Gender-specific Prevalence and Influencing Factors of Ideal Cardiovascular Health in Chinese Rural Population: The Henan Rural Cohort Study

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Research article

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Abstract

Background: The American Heart Association define a new concept of ideal cardiovascular health (ICH), which was widely used. However, the prevalence of ICH according to the definition of Chinese rural population is unclear. The study aimed to estimate prevalence and influencing factors of ICH in rural areas of China.

Methods: This study included 35081 participants (13711 men and 21370 women)aged 18 to 79 years from “the Henan Rural Cohort study”. The cardiovascular health (CVH) metrics, the ICH scores, the ideal health behaviors (IHB) scores and ideal health factors (IHF)scores were evaluated in Chinese rural adults. Each CVH metrics divided into ideal and non-ideal including diet, physical activity, smoking, BMI, blood pressure, total cholesterol and fasting plasma glucose. The influencing factors of ideal CVH (ICH scores≥5), ideal HB (IHB scores>3) and ideal HF (IHF scores>3) were explored by logistic regression analysis.

Results: The age-standardized mean scores of the ICH was 4.30(3.62 in men and4.69 in women). Prevalence of ICH metrics about ideal physical activity was the highest (91.37%), while about ideal diet was lowest (0.48%).The age-standardized prevalence of population who with 7 scores of ICH was 0.10% (0.07% in men and 0.11% in women). The age-standardized prevalence of Ideal CVH (ICH scores≥5) was 48.86% (28.26% in men and 60.70% in women). The age-standardized prevalence of 4 of IHB scores and 4 of IHF scores were 0.16% (0.17% in men and 0.16% in women) and 33.26% (10.06% in men and 46.60% in women), respectively. Further, apart from IHB scores, age had an inverse relationship with the ICH scores and IHF scores in total populations and women. Much older, men, low family income, current drinking and abdominal obesity were independently associated with ICH in Chinese rural adults.

Conclusions: The percentage of ideal cardiovascular health is extremely low in rural China. There is an increasing need for primordial prevention of unhealthy lifestyles and monitoring high risk factors to promote cardiovascular health in rural China.

Clinical Trial Registration

The Henan Rural Cohort Study has been registered at Chinese Clinical Trial Register (Registration number: ChiCTR-OOC-15006699). Date of registration: 2015-07-06.http://www.chictr.org.cn/showproj.aspx?proj=11375

What Is Already Known On This Topic?

Previous studies have explored the prevalence and influencing factors of ideal cardiovascular health, but evidence on the ideal cardiovascular health remains uncertain and limited in China, especially in rural population.

What Does This Study Add?

The results of this study showed that the prevalence of ideal cardiovascular health (ICH) is extremely low, and the status of health behaviors was worse than health factors in Chinese rural adults. Further, the ideal physical activity (91.37 %) was the highest prevalence of ICH metrics, while the ideal diet (0.48 %) was the lowest prevalence of ICH metrics. In addition, apart from ideal health behaviors (IHB) scores, age had an inverse relationship with the ICH scores and ideal health factors (IHF) scores in total populations and women. Much older, men, low family income, current drinking and abdominal obesity were independent influencing factors for ICH in Chinese rural adults.

Background

Cardiovascular disease (CVD) is now the leading cause of premature mortality and disability in world in noncommunicable diseases[1,2]. The national disability-adjusted life-years (DALYs) among non-communicable disease

causes were estimated and more than 17 million people died prematurely by CVD in 2017[1].With rapid economic development, urbanization, and an aging population, CVD has become the leading cause of death in China. Compared with western countries, China has higher age-adjusted mortality from CVD[3]. Aging and population growth will increase cardiovascular disease by more than a half over the coming 20 years and there would be an increase of approximately 7.7 million cardiovascular deaths in China from 2010 to 2030[4]. Several studies have suggested the risk factors of CVD, including elevated blood pressure, high total cholesterol, diabetes, obesity/overweight and smoking[3,5-7].

In 2010, ideal cardiovascular health (ICH) has been formulated by the American Heart Association (AHA) to reduce deaths from all CVDs, and to improve the cardiovascular health of the population as a whole, which is defined as the simultaneous presence of four ideal health behaviors (nonsmoking status, ideal body mass index (BMI), regular physical activity (PA), and healthy diet) and four ideal health factors (ideal smoking status, untreated total cholesterol (TC) <5.18 mmol/L, untreated blood pressure (BP) < 120/< 80 mm Hg, and untreated fasting plasma glucose (FPG) <5.6 mmol/L) in the absence of cardiovascular disease history. Smoking appears on both lists of health behaviors and health factors due to its importance for health promotion[8].

Previous studies have indicated the inverse association between the number of ICH metrics and the risks of hypertension[9,10], type 2 diabetes mellitus[11,12], CVDevents (stroke, heart failure, myocardial infarction, and fatal coronary disease)[13-20], CVD mortality[21,22], all-cause mortality[10,23]and concer[24,25]. However, most of the previous studies were conducted in western countries and Chinese urban areas[26-28], much fewer in Chinese rural areas, which may not completely reflect the characteristics of Chinese rural population. Status of ICH of Chinese rural population needs to be studied independently, considering the racial and ethnic diversity between western and Asia and the economic and geographic differences between rural and urban areas[29].

Hence, the aim of this study was to explore the prevalence of ideal cardiovascular health according to the definition of AHA and the related factors in Chinese rural population. We performed the current study based on the cohort of the Henan Rural Cohort.

Methods

Study design and participants

The study population was selected from the Henan Rural Cohort Study, which is a prospective study of chronic non-communicable disease with a large sample of rural people established in Henan Province, China during 2015–2017.In brief, the cohort used a multistage stratified cluster sampling method to recruit participantsaged from 18 to 79 years. With a response rate of 93.7%, 39259 individuals were included in the cohort study. Detailed information of the cohort has been described elsewhere[30]. The participants were excluded if they: (1) were diagnosed with CHD (n=1734); (2) were diagnosed with Stroke (n=2642); (3)were missed information needed in the present study excluded (n=124). Finally, 35018 adults were ultimately included in the study. Before the study commenced, participants were informed of the study's purpose, health benefits, and potential hazards. Participants were required to provide informed consent and both the researchers and respondents agreed to use the data for scientific research purposes only.

