called Ira-PEN was integrated into the primary care program in health centers. The Ira-PEN program is adapted from the comprehensive WHO-PEN program to estimate the 10-year risk of cardiovascular diseases to control the main risk factors of noncommunicable diseases nationally. This study was conducted to investigate the process of service provision to determine the information needs and the necessary interventions in the comprehensive health service centers of Ardabil Province.

MATERIALS AND METHODS: The present descriptive and analytical study was conducted in the Ardabil University of Medical Sciences. It used the data available in the registration system of the Health Network. The research population consisted of all people aged between 40 and 80 who visited the comprehensive health service centers to perform risk assessment of cardiovascular strokes in the province from 2018 to the end of 2021. The collected data were added to Excel. FORCAST function was used to predict the future through a linear regression analysis. To compare the final results, which is actually a reduction in mortality due to cardiovascular diseases, the difference test of two mortality rates due to cardiovascular diseases was used in 2018 and 2021. Test of two death proportions was performed through z test and Minitab21 Software.

RESULTS: The prevalence of cardiovascular disease risk factors was as follows: history of heart attack (0.59%), history of stroke (0.51%), history of diabetes (7.9%), history of high blood pressure (15.7%), and history of prediabetics (12.8%). The probability of suffering from lipid disorder was 26.4% and BMI > 30 was 32.4%. The risk factors of hypertension, abdominal obesity, and smoking showed a decrease in the measurement of disease risk factors during 4 years.

CONCLUSIONS: Identification of the common risk factors in the region helps to focus interventions on effective prevention and treatment measures and adopt evidence-based policies in order to reduce these risk factors. Since the investigated risk factors are rooted in inappropriate behaviors and lifestyles, by modifying these behaviors and changing lifestyles, their prevalence can be reduced and reducing these risk factors will lead to a reduction in the prevalence of cardiovascular diseases.

Keywords:

Cardiovascular disease, Ira-PEN, risk assessment

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Introduction

Noncommunicable diseases account for more than 21% of all mortalities worldwide, and more than three quarters of these mortalities occur in low- and middle-income countries.[1] The results of epidemiological studies show that four major noncommunicable diseases, including heart disease and stroke, cancer, chronic respiratory disease, and diabetes, account for 28 million mortalities annually. The abovementioned diseases are the most common noncommunicable diseases in low- and middle-income countries. The World Health Organization (WHO) predicts that in the next 10 years, the greatest increase in death will be caused by cardiovascular diseases, cancer, respiratory diseases, and diabetes that occur in developing countries.[2] Also, it is estimated that the economic costs imposed on countries between 2011 and 2030 induced by the four cardiovascular diseases, cancer, diabetes, and chronic respiratory diseases will be about 34 billion dollars.[3] Cardiovascular diseases account for 60% of mortalities worldwide, and in low- and middle-income countries, 58% of mortalities under the age of 60 are induced by these diseases.[4] In the Eastern Mediterranean region, 54% of mortalities caused by noncommunicable diseases are induced by cardiovascular diseases.[5] In Iran, half of all mortalities and 79% of those induced by noncommunicable diseases are due to cardiovascular diseases. Moreover, more than 76% of the total burden of diseases and the first cause of high medical costs in Iran are due to these diseases.[6,7] The above four diseases, especially cardiovascular diseases, along with four behavioral risk factors including inactivity, unhealthy diet, and alcohol consumption and smoking, are the most important causes of death due to noncommunicable diseases. For this reason, the WHO has set the control of these diseases and their underlying risk factors as a major goal to reduce 25% of deaths caused by noncommunicable diseases by 2025.[2]

A study conducted in Iran showed that the cause of 49% of mortalities in people with hypertension, 56% in those with obesity, and 22% in tobacco smokers was cardiovascular diseases.[8] Also, other studies showed that hypertension, smoking, and obesity are the main causes of mortalities induced by cardiovascular diseases.[9,10] Special interventions have been designed to control these diseases, including a package of essential interventions for noncommunicable diseases known as PEN proposed by the WHO.[11] In Iran, due to the high rate of noncommunicable diseases, a modified version of PEN called Ira-PEN was integrated into the primary care program in health centers.[12] The Ira-PEN approach of estimating the 10-year risk for cardiovascular diseases to control the main risk factors of noncommunicable diseases in Iran is an adaptation of the WHO-PEN comprehensive plan, with a specific guideline for disease management or action based on the level of disease risk.[13]

