Cardiovascular Disease Risk factor / Triglyceride Level Analysis

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Abstract: Background: Recently, China is economically to become the second-largest in the world after the United States [1]. The cardiovascular health of the state employees in Chinese government is worth noticing [2]. This study cohort was from Henan Province, as Henan is the largest one of the provinces in China, the statistics can be applied equally to the entire China. Controlling risk factor to reduce morbidity for disease is one of the concerns in preventive medicine. Thirty thousand state employees were participated for the investigation, triglyceride effect is found as a major risk factor for Cardiovascular disease. **Methods:** Randomly sampled thirty thousand state employees from Henan Province Hospital aged 35 years to 59 years. This article subjected the participants to physical examinations and instructed them to answer medical questionnaires. A simple assessment model of the morbidity risk on local individuals with ICVD was included. **Results:** The average exposure rates of civil servants in terms of overweight, hyperlipidemia, hypertension, diabetes mellitus, and smoking were 62.96%, 76.07%, 34.87%, 8.10% and 21.30%, respectively. The prevalence of hyperlipidemia and diabetes mellitus increased with age. The risk factor exposure of male civil servants was significantly higher than that of female civil servants. The absolute risk of male civil servants of ICVD for 10 years was higher than that of healthy individuals of the same age, and the absolute risk increased rapidly beyond the age of 45 years. The absolute risk of female civil servants was also higher than that of healthy individuals beyond the age of 40 years; nevertheless, this risk likely increased rapidly beyond the age of 50 years. A prediction model for Myocardial Infarction is proposed. **Conclusion:** The morbidity risk of Henan provincial state employees with ICVD remains at a high level. As such, effective health management is recommended for them. The assessment method for ICVD is available to screen high risk populations, but this information should be further evaluated and developed in terms of index score weighting.
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Introduction

The epidemiological characteristics of cardiovascular diseases in developing countries gradually approximate that in developed countries. [1] The morbidity and mortality of these diseases rank first among all diseases. [2,3] Cardiovascular diseases are also the leading causes of death in China. For instance, approximately three million people die in this country each year because of cardiovascular diseases. [4] Furthermore, ischaemic cardiovascular disease (ICVD) prevails in this country; ICVD is significantly associated with age, gender, blood pressure, serum cholesterol, body mass index, smoking and diabetes mellitus. [5–9] In addition to these factors, hypercholesterolaemia, hyperlipidaemia and hypertension elicit a synergistic effect and increase the mortality of cardiovascular diseases. [10] Therefore, groups holding various risk factors exhibit different risks of morbidity related to ICVD.

Civil servants are a special group of individuals. According to the famous Whitehall study II, coronary artery disease is correlated with working category or class.[11] However, Chinese civil servants are at risk of adverse health conditions. Working pressure often causes mental health problem; [12,13] however, physiological health assessment for civil servants is rare.[14] In this study, the status of risk factors of cardiovascular diseases was investigated in 2,400 Henan provincial civil servants. The risk of morbidity related to ICVD for 10 years was also evaluated to

examine the main causes affecting the cardiovascular health of civil servants. Furthermore, a possible method was proposed to improve assessment strategies.

Methods

Study population

Using a cross-sectional survey method, we randomly sampled 2,400 Henan provincial civil servants aged 35 years to 59 years from 65 provincial units. These civil servants underwent physical examination in Henan Provincial People's Hospital. Among these servants, 2,211 corresponded to effective investigations, excluding coronary heart disease and cerebral apoplexy patients, and the selected effective rate was 92.13%.

Survey methods

Using a unified standard questionnaire, a trained investigator examined the subjects. Survey information included demographic data (gender, age, nature and position of units), lifestyle (smoking and drinking), medical history (history of diabetes mellitus, coronary artery disease and cerebral apoplexy) and physical examination (systolic blood pressure, total cholesterol and body mass index). Blood lipid and blood glucose levels were checked using Switzerland Roche reagents (Roche diagnostics GmbH. Sandhofer Strasse 116, 68305 Mannheim, Germany).

