Risk Management and Healthcare Policy Dovepress

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Prevalence and Associated Factors of Self-Reported Coronary Heart Disease: A Population-Based Cross-Sectional Survey in Tianjin

He Jiao[1], Yingyi Zhang[2], Zhigang Guo[3]

[1]Medical School, Tianjin University, Tianjin, People's Republic of China; [2]Department of Cardiology, Chest Hospital, Tianjin University, Tianjin, People's Republic of China; [3]Department of Cardiac Surgery, Chest Hospital, Tianjin University, Tianjin, People's Republic of China

Correspondence: Yingyi Zhang, Department of Cardiology, Chest Hospital, Tianjin University, No. 261 Taierzhuang South Road, Jinnan District, Tianjin, 300222, People's Republic of China, Tel +86-22-88185081, Email zyyzh2010@126.com; Zhigang Guo, Department of Cardiac Surgery, Chest Hospital, Tianjin University, No.261 Taierzhuang South Road, Jinnan District, Tianjin, 300222, People's Republic of China, Email zhigangguo2022@126.com

Objective: To describe the prevalence of self-reported coronary heart disease (CHD) and assess the influence of varied risk factors on it in Tianjin.

Methods: This study included a total of 102,576 individuals aged 35 to 75 from 13 community health centers and grassroots hospitals in Tianjin. Basic information, questionnaire responses, physical examinations, and laboratory tests of each participant were researched, and documented. Participants were categorized into CHD group and non-CHD group. Multivariate logistic regression was utilized to evaluated the relationships between associated factors and CHD.

Results: The prevalence of self-reported CHD was 2.56%, 3.97% among men and 1.69% among women. In multivariate logistic regression analysis, older age (41–65 years: OR: 7.37, 95% CI: 4.56–11.94; >65 years: OR:17.88, 95% CI: 11.02–29.01), female sex (OR: 0.40, 95% CI: 0.36–0.44), education (sedentary level: OR: 0.88, 95% CI: 0.79–0.97; high level: OR: 0.74, 95% CI: 0.63–0.87), family annual income (10,000–50,000 yuan: OR: 0.68, 95% CI: 0.60–0.77; >50,000 yuan: OR: 0.71, 95% CI: 0.62–0.82), recently drinking habits (2–4 times /month: OR: 0.75, 95% CI: 0.63–0.90; 2–3 times/week: OR: 0.69, 95% CI: 0.56–0.86; >4 times/week: OR: 0.72, 95% CI: 0.63–0.83), obesity (OR: 1.17, 95% CI: 1.07–1.28), central obesity (OR: 1.51, 95% CI: 1.33–1.71), hypertension (OR: 1.60, 95% CI: 1.43–1.80), dyslipidemia (OR: 0.90, 95% CI: 0.83–0.98), diabetes mellitus (OR: 2.02, 95% CI: 1.85–2.19), stroke (OR: 1.42, 95% CI: 1.24–1.63), family history (CVD: OR: 4.48, 95% CI: 4.00–5.01; stroke: OR: 1.83, 95% CI: 1.58–2.12) were associated with CHD ($P < 0.05$).

Conclusion: These findings highlight growing concerns regarding the escalating rates of CHD. Implementing multifaceted, population-based interventions is crucial to mitigate the burden of cardiovascular conditions.

Clinical Trial Registry Number: The study received approval from the Ethics Committee of Tianjin Chest Hospital (approval number: 2018KY-003-01). Written informed consent was obtained from all survey participants.

Keywords: coronary heart disease, hypertension, diabetes, smoking

Introduction

Cardiovascular disease (CVD) is the single largest cause of mortality globally, with estimated 17.9 million individuals succumbing to CVD in 2019, accounting for 32% of all deaths worldwide.[1] The impact of CVD extends beyond the loss of lives, significantly driving up healthcare costs, notably in developing world including China. It is projected that the global economic burden attributable to CVD will soar to a staggering $1.002 trillion in 2020.[2]

Coronary heart disease (CHD) stands as a predominant form of cardiovascular diseases, with risk factors like genetic predisposition, social surroundings, and lifestyle choices playing pivotal roles in its development. More than 90% of CHD cases manifest in individuals possessing at least one risk factor.[3] Notably, some factors such as overweightness, smoking, alcohol consumption, sedentary behavior and unhealthy diet can be modifiable.[4]

Received: 21 September 2024
Accepted: 28 November 2024
Published: 12 December 2024

In recent years, China has witnessed a surge in the prevalence of risk factors linked to CHD. This mounting tendency highlights the imperative necessity for proactive measures to mitigate the growing burden of CHD within the population. The prevalence of CHD varies by geographic region.[5] Tianjin, the largest port city in northern China, currently lacks large-scale epidemiologic studies on CHD. The purpose of this study is to delineate the prevalence of self-reported CHD and assess the influence of varied risk factors in Tianjin.