An important intervention in this package is the 10-year risk assessment of cardiovascular problems.[11] This program employs a 10-year risk assessment approach to cardiovascular diseases. It uses risk assessment charts and places people in 10-year risk classification. Using risk assessment tools is an effective approach to disease management. This approach is cost-effective and minimizes overtreatment. It also provides a clear guideline for disease management that can be used to evaluate interventions.[13] Prediction charts of 10-year risk assessment of cardiovascular are a tool for overall risk classification and management of heart disease in primary health care (PHC). These charts use important indicators that can be easily measured to calculate the 10-year risk of heart attacks and strokes. These indicators include age, sex, systolic blood pressure, smoking status, alcohol consumption, type 2 diabetes, and total blood cholesterol.[2]

A body of research showed the positive impact of the risk assessment program on the reduced rate of risk factors in the people being followed up.[14,15] However, this program, like all interventions of the health system, needs evaluation studies. In addition, knowing the common risk factors of each region helps to focus interventions on effective preventive and therapeutic measures and to adopt evidence-informed policies to reduce these risk factors. Therefore, this study was conducted to investigate the process of service provision to assess the information needs to make the necessary interventions in the comprehensive health service centers of Ardabil Province.

Materials and Methods

Study design and setting
The present descriptive and analytical study was conducted in the Ardabil University of Medical Sciences and used the data available in the registration system of the health network system.

Cardiovascular disease risk assessment is a proper way of estimating the probability of these diseases occurring in the next 10 years. Using this approach and the integrated care of noncommunicable diseases, limited resources can be provided for the neediest population.[2] So far, several well-known risk assessment models and guidelines have been proposed. In Iran, the 10-year cardiovascular risk assessment model is used according to the WHO/ISH table of Eastern Mediterranean region B. The WHO model is adapted from the Framingham prediction model, the first cardiovascular disease prediction model,

and is adjusted based on the prevalence of risk factors and incidence of cardiovascular diseases for each region of the WHO. In this instrument, the variables included are age, sex, blood pressure, smoking, and alcohol consumption, diabetes, and blood cholesterol to assess the risk. After the required information is recorded in the integrated health system (Sib) by health-care providers, this instrument assesses a risk score as the probability of an individual suffering from heart and brain strokes in the next 10 years.

Therefore, the population is divided into four categories: low risk (10-year risk <10%), medium risk (10–20%), high (20–30%), and very high (>30%).[14]
- Heart and brain stroke risk assessment program began with the notification of the program strategy from the Ministry of Health, Treatment and Medical Education. The type of service at different levels of the service delivery system is presented in Figure 1.
- All service provider staff have been trained and received a certificate for their qualifications as shown in Figure 1.

- Risk assessment application for noncommunicable diseases is designed in an electronic system and risk assessment care services are provided accordingly.
- Based on the risk level of the disease, appropriate services are provided for each individual, including education, care services, and medical services.
- Using the referral system, the visitors are referred to different centers based on the level of risk to receive the required services.

