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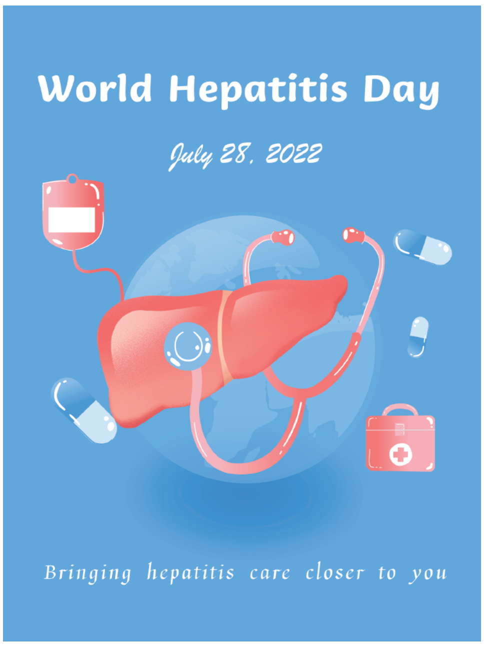

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Healthy China

Interpretation of the National Action Plan for Eliminating Hepatitis C as a Public Health Threat (2021–2030)

Jian Li[1]; Lin Pang[1]; Zhongfu Liu[1,#]

Summary

Hepatitis C virus (HCV) infection is a major public health problem in China. In 2016, the World Health Organization (WHO) proposed a goal to eliminate viral hepatitis as a public health threat by 2030, and in 2018, the National Health Commission of China launched Hepatitis C Elimination Action by 2030. Hepatitis C control and prevention has made significant progress in China in recent years. To implement the "Healthy China 2030" plan and the Healthy China Initiative (2019–2030), and to contribute to the global target of eliminating viral hepatitis as a public health threat by 2030, the National Health Commission of China and eight other government departments jointly issued the *National Action Plan for Eliminating Hepatitis C as a Public Health Threat (2021–2030)* (hereinafter referred to as the "National Plan") in 2021. The National Plan has an overarching goal and 15 specific targets that cover health education, comprehensive prevention interventions, testing and treatment, and capacity building. The National Plan introduces key tasks and strategies of "five strengthenings, one expanding, and one implementation," i.e., strengthening health education, comprehensive prevention, referral and treatment, drug supply, and information management; expanding testing; and implementing relevant medical insurance policies. The National Plan also proposes key guaranteeing measures of "four intensifications and one mobilization," i.e., intensification of organizational leadership, capacity building, scientific research and international cooperation, and supervision and fulfillment; mobilization of social participation. The National Plan is an important component of the Healthy China initiative, adhering to the integration of treatment and prevention and deepening the "integration of medical treatment, medical insurance, and medicine supplies." In this review, we describe the National Plan and discuss its challenges and prospects.

BACKGROUND

Hepatitis C is a global public health problem. The World Health Organization (WHO) estimated that in 2019, approximately 58 million people were living with chronic hepatitis C virus infection and 290 thousand people died from hepatitis C worldwide (*1*). Hepatitis C is a major infectious disease that impacts China. The Law of the People's Republic of China on the Prevention and Control of Infectious Diseases designates hepatitis C a Class B infectious disease (*2*). In recent years, approximately 200 thousand hepatitis C cases have been newly reported each year. Approximately 7.6 million people have been infected by hepatitis C virus (HCV) in China, and 4.56 million people are currently living with chronic HCV infection. Hepatitis C infection causes a large disease burden and can lead to liver cirrhosis and hepatocellular carcinoma (HCC) without timely diagnosis and treatment.

In 2016, WHO proposed a goal to eliminate viral hepatitis as a public health threat by 2030 (*3*). In 2018, the National Health Commission of China launched the Hepatitis C Elimination Action by 2030. The document, "*China Viral Hepatitis Prevention and Control Program (2017–2020)*" was issued in 2017, and the program has been conscientiously implemented ever since (*4*). Significant progress has been made in terms of publicity and education, comprehensive interventions, testing and diagnosis, standardized treatment, direct-acting antiviral agent (DAA) development and registration, national-level negotiation of DAA price, and National Reimbursement Drug List (NRDL) updates — all of which have laid a foundation for eliminating hepatitis C as a public health threat (*5*).

In 2021, National Health Commission, Ministry of Science and Technology, Ministry of Industry and Information Technology, Ministry of Public Security, Ministry of Civil Affairs, Ministry of Justice, Ministry of Finance, National Healthcare Security Administration, and National Medical Product

Administration jointly issued the National Action Plan for Eliminating Hepatitis C as a Public Health Threat (2021–2030) (the "National Plan") (*6*), which proposed 15 targets, seven key tasks, and five guaranteeing measures.

ACTION GOAL

The overall goal of the National Plan is to fully implement the strategies and measures of hepatitis C control and prevention and contain new HCV infections, find and cure people living with chronic HCV infection, significantly reduce deaths due to hepatitis C-related liver cirrhosis and HCC, reduce the disease burden, and eliminate hepatitis C as a public health threat. The National Plan has 15 targets — for 2021, 2025, and 2030 — in the domains of publicity and education, comprehensive prevention interventions, testing and treatment, and capacity building (Table 1). The key tasks for 2021 focus on building mechanisms and systems, and consolidating the achievements of curbing HCV transmission by blood. From 2022 to 2025, the key tasks focus on containing new HCV infections, with the strategies of "testing all in need" in key populations and "treating all eligible" for persons with newly diagnosed HCV infection. From 2026 to 2030, the key tasks focus on reducing the prevalence of hepatitis C by further implementing the strategies of "testing all in need" and "treating all eligible" among all people living with chronic HCV infection.

STRATEGIES AND MEASURES

The National Plan includes seven key prevention and control tasks and strategies: "five strengthenings, one expanding, and one implementation." The first is strengthening publicity and education, popularizing HCV knowledge and improving public awareness of HCV control and prevention. The second is to strengthen comprehensive prevention interventions among key populations, nosocomial infection control, blood safety, and epidemiological investigations. The third is to expand HCV testing and improve detection rates by implementing the strategies of "testing all in need" in medical institutions and among key populations, "testing all of those with the willingness to be tested" for the general public, and "nucleic acid testing for anyone tested positive for anti-HCV." The fourth is to strengthen referrals and standardized treatment by establishing a designated hospital healthcare service model for "treating all eligible" people living with chronic HCV infection with the aim to improve treatment coverage and cure rates. The fifth is to implement healthcare insurance policies and NRDL that reduce patients' financial burden and improve the affordability of care. The sixth is to strengthen the supply and availability of HCV medicines, and promote a "DTP (Direct to Patient) pharmacy" mechanism with a sustainable drug supply that improves access to affordable treatment. The seventh is to strengthen information management and improve scientific monitoring and evaluation, including improving HCV case report quality, establishing and improving information management systems, strengthening data analyses and applications, and improving early warning mechanisms for cluster outbreaks.

For guaranteeing measures, the National Plan has "four intensifications and one mobilization." The first is to intensify organization and leadership, including establishment of a national leadership group and an expert group, and clarification of the responsibilities of medical and health institutions. The second is to intensify capacity building, including laboratory and professional workforce capacity. The third is to mobilize social forces to participate in hepatitis C control and prevention. The fourth is to intensify scientific research and international cooperation. The fifth is to intensify supervision and National Plan fulfillment.