Diagnostic criteria

The following diagnostic criteria were considered. (1) Hyperlipidaemia: total cholesterol > 5.17 mmol/L; triglyceride > 1.46 mmol/L; and LDL cholesterol > 3.1 mmol/L.[15] (2) Hypertension, if antihypertensive drugs were not used, systolic pressure ≥ 140 mmHg; and diastolic pressure ≥ 90 mmHg.[16] (3) Diabetes mellitus: for patients with diabetes mellitus symptoms associated with fasting plasma glucose ≥ 7.0 mmol/L or non-fasting plasma glucose ≥ 11.1 mmol/L; for those without typical symptoms of diabetes mellitus, at least twice fasting plasma glucose ≥ 7.0 mmol/L or non-fasting plasma glucose ≥ 11.1 mmol/L.[17] (4) Overweight: BMI = weight/height^2 (kg/m^2), index is defined as overweight between 24.0 and 27.9.[18] (5) Smoking: according to the criteria recommended by WHO, two or more cigarettes each day and lasting more than six months.[19]

Grouping of risk factors and risk classification

In this thesis, the absolute risk of ICVD was calculated using the following simple assessment method model of morbidity risk on local individuals with ICVD for 10 years.[20] (1) Age: each of the five different ages constituted a group. (2) Systolic pressure (mmHg): six groups including <120, 120, 130, 140, 160 and ≥180. (3) BMI (kg/m^2): three groups including <2424 and ≥28. (4) Total cholesterol (mmol/L): two groups, including <5.20 and ≥5.20. (5)

Smoking: two groups, including positive and negative. (6) Diabetes mellitus: two groups, including positive and negative. (7) The total scores of each investigated individual in each of the six risk levels by gender were calculated; the absolute risk (%) was recorded as follows: very low risk, ≤5; low risk, <5.20 and ≥5.20; moderate, risk 10 to 19.9; high risk, 20 to 39.9; and very high risk, ≥40. Moderate risk (≥10) and high levels were considered abnormal.

Statistical analysis

The database was established using Epidata 3.02, and data were double checked for entry. The process was preceded by SPSS (version 21.0; SPSS Inc., USA). The gender distribution of civil servants associated with the risk factors was analysed by conducting a descriptive analysis of frequency. The risk factor exposure among the groups of different genders and ages was evaluated by performing a crosstab chi-square test. The average absolute risk of morbidity of ICVD for 10 years between different genders was investigated using two independent t-test. The major risk factors of disease prevalence among different individuals with various absolute risks were also evaluated using crosstab chi-square test. Civil servants and healthy individuals were compared using single-sample information t-test.

Results

Baseline characteristics

The subjects were selected from 2,211 Henan provincial civil servants aged 35 years to 59 years; among these servants, 1,468 were males (66.40%) and 743 were females (33.60%). The average age was 48.09 ± 6.99 years. Their general exposure rates related to overweight, hyperlipidaemia, hypertension, diabetes mellitus and smoking were 62.96%, 76.07%, 34.87%, 8.10% and 21.30%, respectively. The exposure rate of the risk factors in the male civil servants was higher than that of the female civil servants. The exposure rates on overweight (χ^2 = 350.395, p = 0.000), hyperlipidaemia (χ^2 = 120.994, p = 0.000), hypertension (χ^2 = 118.230, p = 0.000), diabetes mellitus (χ^2 = 123.154, p = 0.000) and smoking (χ^2 = 302.917, p = 0.000) were distinctly different between male and female civil servants (Figure 1). The different age groups with more than five stated exposure rates of risk elements exhibited significant differences. The morbidities of dyslipidaemia and diabetes mellitus increased with age (Table 1).

Average absolute risk of morbidity related to ICVD for 10 years

The average absolute risk of morbidity related to ICVD for 10 years increased with age in male and female civil servants. No significant difference was found in terms of morbidity risk of the male civil

servants between the age groups of 35 years to 39 years and 40 years to 44 years ($P = 0.480$). Beyond the age of 45 years, three stages of age risk increased significantly, and this finding was evidently different from that of the other age groups ($P < 0.05$). The absolute risk of morbidity related to ICVD in the female civil servants aged 35 years to 49 years was retained at a low level. No evident difference was observed among the three age groups, including 35 years to 39 years, 40 years to 44 years and 45 years to 49 years. Beyond the age of 50 years, morbidity risk increased with age, and this result significantly differed from that of servants aged <50 years ($P = 0.000$). The average absolute risk of morbidity on ICVD between different genders was statistically significant (male 3.88 ± 5.19; female 1.68 ± 3.00; 95% CI $= 1.79$ to 2.60, $P = 0.000$). Among the age groups and between genders, the average absolute risk of the male civil servants was significantly higher than that of the female civil servants (Table 2).