Study participants and sampling
The research population consisted of all individuals aged 40–80 who visited comprehensive health service centers to perform risk assessment of cardiovascular diseases in Ardabil Province from 2018 to the end of 2021. The total number of visitors (to health-care centers) within 4 years was 374,829. Among them all, the risk factors investigated in the cardiovascular disease risk assessment program included the place of residence, gender, age, height, weight, BMI, cholesterol level, and blood sugar level, blood pressure, waist circumference,
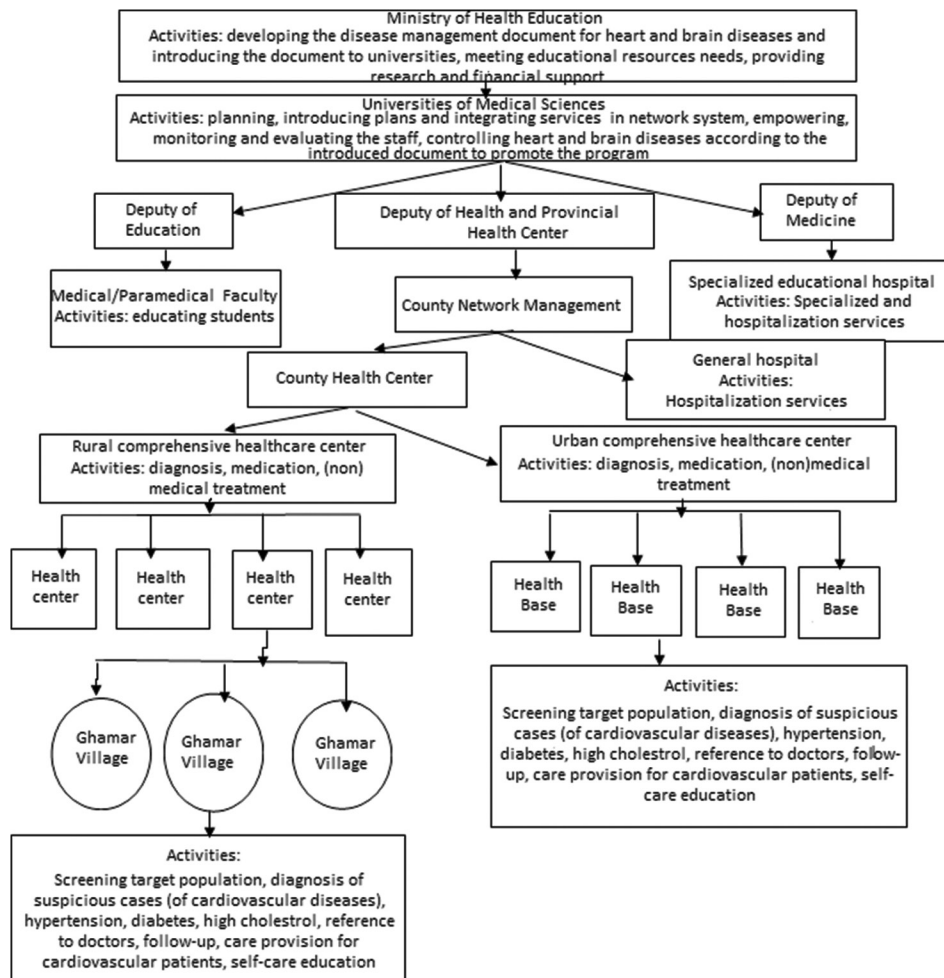

Figure 1: Service provision at different levels of Iran's network system in the cardiovascular disease risk assessment program

history of diabetes and high blood pressure, and the 10-year risk level.

Data collection tool and technique

This information had already been added to the Sib national health system and was retrieved to be analyzed in this study. The collected information was added to Microsoft Excel. FORCAST function was used to predict the future using a linear regression analysis. To compare the final results, which is the reduced mortality due to cardiovascular diseases, the difference test of two mortality rates due to cardiovascular diseases was used to compare 2018 and 2021. After collecting the data, import it into Minitab21, which is manufactured by Minitab Inc, was analyzed and the test of two death proportion was performed through z test.

Ethical consideration

This study proposal was reviewed and approved by the Research Ethics Committee in the Ardabil University Medical of Sciences (IR.ARUMS.REC.1399.152). Information will be confidential. All the methods were carried out in accordance with relevant guidelines and regulations.

Results

In this study, 374,829 individuals participated from the population receiving health-care services from the Ardabil University of Medical Sciences. The data were assessed for the risk of cardiovascular diseases. The number of male participants was 154,748 (41%), and the number of female participants was 221,081 (59%). A percentage of 22.3 of the participants were illiterate, 41.5% had an elementary and middle school education, 17.4% had a diploma and 18.6% had a university degree. A total of 2224 (0.59%) had a history of heart attack, 1923 (0.51%) had a history of stroke, 29,687 (7.9%) had a history of diabetes, and 59,587 (15.7%) had a history of high blood pressure. Diabetic, 99,017 (26.4%), patients were likely to suffer from lipid disorders and

121,538 (32.4%) of the participants had a BMI >30. Also, 11,650 (3.1%) had a risk level of 10–20%. A total number of 17,070 (0.45%) had a risk level of 20–30% [Table 1].

