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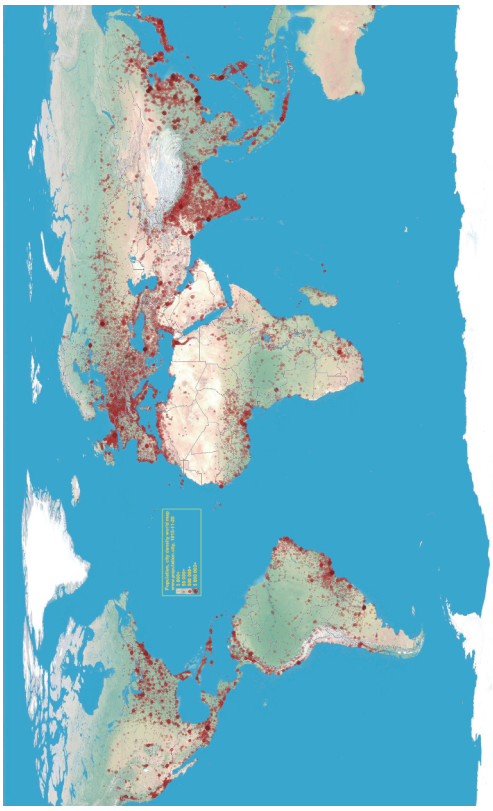

The 31th World Population Day, July 11, 2020

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Announcements

The 31st World Population Day — July 11, 2020

World Population Day (WPD) was established by the United Nations (UN) in 1989 and celebrated annually on July 11 (*1*). The aim of celebrating WPD is to overcome urgent and important population issues and to raise the awareness of the public. While many countries face challenges of rapid population growth, other countries such as China are experiencing a reduction in population size and facing the challenges of a falling proportion of working-age population, population ageing, urbanization, and population migration (*2*). Compared with 2017, China's total number of births has decreased by 2.58 million in 2019 (*3*), and the total population is projected to decrease by 31.4 million (2.2%) between 2019 and 2050 (*2*). Moreover, China is currently the only country in the world with an elderly population of more than 200 million, and the migrant population has reached 236 million in 2019 (*4*). The above population issues are closely interrelated with the 2030 Sustainable Development Goals (SDGs) put forth by the UN. Therefore, in order to achieve the world blueprint of sustainable development, we must understand and overcome these population issues.

The theme of the coming 31st WPD in 2020 will be "Putting the brakes on COVID-19: how to safeguard the health and rights of women and girls now" (*5*). This theme aims to raise awareness about the sexual and reproductive health needs and vulnerabilities of women and girls during the pandemic and to explore how to maintain the momentum towards achieving the SDGs by 2030.

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Preplanned Studies

Utilization Rate of Healthcare Service of the Elderly with Disabilities — China, 1987–2014

Chao Guo[1,2]; Jinghua Chang[2]; Xiaoying Zheng[1,2,#]; Linhong Wang[3,#]

Summary

What is already known about this topic?

In the context of rapid population ageing and over represented disabilities among the elderly, healthcare services for the elderly persons with disabilities are one of the most urgent and important population and public health issues. Previous studies indicated that the weighted prevalence rate of lifetime healthcare service use was 36.6% (95% CI: 35.6–37.5) among persons with disabilities aged 60 years and above in 2006.

What is added by this report?

We found that the lifetime utilization rate of auxiliary aids among elderly with disabilities increased significantly from 4.96% in 1987 to 9.07% in 2006 (p_{trend}<0.001), and the utilization rate of healthcare service in the last 12 months increased significantly from 18.6% in 2007 to 56.9% in 2014 (p_{trend}<0.001) among total elderly with disabilities.

What are the implications for public health practice?

The arduous achievement indicated the success of social, economic, and medical reforms as well as health equity improvement of China. However, more sound policies and action are needed to further reduce the unmet needs in healthcare services.

As the nation with the largest population, China has also been the country with the fastest aging speed. Providing healthcare services for the elderly persons with disabilities is one of the most urgent and important population and public health issues and also presents a major challenge for the government. Using data from the first and second China National Sample Survey on Disability (CNSSD) in 1987 and 2006, respectively, as well as the consecutive follow-up investigations once a year from 2007 to 2014, we investigated the healthcare service utilization among

China's elderly with disabilities from 1987 to 2014. Significant increases in the use of healthcare service were found, but the utilization rate in China was still lower than some high-income countries. These findings may provide information for further action and policymaking on healthcare service for the elderly, especially those living with disabilities.

The two CNSSDs were conducted to understand the prevalence, causes, and severity of various disabilities in the household population in the of mainland China. Nationally representative samples were derived by multistage, stratified random cluster sampling with probability proportional to size. The follow-up surveys aimed to investigate the living conditions, environment, and healthcare of people with disabilities in a sub-sample of those living with disabilities that were randomly selected from the second CNSSD. Standardized quality control systems including interviewer training and crosschecking of returned responses, and consistent approaches were conducted during the CNSSDs and the follow-up survey operations. More details about the surveys can be found in our previous work (*1*–*2*). For the purposes of this study, only survey respondents at and above 65 years-of-age were considered. A flowchart about the derivation of study samples was presented in a Supplementary File (Supplementary Figure S1 available in http://weekly.chinacdc.cn/).

In the surveys, disabilities referred to one or more abnormalities in anatomical structure or the loss of a particular organ or function, either physical or psychological, that affected a person's ability to carry out a normal activity and to participate fully in study, work, and community and social life (*1*). Healthcare service use in the surveys was self-reported by the respondents. In the two CNSSDs, the lifetime healthcare service use was investigated. In the 1987 survey, only the information of auxiliary aids use was investigated; in the 2006 survey, information of the rehabilitation therapy and training services use was available. In the follow-up surveys, healthcare service use was focused on the use during the past 12 months, and the health services widely involved rehabilitation therapy and training, auxiliary aids, medical diagnosis and needs assessment, psychological counseling, home service, day care and nursing, follow-up and evaluation service, rehabilitation knowledge education and so on.

In the 1987 and 2006 surveys, we constructed sample weights using standard weighting procedures allowing for complex sampling design to estimate the population weighted numbers and prevalence with 95% confidence intervals (CIs) of disability among the elderly. Population numbers and rate of healthcare service use in the utilization of healthcare service among the elderly with disabilities were calculated where appropriate. A chi-square test was used to determine the difference in utilization of healthcare service by age, sex, and residence. Wald tests of linear trend were used to determine differences in the utilization of rehabilitation services over the time series. STATA 13 (STATA Corp, College Station, TX, USA) was used for data analysis above. Annual percent change (APC) and average annual percent change (AAPC) with 95% CIs were calculated by Joinpoint Regression models with Joinpoint software (Depuy Orthopaedics Inc, IN, USA) among total elderly with disabilities and sub-population by age, sex, and residence. Details of the AAPC calculation method were shown in the supplementary file. A two-sided *p*-value of less than 0.05 was identified as statistically significant in all statistics of the present study.

In 1987, it was estimated that a weighted number of 16.87 million elderly were living with disability, accounting for 27.64% (95% CI: 27.34%–27.94%) of the total elderly aged 65 years old and above according to the first CNSSD, and the weighted number and proportion increased to 38.26 million and 29.42% (95% CI: 29.23%–29.61%) according to the second CNSSD, respectively. Considering the age structure of the elderly in the 2010 population census, the age-standardized prevalence of disability among elderly in 1987 and 2006 was 30.24% and 30.14%, respectively.

Table 1 presented the lifetime healthcare service use among the elderly with disabilities in 1987 and 2006. The utilization rate of auxiliary aids increased significantly from 4.96% in 1987 to 9.07% in 2006 (p_{trend}<0.001). The stratified analyses showed that the growth of auxiliary aids use was significant in the sub-population by age, sex, and residence (all p_{trend}<0.001). In addition, the utilization rate of auxiliary aids in 1987 was lower in older elderly aged 80 years old and above (3.57%), female elderly (4.00%), and rural elderly (4.96%); however, the difference between age group was not found in 2006 (all p_{trend}>0.05).

As shown in Table 2, the utilization rate of healthcare services during the last 12 months in elderly with disabilities increased significantly from 18.6% in 2007 to 56.9% in 2014 (p_{trend}<0.001), with a significant AAPC of 17.7% (95% CI: 9.3%–26.8%). The growth was also found in the sub-population by age, sex, and residence (all p_{trend}<0.001). A joinpoint was found in 2012 in the stratified analyses by sex and residence, i.e. the APC increased significantly during

TABLE 1. The lifetime healthcare service use of elderly with disabilities in China, 1987–2006.

Group	Elderly with disabilities (n)		Lifetime healthcare service use				
			Auxiliary aids (n, %)			Rehabilitation therapy (n, %)	Any healthcare service (n, %)
	1987	2006	1987	2006	p_{trend}	2006	2006
Total	24,682	72,401	1,224 (4.96)	6,570 (9.07)	<0.001	27,254 (37.64)	28,300 (39.09)
Age (years)							
65–79	19,245	53,345	1,030 (5.35)	4,803 (9.00)	<0.001	20,583 (38.58)	21,297 (39.92)
≥80	5,437	19,056	194 (3.57)	1,767 (9.27)	<0.001	6,671 (35.01)	7,003 (36.75)
p			<0.001	0.267		<0.001	<0.001
Sex							
Male	10,617	33,548	662 (6.24)	3,313 (9.88)	<0.001	12,547 (37.40)	13,115 (39.09)
Female	14,065	38,853	562 (4.00)	3,257 (8.38)	<0.001	14,707 (37.85)	15,185 (39.08)
p			<0.001	<0.001		0.210	0.978
Residence							
Urban	7,053	21,828	543 (7.70)	3,255 (14.91)	<0.001	11,030 (50.53)	11,414 (52.29)
Rural	17,629	50,573	681 (4.96)	3,315 (6.55)	<0.001	16,224 (32.08)	16,886 (33.39)
p			<0.001	<0.001		<0.001	<0.001

Note: Participants were categorized by age (young elderly aged 65–79 years or super elderly aged 80 years and above), sex (male or female), and residence (rural areas or urban areas).

