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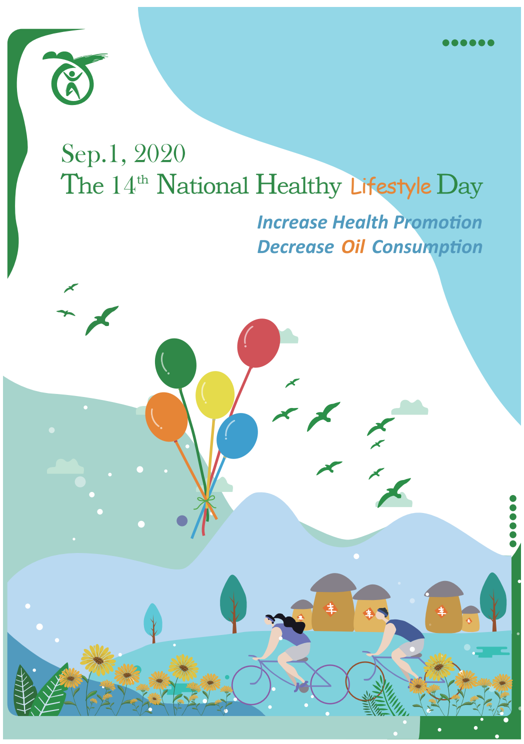

CHINESE CENTER FOR DISEASE CONTROL AND PREVENTION

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Announcements

The 14th National Healthy Lifestyle Day — September 1, 2020

To encourage its residents to stop unhealthy habits and become a practitioner and beneficiary of healthy lifestyles, the Chinese government initiated the China Healthy Lifestyle for All (CHLA) in 2007. It is celebrated annually on September 1 and was named the National Healthy Lifestyle Day. The theme for this year is “Increase Health Promotion, Decrease Oil Consumption”.

The burden of non-communicable diseases (NCDs) continues to be a major public health challenge globally and in China. Globally, physical inactivity was responsible for 9% of premature mortality, insufficient fruit and vegetable consumption for 11.3%, and harmful alcohol consumption for 5.3% (*1–3*). The scientific evidence strongly supports changing dietary habits and physical activity habits can powerfully influence several of these risk factors at the population level. Since the initiation of CHLA in 2007, the atmosphere of “Health for all, participation for all” gradually formed. By the end of 2018, 2,627 counties/districts carried out the action, which accounted for 88.78% of all counties/districts in China (*4*). The content of CHLA was further expanded in 2016 and included less salt, less oil, less sugar, oral health, healthy weight, and healthy bones. Within the coming 10 years and with the construction of a healthy environment, dissemination of health knowledge, promotion of a healthy lifestyle, the nation’s health will be further improved.

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Preplanned Studies

Leisure-Time Physical Activity Among Chinese Adults — China, 2015

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Summary

What is already known on this topic?

Leisure-time physical activity (LTPA) such as sports, fitness, and recreation, is well documented to prevent chronic disease and improve health. The age-adjusted prevalence of regular LTPA was only 11.9% among Chinese adults in China in 2010. It has been reported that the age-adjusted LTPA prevalence increased from 7.13% in 2000 to 11.79% in 2011.

What is added by this report?

According to the latest available data, in 2015, the prevalence of LTPA and regular LTPA was 19.7% and 12.5% in adults aged 18 years old and above, respectively. Both LTPA and regular LTPA were lower in rural areas than in urban areas, higher in people with higher socioeconomic position, and varied across provinces.

What are the implications for public health practice?

To promote more people, especially those with lower socioeconomic position to participate in LTPA, great efforts are required to strengthen national and local policy initiatives, financial support, sports facility construction, and health education, especially in rural areas and in western China.

Leisure-time physical activity (LTPA), which includes sports, fitness, and recreational activities, is well-documented as being able to reduce the burden of chronic disease, prevent early death, and improve health. About 83.8% of adults did not engage in LTPA, and regular LTPA was only reported by 11.9% of adults in China in 2010. In order to understand the latest status of LTPA in China, data from the China Chronic Disease and Nutrition Surveillance (CCDNS), a nationally and provincially representative cross-sectional survey, were analyzed, and the prevalence of LTPA and regular LTPA were determined based on face-to-face interviews with a Global Physical Activity Questionnaire (GPAQ). Key demographic and geographic factors were analyzed via Rao Scott chi-square tests and logistic regression models. This study showed that the prevalence of LTPA and regular LTPA increased from the past but remained at relatively low levels among adults in China. LTPA presented important socioeconomic and geographic inequality. More effort should be made to promote the implementation of the national fitness program, including the construction of public sports facilities, opening more sports venues, developing a variety of fitness activities and special sports items, and strengthening sports education in schools.

Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure (*1*). The Global Burden of Disease (GBD) study estimated that low levels of physical activity accounted for 1.3 million premature deaths and 2.4 million disability-adjusted life-years (DALYs) worldwide in 2017 (*2*). To achieve a target of 15% relative reduction in the global prevalence of physical inactivity in adults and in adolescents by 2030, the World Health Orgnization (WHO) has released the "Global action plan on physical activity 2018–2030: more active people for a healthier world" (*3*). A target of 435 million people regularly exercising by 2020 has also been included in Healthy China 2030 and a national fitness program was implemented in 2016 to improve the physical fitness and health level of the whole nation. Compared to other domains of physical activity, such as for work, for housework, and for transportation, LTPA was found to be better for preventing cardiovascular disease and protecting cognition (*4*). In China, 83.8% of adults reported no LTPA, and only 11.9% of adults aged 18 years old and above engaged in the regular LTPA in 2010 (*5*). It was reported that the age-standardized LTPA prevalence increased from 7.13% in 2000 to 11.79% in 2011 (*6*). While policy initiatives, environmental and financial support, and health education were taken to promote LTPA in China in recent years, little is known about the latest LTPA in China, particularly in rural areas and at the provincial level.

The prevalence of LTPA and regular LTPA among Chinese adults were estimated by using the data from China Chronic Disease and Nutrition Surveillance (CCDNS) in 2015. CCDNS is a periodical cross-sectional survey of major risk factors and major non-communicable and chronic diseases (NCDs), that was conducted in 298 districts/counties acting as surveillance sites across 31 provincial-level administration divisions (PLADs). The surveillance sites were selected randomly from over 2,400 districts/counties to be representative of the population nationwide as well as in every PLAD and specific regions, including urban and rural areas. A multi-stage, cluster-randomized sampling method was used to select respondents aged 18 years old and above within every district/county (*7*). Using a set of questionnaires, data on chronic-disease-related behaviors was collected by trained professionals from local CDCs. The information on moderate or vigorous physical activity (MVPA) participation in three domains (work, travel, and recreation) was collected by the Global Physical Activity Questionnaire (GPAQ) (*8*–*9*). LTPA was measured by asking participants whether they carried out vigorous or moderate LTPA at least 10 minutes continuously (yes/no), frequency of the activities (days per week), and time spent doing the activities in a typical day. In this study, LTPA was defined as participants engaging in any vigorous or moderate LTPA at least once a week. Regular LTPA was defined as carrying out moderate LTPA or an equivalent at least 30 minutes per day and 3 days or more per week.

In 2015, 189,605 participants from 88,250 households completed the survey, which yielded a 95.4% family response rate and 94.9% individual response rate. After excluding 1,675 participants with incomplete data (0.88%), a final sample of 187,930 participants was analyzed in this study. The study was approved by the Ethical Committee of the National Centre for Chronic and Non-Communicable Disease Control and Prevention, China CDC (Approval Notice: No.201519-A). All participants provided written informed consent.

All statistical analyses were weighted to represent both national and region-specific estimates (*10*). The weighted proportion for the characteristics of Chinese adults aged 18 years old and above was reported. Chi-square tests were used for comparisons among unordered categorical variables, whereas logistic regression models were used to examine the trend for ordered categorical variables. Taylor linearization methods with a finite population correction were used to estimate standard errors (SE) accounting for the complex sampling design. Statistical significance was determined as a two-sided $p<0.05$. All statistical analyses used software SAS (version 9.4, SAS Institute Inc., Cary, USA).

Among the 187,930 samples in this study, 88,231 men (46.9%) and 99,699 women (53.1%) were included. In 2015, the prevalence of LTPA among adult residents aged 18 years old and above in China was overall 19.7% (95% confidence interval [CI] : 17.9%–21.4%), in males 22.0% (95% CI: 19.9%–24.1%), and in females 17.3% (95% CI: 15.9%–18.8%). The prevalence of LTPA among residents in urban areas was significantly higher than that in rural areas (28.0% *vs*. 13.8%, $p<0.0001$), and the prevalence of LTPA among residents in eastern areas (24.7%, 95% CI: 21.6%–27.9%) was significantly higher than other areas. The current prevalence of LTPA differed greatly between men and women in terms of different education levels, family income levels, and occupations. The prevalence of LTPA increased with education level and household income but decreased with age for both men and women ($p<0.0001$). According to the analysis of different occupations, the prevalence of LTPA (33.7%, 95% CI: 31.3%–36.0%) among office/shop/other non-manual workers was the highest, and the prevalence of LTPA among farming-related workers (10.6%, 95% CI: 9.7%–11.4%) was the lowest. In 2015, the prevalence of regular LTPA among adult residents aged 18 years old and above in China was overall 12.5% (95% CI: 11.4%–13.5%), in males 13.3% (95% CI: 12.1%–14.6%), and in females 11.6% (95% CI: 10.7%–12.5%). Similar to the prevalence of LTPA among residents, the prevalence of regular LTPA differed greatly between men and women in different residences, geographic locations, education levels, household income, and occupations. (Table 1)

Figure 1 and Figure 2 showed the current provincial geographic distribution of the prevalence of LTPA and regular LTPA, respectively, among adult residents aged 18 and above in China. Figure 1 showed that in 2015, the prevalence of LTPA exceeded 25% in 7 PLADs and was highest in Beijing (44.1%). The prevalence of LTPA in 6 PLADs was less than 14.9%. In Figure 2, the prevalence of regular LTPA in Beijing, Shanghai, Qinghai, Guangdong, Jiangsu, Fujian, and Shandong exceeded 15%, while the prevalence of regular LTPA in Hainan, Sichuan, Chongqing, Hunan, Guizhou, and Xizang (Tibet) Autonomous Region was less than 9.3%.