Data collection

A standard questionnaire was conducted by well-trained research staffby face to face interviews to obtain information regarding participants' demographic characteristics, lifestyles, Food Frequency Questionnaire (FFQ),individual history of diseasesand medication. Demographic characteristics included age, gender, educational level (elementary school or below, junior high school and high school or above), marital status (married/cohabitating and unmarried/divorced/widowed), per capita monthly income (< 500, 500~ and ≥ 1000 renminbi (RMB)).

Lifestyle factorsincluded smoking (current smoker, non-current smoker), drinking (current drinking, non-current drinker) and physical activity. International Physical Activity Questionnaire (IPAQ 2001) was used to assess the levels of physical activity[31]. The FFQ, covered questions about thirteen main food groups, including staple foods, livestock, poultry, fish, eggs, dairy, fruits, vegetables, beans, nuts, pickles, cereal and animal oil, which based on the Dietary Guidelines for Chinese Residents and the eating habits of Henan people.Participants were asked generally about the frequency (daily, weekly, monthly, yearly, or never) and amount (in liang (50 g)) of their consumption of each food or food group in the past 12 months. Previous studies have shown that the FFQ has good reproducibility and validity[32]. Individual history of disease and medication were self-reported by the participants, including CVD (coronary heart disease, myocardial infarction, stroke, or heart failure), hypertension, diabetes mellitus, hyperlipidemia, and the use of antihypertensive, cholesterol-lowering, or glucose-lowering medications.

Weight and height were measured twice in light clothing with shoes offand recorded to the nearest 0.1kg and 0.1cm respectively and we calculated the average of the two measures. Body mass index (BMI) was computed as body weight (kg) divided by height square (m^2) based on the measurement.WC was also measured twice with a standard tape around the waist about 1 cm above the navel and parallel to the ground. Blood pressure was measured three times by electronic sphygmomanometer (Omron HEM-7071A, Japan) in the right arm of sitting position after at least 5 min rest. There were 30s intervals between the three measurements.

The venous blood samples were collected from subjects after overnight fasting for at least 8 hours and stored in -80°C cryogenic refrigerator before analysis. The fasting blood glucose (FBG) was analyzed with via glucose oxidative method (GOD-PAP) by ROCHE Cobas C501 automatic biochemical analyzer[30]. Total cholesterol, triglyceride, high-density lipoprotein cholesterol and low-density lipoprotein cholesterol were measured by Roche Cobas C501 automatic biochemical analyzer.

Definitions

Tracking disease was easy because all respondents were covered by the New Rural Cooperative Medical System (NRCMS) and each participant had a unique medical insurance card number and ID. NRCMS medical records reviews of CVD were confirmed by rural doctor after self-reporting the history of CVD, and further determined by the outcome committee which is composed of a physician, an endocrinologist, a cardiologist, and an epidemiologist according to standardization recommended by World Health Organization criteria[33,34].

Smoking status was classified into current smoker who smoked more than one cigarette per day in the past six months and non-current smoker including ever smoker and never smoker. Alcohol drinking status was categorized into current drinking who consumed alcoholic drinks for twelve or more times in the past one year, whether spirits, beer, wine or other forms of alcoholic beverage, and non-current drinker including ever drinker and never drinker.WC < 90 cm for men and WC <80 cm for women were classified as normal waist circumference, and WC ≥ 90 cm for men and WC ≥ 80 cm for women were classified as abdominal obesity.

Ideal Cardiovascular Health metrics

According to the AHA definitions of ideal cardiovascular health(ICH)[8], each of the 7 cardiovascular health metrics (smoking, physical activity, BMI, diet, total cholesterol, blood pressure and fasting plasma glucose) was categorized as ideal and non-ideal, respectively. ICH metrics were as follows: ideal smoking status, never smoker; ideal BMI, BMI < 25 kg/m^2; ideal physical activity (PA), PA ≥ 150 min/wk of moderate intensity or ≥ 75 min/wk of vigorous intensity or ≥ 150 min/wk of moderate-vigorous intensity combination; ideal diet, ≥4 components; ideal total cholesterol (TC), TC < 5.18 mmol/L untreated; ideal blood pressure (BP), BP <120/< 80 mm Hg untreated, and ideal fasting plasma glucose (FPG), FPG < 5.6 mmol/L untreated. Furthermore, ICH was defined according to the American Heart Association's 2020 Strategic

Impact Goals as follows: the simultaneous presence of 4 ideal health behaviors (ideal smoking status, ideal BMI, ideal PA, and ideal diet) and 4 ideal health factors (ideal smoking status, ideal TC, ideal BP, and ideal FPG) in the absence of a history of cardiovascular disease.

We made some adaptations as appropriate for the healthy diet score. Ideal diet was defined as healthy diet score ≥ 4 components[35] (fruits and vegetables ≥ 500 g/d; fish ≥ 200 g/week; soybean products ≥ 125 g/d; red meat < 75 g/d; drinking tea).

Statistical analysis

All analyses were performed separately for men and women. Continuous variables presented as mean ± SD were compared by using the t-test or analysis of variance, while categorical variables presented as numbers and proportions were compared by using chi-square test. The prevalence was standardized by using the direct method according to the Chinese Population Census 2010.We calculated the ICH scores by summing the total number of ideal metrics for each participant, ranging from 0 to 7, and ICH scores was further categorized into Non-CVH (0–4 scores) and Ideal CVH (5–7 scores) based on the total number of ideal indices. Ideal health behaviors (IHB) scores was calculated by summing the total number of IHB metrics ranging from 0 to 4, and IHB scores was further categorized into Non-HB (0–3 scores) and Ideal HB (4 scores). Ideal health factors (IHF) scores was calculated by summing the total number of IHF metrics ranging from 0 to 4, and IHF scores was further categorized into Non-HF (0–3 scores) and Ideal HF (4 scores) The association between socioeconomic factors and the prevalence of Ideal CVH, Ideal HB and Ideal HF were estimated by the multivariable logistic regression models, and were shown by odds ratio (OR) and 95% confidence interval (*CI*). All selected characteristics were included in multivariable logistic regression models. Besides, the three indices including age groups, educational attainment and per capita monthly income were taken as continuous variables to explore whether there was a linear trend of ORs. A *p*-value less than 0.05 (two tailed) was applied to assess the statistical significance. Statistical analyses were performed by SPSS software V.26.0 and R version 3.6.3.