FEATURES

The National Plan is an important component of the Healthy China construction, which reflects a people-centered developmental philosophy and strengthens the "four-party responsibilities" of governments, departments, communities, and individuals. The National Plan was jointly issued by nine governmental departments, reflecting government leadership, departmental coordination, integration of treatment and prevention, and deepening of the "integration of medical treatment, medical insurance, and medicine supplies." The National Plan references the WHO targets of the Global Health Sector Strategy on Viral Hepatitis and interim guidance for country validation of hepatitis elimination (*7*). The National Plan's overall goal, phased targets, and phased strategies and measures are in accordance with China's current situation and the Healthy China construction planning.

TABLE 1. Targets of the National Action Plan for Eliminating Hepatitis C as a Public Health Threat (2021–2030) by Year.

Target	2021	2025	2030
1. Establishment of a working mechanism for hepatitis C elimination	√	√	√
2. Designation at least one hospital per county qualified for HCV antiviral treatment	√	√	√
3. Percent of general hospitals of level-2 or above, infectious disease hospitals, and centers for disease control and prevention (CDCs) that can conduct anti-HCV testing	100%	100%	100%
4. Percent of general hospitals of level-2 or above, infectious disease hospitals, and CDCs that can conduct HCV RNA testing	100%	100%	100%
5. Percent of clinical blood tested for HCV RNA at the national level	100%	100%	100%
6. Percent of safe injections at medical institutions	100%	100%	100%
7. Percent of injection drug users (IDUs) covered by interventions	>80%	>80%	>80%
8. Establishment of a national hepatitis C control and prevention information system	√	√	√
9. Percent increase of hepatitis C knowledge in the general public compared with a 2020 baseline	−	10%	20%
10. Percent of newly reported anti-HCV positive cases tested for HCV RNA	−	>90%	>95%
11. Percent of newly reported chronic hepatitis C patients who receive antiviral therapy	−	>80%	>80%
12. Percent of all reported chronic hepatitis C patients who receive antiviral therapy	−	−	>80%
13. Clinical cure rate of chronic hepatitis C patients who receive antiviral therapy	−	>95%	>95%
14. Percent of healthcare professionals that received HCV-related training	−	>90%	100%
15. Percent of healthcare professionals who have received HCV-related training and are rated as qualified	−	>95%	>95%

Note: "−"represent not applicable.

CHALLENGE AND PROSPECTS

China faces several challenges to the elimination of hepatitis C as a public health threat by 2030. First, the number of patients with chronic hepatitis C in China is relatively large and the risk of HCV transmission still exists, leading to the potential of a huge burden of hepatitis C-related liver cirrhosis and HCC. Second, the "integration of medical treatment, medical insurance, and medicine supplies" is not enough, and mechanisms for integrating hospitals and centers for CDCs are not yet smooth. The "testing all in need" and "treating all eligible" strategies are not yet fully implemented, and the accessibility and affordability of medicine are inadequate. There are large gaps between targets and current progress, such as for testing and treatment coverage (*8*). Third, department attention, input, and effective measures are insufficient in some regions. The number and capacity of relevant health workers need to be increased and strengthened urgently.

It is critically important to fully promote and implement the national hepatitis C elimination action plan. First, more financial resources are needed to be invested and laboratory and professional workforce capacity are needed to be strengthened. Second, comprehensive strategies and measures should be implemented that can reduce both incidence and prevalence, including accelerating the HCV elimination working mechanism, establishing a designated medical service model, integrating resources, strengthening publicity and education, popularizing hepatitis C knowledge, strengthening comprehensive intervention, expanding testing, improving the detection rate of HCV, strengthening referral and standardized treatment, and increasing antiviral treatment coverage and cure rate of people living with HCV. Third, hepatitis C elimination should be integrated with Human Immunodeficiency Virus (HIV) control and prevention since they share the similar route of transmission. Comprehensive interventions should be strengthened among injecting drug users and other key populations vulnerable to HIV and sexually transmitted infections (STIs), including methadone maintenance treatment (MMT), needle exchange, and condom use promotion. Anti-HCV testing should be expanded among drug users receiving MMT, people seeking HIV voluntary counseling and testing service, people living with HIV and their spouse or sexual partners, and other key populations vulnerable to HIV and STIs. Fourth, it is vital to implement appropriate medical insurance policies that increase outpatient reimbursement, improving accessibility and affordability of diagnosis and treatment. Fifth, greater investment in research and development for hepatitis C elimination is needed.

China's hepatitis C elimination model must fit our actual situation.

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Preplanned Studies

Identifying the Optimal Age for Herpes Zoster Vaccination — Yichang City, Hubei Province, China, 2017–2019

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Summary

What is already known about this topic?

Herpes zoster (shingles) is a common skin condition in older adults, which usually presents as a painful rash with blisters. Vaccination is the most effective method to prevent shingles. However, there is not sufficient population-based epidemiological data in China to optimize the timing of zoster vaccination.

What is added by this report?

Clustering analyses of population-wide epidemiological data from the Healthcare Big Data Platform in Yichang, China showed that the average annual zoster incidence is the highest among people 55 years or older, at 10 cases per thousand persons per year, making this age group the optimal target population for vaccination. Incidence was lower but increased with age among younger adults, 28–54 years old.

What are the implications for public health practice?

With limited vaccination resources, zoster vaccinations should be targeted at adults 55 years or older who are at the greatest risk for shingles. Research should be conducted to understand the risk of shingles among young and middle-aged adults and identify triggers of shingles: potentially leading to preventive measures.

Herpes zoster (shingles) is a skin condition caused by the reactivation of varicella-zoster virus along dorsal nerve roots to the nerve root distribution on the skin, which causes a painful rash with blisters. Shingles mainly affect immunocompromised individuals and older adults (*1*). The most common complication of shingles is postherpetic neuralgia: a debilitating, burning pain that lasts long after the shingles blisters have healed. Treatment of shingles with antivirals can shorten the length and severity of shingles, but antiviral therapy should be started within 72 hours of the onset of the acute shingles rash and usually cannot be started in time (*2*). As such, vaccination is the best preventive measure. Recombinant zoster vaccines have been marketed in China for two years. Selecting the most suitable vaccine recipients can promote the implementation of the vaccine in China and effectively reduce the incidence of shingles. This study used a clustering methodology to partition age groups by shingles incidence using diagnostic data from January 1, 2017 through December 31, 2019 in Yichang, China. The highest risk age group was adults 55 years or older, with an average incidence of 10.13 episodes of shingles per 1,000 person-years. This age group is therefore the priority target for zoster vaccination. Among adults aged 28–54 years, shingles incidence increased with increasing age, requiring further study to identify potential shingles triggers.

In 2020, the recombinant zoster vaccine (RZV) was approved by China's National Medical Products Administration for market authorization. RZV is a two-dose, subunit vaccine of a recombinant glycoprotein E with a novel adjuvant (AS01B) shown to prevent shingles in adults aged 50 and above with normal immune functioning (*3*). RZV is administered in 0.5-mL intramuscular injections in the deltoid region of the upper arm, with the 2 doses separated by 2–6 months. Post-licensure data showed vaccine efficacy to be 97.2% (95% CI: 93.7–99.0) in adults 50 years or older, with a relatively long duration of protection; 4 years after vaccination, efficacy is 93.1% (95% CI: 81.2–98.2) among adults greater than or equal to 50 years and 87.9% (95% CI: 73.3–95.4) among adults greater than or equal to 70 years. RZV is a non-program vaccine; the 2-dose series costs approximately CNY 3,240.