DISCUSSION

This study showed that the prevalence of LTPA (19.7%) and regular LTPA (12.5%) remained low in China. The male adults or adults who were living in urban areas, living in eastern China, had better education, had higher income, and doing non-manual work or retired were more likely to be physically active in their leisure time than their counterparts.

The prevalence of regular LTPA was found to increase slightly from 11.9% in 2010 to 12.5% in 2015. However, the criteria of regular LTPA in the previous study was at least 10 minutes per day and at least 3 days per week, which was less strict the criteria in this study so the estimated prevalence in 2010 would likely be lower than 11.9%. The current prevalence of regular LTPA was far below the prevalence of 46.7% in adults in the United States (*11*). The gap between urban and rural areas still existed but has narrowed from 11.7% in 2010 to 9.6% in 2015. The main reason might be attributable to the increasing investment in sports facilities in rural areas in recent years. In addition, the prevalence of LTPA and regular LTPA were also lower in undeveloped western regions, compared to central and eastern China.

A previously reported study showed different prevalence of LTPA than that reported in this study (*6*). However, the questionnaire used in that study differed from the questionnaire used in this study in the design of questions about LTPA. These differences could be explained due to the questionnaire in this study covering a wider range of LTPA.

Our study showed a positive association between socioeconomic position (SEP) and LTPA, which was consistent with the previous studies (*12*). With an increase of education or income level, people were more likely to be physically active in their leisure time. Also, no-manual workers were more physically active in leisure time than manual workers. Adults with higher SEP were considered to have a better knowledge about the benefit of PA, or have more financial possibilities to participate in LTPA. Furthermore, manual workers, most of whom also might have lower SEP, generally engaged in more occupational PA. A study had shown that fatigue after work was a barrier of LTPA (*13*).

The comparative estimates of provincial LTPA among all 31 PLADs in China were shown for the first time in our study. The provincial variations in the prevalence of LTPA and regular LTPA were identified, which indicated the potential impacts of geographical feature, leisure life customs, and socioeconomic development. Beijing, as the only host city for the Olympic Games in China, had the highest prevalence of both LTPA and regular LTPA and was 10% more

TABLE 1. Prevalence of LTPA and regular LTPA among Chinese adults aged 18 years old and above at the provincial level in China in 2015*.

Items	Overall			Men			Women		
	N	Prevalence/% (95% CI)		N	Prevalence/% (95% CI)		N	Prevalence/% (95% CI)	
		LTPA	Regular LTPA		LTPA	Regular LTPA		LTPA	Regular LTPA
Total	187,930	19.7 (17.9−21.4)	12.5 (11.4−13.5)	88,231	22.0 (19.9−24.1)	13.3 (12.1−14.6)	99,699	17.3 (15.9−18.8)	11.6 (10.7−12.5)
Age									
18−24 years	6,610	26.6 (24.0−29.3)	14.0 (12.3−15.6)	3,189	31.7 (28.6−34.8)	17.5 (14.7−20.4)	3,421	21.3 (18.6−24.1)	10.2 (8.6−11.8)
25−34 years	21,429	20.7 (18.1−23.4)	11.3 (10.1−12.5)	9,367	26.1 (22.1−30.2)	13.9 (12.2−15.6)	12,062	15.2 (13.6−16.7)	8.6 (7.7−9.6)
35−44 years	29,870	20.3 (18.2−22.5)	12.8 (11.3−14.2)	13,749	22.1 (19.6−24.6)	12.8 (11.2−14.4)	16,121	18.5 (16.6−20.4)	12.8 (11.3−14.3)
45−54 years	47,936	18.5 (17.0−20.0)	13.2 (12.0−14.3)	21,698	18.2 (16.5−19.9)	12.1 (10.9−13.4)	26,238	18.8 (17.4−20.3)	14.2 (13.0−15.4)
55−64 years	45,053	16.4 (15.1−17.6)	12.8 (11.8−13.8)	21,370	16.1 (14.7−17.4)	12.0 (10.9−13.1)	23,683	16.7 (15.3−18.1)	13.5 (12.3−14.7)
≥70 years	37,032	12.9 (11.8−14.0)	10.3 (9.3−11.3)	18,858	13.9 (12.7−15.1)	11.0 (10.0−12.1)	18,174	12.0 (10.8−13.2)	9.6 (8.4−10.7)
p value for trend		<0.0001	0.0389		<0.0001	<0.0001		<0.0001	0.0007
Residence									
Urban	76,521	28.0 (24.9−31.1)	18.1 (16.3−19.9)	34,686	31.2 (27.5−34.9)	19.5 (17.3−21.7)	41,835	24.7 (22.2−27.2)	16.6 (15.2−18.1)
Rural	111,409	13.8 (12.5−15.1)	8.5 (7.7−9.3)	53,545	15.4 (13.8−17.0)	8.9 (7.9−10.0)	57,864	12.2 (11.0−13.3)	8.0 (7.3−8.8)
p value for difference		<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001
Geographic location									
East	70,133	24.7 (21.6−27.9)	15.8 (14.0−17.6)	32,783	28.1 (24.2−31.9)	17.6 (15.3−19.9)	37,350	21.3 (18.7−23.9)	14.0 (12.5−15.5)
Central	53,214	16.1 (14.3−18.0)	10.2 (9.1−11.4)	25,044	17.9 (15.8−20.0)	10.5 (9.3−11.8)	28,170	14.4 (12.6−16.2)	9.9 (8.7−11.1)
West	64,583	15.7 (14.0−17.4)	9.7 (8.5−10.8)	30,404	16.9 (15.0−18.7)	9.7 (8.4−10.9)	34,179	14.5 (12.8−16.2)	9.7 (8.6−10.8)
p value for difference		<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001
Education									
Primary or less	92,013	9.8 (9.0−10.6)	6.8 (6.2−7.4)	36,634	9.3 (8.5−10.1)	6.0 (5.4−6.5)	55,379	10.2 (9.3−11.1)	7.4 (6.7−8.2)
Junior high	57,434	16.9 (15.4−18.4)	10.6 (9.6−11.6)	31,321	17.2 (15.7−18.6)	10.0 (9.1−10.9)	26,113	16.5 (14.7−18.4)	11.3 (9.8−12.8)
Senior high	24,334	28.7 (25.9−31.4)	18.1 (16.5−19.6)	13,379	31.4 (27.2−35.6)	19.3 (16.6−22.1)	10,955	24.8 (23.0−26.6)	16.3 (15.1−17.4)
College or above	14,149	38.8 (36.4−41.1)	23.4 (21.8−25.1)	6,897	45.4 (42.5−48.3)	27.4 (25.2−29.6)	7,252	31.7 (29.1−34.4)	19.2 (17.4−21.0)
p value for trend		<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001
Household income per capita, CNY									
Q1(<6,667)	40,567	11.7 (10.6−12.8)	7.1 (6.4−7.8)	19,738	12.6 (11.4−13.8)	7.4 (6.5−8.2)	20,829	10.9 (9.4−12.3)	6.8 (5.9−7.6)
Q2(6,667−13,332)	37,494	15.6 (14.4−16.8)	9.1 (8.2−9.9)	17,742	17.0 (15.4−18.5)	9.1 (8.0−10.3)	19,752	14.2 (12.8−15.7)	9.0 (8.0−10.0)
Q3(13,333−27,999)	40,398	20.9 (19.0−22.8)	13.5 (12.2−14.8)	18,750	22.9 (20.4−25.4)	14.1 (12.4−15.8)	21,648	18.8 (17.3−20.3)	12.9 (11.8−14.0)
Q4(28,000+)	37,617	29.1 (26.7−31.5)	19.3 (17.8−20.7)	17,376	33.0 (30.2−35.8)	21.4 (19.4−23.4)	20,241	25.0 (22.9−27.2)	17.0 (15.8−18.2)
Don't know or refused	31,854	17.4 (14.9−19.9)	10.7 (9.2−12.2)	14,625	20.1 (16.8−23.3)	11.4 (9.7−13.2)	17,229	14.8 (12.6−17.0)	10.0 (8.5−11.6)
p value for trend		<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001
Occupation									
Office/shop/other non−manual	27,281	33.7 (31.3−36.0)	20.2 (19.0−21.3)	14,216	37.4 (34.7−40.2)	22.5 (20.9−24.0)	13,065	29.0 (26.9−31.2)	17.3 (16.2−18.5)
Factory and construction manual	24,343	20.8 (17.7−23.8)	12.4 (10.1−14.6)	15,227	22.5 (19.1−26.0)	13.0 (10.3−15.6)	9,116	16.9 (14.3−19.6)	11.1 (9.3−12.9)

TABLE 1. (Continued)

Items	Overall			Men			Women		
	N	Prevalence/% (95% CI)		N	Prevalence/% (95% CI)		N	Prevalence/% (95% CI)	
		LTPA	Regular LTPA		LTPA	Regular LTPA		LTPA	Regular LTPA
Farming related	84,883	10.6 (9.7−11.4)	6.6 (6.1−7.1)	42,288	10.7 (9.8−11.6)	6.1 (5.6−6.5)	42,595	10.4 (9.5−11.4)	7.1 (6.4−7.8)
Retired	17,103	29.8 (27.8−31.8)	25.7 (23.9−27.5)	7,877	29.4 (27.0−31.9)	25.2 (23.0−27.4)	9,226	30.1 (27.9−32.3)	26.2 (24.3−28.1)
Not working	34,320	13.8 (12.5−15.2)	9.3 (8.2−10.4)	8,623	14.8 (12.9−16.8)	9.1 (7.6−10.5)	25,697	13.4 (11.9−15.0)	9.3 (8.1−10.6)
p value for difference		<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001

Abreviation: LTPA=leisure-time physical activity.
* Table presented weighted prevalence, which represents the national total population.

