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Time trend of cardiometabolic risk factors over a 10-year period in the office-working population in China

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ABSTRACT

Objectives Recent dramatic increases in cardiovascular disease mortality in China can be mostly explained by adverse changes in hypertension, dyslipidaemia, diabetes and obesity, known as cardiometabolic risk factors. Our study aimed to assess the trend of these four signatures by a 10-year lag in Nanjing, China.

Methods 8017 subjects attended the routine health examination in 2008, and 9379 subjects in 2017, from multiple work units of Nanjing, were included in the present study. The prevalence and trend of four cardiometabolic risk factors: hypertension, dyslipidaemia, diabetes and obesity were analysed.

Results From 2008 to 2017, the prevalence of hypertension declined, while the prevalence of dyslipidaemia, diabetes and obesity increased. Besides, the population in 2008 and 2017 had an average of 0.66 and 0.78 risk factors, respectively.

Conclusion Cardiometabolic risk factors are common for the staff in administrative agencies and institutions of Nanjing, China. Effective screening and interventions against these risk factors should be adopted in high-risk populations such as the office-working population in China.

Strength and limitations of this study

- We used two independent large health check-up populations with a sample size of approximately 10 000, most of whom were office-working to assess trends in cardiovascular risk factors over a 10-year period.
- The exposure distribution of all risk factors was estimated on the basis of original data.
- We only considered four factors (blood pressure, LDL, glucose and body mass index), without considering any dietary factors and smoking, because of the lack of these parameters.
- The definitions of these conditions are continuously changing and may also be stratified.

INTRODUCTION

Cardiovascular disease (CVD) is highly prevalent and remains the predominant cause of premature mortality worldwide.[1] In China, the estimated annual deaths due to CVD increased to 2.7 million, which accounts for about 40% of all-cause mortality per year.[2] Obesity, diabetes, hypertension and dyslipidaemia are established risk factors of CVD and contribute to the prevalence of CVD,[3–8] which were also known as cardiometabolic risk factors because of their close link with metabolic disorders, cancers and chronic respiratory diseases.[9 10]

In recently years, a substantial increase was seen in the prevalence of overweight and diabetes mellitus worldwide,[11 12] whereas the prevalence of hypertension was reported to be stable over time[13–15] and the prevalence of hypercholesterolaemia remained at almost epidemic levels.[16–18] In China, with the huge economic development and changes in lifestyles including higher calorie and cholesterol intake and reduced physical activity, the frequencies and profiles of four signatures such as obesity, diabetes, hypertension and dyslipidaemia have changed even more dramatically. Given the ongoing deterioration of these cardiometabolic risk factors in China, which may greatly contribute to the surge of cardiometabolic health, more understanding of these factors may be quite important. However, to date, little is known about the time trend of these risk factors in China.

The present study aims to investigate the long-term trends of cardiometabolic risk factors in the office-working population in China by a 10-year lag from 2008 and 2017, using a large health administrative database in Jiangsu, China. The office-working population has been shown to be 'high risk group' for metabolic diseases[19] due to their lifestyle, as most of them perform their daily work mainly in the office with low amount of physical activity.

METHODS

Participants

This was an observational study using health check-up data from the health management centre in the Geriatric Hospital of Nanjing

Table 1 The prevalence rates of hypertension, dyslipidaemia, diabetes and obesity in 2008 and 2017 based on examination tests and self-reports

Disease	Survey year	No. of subjects	No. of cases	Prevalence (95% CI) (%)	Standard prevalence (95% CI) (%)*	*P* values †
Hypertension	2008	8017	3036	37.87 (36.81 to 38.93)	27.51 (26.53 to 28.49)	<0.001
	2017	9379	3671	39.14 (38.15 to 40.13)	25.16 (24.28 to 26.04)	
Dyslipidaemia	2008	8017	869	10.84 (10.16 to 11.52)	8.25 (7.65 to 8.85)	<0.001
	2017	9379	1332	14.20 (13.49 to 14.91)	11.95 (11.29 to 12.61)	
Diabetes	2008	8017	687	8.57 (7.96 to 9.18)	5.40 (4.91 to 5.89)	<0.001
	2017	9379	1141	12.17 (11.51 to 12.83)	6.68 (6.17 to 7.19)	
Obesity	2008	8017	725	9.04 (8.41 to 9.67)	7.44 (6.87 to 8.01)	<0.001
	2017	9379	1154	12.30 (11.64 to 12.96)	11.33 (10.69 to 11.97)	

*Standardised prevalence; the prevalence rates were standardised by age and sex based on the 2010 Chinese census population.
†*P* values for standardised prevalence between 2008 and 2017.