Methods

Data Source and Study Population

The data for this study were sourced from the Tianjin Early Screening and Comprehensive Intervention Program for Individuals at High Risk of Cardiovascular Disease,[6] a population-based cross-sectional study, between 2016 and 2020. The program employed convenience sampling to select a representative cohort from the general population aged 35 to 75 years old, residing in community health centers and grassroots hospitals in Tianjin for a minimum period of six months, and who voluntarily agreed to participate in the survey. The study received ethical approval from the Ethics Committee of Tianjin University Chest Hospital (approval number: 2018KY-003-01), according to the standards of the Declaration of Helsinki. Written informed consent was duly obtained from all participants in the survey. Initially, the study enrolled 123,306 participants. After excluding subjects with missing data, unclear entries, and significant discrepancies, a grand total of 102,576 individuals were ultimately included in the final analysis.

Data Collection

The screening mainly consisted of four parts: basic information, on-site questionnaire, physical examination and laboratory tests. Basic information encompassed details such as gender, age, education level, family annual income, marital status, occupation, and contact information. In on-site questionnaire, participants were queried about their smoking and alcohol consumption habits, medication history (including blood pressure, blood lipids, blood glucose, and antiplatelet drugs), past medical conditions (including hypertension, diabetes mellitus, stroke, and malignant tumors), as well as family history of CHD, and stroke. Physical examination involved blood pressure, heart rate, height, weight, and waist circumference (WC) in the early morning fasting state. Laboratory examination covered a fasting fingertip blood rapid glucose and lipid test. The survey data were double-entered to minimize possible errors during data entry.

Definition of Relevant Indicators and Diagnostic Criteria

Hypertension was defined as systolic blood pressure (SBP) $\geq$ 140 mmHg and/or diastolic blood pressure (DBP) $\geq$ 90 mmHg, or a previous diagnosis of hypertension.[7] Dyslipidemia referred to total cholesterol (TC) $\geq$ 5.2 mmol/L, or low-density lipoprotein cholesterol (LDL-C) $\geq$ 3.4 mmol/L, or high-density lipoprotein cholesterol (HDL-C) $\leq$ 1.0 mmol/L, or triglyceride (TG) $\geq$ 1.7 mmol/L, or a previous diagnosis of dyslipidemia.[8] Diabetes mellitus was defined as blood glucose $\geq$ 7.0 mmol/L, or a previous diagnosis of diabetes mellitus.[9] Obesity referred to body mass index (BMI) $\geq$ 28 kg/m^2, and central obesity referred to WC $\geq$ 85 cm in men and WC $\geq$ 80 cm in women.[10] Patients with CHD were identified on the basis of previous diagnostic certificates from hospitals at the county level or above, defining patients as those with a self-reported history of myocardial infarction or those who had undergone percutaneous coronary intervention treatment or coronary artery bypass grafting surgery.[11]

Statistical Analysis

SPSS 24.0 software was utilized for statistical analysis. Continuous data were represented as mean ± standard deviation (x ± s), and count data were expressed as the number of cases and composition ratio [n (%)]. Comparative analyses were conducted on all baseline characteristics, with continuous data analyzed using the *t*-test and count data analyzed using the $\chi 2$ test or Fisher's exact test. Variables with a significance level of $P < 0.1$ in the univariate logistic regression analysis were included in the multivariate logistic regression model to investigate the primary factors influencing CHD, with $P < 0.05$ indicating a statistically significant difference.

Results

Sample and Self-Reported CHD Prevalence Characteristics

The sample included 102,576 individuals (35–75 years; with 56 median age), 61.72% were female, majority (98.10%) belonged to Han ethnic group, 54.23% resided in town, 93.32% were married, 15.40% had higher education, and 33.19% had annual household incomes over 50,000 yuan. 16.59% smoked frequently, and 8.09% recently drank alcohol more than four times a week. One in four individuals (25.37%) had obesity, 75.10% central obesity, 65.19% hypertension, 58.79% dyslipidemia, 20.13% diabetes mellitus, and 3.69% stroke. One in twenty-five individuals (4.47%) had family history of CVD, and 3.31% had family history of stroke. The prevalence of self-reported CHD was 2.56% (Table 1).