Results

Characteristics of the participants

The characteristics of the study participants according to sex is presented in **Table 1**. Among the 35081 participants, 21370 (60.92%) were women. The mean age of participants was 54.72 years with a range from 18 to 79 years. Most of the participants were married (90.19 %) and only 16.04 % of the participants had high school or above education. The proportion of current smokers was 19.60 %, and 50.28% were current drinkers in men. The mean BMI of participants was 24.79±3.56 kg/m^2. Compared with men, women were more likely to be of lower educational level, lower proportion of current smokers and current drinkers, lower SBP, DBP and WC, and of higher BMI and TC. The differences in age, education, income, smoking, drinking, SBP, DBP, TC and WC were statically significant between men and women (P< 0.05 for each).

Prevalence of the ICH metrics

Fig. 1shows the distribution of components of each ICH metrics. The proportions of ICH metrics of participants were as follows: ideal smoking status, 73.12% (31.81 % in men and 99.62% in women); ideal BMI, 54.49% (56.85% in men and 52.97% in women); ideal diet, 0.48% (0.81% in men and 0.26% in women); ideal physical activity, 91.37% (85.85% in men and 94.91% in women); ideal total cholesterol, 67.83% (71.96% in men and 65.18% in women); ideal blood pressure, 39.99% (36.32% in men and 42.35% in women); ideal fasting plasma glucose, 71.13% (70.68% in men and 71.42% in women). Obviously, diet (0.48%) was the lowest prevalence of ICH metrics, whereas physical activity (91.37%) was the most prevalent, and the features were similar in men. However, the most and least prevalent of ideal metrics in women

were smoking and diet, respectively. Most study participants reached ideal health status for the following ICH metrics: physical activity, blood glucose, smoking, total cholesterol, and BMI. Apartfromtotal cholesterol, Blood pressure, diet and BMI, each ideal ICH metric in women were significantly higher than men (P< 0.001) (**Table S1**).**Fig. 2** presents the prevalence of each ICH metric with age groups. With the increase of age, the proportions of ideal total cholesterol, ideal blood pressure, ideal fasting glucose, ideal smoking status and ideal diet decreased.

The prevalence of the ICH scores, IHB scores and IHF scores

Only 14 participants (0.04%) met 7 scores of ICH, and the prevalence of ≤ 1 was 2.81 %. The age-standardized prevalence of Ideal CVH (ICH scores ≥ 5) was 48.86% (28.26% in men and 60.70% in women). The age-standardized mean levels of the ICH scores was 4.30 (3.62 in men and 4.69 in women). There was significant difference about the ICH scores between men and women (P< 0.001). Only 0.12% of participants had all 4 of IHB scores, and 23.73% had all 4 of IHF scores. The age-standardized prevalence of 4 of IHB scores and 4 of IHF scores were 0.16% (0.17% in men and 0.16% in women) and 33.26% (10.06% in men and 46.60% in women), respectively. Furthermore, the percentage of 4 of IHF was higher (19.56%) than the percentage of 4 of IHB (0.11%). The proportions of meeting 4 of IHF scores for women was higher than men (27.49% vs. 7.20%), while the proportions of 4 of IHB scores for women was the same as that of men (0.11% vs. 0.11%) (**Table 2**).**Fig. 3** showsthe distribution of ICH scores, IHB scores and IHF scores by sex. The most prevalence of ICH scores was 4 (4 in men and 4 in women), while the most prevalence of IHB scores and IHF scores were 2 (2 in men and 3 in women) and 3 (2 in men and 3 in women), respectively.

The distributions of ICH scores, IHB scores and IHF scores according to age are shown in **Fig. 4.** The scores of ICH, IHB and IHF were higher in younger age groups. Apart from IHB scores, age had an inverse relationship with the ICH scores and IHF scores in total populations and women. The ICH mean score in women were higher than that in men across all age groups.

Associations of potential risk factors for Ideal CVH, Ideal HF and Ideal HB.

Table 3 describes the odds ratios (ORs) of potential influencing factors associated with Ideal CVH, Ideal HF and Ideal HB. Much older, men, current drinking and abdominal obesity were significantly positively associated withthe prevalence of Ideal CVH (ICH scores≥5) and Ideal HF(IHF scores>3). However, age, sex and current drinking were not significantly associated with Ideal HB, and high-level education had a protective effect for Ideal HB. Abdominal obesity was common risk factors for Ideal CVH, Ideal HF and Ideal HB. The risk of abdominal obesity for Ideal CVH was particularly high, and men were much more at risk than women. In addition, women who were much older had a higher risk to Ideal CVH than men, while current drinking had a lower risk (**Table S2**). The risk ofcurrent drinkingfor Ideal HBwas not significantly associated for men and women. However, current drinking for Ideal HF increased the risk of men, and reduces the risk of women (**Table S3**).

Discussion

The present large survey specialized in Chinese rural population provided important new evidence on the prevalence of ideal cardiovascular health (ICH) in China. Our study shows that the prevalence of ICH is severe in rural China. Only 0.10% (0.07% in men and 0.11% in women) metall 7 ICH metrics, and there was a substantial difference between the percentages of 7 ICH metrics. The ideal physical activity was the highest prevalence of ICH metrics, while the ideal diet was the lowest prevalence of ICH metrics. only 0.12% participants met all 4 ideal health behaviors (IHB)metrics, while 23.73% participants met all 4 Ideal health factors (IHF) metrics. Apart from IHB scores, age had an inverse relationship with the ICH scores and IHF scores in total populations and women, and women had higher prevalence than men in all age ranges.