Distribution of absolute risk morbidity on ischemic cardiovascular in decade

The proportion of the absolute risk of 2,211 civil servants included in this study was arranged in the following increasing order: 82.27%, 12.75%, 3.17%, 1.63% and 0.18%. For the male civil servants, the rate of moderate risk was 94.1% (1382 individuals), whereas the rate of moderate and high risk was 5.9% (86 individuals). For the female civil servants, the rate of moderate risk was 96.8% (719 individuals), whereas the rate of moderate and high risk was 3.2% (24 individuals). Gender differences were statistically significant ($\chi^2 = 109.150$, $P = 0.000$; Figure 2). The level of absolute risk morbidity related to ICVD for 10 years increased with age, and the differences between various age groups were statistically significant ($\chi^2 = 287.596$, $P = 0.000$; Table 3).

Occurrence of major risk factors of individuals with different absolute risks

Among the subjects whose absolute risk of morbidity related to ICVD for 10 years was >10%, the morbidity rates of high systolic blood pressure, hypercholesterolaemia, overweight, smoking and diabetes mellitus were 99.10%, 65.45%, 95.45%, 45.45% and 32.73%, respectively. A significant difference ($P = 0.000$) was observed, particularly in high systolic blood pressure (Table 4), compared with the subjects whose risk rate was <10%.

Assessment of absolute risk

The risk of ICVD of the male civil servants was higher than that of healthy individuals. Among the age groups of 35 years to 39 years, 40 years to 44 years, 45 years to 49 years, 50 years to 54 years and 55 years to 59 years, the absolute risks of morbidity related to ICVD for 10 years were increased by 0.53%, 0.46%, 1.40%, 1.64% and 3.64%[21]; these findings were 1.53

(95% CI 0.27 to 0.79, $P = 0.000$), 1.33 (95% CI 0.19 to 0.73, $P = 0.001$), 1.74 (95% CI −0.73 to 0.61, $P = 0.000$), 1.63 (95% CI 1.12 to 2.16, $P = 0.000$) and 1.84 (95% CI 2.28 to 3.81, $P = 0.000$) times higher than those of healthy individuals, respectively. Beyond the age of 45 years, the risk of morbidity related to ICVD was statistically different from that of the healthy individuals. Among various age groups, the absolute risks of morbidity related to ICVD for 10 years were increased by 0.04%, 0.12%, 0.37%, 1.29% and 2.61%; these results were 1.13 (95% CI −0.05 to 0.13, $P = 0.399$), 1.30 (95% CI 0.04 to 0.21, $P = 0.005$), 1.62 (95% CI 0.13 to 0.61, $P = 0.002$), 2.43 (95% CI 0.82 to 1.75, $P = 0.000$) and 2.86 (95% CI 1.87 to 3.35, $P = 0.000$) times higher than those of the healthy individuals, respectively (Table 5).

Discussion

This study investigated the current situation of risk factor exposure related to ICVD of civil servants and their risk of morbidity for 10 years. The result showed that the occurrence rate of ICVD in civil servants and the risk of morbidity were evidently higher than those of healthy individuals. Among the subjects, the cardiovascular health of male civil servants was the poorest.

The exposure rate of risk factors of ICVD in Henan provincial civil servants was high. The health conditions of male civil servants were weaker than those of the females. The detection rates of five risk factors were higher in male civil servants than in female civil servants, and 32.08% of male civil servants were smokers. The occurrence rates of high blood pressure and diabetes mellitus were related to age, whereas overweight, high cholesterol and smoking were not. The risk factor of cardiovascular diseases is also directly related to lifestyle.