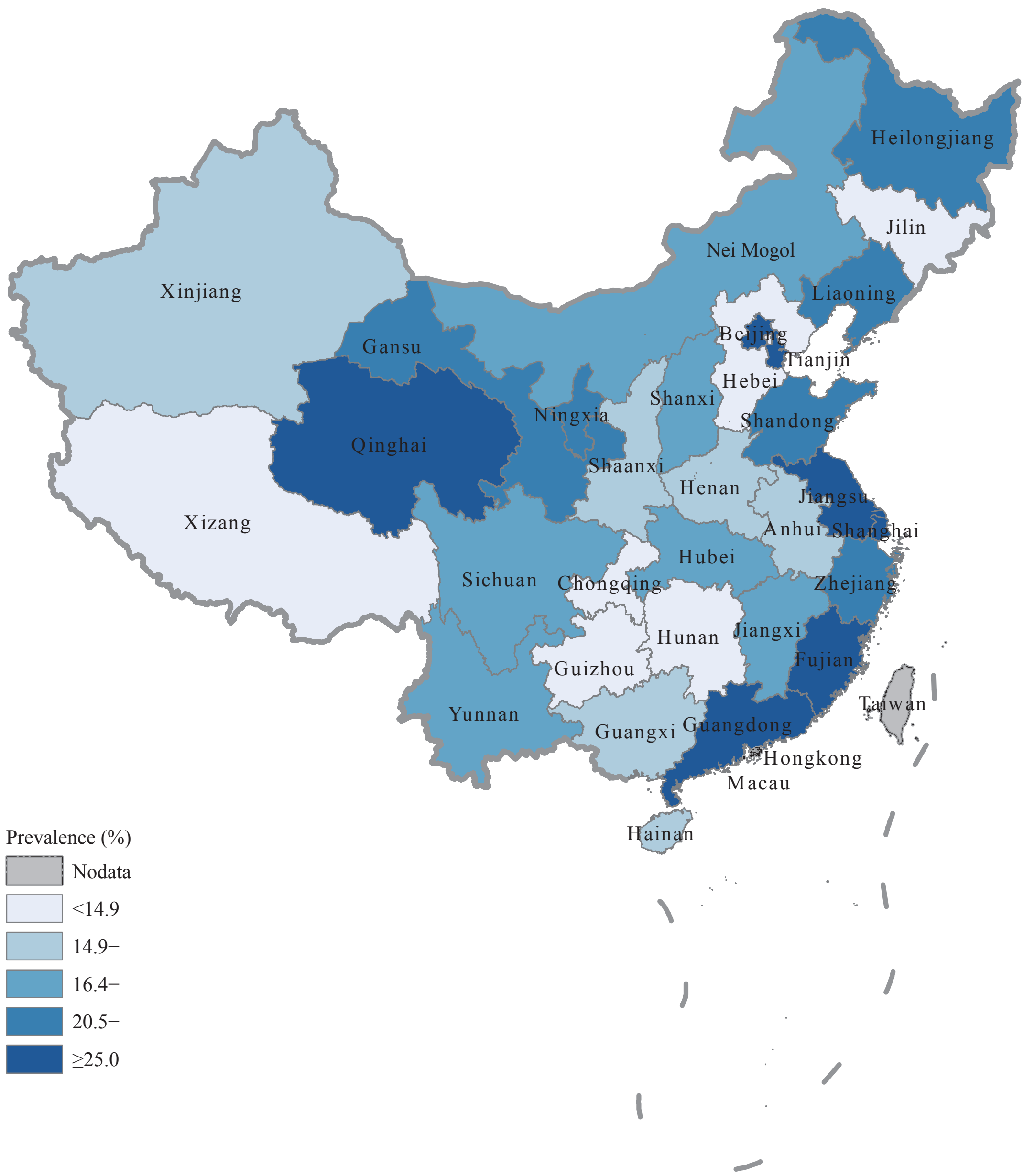

FIGURE 1. Age-standardized prevalence of leisure-time physical activity (LTPA) among adults at the provincial level in China in 2015.

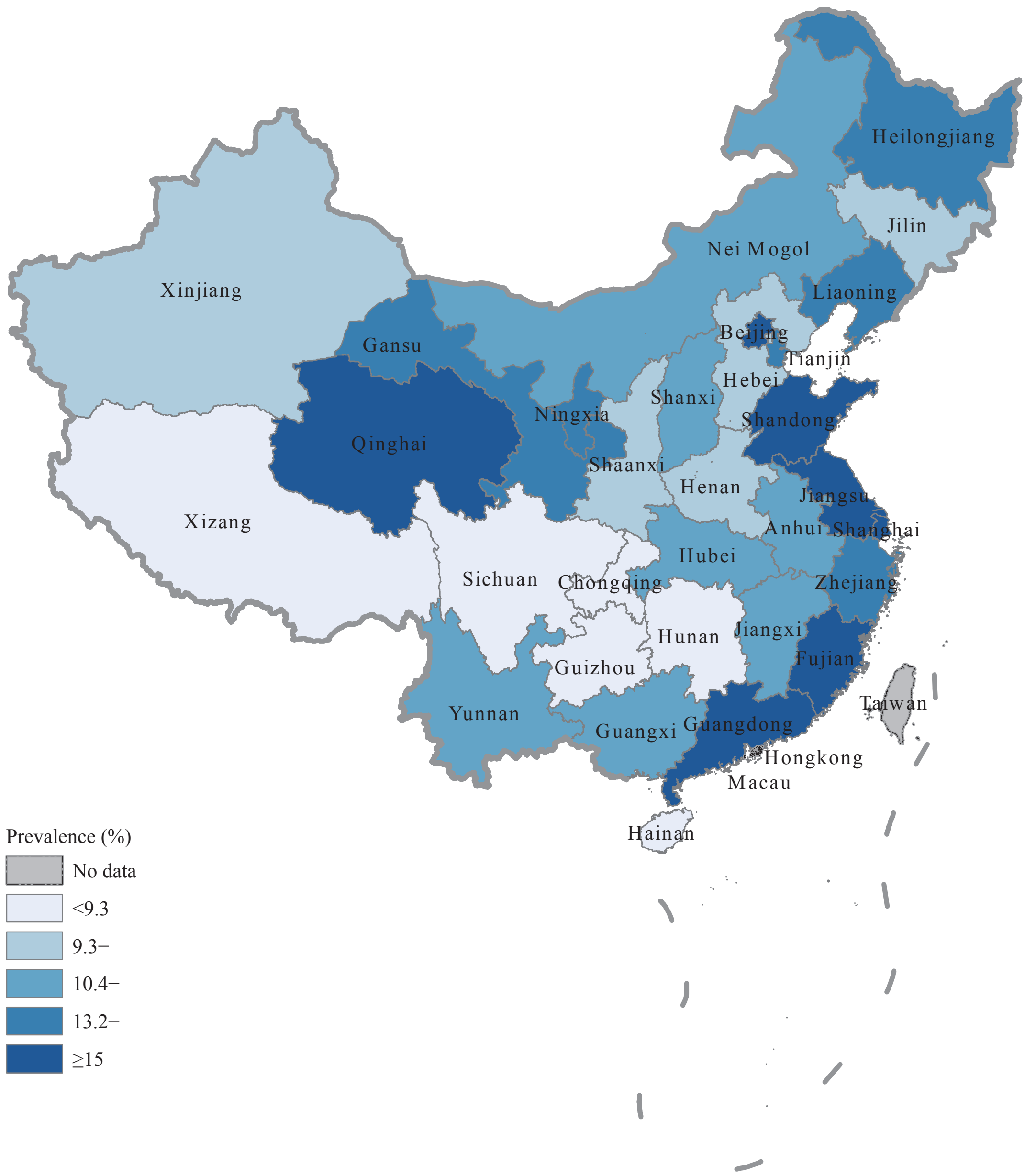

FIGURE 2. Age-standardized prevalence of regular leisure-time physical activity (LTPA) among adults at the provincial level in China in 2015.

than Shanghai, which ranked second. The lowest LTPA among adults in Xizang (Tibet) Autonomous Region was probably due to the high-altitude hypoxic environment.

According to Healthy China 2030 issued by the State Council in 2016, 435 million people (>30% of the whole population) and 530 million people (>40% of the whole population) are expected to do physical exercise regularly by 2020 and 2030, respectively. However, based on our study, with approximately 1.09 billion adults in total in the mainland of China, it was projected that only less than 150 million adults were involved in regular LTPA in 2015. So it seems to be difficult to reach the goal by 2020. Thus, to achieve the goal in 2030, more effort should be made to promote the implementation of the national fitness program.

This study was subject to at least one limitation. The individual history of physical activity was based on self-reporting. Some participants might have difficulty distinguishing between low-intensity activities and moderate-intensity activities as well as accurately recalling specific amounts of activity. This recall bias and difficulty interpreting the questions might have resulted in a slight overestimation of LTPA in Chinese adults.

In conclusion, this study provides an updated assessment as of 2015 of the largest nationwide and population-based self-reported status of LTPA in China. The prevalence of LTPA and regular LTPA had increased from the past but were still at a low level. To promote more people, especially those with lower socioeconomic status, to participate in LTPA, great effort are required to strengthen national and local policy initiatives, financial support, sports facilities construction, and health education, especially in rural areas and in western China.