Figure 2 shows that during 4 years of smoking, abdominal obesity, prediabetic, suspected diabetes, lipid disorder, and BMI of 25–30 and >30 decreased. The history of heart attack and the history of brain stroke have been almost unchanged and the history of diabetes and hypertension has been increasing.

In order to predict the future trend, the FORCAST function was used using a linear regression analysis, the results of which are shown in the following figures. The predicted mean score of the tobacco control service (3.7%) will be better than the current condition according to the process of service provision, and the upper and lower limits according to the three standard deviations of the mean score also show that the process of service provision is under control [Figure 3].
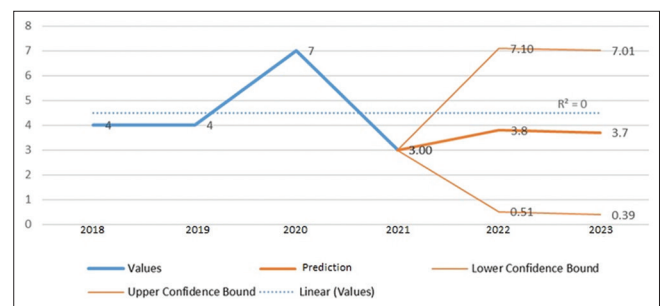
The care provision services in controlling the history of heart diseases show that the predicted mean score (0.27%) will be better than the current condition (0.42%) according to the service provision process and the upper and lower limits according to the three standard deviations of the mean score as well. It can be observed that the process of service provision is under control [Figure 4].

Table 1: Distribution of risk factors in 2018–2021

Risk factor	(%) *N*
History of heart attack	(0.59) 2224
History of stroke	(0.51) 1923
History of diabetes	(7.9) 29,687
History of high blood pressure	(15.7) 59,587
History of smoking	(7.9) 29,687
Abdominal obesity	(4.1) 15,512
Prediabetic	(12.8) 48,193
Suspected of diabetes	(2.9) 11,059
Possibility of lipid disorders	(26.4) 99,017
MBI ≥ 30	(32.4) 121,538
MBI 25–30	(37.5) 140,713
Risk level 10–12%	(3.1) 11,650
Risk level 20–23%	(0.45) 17,070
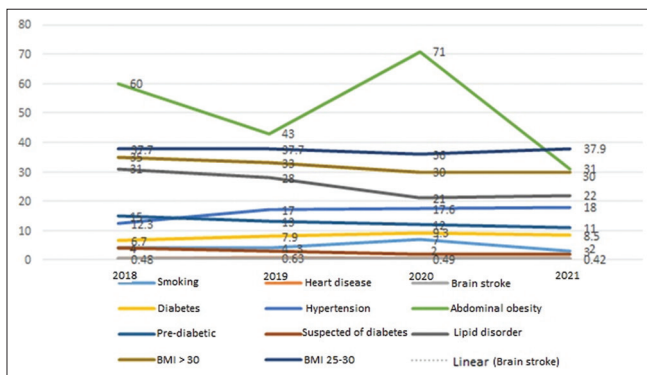
Figure 2: Controlling the risk factors of cardiovascular disease risk assessment program in the Ardabil University of Medical Sciences in 2018–2021

Figure 3: Tobacco control services in comprehensive health service centers in 2018–2021

Care services in controlling the history of cerebral disease show that the mean prediction value (0.4%) is almost equal to the current condition and the 4-year data of controlling the history of cerebral disease, except for the year 2018 when there was an increase in the variable; in the rest of the years, this risk factor has always been consistent [Figure 5].

Care services in the control of history of diabetes show that the average rate of prediction (10.1%) is higher than the current situation (8.5%) and the 4-year data of control of history of diabetes always shows a rising trend of this risk factor [Figure 6].

Care services in controlling the history of hypertension show that the average rate of prediction (21.7%) is higher than the current situation (18%) and the 4-year data of controlling the history of hypertension always shows the rising trend of this risk factor [Figure 7].

The research findings on abdominal obesity control services show that at one point the process of service

provision is affected by certain factors and the prediction average rate (26.4%) is better than the current situation (31%) in terms of the service provision process. The upper and lower limit values according to the three standard deviations of the mean score also show that the service provision process is under control [Figure 8].