According to the studies, the proportions of ICH in the general population in various countries was extremely low. A review including 18 studies in United States showed ICH was very low ranging from 1% to 12% with 11 of 15 (73%) studies

reporting ≤5%[36]. In a community-based sample from Central Europe, few adults had ideal CVH, and men were more affected by poor CVH[37].Results from the National Health Survey showed that only 1% of Brazilian Population reached ICH[38]. Only 0.15% of Australian adults had ideal status on all of the seven metrics among Australian adults[39]. The prevalence of meeting all 7 ICH metrics was 0.67% among middle-aged Korean men[23].Similar results were found in our study, and our results complement the research of ICH among Chinese rural population. The prevalence of ICH in Chinese rural population waslower than Chinese urban population (0.5%)[26] and Chinese general population (0.2%)[27,28].Compared with the percentages of 7 ICH metrics among American adults[8], the rural Chinese displayed higher ideal percentages of physical activity, BMI, total cholesterol and FPG. Both populations have similar ideal proportions of smoking status, diet and blood pressure, and the proportions of ideal diet was extremely low. In addition, Fasting plasma glucose was the most prevalent ideal metric (71.2%), whereas physical activity was the least prevalent (18.1%)in Chinese urban population[26]. However, in our findings, the ideal physical activity (91.37%) was the highest prevalence of ICH metrics, while the ideal diet (0.48%) was the lowest prevalence of ICH metrics in Chinese rural population. In Chinese rural areas, both men and women engage in agricultural activities from sunrise to sunset, with intervening rest, which is associated with higher prevalence of ideal physical activity. It is beneficial to improve the status of TC, FPG, BMI. Rural areas had lower riskfactors burden but higher age-standardized prevalence of CVDs compared with urban areas[40,41], which might be due to the lower educational level, lower quality of health services, and less frequency of proven therapies used. Previous studies have reported that the prevalence of ICH was higher in women[26,27,42,43]. Similar results were found in our study.The age-standardized prevalence of ICHin men and women were 0.08% vs. 0.12%. Thus,men should be taken as a primary risk factor for cardiovascular health in Chinese rural region.

Only 0.17% and 36.03% participants met all 4 IHB and all 4 IHF, respectively. The higher percentages in IHF than IHB were in agreement with several studies[27,44-47], while a US study reported a 2.0% ideal health behaviors' index and a 1.4% ideal health factors' index[48], and 0.52% of Australian adults had all four ideal cardiovascular health factors and 16.38% had all four ideal cardiovascular health behaviors[39]. Regional differences, socioeconomic level and lifestyle might partly contribute to the differences. The IHB scores, IHF scores and ICH scores were higher in younger age groups,and women had higher prevalence than men in all age ranges. Another interesting phenomenon is that there were different trend changes in the mean of IHB scores, IHF scores and ICH scores according age in men and women. Apart from IHB scores, age had an inverse relationship with the ICH scores and IHF scores in total populations and women. The results of our findings showed that IHB was most likely to achieve the highest yield, especially diet, because they were noted to be least prevalent uniformly across all cohorts studied in many countries. The low percentage of ideal diet was the major reason to the extremely low percentage of ICH.The low prevalence of ideal diet suggests that we should put in more effort to improve the status of diet metrics. Compositive efforts focusing on these targets will accelerate the achievement of ICH goals, which will also indirectly influence attainment of ideal status forBMI, total cholesterol, blood pressure, and fasting glucose metrics. Thus, health behaviors included in the definition of overall cardiovascular health represents a critical step toward implementation of primordial prevention (primary prevention), and it is urgent to promote healthy lifestyle in middle- and older-aged individuals to come up to the ideal cardiovascular health status. There have been a lot of research reports that adherence to healthy lifestyle may substantially lower the burden of cardiovascular diseases[49-52]. Maintaining ICH from early adulthood results in higher health-related quality of life in middle age[10,53]. Even for patients with diabetes and hypertension, maintaining ICH is beneficial to reduce the risk of cardiovascular disease[51,54].

Our study further found that abdominal obesity was associated with a higher risk for Ideal ICH, Ideal HB and Ideal HF. Previous studies have found similar results that abdominal obesity showed higher risks on cardiovascular diseases[55,56]. The rates of abdominal obesity still increased rapidly in the Chinese population, especially in rural population[57]. The age-standardized prevalence of abdominal obesity was 43.71% in the general Chinese rural adults[58]. Thus, effective measures should be taken to improve the status of prevention and control of abdominal obesity to improve the status of ICH.In addition, we found that drinking may be associated with a more ideal CVH and a more ideal HF in women, but not in men.

In a previous study in U.S, women with light or moderate drinking were more likely to have optimal CVH compared to non-drinking women, which was not seen in men[59], which was consistent with our study. However, since alcohol and smoking are closely related behaviors, drinkers are more likely to not meet the ideal standard of smoking. There have been some research reports that light to moderate alcohol consumption was associated with increased odds of ideal physical activity and ideal BMI[60-62]. But the mechanism is not clear and further research is needed.

Strengths And Limitations

Our study combines the epidemiological characteristics and influencing factors of ICH according to the relatively large sample size of rural population in China. Standardized investigation tools, training and on-site implementation, as well as adjustments of a wide range of potential confounding factors, ensure the reliability of the analysis. Nevertheless, several limitations should also be considered. First, these findings come from a cross-sectional study, rather than a prospective cohort design, thus do not accurately describe causality. Secondly, some residents, such as college students and migrant workers, were not included in the scope of this study because they were studying or working outside. These people are more likely to be young and healthy and have a higher prevalence of ICH, which may lead to the underestimation of ICH in the rural population. Finally, the result was based on a geographical region of central China, which may not be a representative sample of Chinese rural population. However, the rural population of Henan Province accounts for 9% of Chinese rural population. Therefore, the results of relatively large rural epidemiological studies could reflect the prevalence of ICH in rural areas of China to some extent.