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Preplanned Studies

Salt-Related Knowledge, Behaviors, and Associated Factors Among Chinese Adults — China, 2015

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Summary

What is already known about this topic?

Excessive salt intake is an important risk factor for hypertension and cardiovascular diseases (CVDs). The amount of salt intake of Chinese is one of the highest all over the world. At a national level, the awareness of maximum daily salt intake recommended by the "Dietary Guidelines of Chinese residents" had not been reported.

What is added by this report?

This is the first nationally representative study about awareness of maximum daily salt intake in China. In 2015, the awareness rate of maximum daily salt intake and behavior rate of salt reduction among Chinese adults aged 18 years old and above was 6.1% and 37.3%, respectively. The awareness rate of maximum daily salt intake and behavior rate of salt reduction was low among adult residents in China.

What are the implications for public health practice?

To increase the behavior rate of salt reduction in China, awareness of the maximum daily salt intake needs to be strengthened to Chinese residents, especially in rural areas or for people with low education levels and low incomes.

According to the 2018 Report on Cardiovascular Disease in China, hypertension and cardiovascular diseases (CVDs) were estimated to account for more than 40.0% of all deaths in China and were the leading cause of all death (*1*). Excessive salt intake is an important risk factor for CVDs, and China has one of the highest salt intakes in the world. According to the "National Nutrition and Health Survey of Chinese Residents," the average salt intake among Chinese residents was 12 grams/day (g/d) in 2002 and 10.5 g/d in 2012 (*2*), which were both much higher than the maximum daily salt intake (6 g/d) recommended by "Dietary Guidelines for Chinese Residents". However, most Chinese residents were still unclear about the recommended maximum daily salt intake. The awareness of maximum daily salt intake, the salt reduction behavior, and associated factors of Chinese residents aged 18 years old and above were analyzed by using data from the China Chronic Diseases and Nutrition Surveillance (CCDNS) system in 2015 for providing the evidence and basis for the follow-up control measures of salt reduction. This study found that the awareness rate of maximum daily salt intake and the behavior rate of salt reduction of Chinese adult residents was low, and nutrition education activities and targeted interventions should be enhanced, especially in rural areas, people with low education levels and low incomes.

Cross-sectional survey data for this study was obtained from the CCDNS in 2015, which used 298 surveillance points (counties or districts) across 31 provincial-level administrative divisions (PLADs) and a multistage stratified cluster randomized sampling method to select a national representative sample of households. Eligible residents aged 18 years old and above in the selected households were invited to participate by local CDCs. In a sample of the 88,250 households, 189,605 participants completed the survey, which yielded a 95.4% family response rate and a 94.9% individual response rate. After excluding 8,701 participants with incomplete data, 180,904 participants were included in this study. The study protocol was approved by the Ethical Committee of the National Center for Chronic and Non-Communicable Disease Control and Prevention of China CDC. All participants signed informed consent.

The CCDNS included face-to-face interviews, body measurements conducted by locally-trained personnel, and blood testing in the certified laboratories. The questionnaire related to this study included demographic characteristics (gender, age, education level, income, occupation, etc.), maximum daily salt intake recommended by "Dietary Guidelines for Chinese Residents", salt reduction behaviors, and information on chronic diseases. The awareness rate of maximum daily salt intake was defined as the percentage of people who had heard the Dietary Guidelines for Chinese residents and could correctly answer the recommended maximum daily salt intake (6 g/d). The behavior rate of salt reduction was defined as the percentage of people self-reporting taking salt reduction measures. Hypertension was defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg, or those who had been diagnosed with hypertension by township (community) and above hospitals and took antihypertensive medicine in the 2 weeks before surveying.

All statistical descriptions were weighted to obtain nationally representative estimates. Population data from the National Bureau of Statistics in 2015 was used to adjust the post-stratification weights. Rao Scott chi-square test was used to compare the disordered categorical variables, and the logistic regression model was used to test the trend of ordinal categorical variables. Multivariable logistic regression models were used to explore the factors associated with being aware of maximum daily salt intake and salt reduction. All statistical analyses were performed using software SAS (version 9.4, SAS Institute, Inc. Cary, NC, USA), and $p<0.05$ was statistically significant.

A total of 180,904 participants were included in this study, including 84,407 men and 96,497 women, 73,738 in urban areas, and 107,166 in rural areas. In 2015, the awareness rate of maximum daily salt intake among Chinese adults aged 18 years old and above overall was 6.1% (95% CI: 5.2%–6.9%), males 5.4% (95% CI: 4.7%–6.2%), females 6.7% (95% CI: 5.7%–7.7%), urban residents 9.3% (95% CI: 7.7%–10.9%), and rural residents 2.6% (95% CI: 2.2%–3.0%). The awareness rates of the 30–39 age group (7.8%, 95% CI: 6.6%–9.0%), residents of the eastern region (7.6%, 95% CI: 5.9%–9.3%), retired residents (14.3%, 95% CI: 12.3%–16.2%) and hypertension group (6.4%, 95% CI: 5.5%–7.4%) were significantly higher than those of others residents ($p<0.001$) and tended to increase with an increase in education level, family per capita income, and high body mass index (BMI). (Table 1)

In 2015, the behavior rate of salt reduction of Chinese adult residents was overall 37.3% (95% CI: 35.5%–39.1%), males 33.8% (95% CI: 32.1%–35.4%), females 40.9% (95% CI: 38.8%–43.0%), urban residents 44.6% (95% CI: 42.4%–46.7%), and rural residents 29.7% (95% CI: 27.6%–31.7%). In males or urban areas, the behavior rate of salt reduction of the 18–29 age group was significantly lower than that of other age groups ($p<0.001$), while in females or rural areas, there were no significant differences among different age groups. The behavior rate of salt reduction was higher in eastern regions, retired residents, the hypertension group, and people who knew the maximum daily salt intake and increased with an increase in education level, family per capita income, and BMI. (Table 2)

Multivariate logistic regression models showed that age, sex, residential area, educational level, family per capita income, employment status, and BMI were related to the awareness of daily maximum salt intake and behavior of salt reduction. The awareness rate of daily maximum salt intake and behavior rate of salt reduction of high-income families were significantly higher than those of the low-income group, and retired people were higher than the employees. Regions and hypertension were not associated with awareness of maximum daily salt intake but were associated with salt reduction behaviors. There was a significant association between awareness of daily maximum salt intake and behavior of salt reduction (OR=3.20, 95% CI: 2.77–3.70). (Table 3)

DISCUSSION

This study showed that the awareness rate of maximum daily salt intake and behavior rate of salt reduction among adult residents in China was quite low, especially in rural areas and people with low education levels. In this study, only 6.1% of Chinese adults knew of the daily maximum salt intake, and 37.3% of Chinese adults took salt reduction measures. Previous studies have shown that reducing salt intake can decrease blood pressure, reduce the incidence of hypertension, and the burden of cardiovascular events (*3*). Therefore, it is necessary to take measures to increase the awareness rate of daily maximum salt intake and reduce salt intake in China.

Previous studies had shown that the awareness of daily maximum salt intake varied greatly between different countries or regions. A sample survey of 5 PLADs in rural northern China showed that 5.0% of 5,050 elderly Chinese residents knew of the daily maximum salt intake (*4*). Claro et al. showed that the awareness rate of daily maximum salt intake was 6.3% in Argentina and 54.1% in Canada (*5*). Differences in results between studies may be related to the education level and economic development in the regions and countries. This study found that social inequality had a negative impact on salt-related awareness and behavior. Awareness of maximum daily salt intake and the behavior rate of salt reduction was higher in people living in the urban areas, or with higher education

TABLE 1. Awareness rate of the maximum daily salt intake among Chinese adults aged 18 years old and above — China, 2015.