Effective and efficient use of RZV requires the identification of an optimal target population for vaccination. Because target population identification has great public health significance, real-world evidence from a large population-base of epidemiological data is needed. Real-world data from Yichang, China provided an epidemiological basis for determining the optimal age for shingles vaccination. Under the constraint of limited vaccine resources, maximizing public health value requires maximizing the reduction of the burden of disease by careful selection of priority target populations.

Data for this study came from the government-led Healthcare Big Data Platform in Yichang from January 1, 2017 through December 31, 2019. All shingles outpatient and inpatient cases from 49 medical institutions in 6 urban districts of Yichang were included in this study's analyses. Shingles case inclusion criteria were an International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) disease code containing "B02" and diagnosis of "shingles." Clinical diagnostic criteria for case definitions required the following three symptoms or signs to be present simultaneously: clusters of blisters in the affected skin and distribution along a unilateral peripheral nerve dermatome, neuralgia with local lymph node enlargement, and normal skin outside of the affected dermatome.

This study estimated the number of permanent urban residents in all ages in 2017–2019 based on the total population of Yichang in 2020. The study calculated the year-of-age-specific incidences of shingles for 0 through 79 years of age; 80 years and above was considered as 1 age group. Age-group-specific shingles incidences during the 2017–2019 study period were ordered for cluster analysis with the K-means method. The K-means method is an unsupervised learning technique in which objects (year-of-age groupings for this study) are divided into clusters based on the epidemiological distance between objects, so that the data (incidence) would be maximally similar within a cluster but maximally dissimilar between clusters (*4*). The initial step was to determine the number of clusters, k, using the silhouette coefficient (SC) method. Values of SCs were between −1 and 1. The closer the SC values were to 1, the more optimal was the clustering. Once the optimal number of clusters was determined, the K-means method was used for cluster analysis. Data were analyzed using SPSS software (version 27.0, IBM Corp, Armonk, NY, USA), and the model was implemented in Python (version 3.10.4, Python Software Foundation, Fredericksburg, VA, US).

Based on the number of permanent (more than 6 months) urban residents and their duration of residence during 2017 to 2019, this study's analytic dataset contained 5,691,939 person-years of observation: 2,872,042 men person-years and 2,819,897 women person-years. The overall incidence of shingles was 5.82 per 1,000 person-years (33,130/5,691,939); the incidence among women was 6.29 per 1,000 person-years (17,743/2,819,897) and the incidence among men was 5.36 per 1,000 person-years (15,387/2,872,042). Shingles incidence was thus significantly greater in women (P<0.05).

Shingles occurred in all age groups and increased with age. The incidence of shingles among children 0–9 years of age was low, but not 0. Shingles incidence increased significantly between 10 and 27 years of age and then plateaued between 30 and 50 years of age; incidence increased again after 55 years of age (Figure 1).

There were 3 age-group categories that differed by

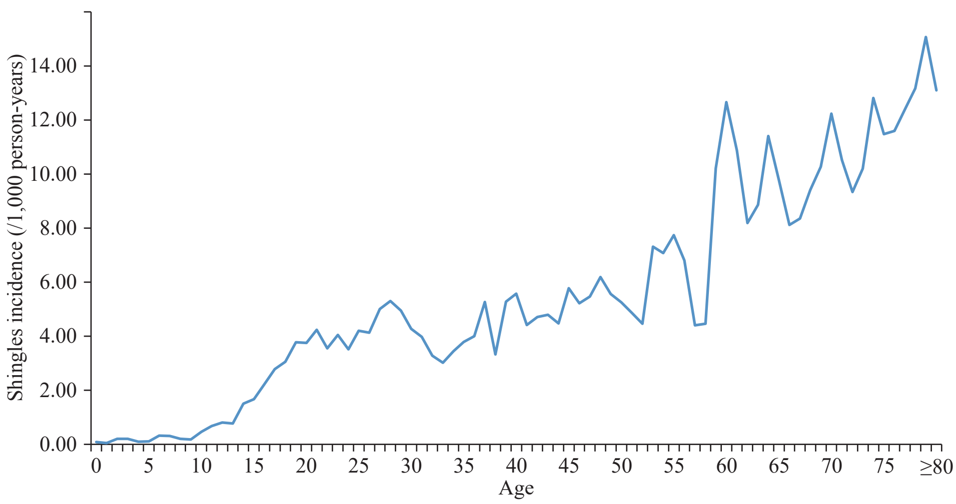

FIGURE 1. Age-specific incidence of shingles from 2017–2019 in Yichang, China.

Notes: Age-specific incidence in 2017–2019 was calculated by the following formulas: n=total urban permanent resident population×age composition ratio of Yichang in 2020; total observed person-years=n×observation years:

$$\text{age-specific incidence}=\frac{\text{number of shingles cases at all ages}}{\text{total observed person} - \text{years in the fixed time period}}.$$

incidence (k=3) (Figure 2): 0–27 years, 28–54 years, and 55 years and above (Figure 3). Mean shingles incidences were 1.86 per 1,000 person-years for 0–27-year-olds, 4.85 per 1,000 person-years for 28–54-year-olds, and 10.13 per 1,000 person-years for those 55 years or older.

DISCUSSION

This study found that individuals of 55 years or older had the highest average incidence of shingles at 10.13 per 1,000 person-years of observation, accounting for 56.50% (18,720/33,130) of all cases in Yichang. Thus, shingles mainly affects older adults. China has more elderly people than any other country, and the proportion of China's population is that the elderly is becoming among the highest in both Asia and the world (*5*). In generalizing these results from Yichang to China's population using the 6th population census, China is expected to have 12.58 million patients with shingles, including 5.27 million among those 55 years or older — an enormous burden of disease.

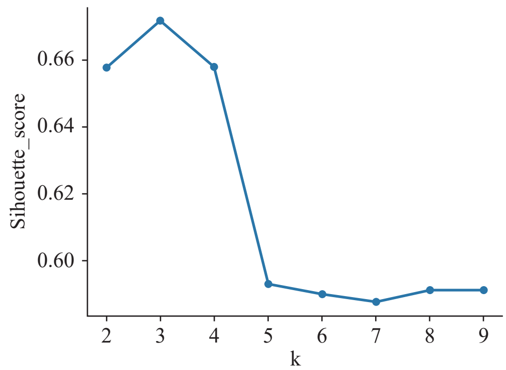

FIGURE 2. The relationship between k and SC.
Notes: The higher the SC value, the better the clustering effect; k=3, $SC_{(max)}$=0.6723.
Abbreviations: SC=silhouette coefficient/score (range –1 to 1); k=number of clusters.

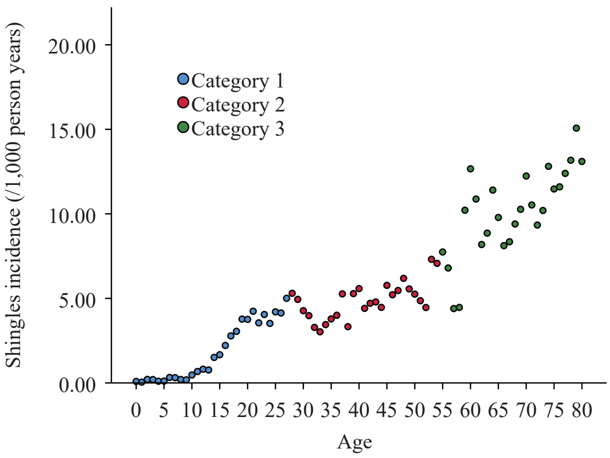

FIGURE 3. Shingles incidence clusters arranged by age in Yichang, China, 2017–2019.
Notes: k=3 (1: 0–27 years; 2: 28–54 years; 3: ≥55 years).