This research showed that the absolute risk of morbidity related to ICVD of civil servants for 10 years increased with age. In males and females aged ≥45 years, the risk of morbidity increased significantly; this result is related to the cumulative effects of risk factors. The morbidity level of ICVD, which is positively correlated with high percentage of smoking and exposure rate of risk factor, in male civil servants was higher than that of females. The absolute risk of morbidity on ICVD in male civil servants was statistically higher than that of the healthy individuals of the same age. After the age of 45 years, the risk of morbidity in female civil servants was evidently higher than that of the healthy individuals; this result indicated a need for a targeted health management of various gender and age groups in terms of risk morbidity related to ICVD in Henan provincial civil servants. In a previous study, income and education are inversely correlated with acute myocardial

infarction.[22] As an upper-middle class of the social economy, the group of civil servants with high social status and education is at a high risk of morbidity related to ICVD. Nevertheless, the reason for this condition should be further investigated.

Among the civil servants whose absolute risk of morbidity related to ICVD for 10 years is ≥10%, the morbidity of high systolic pressure was 99.1% and the morbidity of overweight was 95.45%; this result indicated that high blood pressure and overweight caused much damage to moderate and high risk of morbidity related to ICVD for 10 years. The risk of coronary disease of patients with obesity and hypertension is two to three times higher than that of healthy individuals; furthermore, the risk of sudden death of these patients is seven times higher than that of healthy individuals.[23] Thus, the risk morbidity in middle and upper class individuals can be reduced by controlling blood pressure and weight. A clear epidemiological relationship has been observed between hyperlipidaemia and overweight. [24] Weight loss can reduce total cholesterol levels at the same time. Smoking is another accurate predictor coronary heart disease. The simultaneous presence of five other risk factors, except age, can predict 80% of acute coronary syndrome. Moreover, smokers who consume two or more cigarettes a day can increase the morbidity of acute myocardial infarction by 40%. Continuous smoking can be considered to predict 36% of acute myocardial infarction. [25] Among individuals whose absolute risk of morbidity on ICVD is <10%, 20.03% were smokers. In the assessment model, whether smoking is reduced in proportion to score or this model can illustrate the entire situation by adjusting individual cardiovascular risk factors should be further demonstrated and improved.

In summary, a high risk of morbidity related to ICVD is observed in civil servants. Lifestyle and personalized health management should be promoted to reduce the risk factors associated with morbidity, thereby decreasing the morbidity and mortality related to cardiovascular diseases. This study provided the basis of the development of morbidity prediction models related to ICVD.
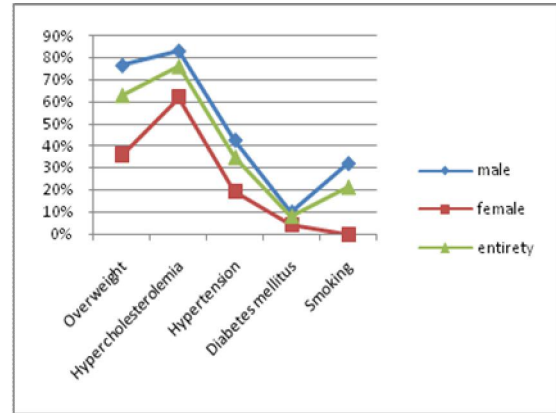

Figure 1. Exposure of risk factors of cardiovascular diseases affecting civil servants of different genders.
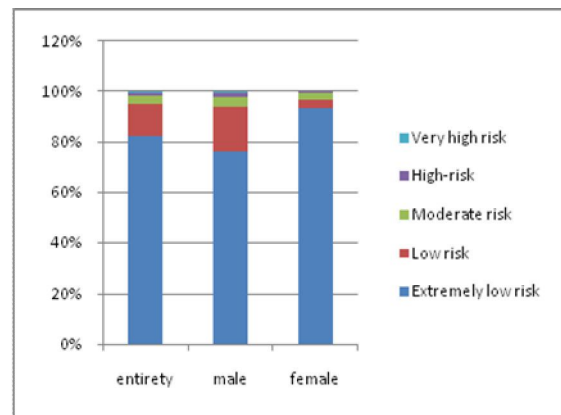

Figure 2. Distribution of absolute risk morbidity related to ICVD for 10 years with different genders.