Characteristics	Total		Men		Women		Urban		Rural	
	N[†]	Prevalence/% (95% CI[*])	N[†]	Prevalence/% (95% CI)	N[†]	Prevalence/% (95% CI)	N[†]	Prevalence/% (95% CI)	N[†]	Prevalence/% (95% CI)
Total	180,904	6.1(5.2–6.9)	84,407	5.4(4.7–6.2)	96,497	6.7(5.7–7.7)	73,738	9.3(7.7–10.9)	107,166	2.6(2.2–3.0)
Age (years)										
18–29	15,881	6.2(5.2–7.2)	7,078	4.9(4.0–5.8)	8,803	7.6(6.3–8.9)	6,636	9.2(7.4–10.9)	9,245	2.6(2.0–3.2)
30–39	21,740	7.8(6.6–9.0)	9,704	6.3(5.1–7.5)	12,036	9.3(7.7–10.9)	9,415	10.5(8.3–12.7)	12,325	4.4(3.3–5.4)
40–49	39,965	6.5(5.5–7.5)	17,954	6.2(5.1–7.2)	22,011	6.8(5.7–7.8)	15,174	9.7(7.9–11.6)	24,791	3.1(2.5–3.7)
50–59	44,221	4.8(3.8–5.7)	20,354	4.6(3.7–5.5)	23,867	4.9(3.8–6.0)	17,702	8.2(6.4–10.0)	26,519	1.6(1.3–1.9)
60–69	40,093	4.6(3.6–5.5)	19,461	4.7(3.9–5.5)	20,632	4.5(3.3–5.6)	16,659	8.6(6.8–10.4)	23,434	1.4(1.0–1.8)
70+	19,004	4.2(3.5–5.0)	9,856	5.2(4.2–6.1)	9,148	3.4(2.6–4.2)	8,152	8.4(6.9–9.9)	10,852	0.9(0.5–1.4)
p value for trend		<0.001		0.449		<0.001		0.130		<0.001
Geographic Location										
Eastern	67,378	7.6(5.9–9.3)	31,273	6.7(5.3–8.1)	36,105	8.5(6.5–10.6)	33,247	9.9(7.1–12.7)	34,131	4.1(3.1–5.1)
Central	51,539	5.1(4.0–6.3)	24,131	4.6(3.5–5.8)	27,408	5.6(4.3–6.9)	21,038	8.9(6.6–11.2)	30,501	1.9(1.6–2.1)
Western	61,987	4.7(3.6–5.8)	29,003	4.3(3.3–5.3)	32,984	5.1(3.7–6.5)	19,453	8.6(6.5–10.8)	42,534	1.7(1.2–2.3)
p value for difference		0.002		0.007		0.003		0.727		<0.001
Education										
Primary or less	88,819	1.0(0.8–1.2)	35,105	1.1(0.9–1.4)	53,714	0.9(0.6–1.1)	24,514	1.8(1.3–2.3)	64,305	0.6(0.4–0.7)
Junior High	55,243	4.2(3.6–4.8)	29,964	3.9(3.3–4.4)	25,279	4.6(3.9–5.3)	23,296	5.8(4.6–7.0)	31,947	2.8(2.3–3.2)
Senior High	23,346	10.1(8.4–11.8)	12,796	8.1(6.5–9.7)	10,550	12.9(10.8–15.0)	14,555	11.8(9.2–14.4)	8,791	6.7(5.6–7.7)
College or above	13,496	17.8(15.6–20.0)	6,542	14.1(12.2–15.9)	6,954	21.7(18.9–24.5)	11,373	18.3(15.9–20.7)	2,123	14.3(9.4–19.2)
p value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Family per capita income, CNY										
Q1 (<6,000)	45,278	2.7(2.1–3.2)	21,699	2.7(1.9–3.5)	23,579	2.6(2.1–3.2)	9,531	4.4(3.1–5.7)	35,747	2.0(1.5–2.5)
Q2 (6,000–11,999)	38,741	4.3(3.7–4.9)	18,059	4.4(3.6–5.1)	20,682	4.3(3.5–5.0)	12,536	6.5(5.2–7.8)	26,205	2.7(2.3–3.2)
Q3 (12,000–21,599)	36,932	7.2(6.2–8.1)	17,022	6.2(5.3–7.1)	19,910	8.2(7.1–9.4)	19,546	9.2(7.9–10.5)	17,386	3.7(3.0–4.4)
Q4 (21,600+)	29,527	12.5(10.1–14.8)	13,780	10.4(8.5–12.3)	15,747	14.7(11.8–17.6)	21,114	14.4(11.4–17.3)	8,413	4.8(2.7–6.9)
Don't know/refused[§]	30,426	4.1(2.7–5.6)	13,847	3.6(2.5–4.8)	16,579	4.7(2.8–6.6)	11,011	7.1(4.1–10.0)	19,415	1.6(1.2–1.9)
p value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Employment status										
Employed	130,625	6.1(5.3–6.9)	68,241	5.3(4.6–6.0)	62,384	7.1(6.0–8.2)	44,637	9.5(7.9–11.2)	85,988	2.8(2.4–3.3)
Housework	25,112	2.2(1.7–2.7)	4,597	1.6(1.0–2.3)	20,515	2.3(1.8–2.8)	9,098	3.6(2.5–4.6)	16,014	1.2(0.8–1.6)
Retired	16,606	14.3(12.3–16.2)	7,624	12.2(10.6–13.7)	8,982	16.0(13.6–18.5)	15,010	15.2(13.1–17.2)	1,596	4.8(2.4–7.3)
Unemployed	8,561	5.6(4.0–7.2)	3,945	4.3(2.7–5.8)	4,616	6.9(4.8–9.0)	4,993	7.6(5.3–9.9)	3,568	2.1(1.3–2.9)
p value for difference		<0.001		<0.001		<0.001		<0.001		<0.001
Body weight status (BMI categories)										
Underweight, BMI<18.5	6,822	4.7(3.2–6.3)	2,986	2.8(1.4–4.2)	3,836	6.3(4.3–8.2)	2,177	7.4(4.1–10.7)	4,645	1.9(1.2–2.6)
Normal weight, BMI: 18.5–23.9	85,129	6.0(5.1–6.8)	40,103	4.4(3.9–5.0)	45,026	7.3(6.2–8.5)	31,491	9.7(8.2–11.2)	53,638	2.2(1.8–2.6)
Overweight, BMI: 24–27.9	63,232	6.1(5.2–7.0)	29,975	6.1(5.2–7.1)	33,257	6.1(5.2–7.1)	27,898	9.1(7.5–10.7)	35,334	2.9(2.3–3.5)
Obesity, BMI≥28	25,721	6.8(5.5–8.0)	11,343	7.6(6.2–8.9)	14,378	5.8(4.3–7.3)	12,172	9.4(7.1–11.7)	13,549	3.6(2.9–4.2)
p value for trend		0.014		<0.001		0.006		0.910		<0.001
Hypertension										
Yes	71,642	6.4(5.5–7.4)	35,181	5.3(4.5–6.0)	36,461	7.5(6.3–8.7)	28,940	9.7(7.9–11.4)	42,702	2.8(2.3–3.2)
No	109,262	5.2(4.4–5.9)	49,226	5.7(4.9–6.6)	60,036	4.4(3.7–5.1)	44,798	8.5(7.0–9.9)	64,464	2.2(1.8–2.6)
p value for difference		<0.001		0.207		<0.001		0.025		0.002

[*] CI=confidence interval.

[†] N=Number of participants.

[§] Participants answering "don't know or refuse" were not included in the trend test.

TABLE 2. Behavior rate of salt reduction among Chinese adults aged 18 years old and above — China, 2015.

Characteristics	Total		Men		Women		Urban		Rural	
	N†	Prevalence/% (95% CI*)	N†	Prevalence/% (95% CI)	N†	Prevalence/% (95% CI)	N†	Prevalence/% (95% CI)	N†	Prevalence/% (95% CI)
Total	180,904	37.3(35.5−39.1)	84,407	33.8(32.1−35.4)	96,497	40.9(38.8−43.0)	73,738	44.6(42.4−46.7)	107,166	29.7(27.6−31.7)
Age (years old)										
18−29	15,881	32.3(30.4−34.2)	7,078	27.4(25.1−29.6)	8,803	37.3(35.0−39.5)	6,636	36.0(33.6−38.5)	9,245	27.6(25.2−30.1)
30−39	21,740	39.6(37.2−42.0)	9,704	35.5(33.3−37.7)	12,036	43.8(40.8−46.9)	9,415	47.0(44.0−50.0)	12,325	30.1(27.9−32.4)
40−49	39,965	39.5(37.5−41.6)	17,954	36.9(34.9−38.9)	22,011	42.2(39.8−44.7)	15,174	48.0(45.4−50.7)	24,791	30.7(28.5−32.9)
50−59	44,221	38.8(36.8−40.8)	20,354	35.2(33.3−37.2)	23,867	42.5(40.2−44.7)	17,702	47.1(44.6−49.6)	26,519	31.2(28.9−33.5)
60−69	40,093	38.7(36.4−41.0)	19,461	35.5(33.2−37.8)	20,632	41.9(39.5−44.4)	16,659	48.3(45.7−51.0)	23,434	31.0(28.2−33.8)
70+	19,004	35.9(32.6−39.2)	9,856	35.0(32.1−37.8)	9,148	36.7(32.5−40.8)	8,152	47.8(44.1−51.6)	10,852	26.3(22.7−30.0)
p value for trend		0.001		<0.001		0.309		<0.001		0.448
Geographic Location										
Eastern	67,378	44.6(41.9−47.2)	31,273	40.7(38.1−43.2)	36,105	48.6(45.5−51.6)	33,247	49.2(45.8−52.6)	34,131	37.4(34.0−40.9)
Central	51,539	33.2(30.3−36.1)	24,131	29.8(27.4−32.3)	27,408	36.6(33.1−40.0)	21,038	40.1(36.4−43.7)	30,501	27.4(24.3−30.5)
Western	61,987	30.5(27.3−33.8)	29,003	27.4(24.4−30.5)	32,984	33.7(30.1−37.4)	19,453	39.7(35.4−43.9)	42,534	23.6(20.0−27.2)
p value for difference		<0.001		<0.001		<0.001		<0.001		<0.001
Education										
Primary or less	88,819	29.3(27.3−31.2)	35,105	25.5(23.8−27.3)	53,714	31.9(29.7−34.1)	24,514	36.3(33.4−39.2)	64,305	25.8(23.8−27.8)
Junior High	55,243	36.4(34.5−38.4)	29,964	32.0(30.2−33.8)	25,279	41.9(39.5−44.4)	23,296	42.3(39.8−44.8)	31,947	31.2(28.9−33.5)
Senior High	23,346	44.2(42.2−46.2)	12,796	39.7(37.8−41.7)	10,550	50.4(47.8−52.9)	14,555	48.2(45.4−51.1)	8,791	35.8(33.2−38.4)
College or above	13,496	50.7(48.5−52.9)	6,542	46.1(43.2−49.0)	6,954	55.4(52.5−58.4)	11,373	51.4(49.0−53.8)	2,123	45.4(39.8−50.9)
p value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Family per capita income, CNY										
Q1 (<6,000)	45,278	30.1(27.8−32.5)	21,699	26.6(24.5−28.6)	23,579	33.7(30.8−36.5)	9,531	35.9(32.3−39.5)	35,747	27.9(25.2−30.6)
Q2 (6,000−11,999)	38,741	34.8(32.7−36.9)	18,059	31.4(29.1−33.6)	20,682	38.2(35.9−40.5)	12,536	40.9(37.7−44.1)	26,205	30.4(28.1−32.6)
Q3 (12,000−21,599)	36,932	41.9(39.7−44.2)	17,022	37.9(35.7−40.2)	19,910	46.1(43.1−49.1)	19,546	46.4(43.9−48.9)	17,386	34.4(31.7−37.1)
Q4 (21,600+)	29,527	49.2(46.5−52.0)	13,780	45.0(42.3−47.6)	15,747	53.8(50.6−56.9)	21,114	52.0(48.6−55.4)	8,413	37.9(33.6−42.1)
Don't know/refused§	30,426	30.7(27.7−33.7)	13,847	27.6(24.6−30.5)	16,579	33.6(30.0−37.3)	11,011	38.1(33.5−42.6)	19,415	24.1(21.5−26.8)
p value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Employment status										
Employed	130,625	36.4(34.4−38.3)	68,241	33.2(31.5−34.8)	62,384	40.4(38.0−42.8)	44,637	43.7(41.5−45.9)	85,988	29.3(27.3−31.4)
Housework	25,112	35.9(33.1−38.8)	4,597	28.2(24.2−32.2)	20,515	37.4(34.6−40.3)	9,098	43.9(40.2−47.6)	16,014	30.3(26.8−33.8)
Retired	16,606	57.2(54.2−60.3)	7,624	53.4(50.4−56.3)	8,982	60.6(57.1−64.0)	15,010	58.7(55.5−61.8)	1,596	42.3(34.6−50.1)
Unemployed	8,561	34.9(31.5−38.2)	3,945	30.5(26.0−35.0)	4,616	38.9(35.6−42.3)	4,993	37.3(32.4−42.2)	3,568	30.5(26.5−34.5)
p value for difference		<0.001		<0.001		<0.001		<0.001		<0.001
Body weight status (BMI categories)										
Underweight, BMI<18.5	6,822	27.5(23.3−31.6)	2,986	23.2(18.3−28.2)	3,836	30.9(26.8−35.0)	2,177	31.8(23.0−40.5)	4,645	23.0(20.5−25.5)
Normal weight, BMI:18.5−23.9	85,129	35.1(33.2−36.9)	40,103	29.5(28.0−31.0)	45,026	40.2(37.7−42.6)	31,491	42.3(39.9−44.6)	53,638	27.8(26.0−29.7)
Overweight, BMI:24−27.9	63,232	40.0(37.9−42.1)	29,975	37.5(35.5−39.6)	33,257	42.9(40.4−45.4)	27,898	47.9(45.6−50.1)	35,334	31.4(28.9−34.0)
Obesity, BMI≥28	25,721	42.0(39.5−44.5)	11,343	41.0(38.4−43.7)	14,378	43.0(40.0−46.0)	12,172	48.1(45.2−50.9)	13,549	34.5(31.1−38.0)
p value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Hypertension										
Yes	71,642	39.3(37.4−41.3)	35,181	37.4(35.4−39.3)	36,461	41.7(39.6−43.8)	28,940	47.6(45.4−49.8)	42,702	31.9(29.6−34.2)
No	109,262	36.5(34.6−38.4)	49,226	32.1(30.5−33.7)	60,036	40.6(38.3−42.9)	44,798	43.4(41.1−45.7)	64,464	28.6(26.6−30.7)
p value for difference		<0.001		<0.001		0.214		<0.001		<0.001
Awareness of maximum daily salt intake										
Yes	9,335	71.8(69.0−74.7)	4,081	68.6(65.0−72.3)	5,254	74.4(71.3−77.6)	6,935	73.6(70.5−76.7)	2,400	28.7(26.7−30.8)
No	171,569	35.1(33.4−36.8)	80,326	31.8(30.2−33.4)	91,243	38.5(36.5−40.5)	66,803	41.6(39.6−43.5)	104,766	65.0(60.3−69.7)
p value for difference		<0.001		<0.001		<0.001		<0.001		<0.001