This study of age-specific shingles incidence showed that vaccinating people 55 or older would have the greatest impact on the burden of shingles. However, the recommended age for shingles vaccination needs to also consider vaccine clinical trial populations and results, post-marketing monitoring, and other factors such as economic analyses. This study recommends conducting comprehensive socioeconomic evaluation and impact research with the Yichang Information System during vaccine implementation to provide a robust evidence base to refine vaccine target population selection.

This study found a plateau in incidence among 28–54-year-olds, although occurring with a relatively large incidence. In generalizing the 6th census data to all of China, it is estimated that 5.11 million young and middle-aged individuals will have shingles episodes — similar to the expected number of elderly cases (5.27 million). Shingles in this age are clearly worthy of attention. In addition to age, immunodeficiency is a well-known risk factor for shingles. The advancing age of onset (younger and younger ages) may be related to common, immuno-compromising, environmental conditions of modern middle-aged and young adults: such as high stress, low immunity, or fatigue. Case-control studies should be conducted in this age group to determine whether there is an association between these factors and shingles, and if so, to identify preventive measures.

Shingles incidence in Yichang from 2017 to 2019 was 5.82 per 1,000 person-years, which is slightly higher than seen in other studies (3–5 per 1,000 person-years) (*6*). Differences could be due to a variety of factors, such as genetic make-up, region, or study year. That the incidence of shingles increased with age and was concentrated in people 55 years or older is consistent with other studies (*7*). Similarly, the higher incidence in women is consistent with studies in Guangdong, China and the Republic of Korea (*8*–*9*). However, the mechanistic relationship between sex and shingles remains unclear (*10*).

Previous shingles epidemiological data in China was among people more than 50 years of age. Data in this study came from the Healthcare Big Data Platform of Yichang, which includes permanent urban residents of all ages. This study's inclusive and large sample size allows for more fine-grained analyses. It was resultantly able to not only observe the entire population, but also refine analyses to obtain age-specific incidence rates all the way down to 1-year-olds. The objective and scientific clustering method used created age groupings based on clusters of single-year incidence rates. The finding that individuals 55 years or older had the highest shingles incidence, combined with census data on age structure, allowed a conclusion that, given limited immunization resources, the greatest public health benefit can be achieved by vaccinating that age group.

The study was subject to at least two limitations. First, no shingles monitoring system exists in the mainland of China. Hence some cases might not have been detected based on the big data from the hospital information system, underestimating the incidence. Second, demographic data for 1-year-olds in Yichang from 2017 to 2019 were not available. As such, data from the 7th population census in 2020 were used to estimate incidences in age groups from 2017 to 2019.

In conclusion, based on the epidemiological data analysis of the urban population in Yichang, China, individuals 55 years or older had the highest risk group of shingles. This age group should be considered as the priority target population for shingles vaccination. Attention should also be paid to the relatively high incidence of shingles in young and middle-aged people.

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Preplanned Studies

Characteristics and Associated Factors of E-cigarette Use Among Secondary School Students — 6 PLADs in China, 2021

Zhaobin Qi[1]; Bingliang Lin[1]; Xiaoyun Xie[1]; Lin Xiao[1,#]

Summary

What is already known about this topic?

Previous studies on electronic cigarette (e-cigarette) use in China among secondary school students have provided information on the awareness and usage of e-cigarettes.

What is added by this report?

This study not only described e-cigarette usage rates, but also explored the characteristics of e-cigarette users' behavior and factors associated with the current use of e-cigarettes among secondary school students.

What are the implications for public health practice?

E-cigarette use among secondary school students, especially among vocational senior high school students, requires more attention. Although some policies have been developed to protect youths from the harmful effects of e-cigarettes, enforcement of these policies needs to be strengthened.

The 2021 World Health Organization Report on the Global Tobacco Epidemic highlighted the addictive nature of e-cigarettes and called for regulation (*1*). China has implemented policies to protect youth from e-cigarettes, such as the revised Law of the People's Republic of China on the Protection of Minors banning the sale of electronic cigarettes to minors. This study was conducted based on the China National Youth Tobacco Survey (NYTS) framework with secondary school students [including junior high school (JHS) students, general senior high school (GSHS) students, and vocational senior high school (VSHS) students] in 2021, which was approved by the Institutional Review Board of China CDC (No. 202110). A total of 52,879 secondary school students from 6 provincial-level administrative divisions (PLADs) in China were asked about e-cigarette usage, purchase behaviors, and factors associated with the current e-cigarette usage to evaluate the previous policies and provide reference for next steps.

Using the results of the 2019 China NYTS (*2*), one PLAD with a relatively high e-cigarette use rate and one PLAD with a relatively low e-cigarette use rate were selected in each of the central, eastern, and western regions of China. Consequently, Beijing Municipality; Guangdong, Hunan, Hubei, and Sichuan provinces; and Ningxia Hui Autonomous Region were selected. A 3-stage stratified cluster random sampling was employed in each PLAD. First, 5 districts (urban areas) and 5 counties (rural areas) were selected in each PLAD using a proportionate to population size sampling scheme (PPS). Second, 3 JHSs, 2 GSHSs, and 1 VSHS were selected using the PPS method within each selected district and county. Third, within selected schools, 1 class was randomly selected in each grade and all the students in the selected class were interviewed (if the class size was less than 30, the sample class was supplemented). Overall, 180 JHSs, 121 GSHSs, and 52 VSHSs from 60 districts/counties of the 6 PLADs participated in the survey from September to December of 2021. A total of 52,879 eligible students (26,751 JHS students, 18,851 GSHS students, and 7,277 VSHS students) completed the questionnaire, of which 27,548 were male and 25,331 were female. The overall survey response rate was 95.2%.

In the interviews, structured paper-based questionnaires with no logical skips were used. Ever e-cigarette users (EES) were defined as students who had used e-cigarettes in the past; simply trying an e-cigarette one time qualified a student for this designation. Current e-cigarette users (CES) were students who had used e-cigarettes at least once in the past 30 days, and current smokers (CS) were students who had used cigarettes at least once in the past 30 days. All participants were asked if they had noticed advertisements for e-cigarettes or related products in the past 30 days and if they believed e-cigarette use is addictive. In addition, students were asked about their pocket money for a week and their parents' or close friends' smoking status. In terms of behaviors around e-cigarette use, all the CES were asked about e-cigarette flavors and the way of their purchase. Prevalence rates and chi-square tests were calculated and reported in this study. A two-level mixed effect model was also constructed to analyze the associated factors of current e-cigarette use. As a potential factor associated with current e-cigarette use, the sale of e-cigarettes to minors was analyzed as a variable by dividing the number of all students who were not rejected when purchasing e-cigarettes due to age in each district/county into three groups: the highest quantile (Percentiles 75) was defined as more, the lowest quantile (Percentiles 25) was defined as less, and the middle fifty (Percentiles 75–Percentiles 25) was defined as general. SAS software (version 9.4, SAS Institute, Inc. Cary, NC, USA) was used to perform the analysis.