Medical University (Nanjing, China). Subjects included in the study came from dozens of work units including government offices, scientific research institutions, banks and so on, in the major urban districts of Nanjing, which is the capital of Jiangsu Province located in the east of China. Most of them perform their daily work mainly in the office with low amounts of physical activity. We also included both currently employed and retired individuals in our study. Totally, 9665 subjects in 2008 and 15 200 subjects in 2017 undergoing a routine annual health check-up in the health management centre were included; the health check-up included a medical examination, anthropometric measurements and information on medical history. There was no difference in the design and recruitment between 2008 and 2017.

After excluding those participants with missing data on height (n=450), systolic pressure (n=29), low-density lipoprotein cholesterol (LDL-C) (n=938) or information of prior history of hypertension, dyslipidaemia and diabetes (n=231), 8017 individuals were eligible for analysis at baseline in 2008. Similarly, a population of 9379 individuals remained for analysis in 2017 after excluding those under 18 years of age (n=21), or those with missing data on height (n=1476), systolic pressure (n=128), blood glucose (n=312), LDL-C (n=3001) or information of prior history of hypertension, dyslipidaemia and diabetes (n=883). Written informed consent was obtained from all participants.

Clinical assessment

Demographic characteristics including age and sex were collected from all participants. Personal medical history, including hypertension, diabetes and dyslipidaemia, was reported by all participants. Body weight, height and blood pressure were measured using standard instruments and protocols by trained nurses.[20] Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared. LDL-C and fasting plasma glucose (FPG) were measured during an overnight fast of more than 11 hours. We defined the same four signatures for cardiometabolic risk factors in 2008 and 2017 (also see online supplementary table 1): (1) Obesity: BMI≥28 kg/m.[21–23] (2) Hypertension: blood pressure ≥140/90 mm Hg and/or self-reported history of hypertension.[24] (3) Dyslipidaemia: LDL-C ≥4.14 mmol/L and/or self-reported dyslipidaemia.[25] (4) Diabetes: FPG≥7.0 mmol/L and/or self-reported diabetes.[26]

Statistical analysis

Comparisons between different years were conducted using Student's t-test for continuous variables and χ^2 test for categorical variables. Comparison between prevalence data of 2008 and 2017 was performed on the basis of standardised mortality rate calculations and by applying the indirect standardisation technique, using reference-specific prevalent rates of hypertension, dyslipidaemia and diabetes by age and gender using the population composition from the Chinese census population (aged 19–96 years).[27] Data analyses were carried out by R software (V.3.0.2, 2013-09-25; R Foundation for Statistical Computing, http://www.cran.r-project.org/). The significance level was set at p<0.05 and p values were given for two-sided tests.

Patient and public involvement

The participants of this study represent a large office-working population in China. They were not involved either in the study design, nor in the conduct of the study. However, they were informed that their physical examination data (including blood pressure, cholesterol levels, blood glucose, etc) and baseline information may be used in a scientific study. All scientific study results were continuously communicated to the participants by phone.

RESULTS

The characteristics of the study population are shown in online supplementary table 2. A total of 8017 and 9397 subjects were included in the analysis in 2008 and 2017, respectively. There was no statistically significant difference in sex distribution. Compared with those of 2008, the percentages of older (age ≥60 years), overweight

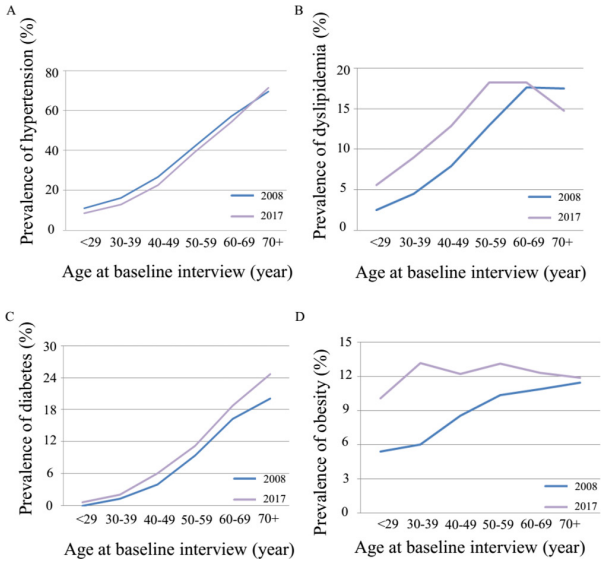

Figure 1 Age-specific prevalence of (A) hypertension, (B) dyslipidaemia, (C) diabetes and (D) obesity in 2008 and 2017.

and obese subjects increased by 9.89%, 2.42% and 3.26%, respectively in 2017. In addition, in 2017, more subjects had a history of the three medical conditions (systolic blood pressure, LDL-C and blood glucose).