* CI=confidence interval.

† N=Number of participants.

§ Participants answering "don't know or refuse" were not included in the trend test.

TABLE 3. Associations between factors and awareness rate of the maximum daily salt intake and behavior of salt reduction among Chinese adults aged 18 years old and above — China, 2015.

Characteristics	Awareness of maximum daily salt intake			Behavior of salt reduction		
	OR	95% CI*	*p* value	OR	95% CI	*p* value
Age (years)						
18−29	Ref			Ref		
30−39	1.49	1.28−1.74	<0.001	1.42	1.31−1.55	<0.001
40−49	1.92	1.65−2.24	<0.001	1.61	1.48−1.76	<0.001
50−59	1.37	1.13−1.66	0.002	1.56	1.42−1.71	<0.001
60−69	1.93	1.54−2.42	<0.001	1.79	1.62−1.97	<0.001
70+	1.90	1.52−2.39	<0.001	1.59	1.36−1.86	<0.001
Sex						
Men	Ref			Ref		
Women	1.60	1.46−1.75	<0.001	1.50	1.42−1.57	<0.001
Residence						
Urban	Ref			Ref		
Rural	0.67	0.51−0.87	0.003	0.75	0.67−0.84	<0.001
Geographic location						
Eastern	Ref			Ref		
Central	0.86	0.65−1.14	0.300	0.69	0.60−0.79	<0.001
Western	0.98	0.75−1.29	0.905	0.68	0.57−0.79	<0.001
Education						
Primary or less	Ref			Ref		
Junior high	4.66	3.81−5.69	<0.001	1.47	1.39−1.56	<0.001
Senior high	11.09	8.83−13.92	<0.001	1.85	1.69−2.02	<0.001
College or above	20.41	14.99−27.79	<0.001	2.16	1.91−2.43	<0.001
Family per capita income, CNY						
Q1 (<6,000)	Ref			Ref		
Q2 (6,000−11,999)	1.17	0.97−1.40	0.097	1.07	0.98−1.17	0.129
Q3 (12,000−21,599)	1.24	0.99−1.55	0.064	1.17	1.05−1.30	0.005
Q4 (21,600+)	1.41	1.08−1.84	0.011	1.20	1.05−1.37	0.009
Don’t know/refused	0.93	0.67−1.29	0.673	0.83	0.74−0.94	0.003
Employment status						
Employed	Ref			Ref		
Housework	0.58	0.48−0.70	<0.001	1.04	0.94−1.15	0.479
Retired	1.67	1.39−2.02	<0.001	1.35	1.19−1.53	<0.001
Unemployed	0.81	0.64−1.01	0.062	0.94	0.80−1.10	0.422
BMI categories						
Normal weight, BMI:18.5−23.9	Ref			Ref		
Underweight, BMI<18.5	0.77	0.55−1.07	0.120	0.73	0.57−0.95	0.019
Overweight, BMI:24−27.9	1.05	0.95−1.15	0.361	1.18	1.13−1.23	<0.001
Obesity, BMI≥28	1.13	1.00−1.27	0.055	1.22	1.14−1.31	<0.001
Hypertension						
Yes	Ref			Ref		
No	0.95	0.86−1.05	0.324	0.90	0.86~0.94	<0.001
Awareness of maximum daily salt intake						
No	−	−	−	Ref		
Yes	−	−	−	3.20	2.77−3.70	<0.001

Note: "−" means not applicable.
Abbreviations: Ref=reference
* CI=confidence interval.

level, or with high family income per capita, or who have retired, which was largely consistent with the results from the previous studies (*6*). Lower awareness rates in rural areas may have been due to lower levels of education, poorer development of health education, and less developed health promotion campaigns.

This study showed that about one-third of the population took measures to control their salt intake, which was lower than that in 2010 (42.2%) (*7*). This showed that bad habits formed in the long term are difficult to change in a short term, and salt reduction requires a long time and sustained efforts (*7*). This study found that the awareness rate of daily maximum salt intake and the salt reduction behavior rate among the hypertension population was significantly higher than that of the non-hypertension population, which was consistent with the result of a previous study (*8*). This may be because people who knew they have high blood pressure were more concerned about their health and thus controlled their salt intake or took salt reduction measures under the guidance of doctors. Previous studies showed that salt-related knowledge could affect salt reduction behaviors (*8*). In this study, the behavior rate of salt reduction was significantly higher in those who knew the maximum salt intake than those who did not. This study showed that improving knowledge is a critical step in behavioral changes, and indicating educational activities in nutrition may be essential for the implementation of good behavior (*6*).

Individuals, businesses, and governments all play an important role in reducing salt. At the national level, China has conducted policies to reduce people's salt intake, including "China Healthy Lifestyle for All" and the "National Nutrition Week". Moreover, China has carried out various regional salt reduction programs, such as the Shandong Ministry of Health Action on Salt Reduction and Hypertension (*9*). In China, salt intake comes mainly from added salt or soy sauce in home cooking, but salt in processed foods also makes up a large portion (*10*). Therefore, it is particularly important to strengthen the salt-related knowledge and salt reduction technology of families and inform residents of maximum daily intake of salt and improve awareness of hidden salt in food and to inform the public of ways to control salt in cooking. Government departments should formulate policies related to salt reduction and strengthen the assessment and evaluation of the corresponding control measures.

This study was subject to at least one limitation. The results of the survey were self-reported and may be subject to a favorable response bias, which may overestimate or underestimate their actual salt reduction behavior, or a recall bias. Furthermore, the questionnaire did not include salt reduction attitudes, so the relationship between salt reduction attitude and behaviors could not be studied.

In conclusion, this study provides a nationwide report on population-based salt-related knowledge and behavior. This study found that the awareness rate of maximum daily salt intake and behavior rate of salt reduction of Chinese adult residents were low. Chinese residents require further nutrition education to better understand the recommended maximum daily salt intake and take further salt reduction measures, particularly in rural areas or people with low education levels, or with low incomes.

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Outbreak Reports

An Outbreak of Dengue Virus Type 1 — Jiangxi Province, China, 2019

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Summary

What is known about this topic?