In 2021, the EES and CES prevalence rates among secondary school students in the six PLADs were 14.9% and 3.0%, respectively. For the EES prevalence rate, we found that males (20.4%) were more likely than females (8.8%) (P<0.001) to have used an e-cigarette and that students in rural areas (17.0%) were more likely than students in urban areas (13.4%) (P<0.001) to have used an e-cigarette. In addition, e-cigarette prevalence was found to be the highest among VSHS students (26.0%), followed by GSHS students (15.4%) and JHS students (11.4%) (P<0.001). The highest EES prevalence rate was reported for Hunan (20.7%), while the lowest EES prevalence rate was in Guangdong (11.9%) (P<0.001) (Table 1). For the CES prevalence rate, we found that males (4.3%) were more likely than females (1.6%) to have used e-cigarettes in the past 30 days (P<0.001), that rural areas (3.4%) had a higher prevalence rate than urban areas (2.8%) (P<0.001), and that VSHS students (7.0%) had the highest prevalence rate, followed by GSHS students (2.6%) and JHS students (2.2%) (P<0.001). The highest CES prevalence rate was reported for Hunan (4.3%), while the lowest CES prevalence rate was in Guangdong (2.5%) and Hubei (2.4%) (P<0.001) (Table 1).

Among CES, 58.3% had used e-cigarettes with fruit flavor and 9.3% had used e-cigarettes with tobacco flavor. Among all e-cigarette users, 52.9% also used combustible cigarettes. Students also bought e-cigarettes through the internet (36.3%), e-cigarette retail stores (27.4%), shops/supermarkets/grocery stores (14.5%), vending machines (3.2%), and at bars/KTVs (3.1%). When they bought e-cigarettes, 67.0% of them reported that they were not rejected because of their age. In addition, 28.0% of secondary school students reported they had seen advertisements for e-cigarettes or related products in the past 30 days. The proportion of students who saw advertisements in e-cigarette retail stores, shops/supermarkets/grocery stores, on websites, social media, TV/broadcasts, billboards, and in newspapers/journals was 15.2%, 12.6%, 7.3%, 5.9%, 5.0%, 3.2%, and 1.8%, respectively.

Potential factors associated with current e-cigarette use among secondary school students were explored using a two-level mixed effect model. The model indicated that students were more likely to use e-cigarettes if they were current cigarette smokers [odds ratio (OR)=9.745, 95% confidence interval (CI): 8.183–11.605], noticed e-cigarette advertisements in the past 30 days (OR=3.518, 95% CI: 3.012–4.108), had weekly pocket money >40 CNY (OR=1.415, 95% CI: 1.143–1.751), and had at least one parent smoking (OR=1.280, 95% CI: 1.089–1.505). Compared to those who had no close friends that smoked, students where all close friends smoked (OR=18.178, 95% CI: 11.953–27.645), most close friends smoked (OR=14.476, 95% CI: 10.950–19.137), or some close friends smoked (OR=5.415, 95% CI: 4.385–6.686) were more likely to use e-cigarettes. In addition, secondary school students who believed e-cigarettes could be addictive were less likely to use e-cigarettes (OR=0.606, 95% CI: 0.496–0.740). Students in the highest quantile districts/counties of e-cigarette sales to minors were more likely to have used e-cigarettes than in the lowest quantile districts/counties (OR=1.871, 95% CI: 1.101–3.177) (Table 2).

DISCUSSION

According to this study, 14.9% of secondary school students had used e-cigarettes and the current use rate was 3.0%. Males had a higher EES and CES prevalence rate than females. The prevalence rates of EES and CES among VSHS students were 26.0% and 7.0%, respectively. These were much higher than the rates observed among GSHS (15.4% and 2.6%) and JHS (11.4% and 2.2%) students. It was worth noting that the EES and CES prevalence rates among VSHS observed in 2019 NYTS were 20.5% and 4.5% respectively (*2*). Although the data from selected counties/districts in this study cannot be compared with the 2019 national-level data, the concern that e-cigarette use may be increasing among VSHS can be further studied.

Although there were some policies protecting youth from e-cigarette use that were enacted in 2018 and 2019, such as banning e-cigarette sales to minors,

TABLE 1. Ever and current e-cigarette use among secondary school students in six PLADs (2021).

Characteristics	Total	Ever e-cigarettes use			Current e-cigarettes use		
	N (%)	n (%)	χ^2	*P*	n (%)	χ^2	*P*
Overall	52,879 (100.0)	7,856 (14.9)			1,599 (3.0)		
Gender			1,409.07	<0.001		340.20	<0.001
Male	27,548 (52.1)	5,626 (20.4)			1,196 (4.3)		
Female	25,331 (47.9)	2,230 (8.8)			403 (1.6)		
Area type			133.84	<0.001		15.36	<0.001
Urban	31,504 (59.6)	4,216 (13.4)			877 (2.8)		
Rural	21,375 (40.4)	3,640 (17.0)			722 (3.4)		
School type			958.81	<0.001		462.91	<0.001
JHS	26,751 (50.6)	3,060 (11.4)			594 (2.2)		
GSHS	18,851 (35.6)	2,908 (15.4)			495 (2.6)		
VSHS	7,277 (13.8)	1,888 (26.0)			510 (7.0)		
PLAD			369.99	<0.001		76.94	<0.001
Beijing	7,956 (15.0)	1,009 (12.7)			250 (3.1)		
Guangdong	8,536 (16.2)	1,015 (11.9)			213 (2.5)		
Hunan	8,576 (16.3)	1,769 (20.7)			370 (4.3)		
Hubei	9,531 (18.0)	1,250 (13.1)			233 (2.4)		
Ningxia	8,693 (16.4)	1,463 (16.8)			286 (3.3)		
Sichuan	9,587 (18.1)	1,350 (14.1)			247 (2.6)		
Weekly pocket money			482.74	<0.001		215.51	<0.001
≤10 CNY	15,433 (29.3)	1,743 (11.3)			287 (1.9)		
11–40 CNY	17,846 (34.8)	2,353 (13.2)			416 (2.7)		
>40 CNY	19,443 (36.9)	3,730 (19.2)			893 (4.6)		
Current smoking			7,325.78	<0.001		9,574.44	<0.001
Yes	2,156 (4.1)	1,684 (78.2)			813 (37.8)		
No	52,517 (95.9)	5,944 (11.8)			724 (1.4)		
Parents smoking			405.69	<0.001		193.11	<0.001
None	23,941 (46.2)	2,709 (11.3)			444 (1.9)		
At least one	27,849 (53.8)	4,903 (17.6)			1,096 (4.0)		
Close friends smoking			8,170.63	<0.001		5,922.85	<0.001
None	36,908 (60.9)	2,574 (7.0)			223 (0.6)		
Some	14,166 (26.8)	4,030 (28.5)			822 (5.8)		
Most	1,425 (2.7)	987 (69.3)			425 (29.9)		
All	356 (0.6)	260 (73.0)			128 (36.0)		
Noticed e-cigarette advertisement			957.48	<0.001		1,077.32	<0.001
Yes	14,631 (28.0)	3,289 (22.5)			1,014 (6.9)		
No	37,623 (72.0)	4,434 (11.8)			554 (1.5)		
E-cigarette addictive cognition			2,656.18	<0.001		902.48	<0.001
Yes	14,774 (27.9)	1,473 (10.0)			281 (1.9)		
No	38,105 (72.1)	6,376 (16.7)			1,311 (3.4)		

Abbreviations: JHS=junior high school; GSHS=general senior high school; VSHS=vocational senior high school; PLAD=provincial-level administrative division; CNY=China Yuan.

TABLE 2. Factors associated with current e-cigarette use using a two-level mixed effect model.