2007 to 2012 and maintained a relatively stable level after 2012 without significant APC (Supplementary Table S1, available in http://weekly.chinacdc.cn/). Higher AAPCs were found in elderly aged 65–79 years old (18.0), female elderly (19.2), and rural elderly (23.1) when compared with their counterparts but not significant (all $p>0.05$).

DISCUSSION

Based on two large, representative population-based cross-sectional surveys covering all provincial-level administrative divisions (PLADs) of China, we found the number of the elderly with disabilities was rising in China. Since there was no significant change in the age-standardized prevalence between 1987 and 2006, the increase of number of the elderly with disabilities may be mainly caused by population aging. According to the latest statistics, there were 166.58 million elderly aged 65 years old and above in China in 2018, accounting for 11.9% of the total population (*3*–*4*). Therefore, the size of elderly with disabilities increased along with the number of the total elderly. Currently, the living population in the world was an estimated 7.8 billion in 2020, among which 9.3% were elderly aged 65 years and above (*5*). Global ageing had a major influence on the trend of global disability prevalence, which increased from 10% in the 1970s to 15% in the 2010s and continued to rise (*6*). By the 31st World Population Day, we need to focus on the wellbeing and healthcare services for the 725.4 million elderly (*3*), especially the elderly with disabilities in the ageing world.

This study found increases in healthcare service use among the elderly with disabilities for the first time. This is an important supplement to our previous research that reported that the weighted prevalence rate of lifetime healthcare service use among persons with disabilities aged 60 years old or more in 2006 (*7*). The increases found in this study were also consistent with previous studies in younger population including children and adolescents (*8*). These findings indicated the major progress China had achieved in providing healthcare for the elderly with disabilities in recent decades, especially after the reform and opening up. This achievement can be attributed to multi-sectoral efforts including increased access to medical resources and the improvement of medical insurance coverage following more than ten years of medical reform in China.

Additionally, the gap between different sub-populations in healthcare service use is narrowing. Specifically, the shortcomings in auxiliary aids use among the older elderly in 1987 were not found in 2006, and the average annual rise was higher in rural areas compared with urban areas but the rise was not significant. However, a gap in health service use remained between urban and rural areas, which may be caused by the low level of access to health resources in

TABLE 2. The healthcare service use during the last 12 months of elderly with disabilities in China, 2007–2014.

Group	Total	Age (years)		Sex		Residence	
		65–79	≥80	Male	Female	Urban	Rural
2007							
EWD, n	9,871	7,191	2,680	4,543	5,328	2,685	7,186
HSU, n (%)	1,832 (18.6)	1,356 (18.9)	476 (17.8)	853 (18.8)	979 (18.4)	810 (30.2)	1,022 (14.2)
2008							
EWD, n	9,211	6,580	2,631	4,255	4,956	2,514	6,697
HSU, n (%)	2,095 (22.7)	1,495 (22.7)	600 (22.8)	963 (22.6)	1,132 (22.8)	926 (36.8)	1,169 (17.5)
2009							
EWD, n	15,515	10,829	4,686	7,193	8,322	3,957	11,558
HSU, n (%)	3,462 (22.3)	2,417 (22.3)	1,045 (22.3)	1,639 (22.8)	1,823 (21.9)	1,410 (35.6)	2,052 (17.8)
2010							
EWD, n	14,474	9,907	4,567	6,696	7,778	3,685	10,789
HSU, n (%)	5,382 (37.2)	3,673 (37.1)	1,709 (37.4)	2,483 (37.1)	2,899 (37.3)	1,775 (48.2)	3,607 (33.4)
2011							
EWD, n	12,869	8,541	4,328	5,979	6,890	3,225	9,644
HSU, n (%)	6,091 (47.3)	3,979 (46.6)	2,112 (48.8)	2,810 (47.0)	3,281 (47.6)	1,833 (56.8)	4,258 (44.2)
2012							
EWD, n	11,979	7,873	4,106	5,568	6,411	3,237	8,742
HSU, n (%)	6,685 (55.8)	4,381 (55.6)	2,304 (56.1)	3,104 (55.7)	3,581 (55.9)	2,057 (63.5)	4,628 (52.9)
2013							
EWD, n	11,261	7,191	4,070	5,215	6,046	2,991	8,270
HSU, n (%)	6,647 (59.0)	4,271 (59.4)	2,376 (58.4)	3,092 (59.3)	3,555 (58.8)	1,950 (65.2)	4,697 (56.8)
2014							
EWD, n	10,439	6,624	3,815	4,848	5,591	2,716	7,723
HSU, n (%)	5,935 (56.9)	3,727 (56.3)	2,208 (57.9)	2,745 (56.6)	3,190 (57.1)	1,738 (64)	4,197 (54.3)
p_{trend}	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Abbreviation: EWD=elderly with disabilities; HSU=healthcare service use.

rural areas as well as health behaviors differences (*9*). More effort and strategies should be taken to improve the health resources, staffing, and education in rural areas.

There were still unmet needs for elderly with disabilities in healthcare service use and the total utilization rate was still lower than some high-income countries according to previous studies (*10*). The implementation of rehabilitation-related policies at the grass-roots level should be strengthened, better rehabilitation programs specialized for the elderly should be designed in rehabilitation institutions, and more residential/community-care should also be carried out for elderly with disabilities to improve their utilization.

This study was subject to several limitations. First, the healthcare service use was self-reported by the participants, so the results may be underestimated because of possible recall bias. Second, underestimates may also be caused by cases lost to follow up each year. Third, the elderly living in institutions such as hospitals were not represented in this community-based survey. In addition, the surveys could not cover all types of healthcare services, and we did not calculate the utilization by different types of disability, which should be explored in future studies.

In conclusion, this study showed increases with high AAPC of nationwide healthcare service use among the elderly with disabilities in China. However, more sound policies and actions are needed to in the new era to further to further narrow the gap in the healthcare service use among elderly with disabilities between China and high-income countries.

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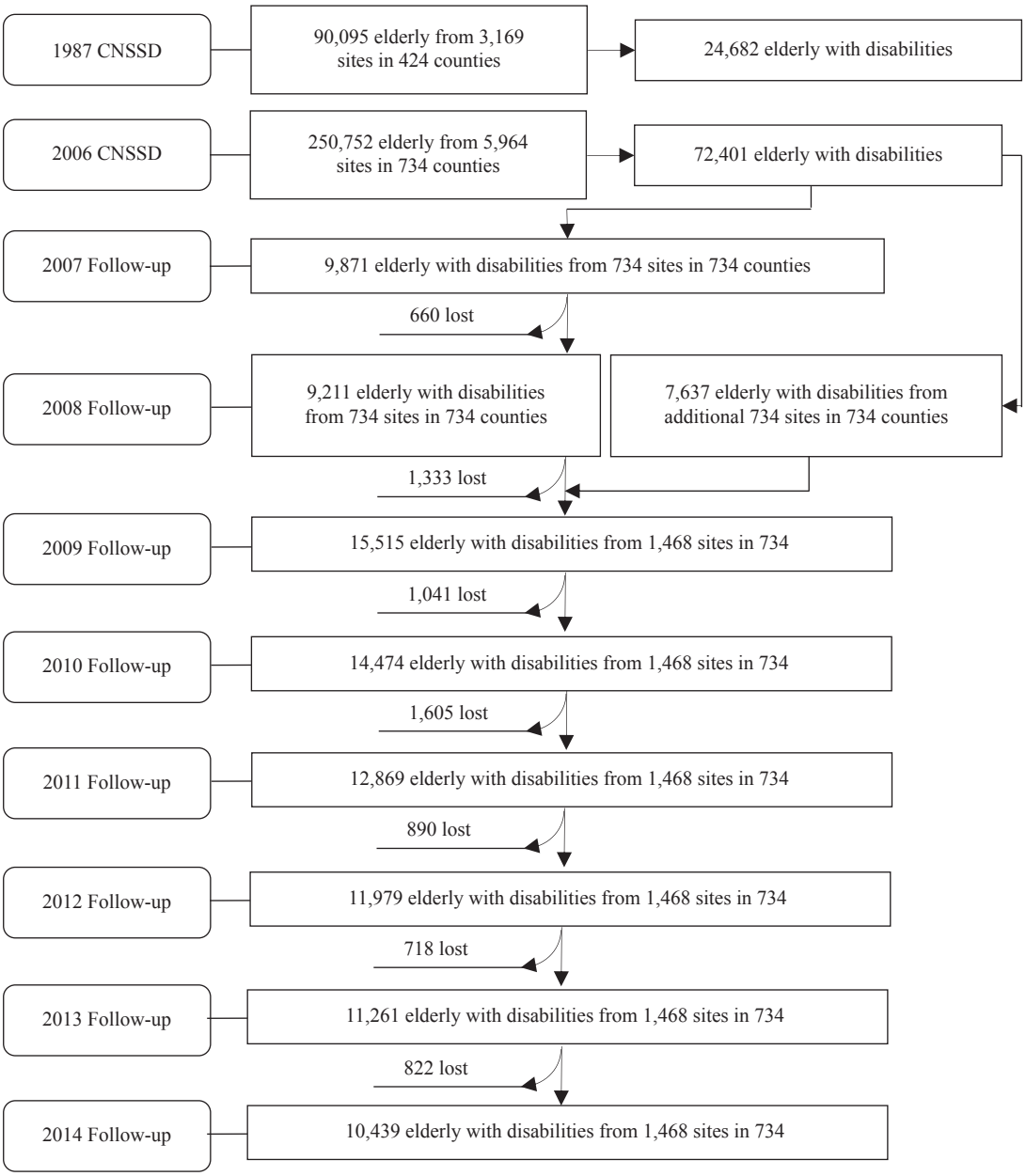
Supplementary information of data

We obtained data from the first and second China National Sample Survey on Disability (CNSSD) in 1987 and 2006, respectively, as well as consecutive follow-up investigations once a year from 2007 to 2014.