Table 1 Sample and Coronary Heart Disease Characteristics Among Cohort

Variable	Sample (n)	Self-Reported CHD (n)	Detection Rate (%)	χ^2 value	*P* value
All	102,576	2628	2.56		
Age (years)				1131.09	<0.001
≤40	9663	17	0.18		
41–65	72,065	1398	1.94		
>65	20,848	1213	5.82		
Sex				507.57	<0.001
Male	39,261	1560	3.97		
Female	63,315	1068	1.69		
Nationality				0.19	0.66
Han	100,623	2581	2.57		
No-Han	1953	47	2.41		
Residence				0.9	0.34
Countryside	46,954	1179	2.51		
Town	55,622	1449	2.61		
Marital status				5.41	0.02
Unmarried	95,722	2423	2.53		
Married	6854	205	2.99		
Education				148.85	<0.001
Primary	17,430	641	3.68		
Secondary	69,345	1739	2.51		
High	15,801	248	1.57		
Family annual income (yuan)				40.72	<0.001
<10,000	8557	343	4.01		
10,000–50,000	59,974	1481	2.47		
>50,000	34,045	804	2.36		
Smoking				46.07	<0.001
Never	83,186	2003	2.41		
Occasionally	2371	60	2.53		
Frequently	17,019	565	3.32		
Recent drinking habits				51.93	<0.001
Never	78,364	1851	2.36		
< 1 time/month	7008	234	3.34		
2–4 times/month	5423	142	2.62		
2–3 times/week	3487	97	2.78		
> 4 times/week	8294	304	3.67		
Obesity				147.23	<0.001
No	76,549	1694	2.21		
Yes	26,027	934	3.59		

(*Continued*)

Table 1 (Continued).

Variable	Sample (n)	Self-Reported CHD (n)	Detection Rate (%)	χ^2 value	*P* value
Central obesity				237.66	<0.001
No	25,540	317	1.24		
Yes	77,036	2311	3		
Hypertension				449.08	<0.001
No	35,708	404	1.13		
Yes	66,868	2224	3.33		
Dyslipidemia				7.25	0.01
No	42,275	1016	2.4		
Yes	60,301	1612	2.67		
Diabetes mellitus				753.11	<0.001
No	81,923	1542	1.88		
Yes	20,653	1086	5.26		
Stroke				380.09	<0.001
No	98,790	2345	2.37		
Yes	3786	283	7.47		
Family history of CVD				1380.6	<0.001
No	97,991	2122	2.17		
Yes	4585	506	11.04		
Family history of stroke				413.7	<0.001
No	99,183	2357	2.38		
Yes	3393	271	7.99		

Abbreviations: CHD, coronary heart disease; CVD, cardiovascular disease.

Associations with Self-Reported CHD Prevalence

Univariate logistic regression analysis revealed that older age (41–65 years: OR: 11.23, 95% CI: 6.95–18.12; >65 years: OR: 35.05, 95% CI: 21.71–56.61), female (OR: 0.41, 95% CI: 0.38–0.45), unmarried (OR: 1.19, 95% CI: 1.03–1.37), education (secondary level: OR: 0.67, 95% CI: 0.61–0.74; high level: OR: 0.42, 95% CI: 0.36–0.48), family annual income (10,000–50,000 yuan: OR: 0.67, 95% CI: 0.61–0.74; >50,000 yuan: OR: 0.58, 95% CI: 0.51–0.66), smoking frequently (OR: 1.39, 95% CI: 0.51–0.66), recently drinking habits (<1 time/month: OR: 1.43, 95% CI: 1.24–1.64; >4 times/week: OR: 1.57, 95% CI: 1.39–1.78), obesity (OR: 1.64, 95% CI: 1.52–1.78), central obesity (OR: 2.46, 95% CI: 2.19–2.77), hypertension (OR: 3.01, 95% CI: 2.70–3.35), dyslipidemia (OR: 1.12, 95% CI: 1.03–1.21), diabetes mellitus (OR: 2.89, 95% CI: 2.67–3.13), stroke (OR: 3.32, 95% CI: 2.92–3.78), and family history (CVD: OR: 5.60, 95% CI: 5.06–6.21; stroke: OR: 3.57, 95% CI: 3.13–4.06) were closely related to CHD ($P < 0.05$) (Table 2).