Parameter	β	SE	t-value	*P*	OR (95% CI)
Fixed part					
Intercept	−7.286	0.303	−24.04	<0.001	
Gender					
Male	0.494	0.091	5.43	<0.001	1.639 (1.371–1.959)
Female					Ref
Area type					
Urban	−0.155	0.115	−1.35	0.178	0.857 (0.683–1.073)
Rural					Ref
School type					
JHS					Ref
GSHS	0.676	0.117	5.78	<0.001	1.669 (1.562–2.472)
VSHS	0.512	0.138	3.71	<0.001	1.965 (1.568–2.482)
PLAD					
Guangdong					Ref
Beijing	0.568	0.201	2.83	0.005	1.765 (1.189–2.619)
Hunan	0.585	0.177	3.30	0.001	1.796 (1.267–2.545)
Hubei	0.296	0.192	1.54	0.123	1.345 (0.922–1.962)
Ningxia	0.217	0.198	1.10	0.274	1.242 (0.842–1.832)
Sichuan	0.047	0.193	0.24	0.809	1.048 (0.716–1.533)
Weekly pocket money					
≤10 CNY					Ref
11–40 CNY	0.122	0.113	1.08	0.002	1.129 (0.905–1.408)
>40 CNY	0.347	0.109	3.19	0.001	1.415 (1.143–1.751)
Current smoking					
Yes	2.277	0.089	25.55	<0.001	9.745 (8.183–11.605)
No					Ref
Parents smoking					
None					Ref
At least one	0.247	0.083	2.99	0.003	1.280 (1.089–1.505)
Close friends smoking					
None					Ref
Some	1.689	0.108	15.70	<0.001	5.415 (4.385–6.686)
Most	2.673	0.142	18.76	<0.001	14.476 (10.950–19.137)
All	2.900	0.214	13.56	<0.001	18.178 (11.953–27.645)
Noticed e-cigarette advertisement					
Yes	1.258	0.079	15.89	<0.001	3.518 (3.012–4.108)
No					Ref
E-cigarette addictive cognition					
Yes	−0.501	0.102	−4.92	<0.001	0.606 (0.496–0.740)
No					Ref
E-cigarette sales to minors					
More	0.626	0.270	2.32	0.021	1.871 (1.101–3.177)
General	0.479	0.215	2.23	0.027	1.615 (1.058–2.465)
Less					Ref
Random part					
2 horizontal variances	0.288	0.058	4.97	<0.001	

Abbreviations: SE=standard error; OR=odds ratio; CI=confidence interval; JHS=junior high school; GSHS=general senior high school; VSHS=vocational senior high school; PLAD=provincial-level administrative division; CNY=China Yuan.

prohibiting selling e-cigarettes on the internet, and banning advertisements of e-cigarettes on the internet (*3*–*4*), 67.0% of current e-cigarette users reported they were not rejected when they bought e-cigarettes in the past 30 days. In fact, 36.3% of current e-cigarette users bought e-cigarettes through the internet. This suggests that relevant e-cigarette policies were not well enforced.

Like other studies (*5*–*6*), the vast majority (58.3%) of e-cigarette users among secondary school students in this study used fruit-flavored e-cigarettes. Previous studies showed that flavors might attract youths to try e-cigarettes (*7*). On May 1, 2022, the Management Regulation of Electronic Cigarettes prohibited flavors except for tobacco flavor. The effect of this policy in reducing the attraction of e-cigarettes among adolescents should be examined in future studies.

Among CES, 52.9% smoked combustible cigarettes, which is much lower than the reported rate in adult populations (90.6%) (*8*). Additionally, our study found that the probability of currently smoking students who use e-cigarettes was 9.745 times that of non-smoking students, which indicates current smokers are more likely to use e-cigarettes. Our study also found that a smoking parent or friend increases the risk for secondary school students to use e-cigarettes. This is consistent with findings from previous studies (*9*–*10*).

In our study, a two-level mixed effect model revealed that "noticed e-cigarette advertisement" was associated with e-cigarette use (OR=3.518). Overall, 28.0% of secondary school students reported they had seen advertisements for e-cigarettes or related products in the past 30 days. This finding highlights the importance of prohibiting e-cigarette advertisements, especially near schools. Our study also found students who believed e-cigarettes could be addictive were less likely to use e-cigarettes (OR=0.606). This suggests that introducing e-cigarette information into health education could reduce e-cigarette use.

A potential limitation of this study is that the survey data was collected using a self-reported questionnaire, which may have led to an underreporting and recall bias. In addition, this study only uses quantitative research methods. Therefore, there is a lack of in-depth research and discussion on the reasons why secondary school students use e-cigarettes and their attitudes on using e-cigarettes.

In conclusion, e-cigarette use among secondary school students, especially among vocational senior high school students, requires more attention. Although there have been some policies enacted to protect youth from e-cigarettes, enforcement of these policies needs to be strengthened. Factors associated with e-cigarette use should be considered to guide new policies, such as health education and banning e-cigarette advertisements.

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Preplanned Studies

Prevalence of Metabolic Syndrome and Risk Factors Among Chinese Adults: Results from a Population-Based Study — Beijing, China, 2017–2018

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Summary

What is already known about this topic?

Metabolic syndrome (MetS) is one of the most easily available health indicative markers for cardiovascular diseases, and it has become a major public health problem worldwide due to increasing urbanization and aging populations. The prevalence of MetS increased dramatically in China, however, there are no records of MetS defined by the 2017 Chinese Diabetes Society for Beijing by far.

What is added by this report?

In this study, the data of 24,412 participants aged 18–74 years from a large population-based study in Beijing was collected. The overall prevalence of MetS among Beijing residents was 24.5%. The prevalence was 35.2% in males and 15.4% in females.

What are the implications for public health practice?

Effective public health strategies should target males, people with older age, lower education, higher body mass index, smokers, those who drink alcohol, those who are unemployed or retired, and those who lived in rural areas on MetS prevention and control.

Metabolic syndrome (MetS) is characterized as insulin resistance, obesity, hypertension, glucose intolerance, and dyslipidemia. MetS is associated with elevated cardiovascular diseases and chronic diseases. With increasing urbanization and aging populations, the prevalence of MetS increased dramatically in China and became a major public health challenge (*1*). Meta-analysis revealed that pooled prevalence in the mainland of China was 24.5% during 2005–2015 (*2*). Genetics, environmental influence, physical activity, diet, and behavior all influence the prevalence of both MetS and its components (*3*). Beijing, a metropolitan city with an aging population, had no record of the prevalence of MetS defined by the new criteria for Chinese adults. The current study estimated the prevalence of MetS and its risk factors in Beijing based on a recent large sample study conducted in 2017–2018. The total prevalence of MetS was estimated to be 24.5% among Beijing residents. Males, especially those who lived in the outer suburbs, smokers, and those of older age were associated with an increased risk for MetS.

The data used in the current study came from the baseline dataset of Beijing Population Health Cohort study, which was designed to measure air pollution and health outcomes. Details of the study have been described in a previous publication (*4*). A stratified, random cluster sampling method was used to select participants from a general population in Beijing in 2017–2018. To ensure the sample size, the survey was conducted with an estimated sample, and if the respondent was not available, another candidate in the list would be surveyed then. Our study included 24,990 individuals from 16 districts, which included urban areas, suburban areas, and outer suburbs to represent a general population of Beijing. Participants were permanent residents living in Beijing for more than 2 years and aged 18–74 years. Among them, 578 individuals without identification number (ID) or repetitive ID were excluded; 24,412 individuals were included in the study. MetS was diagnosed according to the China Diabetes Society (CDS) criteria, which was newly released in 2017 according to Chinese guidelines, where a person has MetS if he or she meets 3 or more of the following criteria: 1) a waist circumference of ≥90 cm for men and ≥85 cm for women; 2) a fasting plasma glucose (FPG) of ≥6.1 mmol/L or previously diagnosed diabetes; 3) a systolic blood pressure (SBP) of ≥130 mmHg, a diastolic blood pressure (DBP) of ≥85 mmHg, or previously diagnosed hypertension; 4) a fasting triglyceride level of ≥1.7 mmol/L; and 5) a high-density lipoprotein cholesterol (HDL-C) of <1.04 mmol/L (5).