The two CNSSDs were conducted to understand the prevalence, causes, and severity of various disabilities in the non-institutional population in the mainland of China. Nationally representative samples were derived by multistage, stratified random cluster sampling, with probability proportional to size. Finally, the survey in 1987 comprised a total of 3,169 sites from 424 counties; the survey in 2006 comprised 5,964 sites from 734 counties. The final sample sizes were 1,579,316 and 2,526,145 in the first and second CNSSDs, representing 1.5 and 1.9 per 1,000 Chinese non-institutionalized residents, respectively. For the purposes of our study, we considered only survey respondents ≥65 years-of-age, yielding a sample size of 90,095 cases in 1987 and 250,752 cases in 2006, respectively. There were 24,682 and 72,401 with disability among the elderly cases in 1987 and 2006, respectively.



SUPPLEMENTARY FIGURE S1. Flowchart of the derivation of study sample in China, 1987–2014.

SUPPLEMENTARY TABLE S1. The average annual percent change in utilization rate of healthcare service of elderly with disabilities in China, 2007–2014.

Group	APC				AAPC			
	Joinpoints	Segment	APC	95% CI	AAPC	95% CI	AAPC Diff.	95% CI
Total	0	2007−2014	17.7*	9.3–26.8	17.7*	9.3–26.8		
Age (years)							0.9	−9.1–11.0
65−79	0	2007−2014	18.0*	9.7–27.0	18.0*	9.7–27.0		
≥80	0	2007−2014	17.1*	8.3–26.6	17.1*	8.3–26.6		
Sex							−0.2	−14.7–14.3
Male	1	2007−2012	27.5*	12.0–45.2	19.0*	9.8–29.0		
		2012−2004	0.0	−27.6–38.2				
		p for segment	0.022					
Female	1	2007−2012	27.9*	10.4–48.1	19.2*	8.8–30.5		
		2012−2014	−0.1	−30.8–44.0				
		p for segment	0.032					
Residence							−11.3	−25.1–2.5
Urban	1	2007−2012	17.0*	7.5–27.3	11.8*	5.7–18.3		
		2012−2004	−0.1	−21.7–27.1				
		p for segment	0.025					
Rural	1	2007−2012	34.1*	13.5–58.4	23.1*	11.5–36.0		
		2012−2014	−0.5	−32.2–46.0				
		p for segment	0.023					

Abbreviation: APC=annual percent change; AAPC=average annual percent change; AAPC Diff.=average annual percent change difference between sub-population.
*p<0.05.

Follow-up surveys aimed to investigate the living conditions, environment, and healthcare of people with disabilities in a sub-sample of those with disability randomly selected from the second CNSSD. In 2007 and 2008, the follow-up samples included all diagnosed individuals with disability from 734 study sites which were randomly selected from the 734 counties in 2006, 1 site for each county. From 2009 to 2014, an additional site was added in each county, leading to a sample of 1,468 sites in 734 counties. The final size of elderly with disabilities that were followed up from 2007 to 2014 was 9,871, 9,211, 15,515, 14,474, 12,869, 11,979, 11,261, and 10,439, respectively.

The method of APC and AAPC calculation

Annual percent change (APC) and average annual percent change (AAPC) with 95% CIs were calculated by Joinpoint Regression models with Joinpoint software (*1*) among total elderly with disabilities and sub-population by age, sex, and residence (*2–3*).

Let u_i denote the utilization rate of healthcare service at time t_i. Assume that $\log(u_i)$ is nonlinear over the entire time interval [a, b] but follows the segmented linear regression model below:

$$\log(u_i) = \begin{cases} \beta_{1,0} + \beta_{1t_i} & if\ a \le t_i \le \tau_1 \\ \beta_{2,0} + \beta_{2t_i} & if\ \tau_1 \le t_i \le \tau_2 \\ \vdots & \\ \beta_{j+1,0} + \beta_{j+1t_i} & if\ \tau_j \le t_i \le b \end{cases} \quad (1)$$

Where j is the number of joinpoints and we have $j+1$ segments as well. The APC for the segment $(\tau_{k-1}, \tau_k]$ is defined as

$$APC = \{exp(\beta_k) - 1\} \times 100 \quad (2)$$

Denote $w_k = (\tau_k - \tau_{k-1}) / (b - a)$, $k=1, \ldots, j+1$, and the AAPC over the entire time interval [a, b] is defined as

$$AAPC = \left\{ exp\left(\sum_{k=1}^{j+1} w_k \beta_k \right) - 1 \right\} \times 100 \quad (3)$$

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Preplanned Studies

Trends and Challenges for Population Health and Migration — China, 2015–2050

Yanan Luo[1,2]; Chao Guo[1,2]; Yiran Wang[1,2]; Xiaoying Zheng[1,2,#]

Summary

What is already known about this topic?

Along with the quick change of society and health transformation, as well as the continued expansion of urbanization, the health risk and its variation of migrants in China would became more complicated.

What is added by this report?

Although a decreasing net migration flow trend was presented from 2015 to 2050, an increasing pace of aging and younger-age trend of migrants would pose serious challenges for population health in China. Deepening aging trend of migrants contributes to the increment of the disease burden of non-communicable diseases (NCDs) and disabilities, and the upward trend of young-age migrant patients with infectious diseases remain a threat to the future intervention and prevention of infectious diseases.

What are the implications for public health practice?

Health policies to eliminate the adverse effects of migration on population health should pay more attention to meet the health care demands of highly vulnerable migrant populations, such as very older and very young migrants.

Migration has been one of the most important drivers of socioeconomic progress. However, owing to their unfavorable socioeconomic conditions and barriers to resources, migrants often become the vulnerable and marginalized group at high risk of health problems in China (*1*). Along with the quick change of society and health transition, as well as the continued expansion of urbanization, the health risk and its variation of migrants in China would became more complicated. To better understand the future trend and population health challenges of migrants are essential for strengthening the health system. Based on Sample Census in 2015 and second hand data, this study used Population-Development-Environment (PDE) model and epidemiological calculations to present a glimpse into the future trend and population health of migrants. An increasing pace of aging and younger-age trend in migrants poses serious challenges for population health. To meet the health care demands of highly vulnerable migrants are needed for eliminating the adverse effects of migration on population health.

2015 Sample Census used in this study was implemented by National Bureau of Statistics, which provided the most detailed data on population and covered 31 provinces in China. Second hand health data was mainly from Global Health Data Exchange, the prediction results based on Second National Sample Survey on Disability and previous publications (*2*–*3*). PDE model and epidemiological calculations were used to predict the trends of migrants and the population health status in 2015–2050, respectively. The mathematical expressions of PDE are as following:

$$P_{(t+1,n+1)}=P_{(t,n)}\times\left(1-D_{(t+1,n+1)}\right)+N_{(t+1,n+1)} \quad (1)$$

$$P_{(0,n+1)}=\sum_{i=15}^{49}\left[F_{(t,n+1)}\times FR_{(t,n+1)}\right]\times\left(1-D_{(0,n+1)}\right) \quad (2)$$

$$F_{(0,n+1)}=P_{(0,n+1)}\times fr_{n+1} \quad (3)$$

$$PT_{n+1}=\sum_{i=1}^{m}P_{(t,n)}+P_{(0,n+1)} \quad (4)$$

where, t, n, P, D, and N represent the age, year, population, mortality rate and net migration flow, respectively. F, FR, and fr represent the number of women, the fertility rate for specific age groups and the proportion of women with the newborn population, respectively. PT and m represent the total population and the highest age of the population, respectively. More details could be found in Supplementary Figure S1 (available in http://weekly.chinacdc.cn/) and previous study (*4*).