The above 15 statistically significant factors identified from the univariate logistic regression analyses were included in the multivariate logistic regression model. The regression process employed the backward method for variable selection, and the results are presented in Table 2. The risk of CHD varied across age groups, with individuals aged 41–65 and over 65 years being 7.37 and 17.88 times more likely to develop CHD than those aged 40 years or younger, respectively (both $P < 0.001$). This suggested an increasing risk of CHD with advancing age in the study population. Females were 0.40 times less likely to develop CHD than males ($P < 0.001$), indicating a higher likelihood of CHD in males within this population.

Individuals with secondary education or higher were 0.88 and 0.74 times more likely to develop CHD than those with elementary education or lower ($P < 0.001$), indicating a gradual decrease in the risk of CHD with higher levels of education. There were differences in the risk of CHD based on annual household income levels. Individuals with annual household incomes of 10,000–50,000 yuan or higher had 0.68 and 0.71 times higher likelihood, respectively, compared to those with incomes below 10,000 yuan (both $P < 0.001$). In addition, regarding alcohol consumption, the difference in the risk of CHD between those who recently drank <1 drink/month and non-drinkers was not statistically significant ($P =$

Table 2 Univariate and Multivariable Associations with Self-Reported CHD

Variable	Crude OR (95% CI)	*P* value	Adjusted OR (95% CI)	*P* value
Age (years)				
≤40	1 (Reference)		1 (Reference)	
41–65	11.23 (6.95, 18.12)	<0.001	7.37 (4.56, 11.94)	<0.001
>65	35.05 (21.71, 56.61)	<0.001	17.88 (11.02, 29.01)	<0.001
Female	0.41 (0.38, 0.45)	<0.001	0.4 (0.36, 0.44)	<0.001
No-Han ethnic group	0.94 (0.70, 1.25)	0.66		
Residence in town	1.04 (0.96, 1.12)	0.34		
Unmarried	1.19 (1.03, 1.37)	0.02		
Education				
Primary	1 (Reference)		1 (Reference)	
Secondary	0.67 (0.61, 0.74)	<0.001	0.88 (0.79, 0.97)	0.01
High	0.42 (0.36, 0.48)	<0.001	0.74 (0.63, 0.87)	<0.001
Family annual income (yuan)				
<10,000	1 (Reference)		1 (Reference)	
10,000–50,000	0.61 (0.54, 0.68)	<0.001	0.68 (0.6, 0.77)	<0.001
>50,000	0.58 (0.51, 0.66)	<0.001	0.71 (0.62, 0.82)	<0.001
Smoking				
Never	1 (Reference)			
Occasionally	1.05 (0.81, 1.36)	0.7		
Frequently	1.39 (1.27, 1.53)	<0.001		
Recent drinking habits				
Never	1 (Reference)		1 (Reference)	
< 1 time/month	1.43 (1.24, 1.64)	<0.001	1.04 (0.9, 1.2)	0.63
2–4 times/month	1.11 (0.93, 1.32)	0.23	0.75 (0.63, 0.9)	<0.01
2–3 times/week	1.18 (0.96, 1.45)	0.11	0.69 (0.56, 0.86)	<0.01
> 4 times/week	1.57 (1.39, 1.78)	<0.001	0.72 (0.63, 0.83)	<0.001
Obesity	1.64 (1.52, 1.78)	<0.001	1.17 (1.07, 1.28)	<0.001
Central obesity	2.46 (2.19, 2.77)	<0.001	1.51 (1.33, 1.71)	<0.001
Hypertension	3.01 (2.7, 3.35)	<0.001	1.6 (1.43, 1.8)	<0.001
Dyslipidemia	1.12 (1.03, 1.21)	0.01	0.9 (0.83, 0.98)	0.01
Diabetes mellitus	2.89 (2.67, 3.13)	<0.001	2.02 (1.85, 2.19)	<0.001
Stroke	3.32 (2.92, 3.78)	<0.001	1.42 (1.24, 1.63)	<0.001
Family history of CVD	5.6 (5.06, 6.21)	<0.001	4.48 (4, 5.01)	<0.001
Family history of stroke	3.57 (3.13, 4.06)	<0.001	1.83 (1.58, 2.12)	<0.001

Abbreviations: CHD, coronary heart disease; CVD, cardiovascular disease.

0.63), whereas the risk of CHD in those who recently drank 2–4 times/month, 2–3 times/week and >4 times/week was 0.75 times ($P < 0.01$), 0.69 times ($P < 0.01$) and 0.72 times ($P < 0.001$).