The research findings on the prediabetic control services show that the predicted mean score (8.3%) is better than the current situation (11%) in terms of the service provision process and the upper and lower limits in terms of the three standard deviations. The man score also shows that the service provision process is under control [Figure 9].

Care services in controlling suspected diabetes show that the mean prediction rate (0.44%) is lower than the current situation (18%) and the 4-year hypertension history control data always show a decreasing trend of this risk factor [Figure 10].
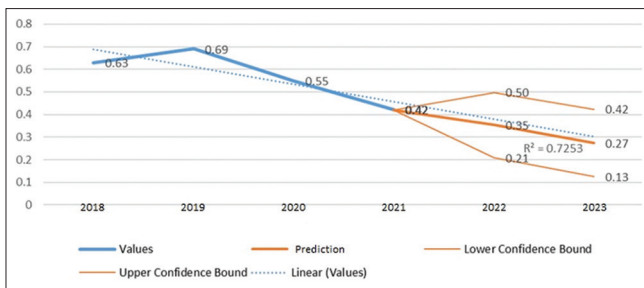

Figure 4: Heart disease history control services in comprehensive health service centers in 2018–2021
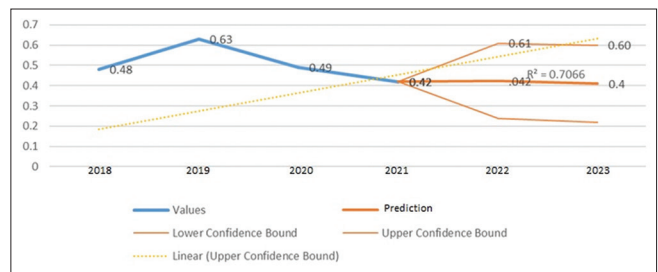

Figure 5: Brain disease history control services in comprehensive health service centers, in 2018–2021
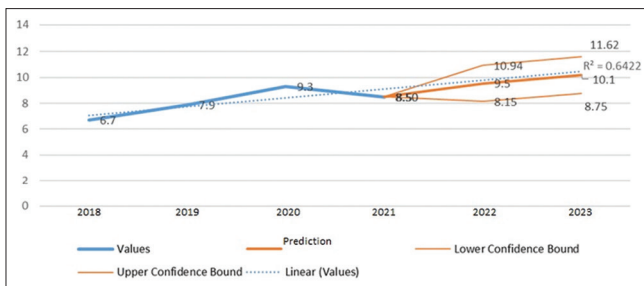

Figure 6: Diabetes history control services in comprehensive health service centers in 2018–2021
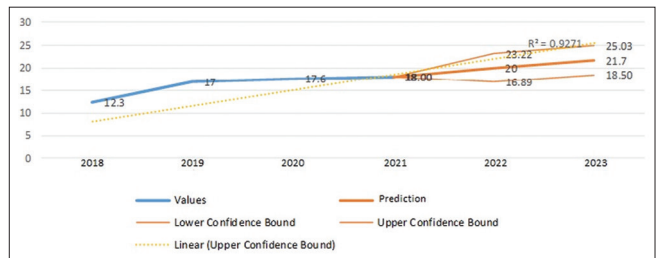

Figure 7: Hypertension history control services in comprehensive health service centers in 2018–2021
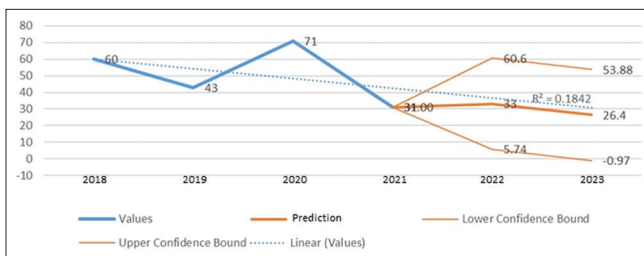

Figure 8: Abdominal obesity control services in comprehensive health service centers, in 2018–2021
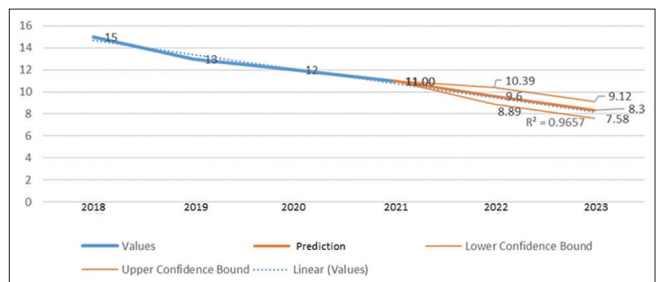

Figure 9: Prediabetic control services in comprehensive health service centers in 2018–2021

Care services in controlling lipid disorders show that the mean prediction rate (14.5%) is lower than the current situation (22%) and the 4-year data of lipid disorder control always show a decreasing trend of this risk factor [Figure 11].