Conclusion

The percentage of ideal cardiovascular health is extremely low in rural China. Therefore, there is an increasing need for primordial prevention of unhealthy lifestyles and monitoring high risk factors including older, men, low family income, current drinking and abdominal obesityto promote cardiovascular health in rural China.

Abbreviations

ICH: ideal cardiovascular health; CVH: cardiovascular health; IHB: ideal health behaviors; IHF: ideal health factors; ideal CVH: ICH scores≥5; ideal HB: IHB scores>3; ideal HF: IHF scores>3; CVD: Cardiovascular disease; AHA: American Heart Association; BMI: body mass index; TC: total cholesterol; BP: blood pressure; FPG: fasting plasma glucose; PA: physical activity.

Declarations

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Author contributions

During the research, XW had full access to all the data in the study. XW analyzed the data and wrote the manuscript. TA corrected the manuscript. CW designed the study. XW, XL, ZL, MN, YH, JH, ZT, ZM, WH, LL, CW conducted the collection of the data. All authors read and approve this version of the article.

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Availability of data and material

The raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher.

Ethics approval and consent to participate

Ethics approval was obtained from the “Zhengzhou University Life Science Ethics Committee”, and written informed consent was obtained for all participants. Ethic approval code: [2015] MEC (S128).Written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing Interests

All authors have read and approved this version of the article, and declared that they had no competing or financial interests to disclosure.

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Tables

Table 1. Characteristics of the participants.

Variables	Total(n = 35018)	Men(n = 13711)	Women(n= 21370)	*P*
Age (years, mean ± SD)	54.74±12.28	55.74±12.43	54.10±12.14	<0.001
Marital status, n (%)				0.706
Married/cohabiting	31639(90.19)	12376(90.26)	19263(90.14)	
Unmarried/divorced/widowed	3442(9.81)	1335(9.74)	2107(9.86)	
Education level, n (%)				<0.001
Primary school or illiteracy	15143(43.17)	4460(32.53)	10683(49.99)	
Junior high school	14311(40.79)	6416(46.79)	7895(39.94)	
High school or above	5627(16.04)	2835(20.68)	2792(13.07)	
Income (RMB per month), n (%)				<0.001
<500	12180(34.72)	4832(35.24)	7348(34.38)	
500□	11630(33.15)	4376(31.92)	72.54(33.94)	
1000□	11271(32.13)	4503(32.84)	6768(31.67)	
Smoking, n (%)				<0.001
No smoking	28205(80.40)	6894(50.28)	21311(99.72)	
Current smoking	6876(19.60)	6817(49.72)	56(0.28)	
Drinking, n (%)				<0.001
No drinking	27101(77.25)	6367(46.44)	20734(97.02)	
Current drinking	7980(22.75)	7344(53.56)	636(2.98)	
BMI (kg/m2 mean ± SD)	24.79±3.56	24.51±3.49	24.97±3.59	0.312
SBP (mmHg, mean ± SD)	125.09± 19.72	125.92±18.26	124.56±20.59	<0.001
DBP (mmHg, mean ± SD)	77.47± 11.60	78.64±11.94	76.72±11.32	<0.001
TC (mmol/L, mean ± SD)	4.76± 0.98	4.66±0.95	4.82±0.99	<0.001
FPG (mmol/L, mean ± SD)	5.52± 1.49	5.51±1.49	5.52±1.49	0.157
WC (cm, mean ± SD)	83.90± 10.38	85.46±10.59	82.90±10.12	<0.001

SD, standard deviation; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; FPG, fasting plasma glucose. Income (RMB per month), Per capita monthly income. Values are means and standard deviation for continuous variables, and numbers and percentages for categorical variables.

Table 2. Prevalence of the ICH scores, IHB scores and IHF scores by sex.

Ideal scores	Total (n = 27745)	Men (n = 11013)	Women (n = 16732)	*P*
IHB scores[1], n (%)				<0.001
0	601(1.71)	598(4.36)	3(0.01)	
1	4750(13.54)	4250(31.00)	500(2.34)	
2	16993(48.44)	6815(49.70)	10178(47.63)	
3	12699(36.20)	2033(14.83)	10666(49.91)	
4	38(0.11)	15(0.11)	23(0.11)	
IHF scores[2], n (%)				<0.001
0	890(2.54)	872(6.36)	18(0.08)	
1	5186(14.78)	2818(20.55)	2368(11.08)	
2	10634(30.31)	4969(36.24)	5665(26.51)	
3	11509(32.81)	4065(29.65)	7444(34.83)	
4	6862(19.56)	987(7.20)	5875(27.49)	
ICH scores[3], n (%)				<0.001
0	106(0.30)	105(0.77)	1(0.003)	
1	881(2.51)	761(5.55)	120(0.56)	
2	3689(10.52)	2073(15.12)	1616(7.56)	
3	7643(21.79)	3512(25.61)	4131(19.33)	
4	9749(27.79)	3851(28.09)	5859(27.60)	
5	8513(24.27)	2730(19.91)	5783(27.06)	
6	4486(12.79)	674(4.92)	3812(17.84)	
7	14(0.04)	5(0.04)	9(0.04)	
ICH group, n (%)				<0.001
Ideal CVH[4]	13013(37.09)	3409(24.86)	9604(44.94)	
IntermediateCVH[5]	17392(49.58)	7363(53.70)	10029(46.93)	
Poor CVH[6]	4676(13.33)	2939(21.44)	1737(8.13)	
ICH scores (mean ± SD)	3.98±1.29	3.54±1.29	4.27±1.21	<0.001

SD, standard deviation; [1], Ideal health behaviors(IHB) scores;[2], Ideal health factors(IHF) scores;[3], ideal cardiovascular health(ICH) scores;[4], 5–7 scores of ICH; [5], 3–4 scores of ICH; [6], 0–2 scores of ICH.

Table 3. The odds ratio and 95% confidence intervals of Ideal CVH, Ideal HB and Ideal HF.