The prevalence was calculated according to demographic and lifestyle factors and compared means using t-tests and distributions of categories using chi-squared tests. Logistic regression was used to estimate the odds ratios (ORs) and 95% confidence intervals (CIs), adjusting for the main potential confounding variables, including age, body mass index (BMI), education, occupation, smoking habits, alcohol use, and other factors. All data were analysed using SPSS Statistics for Windows (version 20.0, IBM Corp., Armonk, NY, US). Two-tailed *P* values <0.05 were considered statistically significant.

Of the total 24,412 participants in the study, 11,418 males and 12,994 females were surveyed. The total prevalence of MetS was 24.5% among Beijing residents. The prevalence of MetS was 35.2% in male participants and 15.4% in female participants. Subjects with MetS were more likely to be 55 years old and above, male, unemployed/student/retired, less educated, smoker, and drinker. (Table 1)

TABLE 1. Prevalence of MetS by demographic characteristics, Beijing, China, 2017–2018.

Characteristics	MetS		Control		*P*	Prevalence of MetS
	n	%	n	%		%
Age, years Mean (SD)	52.1 (12.9)		43.8 (14.4)		<0.001	
BMI, kg/m^2 Mean (SD)	27.8 (3.7)		24.2 (3.8)		<0.001	
Han ethnic	4,828	96.2	1,4861	95.8	0.199	24.5
Sex					<0.001	
Male	3,301	65.8	6,065	39.1		35.2
Female	1,719	34.2	9,454	60.9		15.4
Age group (years)					<0.001	
≤24	65	1.3	1,123	7.2		5.5
25–34	636	12.7	4,233	27.3		13.1
35–44	662	13.2	2,771	17.9		19.3
45–54	1,055	21.0	2,981	19.2		26.1
55–64	1,764	35.1	3,048	19.6		36.6
≥65	838	16.7	1,363	8.8		38.1
BMI group					<0.001	
Normal	1,057	21.1	9,732	62.7		9.8
Overweight	2,806	55.9	4,857	31.3		36.6
Obese	1,157	23.0	930	6.0		55.4
Education					<0.001	
Primary school or lower	617	12.3	1,143	7.4		35.0
Junior high school	1,442	28.7	2,878	18.5		33.4
Senior high school	1,142	22.7	2,949	19.0		27.9
College	808	16.1	3,174	20.5		20.3
Undergraduate and above	1,011	20.1	5,375	34.6		15.8
Marital status					<0.001	
Married	4,601	91.7	12,787	82.4		26.5
Divorced/separated	102	2.0	300	1.9		25.4
Widowed	119	2.4	242	1.6		33.0
Single	198	3.9	2,190	14.1		8.3
Occupation					<0.001	
Farmer, worker, and business	1,072	21.4	2,985	19.2		26.4
Leader, clerk, and technical	1,994	39.7	8,123	52.3		19.7
Others	456	9.1	1,459	9.4		23.8
Unemployment, student, retirement	1,498	29.8	2,952	19.0		33.7

TABLE 1. (Continued)

Characteristics	MetS		Control		*P*	Prevalence of MetS
	n	%	n	%		%
Residence					<0.001	
Urban	1,368	27.3	5,461	35.2		20.0
Suburban	2,211	44.0	6,471	41.7		25.5
Outer suburbs	1,441	28.7	3,587	23.1		28.6
Smoke					<0.001	
Smoke	2,225	44.3	3,730	24.0		37.4
Do not smoke	2,799	55.7	11,827	76.0		19.1
Alcohol use					<0.001	
Drink	1,002	19.9	2,212	14.2		31.2
Do not drink	4,022	80.1	13,345	85.8		23.2

Note: Values for some characteristics may not be equal to total numbers in each group because of missing values.
Abbreviations: SD=standard deciation; MetS=metabolic syndrome; BMI=body mass index.

There was a significant difference between male and female subjects. The mean values for BMI, waist circumference, FPG, and serum triglycerides were higher in males than those in females, while HDL-C was higher in females than in males (P<0.001 for all comparisons). (Table 2)

Multiple logistic regression showed that males, especially those with older age, lower education, higher BMI, smoking, alcohol use, and living in rural areas were associated with MetS. (Table 3)

DISCUSSION

Based on the baseline dataset of this large population-based study, a quarter of participants had MetS. With the disease burden increasing, especially for chronic diseases, understanding the epidemiology of MetS and exploring risk factors of MetS would be an effective approach for disease prevention and health promotion. This study added evidence that nearly one-fourth of the Beijing residents in our study had MetS and implied that special attention should be paid among males, people with older age, lower education, higher BMI, smoker, and those lived in rural areas, for the prevention of MetS.

Few country-wide studies were conducted to describe the epidemiology of MetS in adults for all age groups; a previous study focused on older adults (≥60 years) or middle-aged people (35–59 years) as they were more susceptible to chronic cardiovascular disease (*6*). Using the updated CDS criterion (2017), the current study revealed the prevalence in a general population aged 18–74 years. The prevalence of MetS among Beijing residents (24.5%, 95% CI: 24.0%–25.5%) was generally consistent with a 2017 study of MetS in Beijing residents aged from 18 to 79 years (25.6%), which used the International Diabetes Federation criteria (*7*). The prevalence of MetS in this study was higher than general Xinjiang residents (20.9%) (*8*) and Qingdao residents (17.8%) (*9*). Current study showed that the prevalence of MetS

TABLE 2. Characteristics of components of MetS among adults in Beijing, China, 2017–2018.

Characteristics	Male (N=11,418)		Female (N=12,994)		*P*
	Mean	SD	Mean	SD	
Waist circumference (cm)	90.05	10.898	81.17	10.872	<0.001
SBP (mmHg)	130.16	17.937	123.06	19.582	<0.001
DBP (mmHg)	83.11	11.062	77.90	12.550	<0.001
FPG (mmol/L)	5.85	1.769	5.53	1.515	<0.001
Triglycerides (mmol/L)	2.02	2.079	1.44	1.126	<0.001
HDL-C (mmol/L)	1.31	0.325	1.49	0.335	<0.001

Note: Data were presented as mean and standard deviation for continuous variables or percentage for categorical variables. P value in t-test for means or χ^2 test for proportion differences between males and females.
Abbreviations: DBP=diastolic blood pressure; FPG=fasting plasma glucose; HDL-C=high-density lipoprotein cholesterol; SBP=systolic blood pressure; MetS=metabolic syndrome; SD=standard deciation.

TABLE 3. Factors associated with MetS by sex in Beijing, China, 2017–2018.