Dengue fever is an acute febrile illness caused by four types of dengue virus (DENV 1–4), and is a mosquito-borne infectious disease. The incidence of dengue has increased dramatically around the world in recent decades. An estimated of 3.9 billion people in 128 countries are at risk of infection with dengue viruses, 70% of whom are in Asia. In 2017, the first local infections of dengue virus (DENV-2) in Jiangxi Province was reported in Zhanggong District, Ganzhou City.

What is added by this report?

From August to September 2019, the first dengue outbreak happened in Xin'gan County, where 81 local dengue fever cases were reported, 35 were laboratory-confirmed cases, and 46 were clinically-diagnosed cases; all cases were dengue virus type 1. The DENV-virus strains isolated from the cases of Xin'gan County were close to the strains isolated in Singapore (MF033254|25657|Singapore|2016) and Henan (MK905537|Henan201903|China: Henan Province|2019).

What are the implications for public health practice?

The outbreak might have been caused by imported cases or covert infections. The outbreak in Xin'gan County indicated that more proactive countermeasures should be taken during the dengue epidemic period such as intensifying surveillance for dengue cases, virus serotype, and *Aedes* vector density and strengthening cooperation with customs and tourism departments. Moreover, the outbreak should prompt training in medical institutions and improved ability for doctor's to diagnose dengue fever, which is very important for early detection of dengue cases and taking preventive measures.

On August 28, 2019, Jiangxi Province Center for Disease Control and Prevention (Jiangxi CDC) received a report of a suspected dengue case from Xin'gan County, and a second suspected case was reported from the same county a day later. The two cases were identified as dengue virus infections cases on August 29 and prompted the deployment of a team composed of an epidemiologist and a vector control specialist to Xin'gan County to provide health support, to investigate the infection source, to assess the effects of mosquito control, and especially to assess the risk of regional transmission.

OUTBREAK RECOGNITION AND INITIAL RESPONSE

On August 28, 2019, a patient visited Nanchang City Ninth Hospital with fever, dizziness, headache, fatigue, and rash. The patient's blood sample was tested in Jiangxi CDC and the result showed the patient was experiencing dengue fever viremia. This event was notified to Ji'an City CDC and Xin'gan County CDC. County, city, and provincial CDCs responded to the event immediately, and over the next several days, 80 more local dengue cases were identified in Xin'gan county.

County, city, and provincial CDCs carried out epidemiological investigations in medical institutions and affected areas in Xin'gan County, in which searching definition for suspected dengue cases included fever and the presence of two or more symptoms among the following: rash, arthralgia, myalgia, or headache. By September 8, 2019, a total of 81 patients were identified without serious cases or death.

INVESTIGATION AND RESULTS

On August 29, 2019, the first local suspected dengue case in Xin'gan County was laboratory-confirmed in a patient with symptoms including fever, dizziness, headache, fatigue, and rash. The first case occurred in a 55-year-old male patient without recent travel history. The real-time RT-PCR test result suggested his blood sample was positive for DENV, and additional sample testing identified DENV-1.

During investigation two suspected dengue cases were found in brothers aged 13 and 14 and were likely the initial cases. They presented dengue fever-like symptoms on August 10 and 11 including fever, headache, and muscle or body aches. In late July, they followed their grandfather to visit their parents for summer vacation in Shiling Town, Huadu District, Guangzhou City. They returned to Xin'gan County on August 7 due to a local dengue fever outbreak in Shiling Town. On August 30 and 31, their grandparents presented dengue fever-like symptoms and tested positive for DENV on September 2.

The time distribution indicated that the date of onset of the first case was August 23, and the last case reported was September 8. The incidence was bimodal with the first peak from August 31 to September 2 (26 cases) and second peak from September 4 to September 5 (15 cases). The number of cases decreased rapidly after September 6 (Figure 1).

The outbreak occurred in Jinchuan Town, Xin'gan County, including Huachengmen Village, Mexiang, Zhongshan, Binyang, Chengnan, Hejiashan, Chengbei, Shanzheng, and Wenchang communities. Overall, 70 cases (86.4%) occurred in Mexiang, Zhongshan, Binyang, and Chengnan communities and were surrounded by Binjiang Avenue, Yaocai Street, Shangye Road, and Chuannan Road covering an area of about 1.2 km^2.

Most of the patients experienced atypical symptoms mainly including influenza-like symptoms such as fever, body ache, chills, headache, fatigue, etc. (Table 1).

The median interval of time from onset to diagnosis was 2 days (1–8 days), and 23 (28.4%) cases were diagnosed at 4 days or longer after onset of symptoms. Doctors had a significantly improved capacity to diagnose dengue fever after training as the median onset-to-diagnosis interval of patients that were referred was found to be significantly longer than that of those who were not referred (Table 2). SPSS software (version 24.0, IBM Corporation, New York, USA) was used to carry out statistical analysis on data, non-parametric rank sum test were used for comparing population means among different groups if the normality assumption was violated, and the significance test level is α =0.05.

The dynamic density of the *Aedes* vector was investigated daily by the Breteau index (BI), which investigates the number of positive containers per 100 houses, in the epidemic area to begin the adoption of control measures. At the beginning, the mean BI in the epidemic area was 24.45 with the highest BI being 48.00 in Meixiang Community and the lowest BI being 14.01 in Binyang Community. An elevated BI is consistent with an increased risk for DENV transmission and demonstrates that Xin'gan County was at risk for local DENV transmission. The BI quickly declined below the safety thresholds 2.55 days after implementation of emergency mosquito control

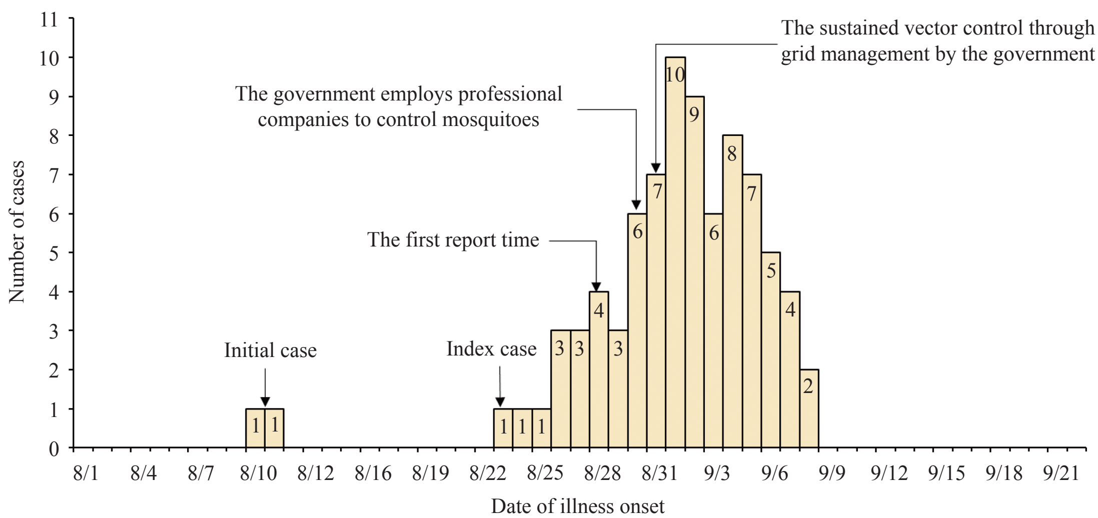

FIGURE 1. The onset time curve among the outbreak cases of dengue fever in Xin'gan County, Jiangxi Province, 2019. The date of onset of the first case was August 23, and the last case reported was September 8. After implementation of emergency mosquito control and clearing of breeding places led by the local government, the number of cases decreased rapidly after September 6.

TABLE 1. The main clinical symptoms among the outbreak cases of dengue fever in Xin'gan County, Jiangxi Province, 2019.

Symptoms	No. of cases	Percentage/%
Fever(≥38 ℃)	63	77.8
Body aches	35	43.2
Chills	31	38.3
Headache	25	30.8
Fatigue	24	29.3
Muscle pain	12	14.8
Arthralgia	9	11.1
Bleeding point of skin	4	4.9
Rash	2	2.5

TABLE 2. The median onset-to-diagnosis time interval among the outbreak cases of dengue fever in Xin'gan County, Jiangxi Province, 2019.

Characteristics		The median interval (days)	*p* value
Hospital type	Hospital	3(1–7)	0.130
	Clinic	3(1–8)	
Referral status	No	1(1–7)	0.002
	Referral	3(1–8)	
Training	Before	4(2–7)	0.004
	After	2(1–8)	

and clearing of breeding places led by the local government.

All cases presenting dengue fever-like symptoms were tested with a dengue rapid diagnostic test (RDT) for DENV nonstructural protein 1 (NS1). Specimens that were RDT positive were further tested by real-time RT-PCR. From August 29 to September 10, 2019, a total of 510 samples were tested for evidence of DENV infection (all by RDT-NS1 alone, and 35 by both methods), 81 (15.9%) of whom tested positive for dengue. By September 10, 2019, 35 cases were laboratory-tested confirmed as being infected with DENV-1. Therefore, 35 out of 81 patients were confirmed by real-time RT-PCR tested results and the remaining 46 patients were clinically diagnosed.

The E genes of some strains were sequenced to construct a phylogenetic tree with the length of the amplified fragment being 1,782 base pairs (bp). The analysis result indicated that about 99.8% to 100% of the 35 strains of DENV-1 isolated from the patients in Xin'gan County were highly homologous. Compared to some strains isolated domestically and overseas, the virus strains from Xin'gan county in 2019 were closest to the strains isolated in Singapore (MF033254|25657|Singapore|2016) and Henan (MK905537|Henan 201903|China: Henan Province|2019), and the strains isolated in cases imported from Cambodia to Jiangxi Province in 2019 had a homology of 99.4%, 99.6%, and 99.6%–100%, respectively.