Table 1. Exposure of risk factors on cardiovascular diseases in civil servants of different ages.

	35~39 years	40~44 years	45~49 years	50~54 years	55~59 years	χ^2	P
Overweight (n, %)	192(59.44)	228(57.22)	309(63.32)	302(63.85)	361(67.86)	12.019	.017
Hypercholesterolaemia (n, %)	226(69.97)	281(71.14)	376(77.05)	381(80.55)	418(78.57)	19.182	.001
Hypertension (n, %)	84(26.01)	98(24.81)	177(36.27)	189(39.96)	223(41.92)	46.221	.000
Diabetes mellitus (n, %)	10(3.1)	14(3.54)	42(8.61)	51(10.78)	62(11.65)	35.662	.000
Smoking (n, %)	57(17.65)	67(16.96)	118(24.18)	110(23.26)	119(22.37)	10.861	.028

Table 2. Average absolute risk morbidity related to ICVD in Henan civil servants with different genders and ages for 10 years.

	Average risk (%)			
Age	Men	Women	t	P
35~39 years	1.53±1.86	0.34±0.53	25.619	0.000
40~44 years	1.86±2.10	0.52±0.54	42.272	0.000
45~49 years	3.30±3.79	0.97±1.45	38.875	0.000
50~54 years	4.24±4.73	2.19±2.89*	8.019	0.050
55~59 years	6.64±7.49	4.01±4.75	9.61	0.020

Table 3. Distribution of absolute risk morbidity related to ICVD for 10 years with different ages.

	Extremely low risk	Low risk	Moderate risk	High-risk	Very high risk
	n(%)	n(%)	n(%)	n(%)	n(%)
35~39 years	312(96.59)	10(3.10)	1(0.31)	0(0.00)	0(0.00)
40~44 years	379(95.95)	14(3.54)	2(0.51)	0(0.01)	0(0.00)
45~49 years	427(87.50)	46(9.43)	10(2.05)	5(1.02)	0(0.00)
50~54 years	377(79.70)	74(15.64)	13(2.75)	9(1.90)	0(0.00)
55~59 years	324(60.90)	138(25.94)	44(8.27)	22(4.14)	4(0.75)

Table 4. Exposure situation of risk factor on cardiovascular diseases in Henan civil servants with different risk levels.

	<10%	≥10%	χ^2	P
	n(%)	n(%)		
Overweight	1405(66.87)	105(95.45)	39.435[a]	.000
Hypercholesterolaemia	815(38.79)	72(65.45)	30.934[a]	.000
Hypertension	575(27.37)	109(99.10)	251.669[a]	.000
Diabetes mellitus	143(6.80)	36(32.73)	94.392[a]	.000
Smoking	421(20.03)	50(45.45)	40.278[a]	.000

Table 5. Assessment of absolute risk in Henan civil servants of different genders.

	Age	N	Absolute risk (%)	Average risk (%)	Relative risk (RR)	t	P	95% CI
Male	35~39	198	1.53±1.86	1	1.53±1.86	4.039	.000	0.27-0.79
	40~44	239	1.86±2.10	1.4	1.33±1.5	3.399	.001	0.19-0.73
	45~49	340	3.30±3.79	1.9	1.74±1.99	-21.746	.000	-0.73-0.61
	50~54	320	4.24±4.73	2.6	1.63±1.82	6.205	.000	1.12-2.16
	55~59	371	6.64±7.49	3.6	1.84±2.14	7.817	.000	2.28-3.81
Female	35~39	125	0.34±0.53	0.3	1.13±1.77	.847	.399	-0.05-0.13
	40~44	156	0.52±0.54	0.4	1.3±1.35	2.823	.005	0.04-0.21
	45~49	148	0.97±1.45	0.6	1.62±2.42	3.102	.002	0.13-0.61
	50~54	153	2.19±2.89	0.9	2.43±3.21	5.502	.000	0.82-1.75
	55~59	161	4.01±4.75	1.4	2.86±3.39	6.965	.000	1.87-3.35

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