The crude prevalence of hypertension, dyslipidaemia, diabetes and obesity increased over the study period, from 37.87%, 10.84%, 8.57% and 9.04% in 2008 to 39.14%, 14.20%, 12.17% and 12.30% in 2017 (table 1). As expected, a significant increase was confirmed for dyslipidaemia, diabetes and obesity in 2017 even standardised by age and sex (dyslipidaemia: 8.25% in 2008 and 11.95% in 2017, p<0.001; diabetes: 5.40% in 2008 and 6.68% in 2017, p<0.001; obesity: 7.44% in 2008 and 11.33% in 2017, p<0.001, table 1). Interestingly, we found that after standardisation for age and sex, the trend for hypertension was reversed with a slight decline in 2017 from 27.51% (26.53%–28.49%)%) to 25.16% (24.28%–26.04%). When subjects were stratified by age, a constant downward trend of hypertension was identified among subjects younger than 70 years from 2008 to 2017 (figure 1A). The prevalent rates for dyslipidaemia, diabetes and obesity were higher in 2017 in each age subgroup (figure 1B–D). Especially, the prevalence of obesity in younger groups in 2017 dramatically increased as compared with that in 2008 (figure 1D). In contrast, the overall prevalence for the four signatures was similar when stratified by gender (figure 2A,B) or for patients identified by examination or self-reported alone (online supplementary table 3).

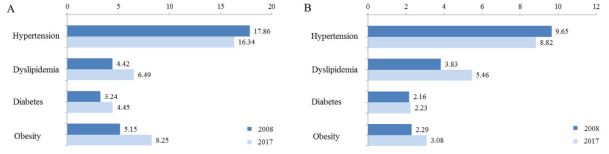

Figure 2 The age-standardised prevalence rates of the three cardiovascular disease factors in men (A) and women (B) in 2008 and 2017.

Changes in the four signatures stratified by gender among the different age groups were further analysed and presented in figure 3. It shows that the prevalence for male or female populations was similar in 2008 and 2017, respectively, for all but dyslipidaemia and obesity (figure 3). Similar results were seen for patients identified by examination or self-report alone (online supplementary table 4).

The distribution and numbers of cardiometabolic risk factors for 2008 and 2017 are shown in table 2. We found that 47.46%, 15.14% and 3.32% of the subjects had at least one, two and three, respectively, risk factors in 2008. In contrast, there was a gain in the percentage of risk factors in 2017 with 54.00%, 19.70% and 3.75%, respectively. The average numbers of cardiometabolic risk factors in 2008 and 2017 were 0.66 and 0.78 (p<0.001), respectively. And the numbers of cardiometabolic risk factors significantly increased with age (online supplementary figure 1).

DISCUSSIONS

To our knowledge, only a few previous studies have estimated cardiometabolic risk factors and future CVD burden in China before 2010.[28 29] In the present study, we examined the prevalence of hypertension, dyslipidaemia and diabetes and the potential impact by a 10-year lag in Nanjing, China, in office-working populations.

In the past 10 years, the percentage of overweight and obesity showed an upward trend, which is consistent with the results from the 2010 China Chronic Disease Monitoring Programme.[30] The worldwide ranking of obese populations of China has moved to the second position in 2014.[31] During the last decades, the Chinese population have become more sedentary, especially for the working staff or retiree in the agency.[32]

Hypertension was reported to the most prominent cardiometabolic risk factors among the Chinese.[33 34] From 1988 to 2008, there was an increasing trend of prevalence of hypertension in Americans aged 40 years and older,[35] however, the prevalence of hypertension in Japan,[36] Germany,[37] Italy[38] and Korea[39] decreased. In our study,