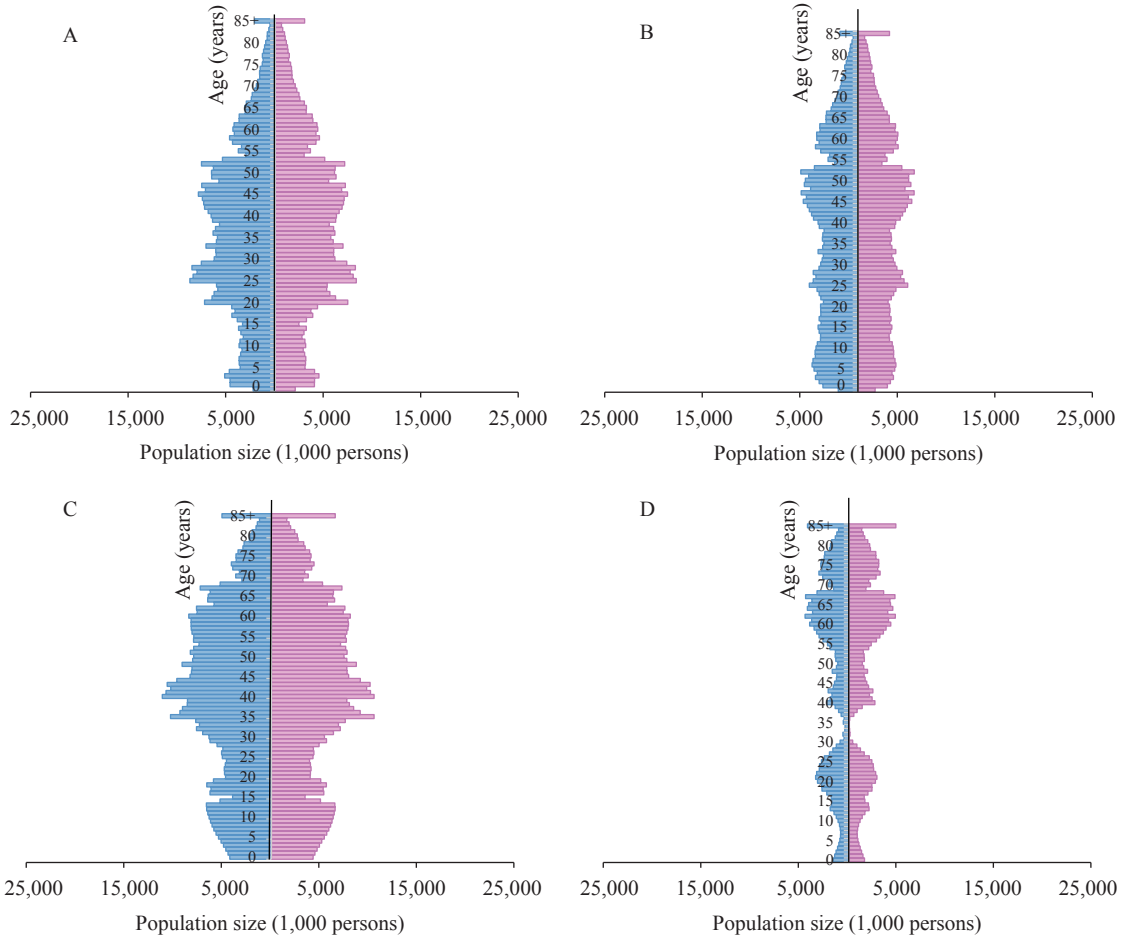
PDE model was based on different scenarios assumptions, and the predictive parameters of scenario assumptions include total fertility rate (TFR), life expectancy (LE) and urbanization rate (UR). TFR in 2015–2017 was set up based on National Fertility Intention Survey, and was assumed to decline since 2017 and reached 1.60 in 2018–2050. According to

the Outline of Healthy China 2030 Plan, LE in 2020 was assumed to be 77 years old and 80 years old in 2030. By 2050, LE would reach to 85 years old according to China's General Program for Sustainable Development. UR in 2020 was set up to be 60% according to the National New Urbanization Plan (2014–2020), and would be around 70% in 2030 and around 80% in 2050 based on the experts' judgements (*5*–*7*). More details could be found in Supplementary Tables S1-S3, available in http://weekly.chinacdc.cn/.

PDE results showed that China was facing rapid aging in future. Although two-child policy may make contribution to raising fertility levels which alleviated aging progress to some extent, the aging trend would be irreversible. Moreover, higher aging progress of rural population was found due to rural-urban population mobility (Figure 1).

A gradual downward trend of net migration flow was found in China from 2015 to 2050, which was similar to our previous prediction work by using 2000 and 2010 census. Net migrant flow would be reached 22.57 million by 2030, and 17.57 million by 2050. Although migrants showed a decreasing trend in the future, the huge population size of migrants may slow down the improvement of health level. From 2015 to 2050, both proportion and scale of older net migrants aged 60 years old and above showed upward trends. Moreover, younger-age trend was found in net migrants of China. The proportion of children aged 0–15 years old would increase and reach the peak number in 2025–2029 and then began to fall (Figure 2).

The upward tendency of older net migrants and the younger-age trend may play the negative role in population health of China. The deepening aging trend of net migrants would contribute to the increment of the disease burden of non-communicable diseases (NCDs) and disabilities. NCDs causing Disability Adjusted of Life Years (DALY) presented an increasing tendency from 2015–2050. Meanwhile, the scale of older migrants with NCDs also showed a trend of increase. Further, from 2015–2050, the prevalence of disabilities (unadjusted prevalence) would keep increasing which may be as the result of population aging, and the ascending of aging in migrants may aggravate the conditions of disabilities in China.



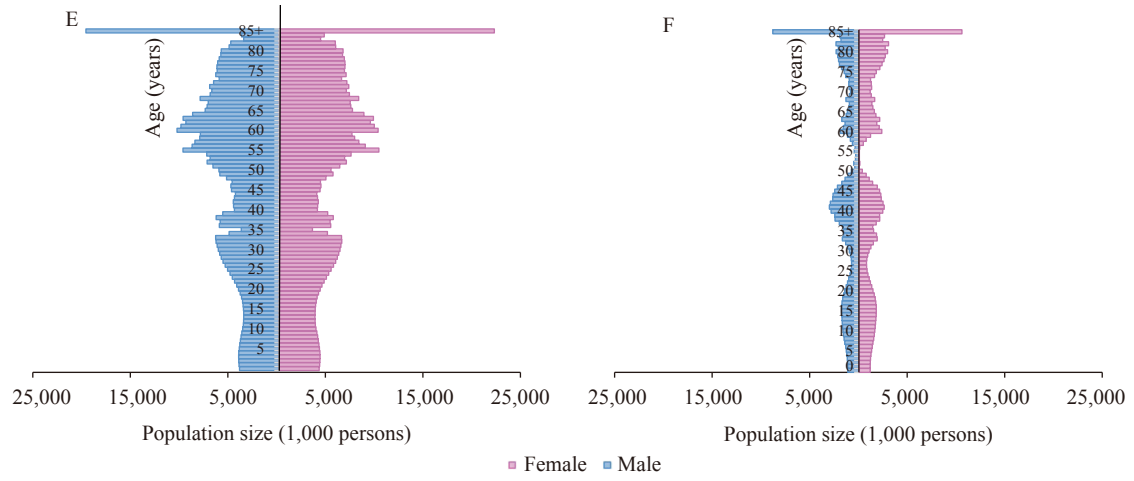


FIGURE 1. Population-Development-Environment prediction results of population pyramids by urban and rural, China 2015–2050. (A) Population Pyramid in urban, 2015; (B) Population Pyramid in rural, 2015; (C) Population Pyramid in urban, 2030; (D) Population Pyramid in rural, 2030; (E) Population Pyramid in urban, 2050; (F) Population Pyramid in rural, 2050.

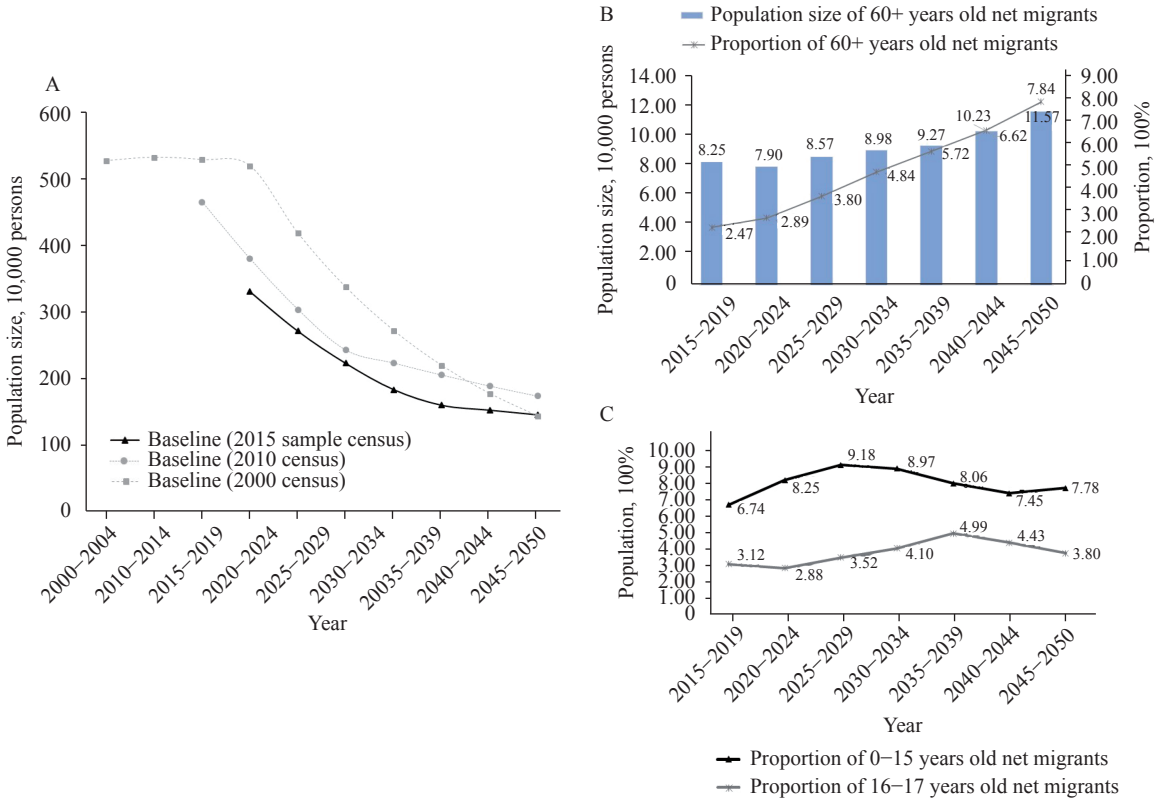


FIGURE 2. The predicted trends of net migration flow, China 2015–2050. (A) Total net migration flow, China 2015–2050; (B) Net migration flow aged 60+ years old, China 2015–2050; (C) Net migration flow aged 0–17 years old, China 2015–2050.

Additionally, although DALY related to communicable, maternal, neonatal, and nutritional diseases would decrease from 2015–2050, the upward trend of migrants aged 0–15 years old with infectious diseases would increase the pressure of infectious diseases intervention and prevention (Figure 3).