Obese individuals had a 1.17 times higher risk of CHD compared to non-obese individuals ($P < 0.001$). Those with central obesity were 1.51 times more likely to have CHD than those without central obesity ($P < 0.001$). Individuals with hypertension had a 1.60 times higher risk of developing CHD compared to those without hypertension ($P < 0.001$). Those with dyslipidemia were 0.90 times more likely to develop CHD than those with normal lipid levels ($P = 0.01$). The risk of CHD was higher in individuals with diabetes, with a 2.02 times higher likelihood compared to those without diabetes ($P < 0.001$). Those who had experienced stroke had 1.42 times higher risk of developing CHD than those without stroke ($P < 0.001$).

Regarding family history, individuals with family history of CHD were 4.48 times more likely to develop the condition than those without such a history ($P < 0.001$). Similarly, individuals with family history of stroke had a 1.83 times higher risk of developing CHD than those without such a history ($P < 0.001$).

Discussion

Comparison of the Prevalence of Self-Reported CHD with Other Regions

Data from various sources reveal varying prevalence rates of self-reported CHD across different regions. In the United States, the NHANES (National Health and Nutrition Examination Survey) indicated an age-adjusted prevalence of 6.0% among adults aged 18 and above.[11] In the UK, the Quality and Outcomes Framework reported hospital-diagnosed rates of around 3% in England and 4% in Scotland, Wales, and Northern Ireland.[12] Iran's SuRFNCD-2011 (the Surveillance of Risk Factors of Non-Communicable Diseases) survey estimated a national prevalence of 5.3% for self-reported CHD.[13] Data from China's Early Screening and Comprehensive Intervention Program for People at High Risk of Cardiovascular Disease revealed a notably lower national prevalence rate of 2.24% among adults aged 35–75 years.[5] Compared with other studies, the prevalence of CHD in China is relatively low.

This study revealed that the overall detection rate of CHD among permanent residents aged 35–75 years in 13 communities in Tianjin was 2.56%, with rates of 3.97% in men and 1.69% in women, which was slightly exceeded the national detection rate.[5] Data from the Ministry of Health indicated significant regional variations in CHD detection rates across China, with notably higher rates in northern regions and cities.[14] Compared with previous studies, the current study's findings were lower than the CHD detection rate in the ≥18-year-old population in Chaoyang District, Beijing (4.95%),[15] lower than the ≥40-year-old population in Yangpu District, Shanghai (7.16%),[16] the ≥15-year-old population in Yuzhong District, Chongqing City (2.91%),[17] the urban population of ≥20-year-old population in Qiqihar City, Heilongjiang Province (5.9%),[18] individuals aged 18–79 years in rural areas of Henan Province (5.39%),[19] and closely aligned with the CHD detection rate among people aged 30–79 years in Chengdu (2.64%),[20] However, it surpassed the CHD detection rate among individuals aged ≥65 years in Shenzhen (2.42%).[21] These disparities may be attributed to the demographic composition of the survey participants, as well as factors such as economic status, geographical conditions, healthcare infrastructure, lifestyle choices, and cultural characteristics of the region.

Analysis of Factors Influencing Self-Reported CHD

The development of CHD is a complex process influenced by a mix of genetic, environmental, and various other factors. Multifactorial analysis indicated that advancing age, obesity, central obesity, hypertension, dyslipidemia, diabetes, stroke, and family history of CHD and stroke are all risk factors for coronary heart disease among permanent residents aged 35–75 years in Tianjin. Conversely, being female, having a higher education level, and a higher annual family income serve as protective factors against the development of CHD.

The increased risk of developing CHD with increasing age is consistent with previous studies.[22] This may be the result of a series of organ and tissue aging phenomena triggered by ageing, which causes slowing down of coronary blood flow in the body, resulting in massive myocardial ischaemia, and ultimately leading to CHD.[23] The study also discovered that women served as a protective factor against the prevalence of CHD. This phenomenon is likely attributed to the elevated levels of estrogen in women, which offer a degree of protection to the endothelium of blood vessels, thereby mitigating and postponing the risk of coronary heart disease. In addition, the study revealed that high education and annual household income levels act as protective factors against CHD. This is because individuals with high education and income levels have increased access to health knowledge about CVD and exhibit a heightened health awareness. Consequently, they are less exposed to associated risk factors.