Variables	Ideal CVH[1]	Ideal HB[2]	Ideal HF[3]
	OR (95%CI)	*OR (95%CI)*	*OR (95%CI)*
Age			
18	1.00	1.00	1.00
30	1.28(1.10-1.50)	1.57(0.33-7.45)	1.65(1.41-1.91)
40	1.93(1.67-2.23)	0.63(0.18-2.22)	2.88(2.50-3.33)
50	3.19(2.77-3.67)	1.45(0.39-5.37)	6.41(5.56-7.39)
60	4.47(3.86-5.17)	1.27(0.32-5.02)	11.59(9.95-13.50)
70 79	5.31(4.52-6.24)	2.09(0.33-13.34)	16.54(13.71-19.96)
P_{trend}	<0.001	0.334	<0.001
Sex			
men	3.86(3.61-4.14)	1.26(0.56-2.86)	4.72(4.31-5.17)
Marital status			
Married/cohabiting	1.00	1.00	1.00
Unmarried/divorced/widowed	1.01(0.92-1.10)	0.48(0.19-1.26)	1.04(0.92-1.16)
Income (RMB per month)			
<500	1.00	1.00	1.00
500	1.07(1.01-1.34)	1.79(0.74-4.37)	1.09(1.01-1.17)
1000	1.00(0.94-1.07)	0.96(0.45-2.04)	1.06(0.98-1.14)
P trend	0.006	0.026	0.027
Education level			
Primary school or illiteracy	1.00	1.00	1.00
Junior high school	0.95(0.90-1.01)	0.56(0.23-1.36)	0.97(0.90-1.04)
High school or above	1.15(1.06-1.25)	0.28(0.11-0.78)	1.11(1.01-1.23)
P trend	0.693	0.812	0.095
Drinking			
No drinking	1.00	1.00	1.00
Current drinking	1.58(1.47-1.72)	1.22 (0.47-3.16)	2.05(1.82-2.30)
Abdominal obesity	6.79(6.42-7.18)	3.26(1.51-7.02)	2.59(2.44-2.75)

[1], ICH scores≥5; [2], IHB scores>3; [3], IHF scores>3. *OR*: odds ratios, *CI*: confidence intervals.Abdominal obesity was defined according to guidelines of the International Diabetes Federation for Chinese populations as a WC≥90 cm for men and ≥80 cm for women. Normal WC was defined as a WC <90 cm for men and <80 cm for women[48].

Figures

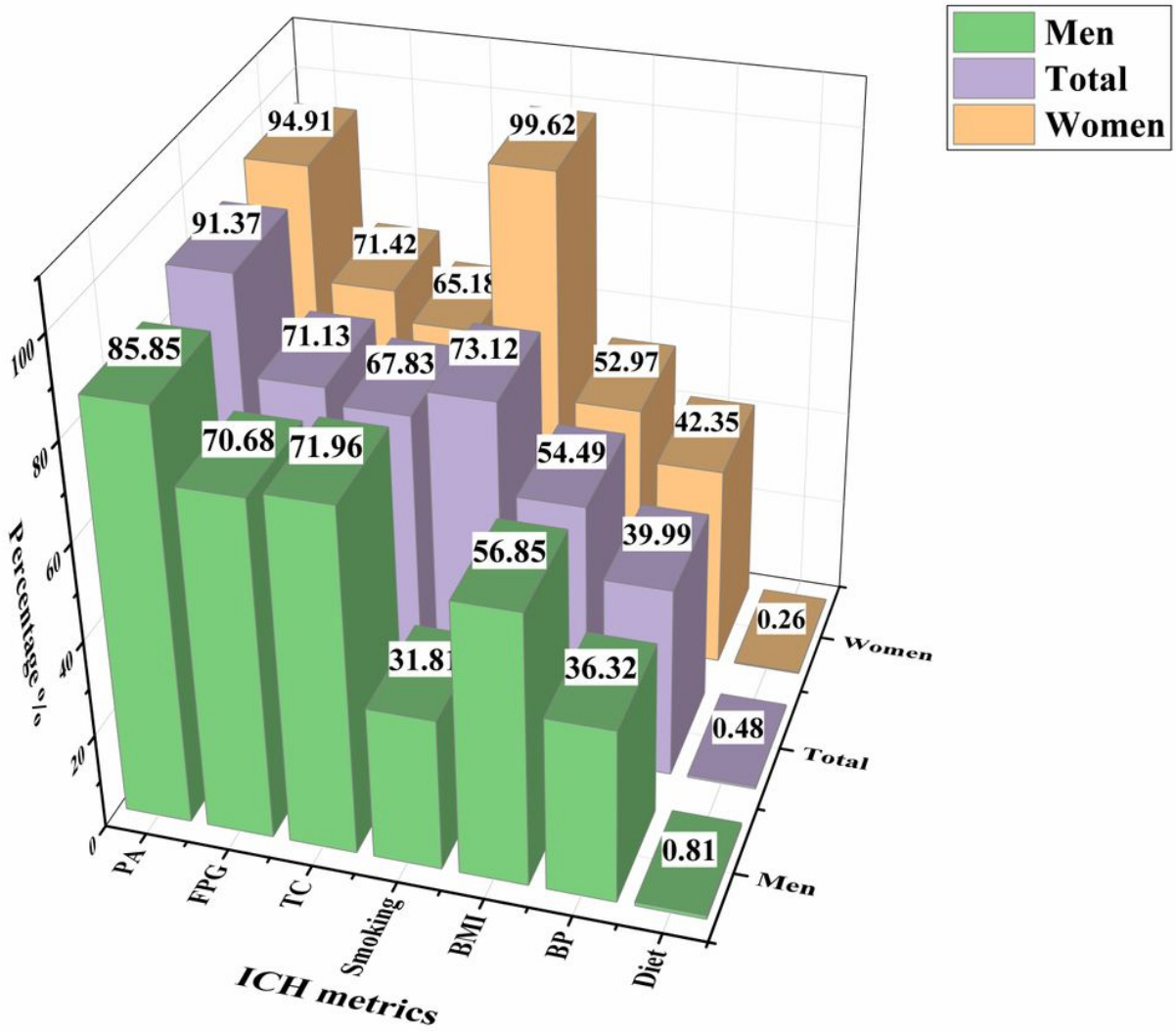

Figure 1

Prevalence of ideal cardiovascular health Metrics (n = 27,745). PA, physical activity; BP, blood pressure; FPG, fasting plasma glucose; BMI, body mass index. ICH, Ideal cardiovascular health.