DISCUSSION

This study presented the future trend of migrants in China and also showed the possible effect of the change of migrant population structure on population health from 2015–2050 in China. Although a

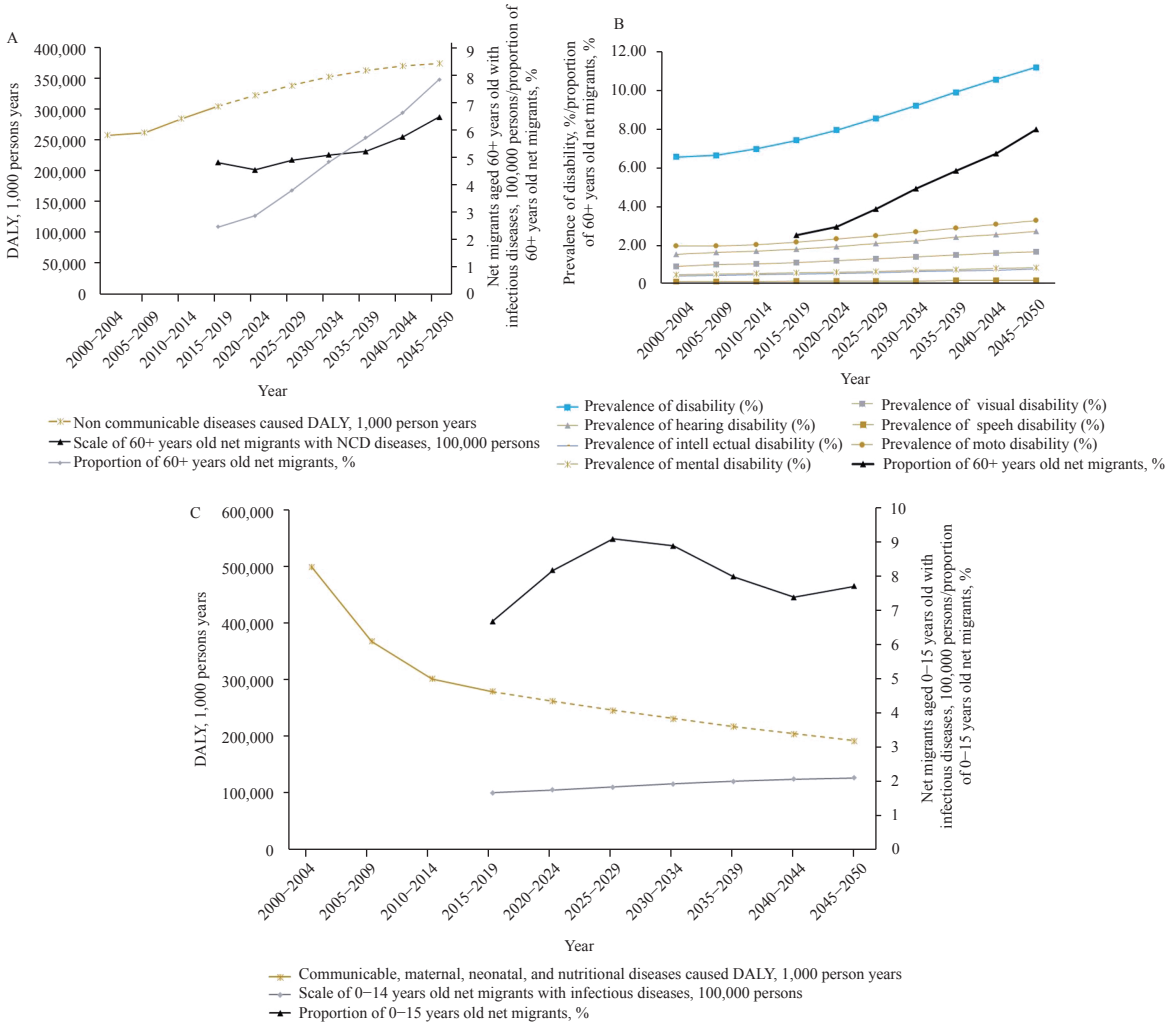


FIGURE 3. The predicted trend of net migration flow and population health conditions, China 2015–2050. (A) The trend of non-communicable diseases (NCDs) among 60+ years old net migrants and NCDs caused Disability Adjusted of Life Years (DALY), China 2015–2050; (B) The trend of 60+ years old net migrants and disabilities, China 2015–2050; (C) The trend of communicable diseases among 0–15 years old net migrants and communicable, maternal, neonatal, and nutritional diseases caused DALY, China 2015–2050.

decreasing net migration flow trend was presented from 2015 to 2050, an increasing pace of aging and younger-age trend of migrants would pose serious challenges for population health in China.

In this study, the proportion and the number of older migrants presented the upward trends from 2015 to 2050, although a decreasing trend among net migrants was found. These results were similar to previous study (*8*). Compared with working ages migrants and local residents, older migrants with weak health awareness, low health literacy, insufficient awareness of chronic disease prevention, and lack of *Hukou* registration protections and the absence of continuous health care, are particularly vulnerable to inadequate health care and in poor health conditions (*9*). Increasing trend of the number of older migrants with NCDs contributed to the increment of NCDs related disease burden and disabilities in China. The barriers to receive local healthcare and the problems of functional decline in older migrants put them into a dual NCDs burden.

An upward trend of infectious diseases among migrant children was found in this study, although our governments get progress from infectious diseases control. Migrant children are lack of adequate critical and routine health services, and have less extensive immunization coverage than their non-migrant counterparts, which lead them into the higher risk of contracting infectious diseases. Little awareness of immunization among parents, unaffordable of the inoculation expenses and frequent job-related changes of residence were the important drivers of low

immunization coverage among migrant children (*10*). Moreover, migrant children are more vulnerable to be exposed to pathogens and diseases related to unfavorable living environments as helminths and tuberculosis, which subsequently increase their risk of infectious diseases (*10*).

Health policies to eliminate the adverse effects of migration on population health should pay more attention to meet the health care demands of highly vulnerable migrant populations, such as very older and very young migrants. Healthcare policy makers should accelerate the progress to achieve the role of universal health coverage, and improve the coverage of affordable health services to migrants irrespective of *Hukou* status. To promote population health among those vulnerable migrants, improving the continuity of health care and health literacy training are also very useful. Strengthening health information systems, such as electronic medical record keeping, can improve health care continuity. Enhancing the coverage of health literacy education can help individuals to improve understanding and responses to NCDs and infectious diseases and make appropriate health decisions. To deal with the challenge of migrants aging and the growing burden of NCDs, the continuity and integration in the chronic care management of older migrants will be essential to improve the outcomes of population health. Additionally, infectious diseases still remain a threat and require continuous efforts to be kept under control especially in migrant children. Enlarging the vaccination coverage and improving health monitoring system are needed to reduce the infectious-disease transmission. Further, improving the living environment and sanitary conditions of the migrants are essential for infectious diseases prevention.

This study existed some limitations. For example, the results should be interpreted with caution, because the net migration flow in this study could not fully represent the status of migration. Due to the restriction of materials and models were used, this study could not predict the rural-urban and urban-urban migration flow. In the future, more studies should be taken to fix these issues.

In conclusion, our prediction found the increasing pace of aging and younger-age trend of migrants in China, which exacerbate the complexity of population health in the future. The deepening aging trend of net migrants contributes to the increment of the disease burden of NCDs and disabilities. The upward trend of young-age migrant patients with infectious diseases remain a threat to the future intervention and prevention of infectious diseases. Future health action plan on migrants should be more concerned about the health impact from the upward trend of young-age and the deepening aging trend of migrants.

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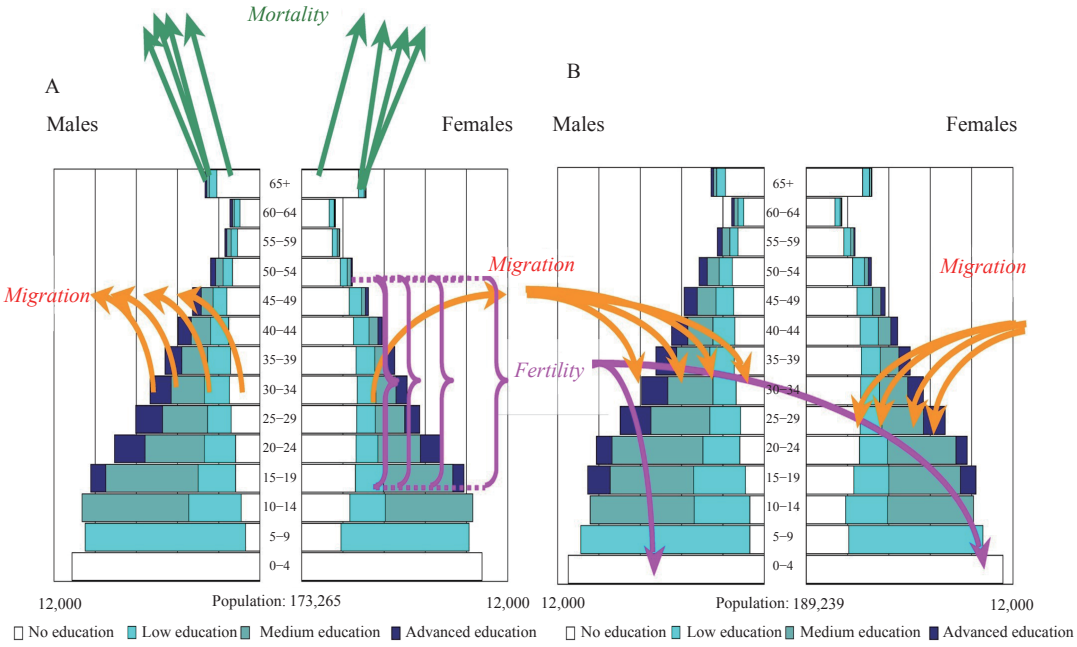

SUPPLEMENTARY FIGURE S1. The principle of Population-Development-Environment model. (A) Population by age, sex, and education, 2000; (B) Population by age, sex, and education, 2005.