PUBLIC HEALTH RESPONSE

The public health response to this outbreak included disposal of waste to remove mosquito breeding sites, indoor residual spraying of pesticides in public places, conducting case monitoring and search, reinforcement of dengue patient management and treatment, outdoor spraying of mosquito repellent, and public education on mosquito avoidance and seeking medical care for symptoms of dengue. The government controlled dengue transmission with sustainable, effective interventions including enhancing the ability of medical institutions to detect, diagnose, and report dengue cases to continue emphasizing health education for the public. One of the most important measures was the sustained mosquito control and environmental improvement under the grid management led by government.

DISCUSSION

The incidence of dengue has grown dramatically around the world in recent decades. An estimated 3.9 billion people in 128 countries are at risk of infection with dengue viruses (*1*), and an estimated 70% of the burden is shouldered by Asia (*2*). In recent years, the outbreak of dengue in China has gradually spread from southeast coastal areas to northern parts of the country. During 2005–2018, an average 0–15 imported dengue fever cases were reported annually in Jiangxi Province, which increased the likelihood of a local outbreak of dengue fever, and on August 29, 2019, the local dengue outbreak was reported for the first time in Xin'gan County, Ji'an City, Jiangxi Province.

The retrospective investigation found that there was an epidemiological correlation among two suspected cases of dengue and the index case in terms of time and space. From August 10 to August 23, all three patients walked or played in Chengdong Wetland Park at dusk. The two suspected patients lived in Chengnan Community and the index patient lived in Meixiang Community, and the linear distance from the houses was about 130 meters. Therefore, it is possible that the outbreak may be caused by the two suspected cases that were imported from Huadu District, Guangzhou City, but the DENV-1 strains isolated from Xin'gan in 2019 may be originally originated from Cambodia.

The distribution of cases reported in this outbreak showed a high degree of spatial aggregation, which is consistent with some studies (*3*). A total of 70 (86.4%) cases were concentrated in four adjacent communities Mexiang, Zhongshan, Binyang, and Chengnan, and the time in which community residents play or walk in parks and squares was consistent with the active time for mosquitoes, which provided evidence for the community transmission of dengue virus through human mobility.

The prompt diagnosis and management of cases are key measures in controlling the spread of the outbreak, and the clinical manifestations of dengue were closely related to the diagnosis, so that correct understanding and analysis of clinical symptoms, combined with investigations of the epidemiological history, are helpful to improve the efficiency of diagnosis and treatment (*4–5*). By investigating and analyzing the median onset-to-diagnosis interval in this outbreak, we found that enhancing the ability of medical faculty to quickly detect and diagnose dengue cases is highly needed.

In Xin'gan County, primary care doctors did not have awareness for the initial cases early in the outbreak that led to missed diagnoses and misdiagnoses. There are two main reasons: base-level health workers lack essential knowledge about dengue fever, and barefoot doctors have insufficient training to properly address dengue fever. Taking this outbreak as an example, accurate diagnosis depended on the ability to intensively collect epidemiological information such as travel history two weeks prior to onset, the dengue condition in countries or areas of origin, etc., the ability to master recognition of the symptoms and signs of dengue fever patients, and the ability to grasp the laboratory diagnosis methods of dengue fever. The professional skills regarding dengue fever in rural health workers could be improved through further education, training, and reallocating experts to rural areas to assist with prevention, diagnosis, and treatment.

The outbreak tells us early detection and diagnosis of cases is key to controlling the spread of an epidemic; timely and effective mosquito control in the early stage of epidemic is another key measure. Thus, during the epidemic period of dengue, more proactive countermeasures must be taken such as intensifying surveillance for dengue cases, virus, and the vector *Aedes*; strengthening the cooperation with customs and tourism departments to yield close partnerships that will be integral components of successful public health initiatives to combat dengue (*6*); and improving the capacity of medical institutions to promptly detect and diagnosis dengue cases. Through early warning and coordination, we can detect the spread of dengue-fever.

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Profiles

Linhong Wang, China CDC's Chief Expert of Chronic and Non-Communicable Disease Control

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Linhong Wang is the Chief Expert of Chronic and Non-Communicable Disease (NCD) Control of China CDC and is a professional with over 30 years of experience in clinical and preventive medical science. Her specialties and professions span multiple fields with extraordinary contributions to public health.

Wang graduated from Beijing Medical University in 1983 with her first job out of university as an obstetrician and gynecologist in the Affiliated Hospital of the University. Under the influence and guidance of her predecessors, she expressed strong interests in maternal and children healthcare with a focus on the health of the larger population in the 1990s. In 1994, Wang pursued further studies in public health at the Centre for Environment and Population Health of Griffith University in Australia, where her knowledge in public health and technical skills in research became more in-depth and solid.

In 2002, she joined and created the National Center for Women and Children's Health of China CDC as the Deputy Director. During her tenure, Wang was engaged in conducting several studies and programs in women's health, reproductive health, and public health. Her research pursuits include but are not limited to the socioeconomic factors analysis of maternal mortality in rural China and its reduction, management of maternal health, and technical capacity training and control in high risk populations.

In 2002, Wang initiated a program for the prevention of mother-to-child transmission (PMTCT) of HIV in China. In this program, she served as the supervisor for a group of pioneers implementing prevention and control mechanisms by formulating policy and clinical treatment guidelines. She also led the group to create assessments of the effects of the intervention and cost-benefit evaluation in China. Wang also conducted a study for National Tenth Five-Year Plan of the Ministry of Science and Technology of China on the PMTCT of HIV transmission mechanism, which was a large-scale epidemiological survey of mother-to-child transmission of AIDS in China and required multidisciplinary research based on molecular virology, serology, and immunology to reveal the prevalence of maternal HIV/AIDS and the mother-to-child transmission mechanism. The results of this study have been used to tailor an approach to improving the system in China, which largely reduced the number of children infected with HIV/AIDS.

She has also been involved with the prevention of women's diseases, such as cervical cancer and breast cancer, with a focus on evaluating the effects of prevention and screening strategies. For instance, she has led the Chinese Breast Cancer Cohort Study (CBCCS) in the Precision Medical Research, which is one of the National Key Research and Development Programs. This study aimed to establish a standardized and sharable breast cancer-specific cohort to precisely identify etiology and to appropriately prevent and treat breast cancer, and this study has provided an open platform and reliable research database to improve the quality of follow ups by integrating existing resources.

As chronic diseases rose to wider public health concern, Wang shifted her academic focus to chronic and non-communicable diseases in 2011 when she joined the National Center for Chronic and Non-Communicable Disease Control and Prevention of China CDC as a Director. In this role, Wang led and joined a series of key projects in chronic diseases and NCDs including China's surveillance and monitoring of the main NCDs and their high risk behaviors, the comprehensive management of the main NCDs of diabetes and hypertension, geographical variation analysis, disease burden research, nationwide investigations on chronic obstructive pulmonary disease, osteoporosis, mental health, elderly health in China, injury prevention, etc.

As a member of national consultation committee of Chinese National Health Commission and many international agencies, Wang is involved in national policy, work-plan development, and technical guideline development for relevant programs for NCDs and community health.

Wang is a member of Academic Commission of China CDC. She was also appointed as an Adjunct Professor in the Centre for Environment and Population Health of Griffith University in Australia and the School of Public Health at Peking University in China. Wang also actively participates in various professional and academic associations including: member of the Chinese Preventive Medicine Association (CPMA); Chairperson of the Women's Health Care Branch of CPMA; member of the Expert Commission of Disease Control and Prevention of China's NHC; Chief of Branch of Non-Communicable Disease Big Data Alliance, Chinese Health Information, and Medical Big Data Association.

She has published over 300 academic theses in various international and domestic academic journals and has been awarded multiple times. She has also edited more than 30 scholarly monographs as the Chief Editor.

Her hands-on academic and administrative experience enables Wang to develop insightful views on full life cycle health by saying: "From maternal health, birth safety, child and adolescent protection, to reproductive age women's health care, menopausal and elderly people's health, on to chronic and non-communicable disease prevention and control, my career speaks volumes for full life cycle health". As China CDC's Chief Expert of Chronic and Non-Communicable Disease Control, Linhong Wang continues to lead the country's response to diseases affecting full life cycle health.

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Notifiable Infectious Diseases Reports

Reported Cases and Deaths of National Notifiable Infectious Diseases — China, July, 2020

Diseases	Cases	Deaths
Plague	1	0
Cholera	3	0
SARS-CoV	0	0
Acquired immune deficiency syndrome	6,124	1,700
Hepatitis	132,782	56
Hepatitis A	1,514	0
Hepatitis B	106,135	46
Hepatitis C	22,400	8
Hepatitis D	21	0
Hepatitis E	1,839	2
Other hepatitis	873	0
Poliomyelitis	0	0
Human infection with H5N1 virus	0	0
Measles	111	0
Epidemic hemorrhagic fever	503	4
Rabies	22	11
Japanese encephalitis	30	1
Dengue	23	0
Anthrax	17	0
Dysentery	7,943	0
Tuberculosis	83,101	146
Typhoid fever and paratyphoid fever	863	1
Meningococcal meningitis	4	0
Pertussis	131	0
Diphtheria	0	0
Neonatal tetanus	5	0
Scarlet fever	789	0
Brucellosis	6,437	0
Gonorrhea	10,621	1
Syphilis	50,386	6
Leptospirosis	23	1
Schistosomiasis	4	0
Malaria	54	0
Human infection with H7N9 virus	0	0
COVID-19*	803	0
Influenza	13,406	1
Mumps	10,583	0

Continued

Diseases	Cases	Deaths
Rubella	82	0
Acute hemorrhagic conjunctivitis	2,796	0
Leprosy	59	0
Typhus	127	0
Kala azar	22	0
Echinococcosis	397	0
Filariasis	0	0
Infectious diarrhea†	116,425	2
Hand, foot and mouth disease	26,778	0
Total	**471,455**	**1,930**

* 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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