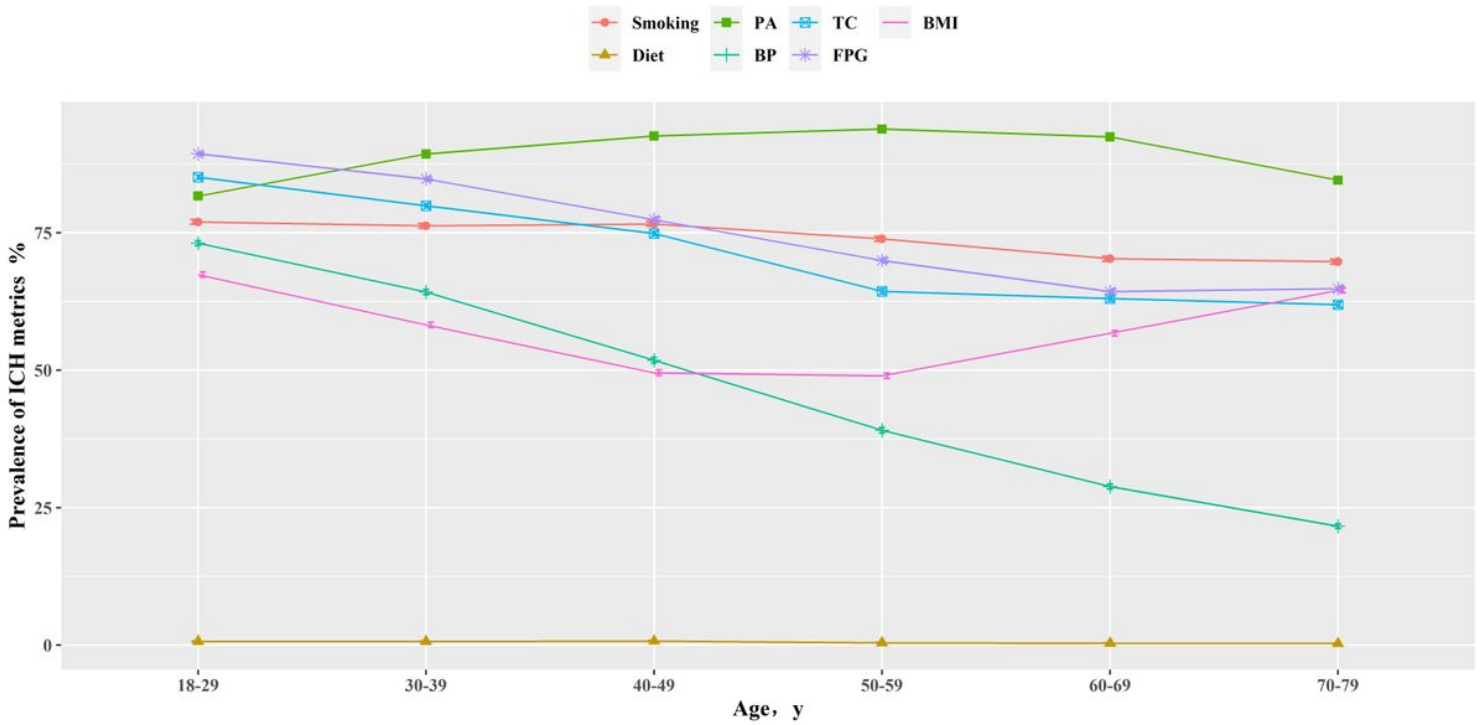

Figure 2

The age-standardized prevalence of ideal cardiovascular health Metrics according to age groups. PA, physical activity; BP, blood pressure; FPG, fasting plasma glucose; BMI, body mass index.