The impact of alcohol consumption on CHD has long been controversial. The univariate analysis in this study indicated that the detection rate of CHD was higher in the drinking than the non-drinking population. After adjusting for age, gender and other factors, the results showed that the risk of CHD was lower in those who drank >2 times/month than in those who did not, which was inconsistent with the results of previous studies.[18] This discrepancy could be attributed to CHD patients modifying their drinking habits to control risk factors and enhance their health, resulting in reduced alcohol consumption. Moreover, this study primarily focused on alcohol consumption frequency without detailed stratification, suggesting the need for further investigation.

The present study found that obesity, central obesity, hypertension, dyslipidemia, diabetes mellitus, and stroke were strongly associated with CHD, which is consistent with the results of previous studies. This suggests that active and

effective control of these traditional risk factors for CHD is essential for the prevention of coronary heart disease. In this study, the detection rate of CHD was higher in dyslipidemic patients (2.67%) compared to normolipidemic patients (2.40%). However, after adjusting for confounding factors like age and gender, dyslipidemic patients were found to have a lower risk of CHD. This contradicts previous findings and may be attributed to limitations of this cross-sectional survey. It's possible that CHD patients adhere to medical advice, including taking lipid-lowering drugs and exercising, which could lower the prevalence of dyslipidemia in this group. Future prospective cohort studies are necessary to explore the causal relationship between abnormal lipid metabolism and coronary heart disease.

In addition to traditional risk factors, emerging biomarkers like homocysteine [24] and bilirubin,[25] anthropometric factors such as a concave-shaped chest wall and narrow antero-posterior thoracic diameter,[26] along with relevant genetic loci,[27] can serve as valuable tools for screening individuals at risk for coronary artery disease. These indicators provide a more comprehensive approach to identifying those who may be predisposed to this condition.

Study Limitations

This study has certain limitations. First, considering the geographic environment, economic level and type of resident population and other related factors in Tianjin, this survey used convenience sampling method, and women and retired groups accounted for a larger proportion of survey respondents, and there were sampling errors and coverage errors in the survey, but this study is the largest multi-centre study in Tianjin at present that includes 13 community health service centres and primary hospitals, and the results of the study can to a certain degree reflect the prevalence of coronary heart disease among Tianjin residents. Secondly, this study collected information on smoking, alcohol frequency, past medical history, and family history of cardiovascular and cerebrovascular disease from patients' self-reporting, which may be subject to recall bias. In addition, the definition of patients with coronary artery disease in this study was based on the diagnostic certificates from previous county-level or higher hospitals, self-reported history of MI or patients who had received PCI treatment or CABG surgery, and therefore the findings of this survey were also only applicable to patients with coronary artery disease who met this definition. Finally, this study is a cross-sectional study describing the current status of coronary heart disease among permanent residents aged 35–75 years in Tianjin, and cannot establish a causal relationship between the prevalence of coronary heart disease. Later, a prospective trial can be conducted to explore the risk factors of patients with coronary heart disease in Tianjin and provide a reliable prediction model for identifying the population of patients with coronary heart disease.

Conclusion

This study revealed that the detection rate of coronary heart disease among permanent residents aged 35–75 years in Tianjin was 2.56%, with differences between different ages and genders. Coronary heart disease stems from a complex interplay of genetic, environmental and other risk factors. For 35–75 years old permanent residents of 13 medical centres in Tianjin, men, advanced age, obesity, central obesity, combined hypertension, dyslipidemia, diabetes mellitus and stroke and other chronic condictions, and individuals with a family history of coronary heart disease and stroke are the key targets for the prevention and treatment. Effective strategies should commence at the primary level of prevention, emphasizing the importance of public awareness, systematic screening, and continuous monitoring of coronary heart disease. By specifically targeting the elimination and modification of risk factors, efforts can be directed towards reducing the prevalence of coronary heart disease within high-risk populations.

Abbreviations

BMI, Body mass index; CHD, Coronary heart disease; CVD, Cardiovascular disease; DBP, Diastolic blood pressure; HDL-C, High-density lipoprotein cholesterol; LDL-C, Low-density lipoprotein cholesterol; SBP, Systolic blood pressure; TC, Total cholesterol; TG, Triglyceride; WC, Waist circumference.

Data Sharing Statement

If someone wishes to access the original data, they should contact the corresponding author.

Acknowledgments

We would like to express our appreciation for the hard work of all the staff involved in the intervention and evaluation.

Funding

This work was funded by the Natural Fund Project of Tianjin Science and Technology Bureau (20JCZDJC00810) and Tianjin Key Medical Discipline(Specialty) Construction Project (TJYXZDXK-042A and TJYXZDXK-055B).

Disclosure

No conflicts of interest for any authors.

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