Characteristics	Adjusted odds ratio and 95% CIs	
	Male	Female
Age group (years)		
≤24	1.000	1.000
25–34	2.453 (1.737−3.463)	1.469 (0.692−3.119)
35–44	3.754 (2.600−5.418)	2.854 (1.310−6.219)
45–54	5.445 (3.773−7.857)	4.229 (1.952−9.162)
55–64	6.154 (4.238−8.934)	11.438 (5.248−24.933)
≥65	6.120 (4.127−9.077)	14.502 (6.588−31.921)
BMI group		
Normal	1.000	1.000
Overweight	3.554 (3.200−3.946)	4.564 (3.979−5.237)
Obese	8.547 (7.357−9.930)	12.545 (10.441−15.073)
Education		
Primary school or lower	0.967 (0.764−1.224)	1.187 (0.887−1.588)
Junior high school	1.154 (0.975−1.366)	1.377 (1.065−1.781)
Senior high school	1.290 (1.104−1.506)	1.202 (0.936−1.543)
College	1.318 (1.142−1.520)	1.338 (1.066−1.680)
Undergraduate and above	1.000	1.000
Marital status		
Married	1.000	1.000
Divorced/separated	1.209 (0.868−1.686)	0.908 (0.589−1.402)
Widowed	1.006 (0.622−1.627)	1.031 (0.767−1.386)
Single	0.777 (0.620−0.973)	0.777 (0.471−1.282)
Occupation		
Farmer, worker, and business	1.000	1.000
Leader, clerk, and technical	1.237 (1.070−1.430)	0.989 (0.782−1.251)
Others	0.979 (0.818−1.171)	0.782 (0.610−1.002)
Unemployment, student, retirement	1.155 (0.984−1.356)	1.074 (0.906−1.273)
Residence		
Urban	1.000	1.000
Suburban	1.081 (0.963−1.214)	1.380 (1.195−1.593)
Outer suburbs	1.186 (1.037−1.357)	1.825 (1.535−2.170)
Smoke		
Never smoke	1.000	1.000
Smoke	1.270 (1.150−1.402)	1.283 (0.935−1.761)
Alcohol use		
Never drink	1.000	1.000
Drink	1.124 (1.009−1.252)	0.951 (0.687−1.317)

Abbreviations: MetS=Metabolic syndrome; CIs=confidence intervals, BMI=body mass index.

* Adjusted for age, study cohort, residential area, sex, education levels, income levels, smoking, and drinking.

increased compared to 2010 (24.5% and 11.0%, respectively) (*10*).

Prevalence of MetS varied significantly by gender. Males had a higher prevalence than females, which was different from the previous study. The prevalence was 27.0% among females and 19.2% among males in a recent Chinese study (*2*). The main reason was survivor bias, as young males who survived the disparities of resources period were more likely to receive sufficient nutrition than young females in their early life. Malnutrition during the critical growth stages may lead to early adaptations in body structure and function, such as the establishment of a thrifty phenotype. Another reason may be biological differences in sex hormones, body composition, and glucose metabolism. The gender disparity in the risk for MetS requires further investigation. In addition, the pattern of risk factors is sex-specific. Alcohol drinking was identified as the main risk factor for MetS among males, while low household income and less education increased the risk for MetS among females (*11*).

A significant increasing trend was observed in different age groups, as metabolic syndrome increased significantly with age (*2*). Developmental origins of health and disease well explained the origins of MetS in later life. Early-life malnutrition and later-life overnutrition were shown to be critical for metabolic disorders in adult life. Low birth weight, low socioeconomic status in early life increased the likelihood of adulthood metabolic disorders and chronic diseases.

Studies observed an association between a lower socioeconomic status and MetS prevalence; the ORs for MetS prevalence for residents in outer suburb were higher than residents in urban. Dietary and lifestyle factors may contribute to the difference. Although it's reported that the prevalence of MetS was higher in urban residents than those in rural, the study was conducted in northwest Chinese adults which had different dietary and lifestyle with Beijing adults (*12*). Smoking and drinking were related to higher risks of MetS, and the correlation between unhealthy lifestyle factors and lower socioeconomic status was also verified (*8*).

The study had several strengths. First, our study included a random representative and large sample of adults in Beijing. Second, all interviews were conducted face to face by trained health workers, and the anthropometric parameters were measured on-site, which allowed for rigorous quality control. Third, the sample constituted of both urban, suburban, and outer suburbs residents, which was representative of the diversity of environments in China. Fourth, this study used the new version of MetS criteria for Chinese adults, 2017 CDS, which would be more suitable since a previous study revealed that CDS definition was superior to The Adult Treatment Panel III of the National Cholesterol Education Program criteria and International Diabetes Federation when predicting factors and MetS among Chinese (*9*).

This study was subject to some limitations. First, this was a cross-sectional study, so the causal relation between factors and MetS risk could not be inferred. Second, lack of environmental exposure prevented us from exploring its effect on MetS.

In conclusion, MetS was prevalent among residents in Beijing. The findings suggested males, especially those living in the rural areas, who smoke, had lower education, higher BMI and were those of older age were associated with an increased risk for MetS.

Conflicts of Interest: No conflicts of interest.

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Notifiable Infectious Diseases Reports

Reported Cases and Deaths of National Notifiable Infectious Diseases — China, May 2022

Diseases	Cases	Deaths
Plague	0	0
Cholera	0	0
SARS-CoV	0	0
Acquired immune deficiency syndrome*	4,490	1,466
Hepatitis	125,758	38
Hepatitis A	960	0
Hepatitis B	102,912	25
Hepatitis C	18,720	13
Hepatitis D	21	0
Hepatitis E	2,503	0
Other hepatitis	642	0
Poliomyelitis	0	0
Human infection with H5N1 virus	0	0
Measles	110	0
Epidemic hemorrhagic fever	553	4
Rabies	6	8
Japanese encephalitis	0	0
Dengue	2	0
Anthrax	19	0
Dysentery	3,520	0
Tuberculosis	63,590	316
Typhoid fever and paratyphoid fever	566	0
Meningococcal meningitis	5	1
Pertussis	3,991	1
Diphtheria	0	0
Neonatal tetanus	1	0
Scarlet fever	2,588	0
Brucellosis	8,824	0
Gonorrhea	8,395	0
Syphilis	43,751	0
Leptospirosis	10	0
Schistosomiasis	39	0
Malaria	37	1
Human infection with H7N9 virus	0	0
COVID-19†	7,547	166
Influenza	78,687	0
Mumps	11,151	0

Continued

Diseases	Cases	Deaths
Rubella	155	0
Acute hemorrhagic conjunctivitis	2,509	0
Leprosy	27	0
Typhus	144	0
Kala azar	35	0
Echinococcosis	235	0
Filariasis	0	0
Infectious diarrhea[§]	82,369	1
Hand, foot and mouth disease	70,042	0
Total	519,156	2,002

* The number of deaths of acquired immune deficiency syndrome (AIDS) is the number of all-cause deaths reported in the month by cumulative reported AIDS patients.

[†] The data were from the website of the National Health Commission of the People's Republic of China.

[§] Infectious diarrhea excludes cholera, dysentery, typhoid fever and paratyphoid fever.

The number of cases and cause-specific deaths refer to data recorded in National Notifiable Disease Reporting System in China, which includes both clinically-diagnosed cases and laboratory-confirmed cases. Only reported cases of the 31 provincial-level administrative divisions in the mainland of China are included in the table, whereas data of Hong Kong Special Administrative Region, Macau Special Administrative Region, and Taiwan are not included. Monthly statistics are calculated without annual verification, which were usually conducted in February of the next year for de-duplication and verification of reported cases in annual statistics. Therefore, 12-month cases could not be added together directly to calculate the cumulative cases because the individual information might be verified via National Notifiable Disease Reporting System according to information verification or field investigations by local CDCs.

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