SUPPLEMENTARY TABLE S1. Population-Development-Environment model predicative parameters assumption: total fertility rate (TFR) in China, 2015–2050.

Year	TFR in total	TFR in rural	TFR in urban
2015	1.41	1.69	1.16
2016	1.77	2.05	1.54
2017	1.72	2.00	1.53
2018–2050	1.60	2.00	1.42

SUPPLEMENTARY TABLE S2. Population-Development-Environment model predicative parameters assumption: life expectancy (LE) in China, 2015–2050.

Year	Rural, years		Urban, years	
	Male	Female	Male	Female
2015	75.83	80.49	80.31	83.85
2020	76.41	80.92	80.79	84.20
2025	76.98	81.34	81.27	84.55
2030	77.54	81.76	81.74	84.89
2035	78.10	82.16	82.20	85.23
2040	78.66	82.56	82.67	85.57
2045	79.20	82.96	83.13	85.90
2050	79.75	83.35	83.58	86.22

SUPPLEMENTARY TABLE S3. Population-Development-Environment model predicative parameters assumption: urbanization rate in China, 2015–2050.

Year	Urbanization Rate, %
2015	56.10
2016	57.35
2017	58.52
2018	59.58
2020	60.00
2030	68.38
2040	75.37
2050	81.63

Preplanned Studies

The Health Status of 50–70 Years Old Women in Some Areas — China, 2018

Bo Song[1,&]; Gengli Zhao[2,&]; Jiangli Di[1,#]; Yu Ma[1]; Linhong Wang[3,#]

Summary

What is already known about this topic?

After menopause, women are prone to chronic diseases such as cardiovascular disease, diabetes and osteoporosis and gynecological diseases such as pelvic floor dysfunction and reproductive tract infection.

What is added by this report?

The prevalence of hypertension, diabetes, cardiovascular disease and osteoporosis increased with age, while the prevalence of vaginitis and cervicitis decreased with the increase of age. The proportions of women aged 50–70 years old suffering from chronic and gynecological diseases in western and rural areas were significantly higher than those in eastern, central and urban areas.

What are the implications for public health practice?

It is necessary to take targeted intervention measures in the western region and rural areas, in order to narrow the gap in health of menopausal and older women between different areas of China.

The number of women over the age of 50 in China is estimated to increase to more than 280 million by 2030 (*1*). With an increase in age, the mortality rate of people aged 50 and above in China is rising rapidly, and the prevalence of chronic diseases in middle-aged and older people (45 years old and above) is much higher than that in other age groups (*2*). With the aging of the population, the health of menopausal and older women has become prioritized. The purpose of this study is to investigate the health status of menopausal and older women in different areas of China through a survey of women aged 50–70 years to provide a scientific basis for promoting the health of women. A cross-sectional survey involving 5,049 women aged 50–70 years was conducted across eastern, central, and western China. The main result of this study showed that the health problems of menopausal and older women in the western region and rural areas were more prominent. Taking effective measures is necessary to narrow the gap in health between different age groups of women and different regions.

This study was a survey of women aged 50–70 years in the National Survey of Women's Health conducted in 2018. The national survey was conducted to represent the three socioeconomic regions of China: eastern (Jiangsu and Shandong provinces), central (Hunan and Anhui provinces), and Western (Shaanxi and Sichuan provinces). In each province, one urban and one rural area were selected as investigation sites. A total of 5,049 women aged 50–70 years were selected by multistage stratified random cluster sampling and completed face-to-face interview questionnaires in the national survey. This study analyzed the relevant survey results of women aged 50–70 years. The reported chronic diseases and gynecological diseases in this study were required to be diagnosed by secondary hospitals or above.

The average age of the respondents was 58.94±6.195 years. Among the respondents, 1,703 (33.7%) came from the eastern region, 1,667 (33.0%) from the central region, and 1,679 (33.3%) from the western region. Most respondents (85.5%) were married, and 11.7% were widowed. The main occupation of the cohort was farming, accounting for 55.2%, followed by retirees, accounting for 17.1%. Most of the participants (55.0%) had only a primary school education or were illiterate, followed by those who had junior and senior high school educations, accounting for 42.0%. Only 3.0% had junior college degrees or higher. The majority (89.9%) of the women were postmenopausal.

Among the 5,049 women, 55.1% (95% CI: 53.7%–56.5%) reported that they had chronic diseases diagnosed by the hospital. The proportions of women suffering from chronic diseases in the western region (58.5%, 95% CI: 56.2%–60.9%) and rural areas (57.8%, 95% CI: 55.9%–59.7%) were higher than that in the eastern (51.8%, 95% CI: 49.4%–54.2%), central (55.0%, 95% CI: 52.6%–57.4%), and urban areas (52.5%, 95% CI: 50.5%–54.4%). There were differences between different regions and areas

(p<0.001). The proportion of self-reported overweight and obesity was the highest (46.5%, 95% CI: 45.0%–47.9%). The prevalence of overweight and obesity among women in the eastern region (55.8%, 95% CI: 53.3%–58.2%) was significantly higher than the western (45.4%, 95% CI: 42.7%–48.0%) and central regions (37.8%, 95% CI: 35.4%–40.3%) (p<0.001). The prevalence of cardiovascular disease (11.9%, 95% CI: 10.4%–13.5%), osteoporosis (10.9%, 95% CI: 9.4%–12.4%), and kidney disease (2.6%, 95% CI: 1.9%–3.4%) among women in the western region were significantly higher than those in the eastern and central regions (p<0.005). The prevalence of osteoarthrosis (15.0%, 95% CI: 13.6%–16.4%) in rural women was higher than that of urban women (11.4%, 95% CI: 10.1%–12.6%). However, the prevalence of osteoporosis (9.8%, 95% CI: 8.6%–11.0%), oral disease (2.6%, 95% CI: 2.0%–3.2%), and thyroid disease (1.6%, 95% CI: 1.1%–2.1%) in urban women were higher than those in rural women (5.7%, 95% CI: 4.8%–6.6%, 1.3%, 95% CI: 0.9%–1.8%, and 0.8%, 95% CI: 0.4%–1.1%, respectively)(p<0.01)(Table 1).

Of the participating women, 39.6% (95% CI: 38.3%–40.9%) reported that they had gynecological diseases diagnosed by the hospital. The proportion of women suffering from gynecological diseases in the central (42.6%, 95% CI: 40.2%–45.0%), western (42.7%, 95% CI: 40.3%–45.1%), and rural areas (42.2%, 95% CI: 40.3%–44.1%) was higher than that in the eastern (33.6%, 95% CI: 38.3%–40.9%) and urban areas (37%, 95% CI: 35.1%–38.9%) (p<0.001)(Table 2).

Among the self-reported gynecological diseases, the prevalence of vaginitis was the highest (24.4%, 95% CI: 23.2%–25.6%). The prevalence of vaginitis (29.4%, 95% CI: 27.2%–31.5%) and pelvic inflammation (9.2%, 95% CI: 7.8%–10.6%) in the western region were significantly higher than those in the eastern region (p<0.001). The prevalence of urinary incontinence in the central region (14.6%, 95% CI: 12.9%–16.3%) was significantly higher than that in the eastern region (6.3%, 95% CI: 5.1%–7.4%) (p<0.001). The prevalence of benign tumors in the eastern region (12.0%, 95% CI: 10.5%–13.6%) was significantly higher than that in the western region (8.9%, 95% CI: 7.6%–10.3%) (p<0.001). The prevalence of vaginitis (29.0%, 95% CI: 27.2%–30.7%) and cervicitis (13.7%, 95% CI: 12.3%–15.0%) in rural women were significantly higher than those in urban women (19.8%, 95% CI: 18.3%–21.4% and 10.2%, 95% CI: 9.0%–11.4%, respectively)(p<0.001)(Table 2).

The prevalence of hypertension, diabetes, cardiovascular disease, osteoporosis, and urinary incontinence increased with age, and there were significant differences among different age groups (p<0.001). The prevalence of vaginitis, cervicitis and gynecological benign tumor was the highest in the age group of 50–54 years old. The prevalence of vaginitis and cervicitis decreased with increasing age, and there were significant differences among different age groups (p<0.001)(Table 3).

DISCUSSION

Chronic non-communicable diseases in menopausal and older women seriously affected their health. The literature showed that the prevalences of hypertension, diabetes, hyperlipidemia, and cardiovascular disease in women over 50 years old were significantly higher than those below 50 years old, and the risk of cardiovascular and cerebrovascular diseases was close to or even higher than that in men in a short period of time (*3*–*4*). In this study, the proportion of women aged 50–70 years old with chronic diseases was 55.1%. Overweight and obesity (46.5%), hypertension (28.5%), osteoarthrosis (13.2%), diabetes (10.2%), cardiovascular disease (9.8%), and osteoporosis (7.8%) were major health problems for menopausal and older women. Moreover, the prevalence of chronic diseases increased gradually with age. The prevalence of chronic diseases in the age group of 50–54 years old was 46.3%, and it had increased to 68.2% in 65–70 age group. However, the prevalence was lower than the results of China's Fifth National Health Service Survey in 2013 (the prevalence of chronic disease in women aged 55–64 years old was 57.0% and that in women aged 65 or above was 82.9%) (*5*). The reason may be related to the strengthening of health management of the elderly in recent years, increased availability of free physical examinations, and the awareness of the healthy lifestyle of older women. Therefore, in order to improve the health of the elderly, the health management of the elderly should be further strengthened and their health awareness should be improved.