Care services in controlling the BMI ≥30 show that the mean prediction rate (26%) is lower than the current situation (30%) and the 4-year control data of BMI ≥30 always show a decreasing trend of the risk factor [Figure 12].

Care services in controlling the BMI of 25–30 show that the mean prediction rate (37.4%) is almost equal to the current situation (37.9%) and the 4-year data of controlling the BMI of 25–30, except for the year 2019 which witnessed a drop of BMI, in other years always showed a consistent progress of this risk factor [Figure 13].

To compare the final results, which is actually a reduction in mortality due to cardiovascular diseases, the difference test of two mortality rates induced by cardiovascular diseases in 2018–2021 was used. The results showed a significant difference between the two mortality rates in the 4-year return, and this finding is consistent with how to improve the provision of cardiovascular disease risk assessment services [Table 2].

Discussion

This study aimed to assess the effect of the Ira-PEN program as an integrated service in PHC, and reducing the mortality rate of cardiovascular diseases in patients aged 40–80 years in Ardabil Province. Today, different measurement instruments are used to assess the risk level of cardiovascular diseases to control the disease and reduce the mortality rate. These instruments include the heart disease fact questionnaire, health beliefs related to CVD-perception measurement, healthy eating survey, risk perception scale, the heart disease, and WHO's step-wise approach to monitor chronic disease factors.[16] In Iran, the 10-year cardiovascular risk assessment model is used according to the WHO/ISH Eastern Mediterranean Region B table.[14]

The present findings show a relatively high prevalence of some risk factors of cardiovascular diseases, including the history of hypertension, prediabetes, the possibility of lipid disorders, and high BMI in the target population. In another study by Jahani *et al.*,[14] conducted under the title of "Analyzing the results of the cardiovascular disease risk assessment program," a relatively high prevalence of cardiovascular disease risk factors was reported. The same study showed that the variables of age, blood cholesterol level, history of diabetes, and history of high blood pressure have a significant relationship with the 10-year risk of cardiovascular disease.[14]

Mohebbi quoted by Martiniuk Uncontrolled BP is a major risk factor for cardiovascular complications and responsible for up to 70% of cardiovascular disease burden in the Asia-Pacific region.[17] Van der Aalst *et al*.'s[18] study showed that having diabetes and high blood pressure puts people at a higher risk level. Based on this, in Iran, based on Ira-PEN instructions and in the
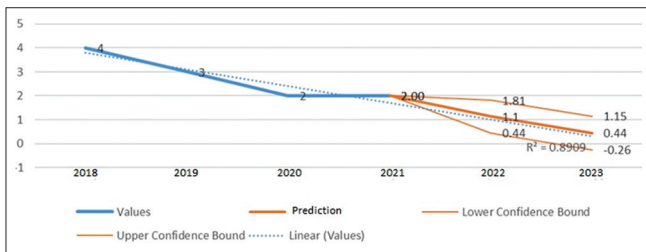

Figure 10: Suspected diabetes control services in comprehensive health service centers in 2018–2021
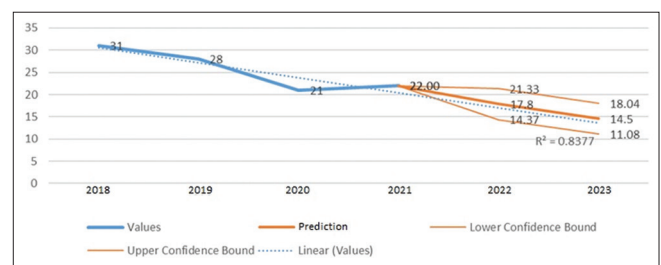