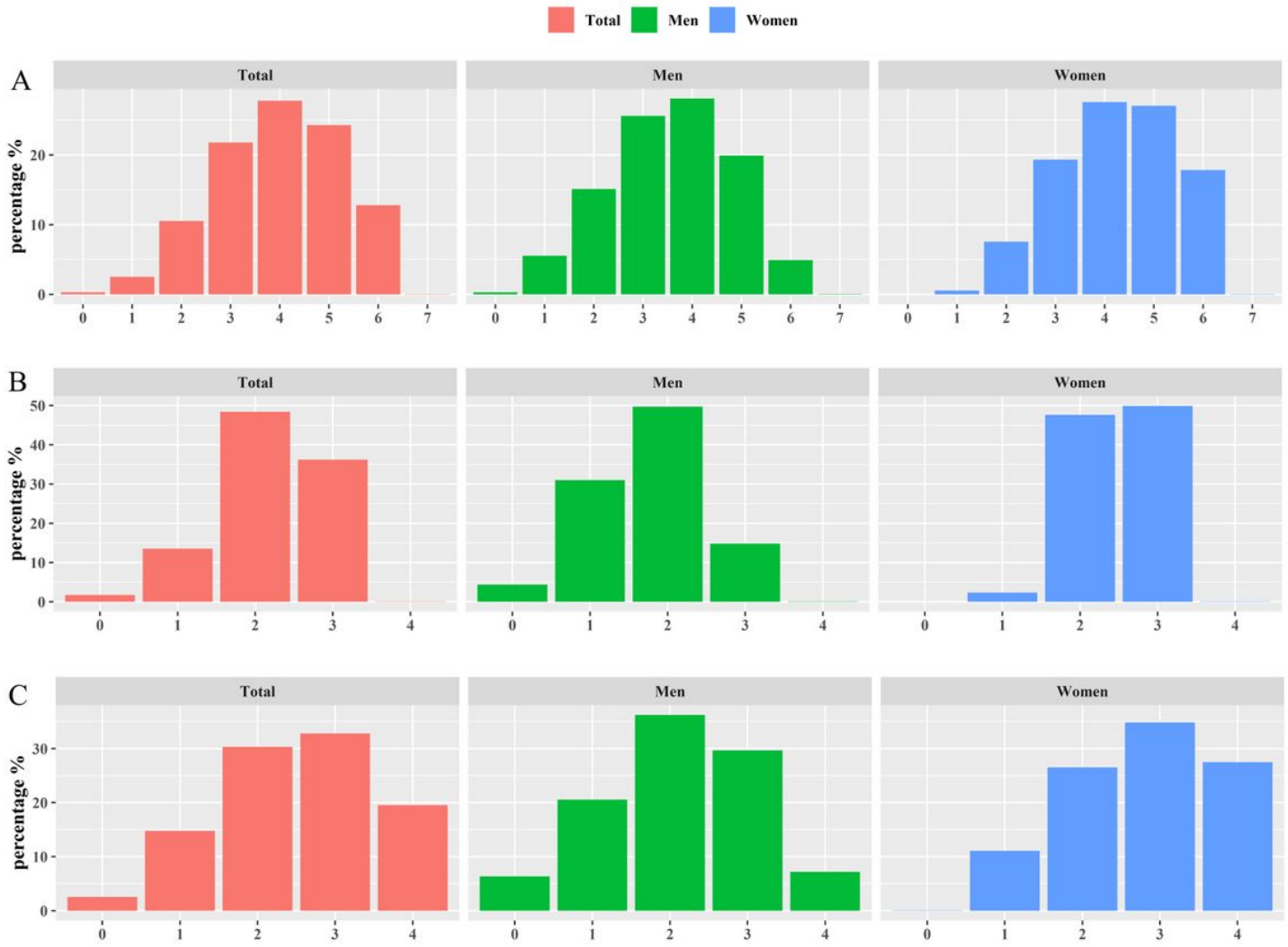

Figure 3

The distribution of ICH scores, IHB scores and IHF scores by sex. A, ICH scores, ideal cardiovascular health scores; B, IHB scores, ideal health behaviors scores; C, IHF scores, ideal health factors scores.

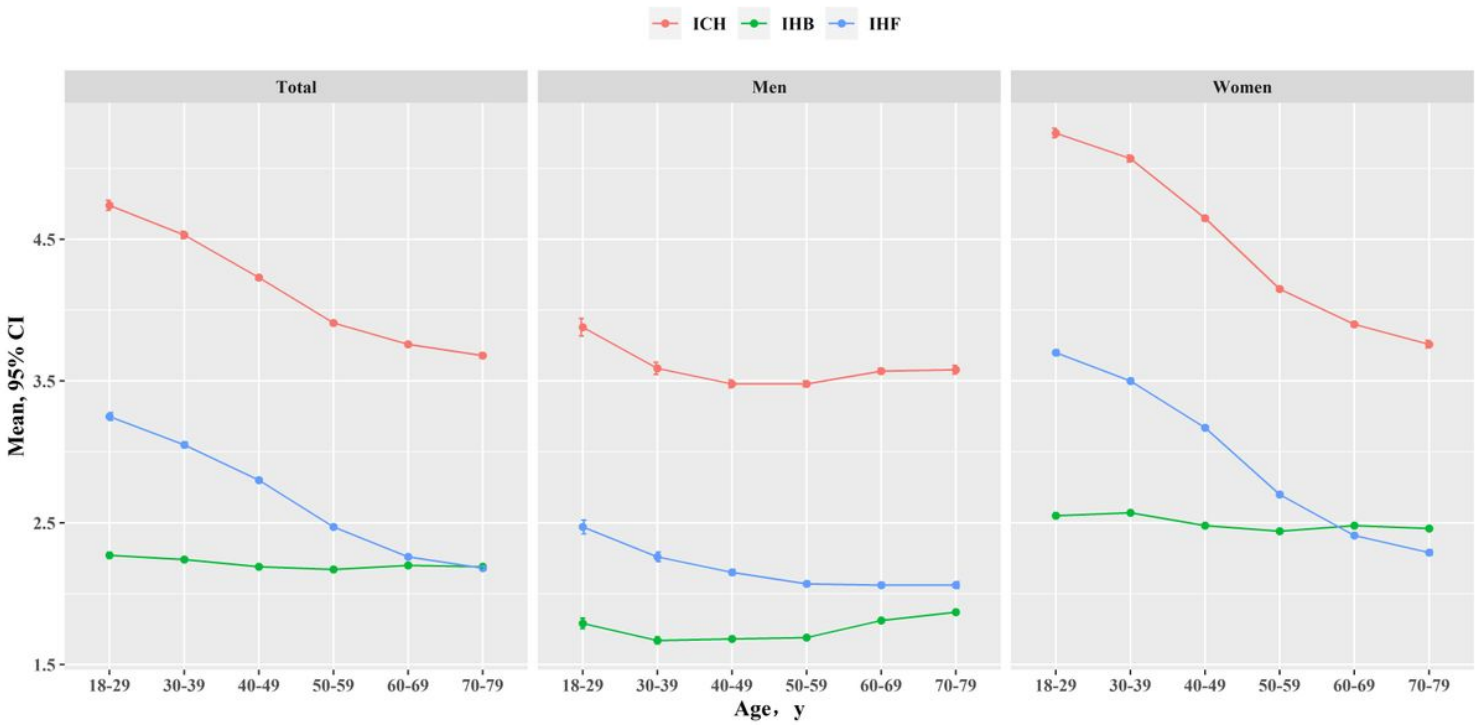

Figure 4

The mean (95%CI) of IHB scores, IHF scores and ICH scores between different age groups for men and women. Error bars indicate 95% confidence intervals. IHB, ideal health behaviors scores; IHF, ideal health factors scores; ICH, ideal cardiovascular health.

Supplementary Files

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