The prevalence of gynecological diseases in menopausal women was higher. This study found that 39.6% of the women were diagnosed with gynecological diseases, and the proportion of gynecological diseases in the 50–54 age group was the highest (47.9%). Most of them were reproductive tract

TABLE 1. Comparison of the prevalence of self-reported chronic diseases among women aged 50–70 years old by regions and area type, 2018, China.

Chronic diseases	Total N (%, 95% CI)	Regions					Area Type			
		Eastern N (%, 95% CI)	Central N (%, 95% CI)	Western N (%, 95% CI)	χ^2	*p*	Urban N (%, 95% CI)	Rural N (%, 95% CI)	χ^2	*p*
Having one or more chronic diseases	2,783 (55.1, 53.7−56.5)	883 (51.8, 49.4−54.2)	917 (55.0, 52.6−57.4)	983 (58.5, 56.2−60.9)	15.341	0.000	1,324 (52.5, 50.5−54.4)	1,459 (57.8, 55.9−59.7)	14.236	0.000
Overweight and obesity	2,047 (46.5, 45.0−47.9)	870 (55.8, 53.3−58.2)	571 (37.8, 35.4−40.3)	606 (45.4, 42.7−48.0)	111.642	0.000	1,115 (46.0, 44.0−47.9)	932 (47.1, 44.9−49.3)	3.353	0.187
Hypertension	1437 (28.5, 27.2−29.7)	479 (28.1, 26.0−30.3)	509 (30.5, 28.3−32.7)	449 (26.7, 24.6−28.9)	6.048	0.049	699 (27.7, 26.0−29.5)	738 (29.2, 27.4−31.0)	1.415	0.234
Osteoarthrosis	665 (13.2, 12.2−14.1)	196 (11.5, 10.0−13.0)	213 (12.8, 11.2−14.4)	256 (15.2, 13.5−17.0)	10.667	0.005	287 (11.4, 10.1−12.6)	378 (15.0, 13.6−16.4)	14.217	0.000
Diabetes	517 (10.2, 9.4−11.1)	183 (10.7, 9.3−12.2)	189 (11.3, 9.8−12.9)	145 (8.6, 7.3−10.0)	7.359	0.025	244 (9.7, 8.5−10.8)	273 (10.8, 9.6−12.0)	1.774	0.183
Cardiovascular diseases	496 (9.8, 9.0−10.6)	151 (8.9, 7.5−10.2)	145 (8.7, 7.3−10.1)	200 (11.9, 10.4−13.5)	12.408	0.002	250 (9.9, 8.7−11.1)	246 (9.7, 8.6−10.9)	0.041	0.839
Osteoporosis	392 (7.8, 7.0−8.5)	72 (4.2, 3.3−5.2)	137 (8.2, 6.9−9.3)	183 (10.9, 9.4−12.4)	53.266	0.000	247 (9.8, 8.6−11.0)	145 (5.7, 4.8−6.6)	28.906	0.000
Oral diseases	99 (2.0, 1.6−2.3)	16 (0.9, 0.5−1.4)	42 (2.5, 1.8−3.3)	41 (2.4, 1.7−3.2)	13.969	0.001	65 (2.6, 2.0−3.2)	34 (1.3, 0.9−1.8)	9.939	0.000
Kidney disease	75 (1.5, 1.2−1.8)	14 (0.8, 0.4−1.3)	17 (1.0, 0.5−1.5)	44 (2.6, 1.9−3.4)	22.376	0.000	36 (1.4, 1.0−1.9)	39 (1.5, 1.1−2.0)	0.118	0.731
Thyroid disease	60 (1.2, 0.9−1.5)	22 (1.3, 0.8−1.8)	21 (1.3, 0.7−1.8)	17 (1.0, 0.5−1.5)	0.670	0.715	40 (1.6, 1.1−2.1)	20 (0.8, 0.4−1.1)	6.771	0.009

TABLE 2. Comparison of the prevalence of self-reported gynecological diseases among women aged 50–70 years old by regions and area type, 2018, China

Gynecological diseases	Total N (%, 95% CI)	Regions					Area Type			
		Eastern N (%, 95% CI)	Central N (%, 95% CI)	Western N (%, 95% CI)	χ^2	*p*	Urban N (%, 95% CI)	Rural N (%, 95% CI)	χ^2	*p*
Having one or more gynecological disease	1,999 (39.6, 38.3−40.9)	572 (33.6, 31.4−5.9)	710 (42.6, 40.2−45.0)	717 (42.7, 40.3−45.1)	38.739	0.000	933 (37.0, 35.1−38.9)	1,066 (42.2, 40.3−44.1)	14.388	0.000
Vaginitis	1,232 (24.4, 23.2−25.6)	299 (17.6, 15.7−19.4)	440 (26.4, 24.3−28.5)	493 (29.4, 27.2−31.5)	69.239	0.000	500 (19.8, 18.3−21.4)	732 (29.0, 27.2−30.7)	57.425	0.000
Cervicitis	602 (11.9, 11.0−12.8)	123 (7.2, 6.0−8.5)	277 (16.6, 14.8−18.4)	202 (12.0, 10.5−13.6)	70.819	0.000	257 (10.2, 9.0−11.4)	345 (13.7, 12.3−15.0)	14.487	0.000
Pelvic inflammation	361 (7.1, 6.4−7.9)	73 (4.3, 3.3−5.2)	134 (8.0, 6.7−9.3)	154 (9.2, 7.8−10.6)	33.357	0.000	168 (6.7, 5.7−7.6)	193 (7.6, 6.6−8.7)	1.833	0.176
Urinary leakage/incontinence	583 (11.5, 10.7−12.4)	107 (6.3, 5.1−7.4)	244 (14.6, 12.9−16.3)	232 (13.8, 12.2−15.5)	70.263	0.000	243 (9.6, 8.5−10.8)	340 (13.5, 12.1−14.8)	18.116	0.000
Benign tumor	511 (10.1, 9.3−11.0)	205 (12.0, 10.5−13.6)	156 (9.4, 8.0−10.8)	150 (8.9, 7.6−10.3)	10.545	0.000	284 (11.3, 10.0−12.5)	227 (9.0, 7.9−10.1)	7.150	0.000
Malignant tumor	43 (0.9, 0.6−1.1)	14 (0.8, 0.4−1.3)	15 (0.9, 0.4−1.4)	14 (0.8, 0.4−1.3)	0.070	0.966	27 (1.1, 0.7−1.5)	16 (0.6, 0.3−0.9)	2.851	0.091

TABLE 3. Comparison of the health status among women aged 50−70 years old by different age groups, 2018, China.

Health status	50–54 N (%, 95% CI)	55–59 N (%, 95% CI)	60–64 N (%, 95% CI)	65−70 N (%, 95% CI)	χ^2	*p*	χ^2_{trend}	*p*
Chronic diseases	740 (46.3, 43.9−48.8)	538 (50.6, 47.6−53.6)	673 (57.6, 54.8−60.5)	832 (68.2, 65.6−70.8)	145.706	0.000	140.620	0.000
Overweight and obesity	672 (46.4, 43.8−49.0)	460 (47.6, 44.4−50.7)	466 (46.6, 43.5−49.7)	449 (45.3, 42.2−48.4)	1.017	0.797	0.315	0.574
Hypertention	327 (20.5, 18.5−22.5)	281 (26.4, 23.8−29.1)	348 (29.8, 27.1−32.4)	481 (39.4, 36.7−42.2)	125.183	0.000	120.818	0.000
Osteoarthrosis	197 (12.3, 10.7−14.0)	127 (11.9, 10.0−13.9)	160 (13.7, 11.7−15.7)	181 (14.8, 12.8−16.8)	5.596	0.133	4.599	0.032
Diabetes	81 (5.1, 4.0−6.1)	98 (9.2, 7.5−11.0)	162 (13.9, 11.9−15.8)	176 (14.4, 12.5−16.4)	87.522	0.000	81.882	0.000
Cardiovascular diseases	73 (4.6, 3.5−5.6)	84 (7.9, 6.3−9.5)	128 (10.9, 9.2−12.7)	211 (17.3, 15.2−19.4)	132.718	0.000	128.679	0.000
Osteoporosis	82 (5.1, 4.1−6.2)	72 (6.8, 5.3−8.3)	91 (7.8, 6.2−9.3)	147 (12.0, 10.2−13.9)	48.159	0.000	43.954	0.000
Oral diseases	22 (1.4, 0.8−1.9)	17 (1.6, 0.8−2.4)	29 (2.5, 1.6−3.4)	31 (2.5, 1.7−3.4)	7.329	0.062	6.635	0.010
Kidney disease	21 (1.3, 0.8−1.9)	8 (0.8, 0.2−1.3)	20 (1.7, 1.0−2.5)	26 (2.1, 1.3−2.9)	8.100	0.044	4.450	0.035
Thyroid disease	23 (1.4, 0.9−2.0)	9 (0.8, 0.3−1.4)	17 (1.5, 0.8−2.1)	11 (0.9, 0.4−1.4)	3.477	0.324	0.778	0.378
Gynecological diseases	765 (47.9, 45.4−50.4)	421 (36.8, 34.0−39.6)	441 (37.7, 34.9−40.5)	372 (30.5, 27.9−33.1)	90.063	0.000	86.622	0.000
Vaginitis	451 (28.2, 26.0−30.5)	248 (23.3, 20.8−25.9)	268 (22.9, 20.5−25.3)	265 (21.7, 19.4−24.0)	19.551	0.000	16.408	0.000
Cervicitis	234 (14.7, 12.9−16.4)	138 (13.0, 11.0−15.0)	125 (10.7, 8.9−12.5)	105 (8.6, 7.0−10.2)	26.927	0.000	26.835	0.000
Pelvic inflammation	128 (8.0, 6.7−9.3)	90 (8.5, 6.8−10.1)	72 (6.2, 4.8−7.5)	71 (5.8, 4.5−7.1)	9.557	0.000	7.366	0.007
Urinary leakage/incontinence	178 (11.1, 9.6−12.7)	101 (9.5, 7.7−11.3)	128 (10.9, 9.2−12.7)	176 (14.4, 12.5−16.4)	14.917	0.000	6.944	0.008
Benign tumor	219 (13.7, 12.0−15.4)	99 (9.3, 7.6−11.1)	119 (10.2, 8.4−11.9)	74 (6.1, 4.7−7.4)	45.479	0.000	38.896	0.000
Malignant tumor	16 (1.0, 0.5−1.5)	8 (0.8, 0.2−1.3)	13 (1.1, 0.5−1.7)	6 (0.5, 0.1−0.9)	3.360	0.339	1.145	0.285

infections (such as vaginitis, cervicitis, and pelvic inflammation). This result is further verified because the decline of ovarian function in menopausal women leads to genitourinary tract atrophy, and they are more prone to reproductive tract infection (*6*).