Figure 11: Lipid disorder control services in comprehensive health service centers in 2018–2021
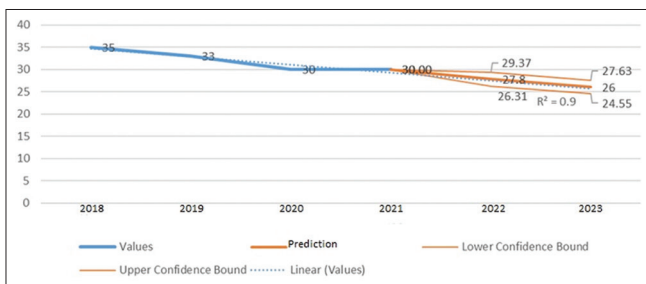

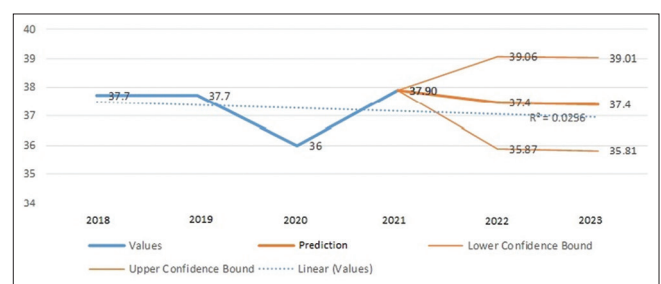**Figure 12:** Control services for BMI ≥30 in comprehensive health service centers in 2018–2021

Figure 13: Control services for the BMI of 25–30 in comprehensive health service centers in 2018–2021

Table 2: The difference test of two mortality rates induced by cardiovascular diseases in 2018–2021

Year	Total mortalities	Induced by cardiovascular diseases	Ratio	Mean ratio difference	Confidence interval	*P*
2018	5845	2583	0.441916	0.0539332	0.037305, 0.070562	0.001
2021	7972	3093	0.387983			

form of referral system, the patients' diabetes and high blood pressure are identified and comprehensive care, referral to higher levels, and tests are done for them.[2]

In another longitudinal study, Islami *et al*.[19] investigated the prevalence of the risk factors of cardiovascular diseases in people over 24 years of age between 2002 and 2014. They found the prevalence of all the risk factors increased during this time Similarly, Chandra *et al*.[20] reported hypertension (31%), smoking (26%), diabetes (23%), and obesity (20%) as the most common risk factors. The same study showed that the major barrier to the prevention of heart disease is the patient him/herself. That is due to the unhealthy lifestyle and inactivity.[20] The prevalence of cardiovascular disease risk factors in Iran for those above 40 years, including hypertension, diabetes, high LDL-C (Low Density Lipoprotein Cholesterol), low HDL-C (High Density Lipoprotein Cholesterol), high triglyceride, high cholesterol level, obesity, and smoking, was, respectively, 42.2%, 18.7%, 58.9%, 52.3%, 52.7%, 65.4%, 26.4%, and 13%.[21]

This study showed that the protocol developed to reduce the mortality rate of heart diseases within the 4 years of implementing the plan was effective and some risk factors were adequately controlled at the community level. Yet, it was not as effective in reducing some factors. Blood pressure, abdominal obesity, and smoking are the risk factors that show a decrease in the measurement of disease risk factors within 4 years, and such a decrease can be observed in some other studies. Several studies showed that screening for heart diseases in high-risk populations can reduce cholesterol and the assessed risk score.[16,22,23] Some risk factors, such as family history, ethnicity, and age, cannot be controlled. However, risk factors that can be controlled include smoking, alcohol consumption, hypertension, obesity, inactivity, diabetes, and unhealthy diet.[20,24] Well-established and modifiable cardiovascular disease risk factors include hypertension, high blood cholesterol, diabetes, physical inactivity, obesity, poor diet, and smoking.[16]