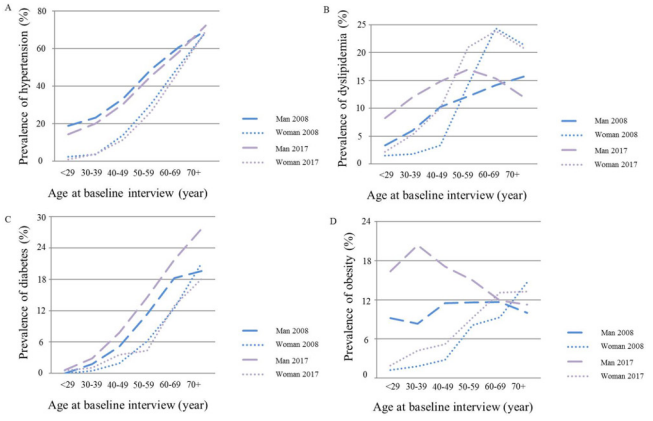

Figure 3 Age-specific prevalence of (A) hypertension, (B) dyslipidaemia, (C) diabetes and (D) obesity among men and women in 2008 and 2017.

Table 2 Details of cardiometabolic risk factors among Chinese subjects, who underwent check-up, in 2008 and 2017

Cardiometabolic risk factors	2008 (8017) N	2008 (8017) %	2017 (9379) N	2017 (9379) %	P values
Obesity					
Body mass index ≥28 kg/m^2	725	9.04	1154	12.30	<0.001
Hypertension	3036	37.87	3671	39.14	0.09
Dyslipidaemia	869	10.84	1332	14.20	<0.001
Diabetes	687	8.57	1141	12.17	<0.001
Cardiometabolic risk factors					
≥1 risk factor	3805	47.46	5065	54.00	<0.001
≥2 risk factors	1214	15.14	1848	19.70	<0.001
≥3 risk factors	266	3.32	352	3.75	0.13

we found a significant decline in the prevalence trend for hypertension among Chinese adults in 2017 compared with 2008. As we all know, higher socioeconomic status could positively improve the awareness and control of hypertension, and people would also have better compliance to medical treatment. According to a survey in 13 provinces from 2009 to 2010, among 50 171 subjects aged at least 18 years, the awareness, treatment and control rates as well as the treatment control rate of hypertension were 42.6%, 34.1%, 9.3% and 27.4%, respectively, higher than those in 2002 (30.2%, 24.7%, 6.1% and 25.0%, respectively).[40]

High blood LDL-C was the second leading risk factor for CVD. In agreement with previous Swiss,[41] French[42] and German[43] studies, the prevalence of hypercholesterolaemia increased significantly between 2008 and 2017. Diabetes is a growing epidemic in China, occurring at a relatively young age.[44] In the 1980s, diabetes was rare in China, with an estimated prevalence of 0.67%. In subsequent national surveys conducted in 1994,[45] 2000–2001,[46] 2007–2008[47] and 2010–2011,[48] the prevalence was 2.5%, 5.5%, 9.7% and 11.6%, respectively. In this study, we found that the crude prevalence increased from 8.57% in 2008 to 12.17% in 2017. These data imply that CVD events associated with high LDL and glucose will continue to increase in the future.

The main strength of this study was the use of two independent large health check-up populations with a sample size of approximately 10 000. All measurements and data were collected using standardised methods over time. Second, the exposure distribution of all risk factors was estimated on the basis of original data. The original data-based estimation allowed us to account for potential residual confounding, although it could not be completely eliminated.

The findings in the present study are subject to several limitations. First, we only considered four factors (blood pressure, LDL, glucose and BMI), without considering any dietary factors and smoking, because of the lack of data on these parameters. Second, this study was carried out in cohorts only comprising Chinese individuals from office-working units in Nanjing. Our results may not be generalisable to the entire population. More studies are expected to confirm our finding.

In conclusion, high blood pressure remains the leading factor among cardiometabolic risk factors in China, although a slight downward trend of this condition was observed from 2008 to 2017 after standardisation by age and sex. However, significant increases in dyslipidaemia, diabetes and obesity in 2017 were confirmed in the present study. More intensive screening and treatment regimens are needed for patients with these conditions, in order to curb the cardiovascular end points expected in the near future.

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Contributors YC completed the analyses and led the writing. ZX-S and LB-G initiated, conceived and supervised the study. CS guided the analysis and modified the article. HL-Y assisted with the study and analyses. HZ participated in the data collation. XH-L and GY managed the physical examination. LK-Z and HD participated in the implementation of physical examination. SP-Y and DH-Y checked the results of physical examination.

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Competing interests None declared.

Patient consent for publication Obtained.

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Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement All available data are included in this manuscript.

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