In a body of research, the interventions used include the use of cardiovascular disease risk assessment by health-care professionals to modify and recommend suitable lifestyles and necessary treatments, and interventions in the risk assessed for each individual. The aim was to understand, influence, and correct behavior and reduce the real risk, estimate the risk based on the model, and provide it to the patient and doctor for making

the right intervention in, for example, the lifestyle, consultation and exercise, systematic presentation of the cardiovascular disease risk score by the doctor, or health-care provider for intervention. Reducing the total level of cholesterol, LDL, systolic blood pressure, diastolic blood pressure, smoking cessation, exercise, diet, drug treatment, quality of life and costs, and assessing the risk of cardiovascular disease using the risk assessment instrument for the at-risk population requires a multifactorial intervention.[25-29] Due to the current condition of cardiovascular disease risk factors, it is essential to use health promotion strategies to prevent and control the risk factors. An early diagnosis of the disease and treatment of acute and chronic cardiovascular diseases is essential to reduce the burden of cardiovascular diseases.[30] Changing and modifying cardiovascular disease risk factors can reduce up to 90% of heart attacks.[31] The Iranian health system is a mixed of public, private, and non-government organizations involving in financing and delivery of healthcare services. The Ministry of Health and Medical Education is responsible for financing, policy making, planning, and controlling healthcare organizations at the national level. Medical universities have the same role at the provincial level. The district health network delivers primary healthcare (PHC) services and the hospital network delivers specialized healthcare services. The primary goal of the health system is to promote and maintain the health and well-being of the population while preventing and controlling diseases.[32] Therefore, At risk, For people should be planned comprehensive, simple, understandable, and appropriate training programs in accordance with healthy lifestyle methods to improve the quality of life.[33] But selecting educational materials should be based on target groups' need assessments, accessibility, and availability, but considering new design educational materials should be assessed in tailoring interventions.[34] Implementing educational, environmental, legal strategies, and intersectoral cooperation can improve lifestyle behaviors and reduce physical and metabolic risk factors and ultimately reduce the incidence of cardiovascular disease.[19]

There is research evidence that conducting studies to analyze the results of risk assessment in different populations helps to find the most important local risk factors and make long-term planning and use intervention measures for disease management.[14] In the national document on noncommunicable diseases, Iran made commitment to reduce the risk of premature death (due to cardiovascular diseases) by 25%. Therefore,

it is necessary to use multisector cooperative role and an integrated plan for a coherent and comprehensive response.[35,36] The present findings showed a statistically significant difference between the two mortality rates in the 4-year time span (2018–2021) and this finding is consistent with the improvement of the provision of cardiovascular disease risk assessment services. Chandra shows that cardiovascular risk factors are among the most important causes of mortality in India, so this study suggests the management of risk factors, and an early diagnosis as an effective method for the prevention and treatment.[20] In Iran, despite the effectiveness of the program in risk assessment, care and follow-up are problematic.[35] However, there are certain opportunities in Iran that can be used as for disease prevention and lifestyle promotion. Examples are an effective PHC structure, risk factor prevention program, heart disease plan, and vascular plan in the network system, a national document for the prevention of noncommunicable diseases, diagnostic and therapeutic technologies at the national level, improving the knowledge of health-care providers and policy makers in CVD prevention and control, and provision of secondary prevention and rehabilitation services.[21] Assessing and predicting the trend of cardiovascular risk factors in the 40–80-year population covered by the Ardabil University of Medical Sciences to manage these risk factors was one of the strengths of this project.

Limitation and recommendation

One of the limitations of this research may be that many other variables on the risk of contracting these diseases are effective, which were not considered in this research. It is suggested that the influence of variables such as factors, economic and social, to be examined in other studies and similar studies in the country, the integrated information of the most common risk factors of diseases should be done cardiovascular.

Conclusion

This study showed a relatively high prevalence of some risk factors for cardiovascular diseases, including a history of hypertension, prediabetes, possibility of lipid disorders, and high BMI in the research population. Identification the common risk factors in the region helps to focus interventions on effective prevention and treatment measures and adopt evidence-based policies in order to reduce these risk factors. Since the investigated risk factors are rooted in inappropriate behaviors and lifestyles, by modifying these behaviors and changing lifestyles, their prevalence can be reduced and reducing these risk factors will lead to a reduction in the prevalence of cardiovascular diseases. It is suggested to implement intervention and educational plans to improve lifestyle. Although recommending lifestyle modification is an important task of a nurse/health-care provider, the participation of doctors in the above training on lifestyle change will be truly effective. It is also suggested to provide population-wide community-based strategies, including an electronic self-care interface, in order to improve the lifestyle.

Conflicts of interest

There are no conflicts of interest.

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