The health problems of menopausal and older women in the western region and rural areas were more prominent. Another important result of this study was that an imbalance of regional development was an important factor restricting the health of menopausal and older women. Compared with the eastern and urban areas, the proportions of women suffering from chronic and gynecological diseases in the western and rural areas were significantly higher. However, China's Fifth National Health Service Survey in 2013 showed that in recent years, the prevalence of chronic diseases among urban and rural residents has increased rapidly, and the growth rate in rural areas was higher than that in urban areas (*5*). The reason may be due to the gradual economic development and the improvement of living standards in rural and western areas, but the population lacks the awareness of active health and the ability of self-health management and the health care service and infrastructure are relatively insufficient. Therefore, the health problems of menopausal and older women in the western region and rural areas are more prominent and need to more attention. The construction of infrastructure, especially medical and health-related facilities, should be improved and the conditions of health care services should be strengthened in the western region and rural areas. In order to achieve the goal of "Joint construction and sharing, health for all" in the outline of the Plan of Healthy China 2030, the imbalance in regional development should be mitigated and eliminated as soon as possible.

This study was subject to at least some limitations. First, the clinical diagnosis was self-reported and might be subjected to biases. Second, although the age composition of the participants in this study was similar to that of women in the 2018 national population sampling survey (the difference of age composition ratio ranged from 0.36% to 4.88%) (*7*), the study used convenience sampling, and data were collected in 12 counties/districts in 6 provinces, so the results might not fully be representative of the regional and national levels.

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Preplanned Studies

The Impact of New Adjustments to the Family Planning Policy on the Number of Live Births in Four Developed Urban Areas — China, 2013–2019

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Summary

What is already known on this topic?

Due to shifting circumstances in China, the government has adjusted the child-bearing policy to allow couples to have a second child. This has affected the total number of live births, especially in more developed urban areas.

What is added by this report?

The total number of live births in the 4 monitoring cities including Chengdu, Wuhan, Shenzhen, and Beijing during 2014–2019 increased by 33.0%, 20.3%, 10.7%, and 8.2%, respectively. From 2014 to 2017, the proportion of total live births that were policy related increased in each city: Chengdu (2.0% to 35.0%), Wuhan (1.0% to 25.1%), Shenzhen (0.6% to 39.4%), and Beijing (3.1% to 30.2%).

What are the implications for public health practice?

Our results showed that the implementation of the new adjusted family planning policy alleviated the downward trends in total live births and is unlikely to lead a baby boom as estimated by previous studies.

The family planning policy has resulted in reduction of live births from 1982 and rapid economic growth in China (*1*). However, the pressure of the ageing, pension fund deficiencies, and increasing labor shortages has accelerated the announcement of the new adjusted family planning policy by the Chinese government, including a policy allowing couples in which at least one marital partners was an only-child to have two children in the end of 2013, and the implementation of a universal two-child policy in January 2016 (*2*). These adjustments were especially important for relatively developed urban areas because rural areas were subject to different policies since the 1980s (*1*). Therefore, we conducted this study based on surveillance data from 4 cities (Beijing, Wuhan, Chengdu, and Shenzhen) in China from 2014 to 2019. The study aimed to investigate the variations in the number of live births during 2013–2019 and the impact of new family planning policy on live births.

The data were collected from 3 continued surveillance projects from 2014–2019 that were founded by China-World Health Organization (WHO) Biennial Collaborative Projects entitled "Impact of the new family planning policy on maternal and children's healthcare services" (2014–2015, 2016–2017) and "Surveillance of high-risk maternal health services and management" (2018–2019). These three surveillance projects were conducted to identify the number of live births and relevant maternal characteristics which may be influenced by changes in the family planning policy. All these projects were implemented by the National Center for Women and Children's Health (NCWCH), China CDC.

In the surveillance, three cities including Chengdu, Wuhan, and Shenzhen were selected for the surveillance from the western, central, and eastern regions of China, respectively. The cities were selected based on their geographical location, their being likely to have been influenced by the policy due to having large population inflows and outflows, and an existing city-wide unified reporting system for maternal and newborn health. Furthermore, these criteria were used to select two districts (Haidian District and Chaoyang District) in Beijing Municipality to represent the northern region of China. Two districts were selected because Beijing had additional challenges due to an excessive number of midwifery institutions and special ministries, agencies, and military hospitals that made data collection much more difficult. The surveillance covered all health facilities providing childbirth services in the cities and included general hospitals, maternal and children's healthcare hospitals, specialized hospitals, community health centers/township hospitals, and private hospitals. A total of 327 health facilities from 48 counties in the 4 cities were covered in the surveillance.

The maternal and child health (MCH) information system covering the whole city was available in each

city, and individual information for all pregnant women who attended antenatal care and delivery in the four monitoring areas were recorded in the system. Our study collected all surveillance information based on the system routinely in each quarter of each year, including the total number of live births (2013–2019). During 2014–2017, if the woman or her husband was an only-child and the couple gave birth to their second child between January 1, 2014 and December 31, 2015, or the woman who gave birth to her second child on or after January 1, 2016, the second child was then classified as a live birth in accordance with the new family planning policy (abbreviated as "policy-related live birth"). Trained medical workers enquired and made sure whether the pregnancy or delivery was in accordance with the new family planning policy in the following two time points: 1) during the pregnancy when the information of the mother was recorded in the maternal and child care handbook or medical record for antenatal care; and 2) after childbirth. After 2017, policy-related live births were not recorded due to the likely stable implementation of the new family planning policy.

Because of different city characteristics, population characteristics, and crude birth rates, significant variation was found in the total number of live births in the four cities. Shenzhen had the largest number of live births each year, and the second was Chengdu. For Beijing, only two districts were included in the surveillance, and the number of live births was the smallest. Compared with 2013, the number of live births in Chengdu increased significantly with the change in rate being between 14.7% to 46.6% and remaining largely stable after the peak period in 2016. Although the increase in the number of live births in Wuhan from 2014 to 2019 was lower than that in Chengdu, it also remained basically stable after the peak period in 2016. The peak number of live births in Shenzhen was in 2016 and 2017, and the change rate of live births declined after 2018. Compared with 2013, the number of live births in the two monitoring districts in Beijing increased significantly in 2014 and 2016, with a nearly 30.0% increase, but declined in other years especially in 2015 where the change in rate was -14.4%. The details were shown in Table 1.

In the 4 cities, the total number of the policy-related live births increased each year from 2014 to 2017, and the overall proportion of policy-related live births reached 33.9% in 2017. Among the four cities from 2014 to 2017, Shenzhen had the largest proportion of policy-related live births (0.6% to 39.4%), followed by Chengdu (2.0% to 35.0%) and Beijing (3.1% to 30.2%), while Wuhan had the comparatively smallest proportion (1.0% to 25.1%). The number and the proportion of policy-related live births in each city were shown in Table 2 and Figure 1.

DISCUSSION

To our knowledge, this study was the first to

TABLE 1. Number of live births from 2013 to 2019 and change rate (%) in the four monitoring cities.

Cities	2013	2014	2015	2016	2017	2018	2019	Average from 2014 to 2019
Beijing								
Live births	86,938	112,854	74,457	111,142	95,409	84,259	86,040	94,027
Change rate (%)	ref	29.8	−14.4	27.8	9.7	−3.1	−1.0	8.2
Wuhan								
Live births	99,493	109,304	109,855	130,334	127,512	120,726	120,191	119,654
Change rate (%)	ref	9.9	10.4	31.0	28.2	21.3	20.8	20.3
Chengdu								
Live births	149,695	171,637	177,553	219,460	213,616	195,197	217,107	199,095
Change rate (%)	ref	14.7	18.6	46.6	42.7	30.4	45.0	33.0
Shenzhen								
Live births	194,010	214,826	197,679	227,876	230,449	207,323	210,699	214,809
Change rate (%)	ref	10.7	1.9	17.5	18.8	6.9	8.6	10.7
All								
Live births	530,136	608,621	559,544	688,812	666,986	607,505	634,037	627,585
Change rate (%)	ref	14.8	5.5	29.9	25.8	14.6	19.6	18.4

TABLE 2. Number and proportion (%) of total live births that were policy related in the four monitoring cities from 2014 to 2017.

Cities	2014		2015		2016		2017	
	n	%	n	%	n	%	n	%
Beijing	3,542	3.1	7,056	9.5	23,530	21.2	28,783	30.2
Wuhan	1,090	1.0	5,718	5.2	24,822	19.0	31,953	25.1
Shenzhen	1,374	0.6	10,852	5.5	76,593	33.6	90,721	39.4
Chengdu	3,502	2.0	27,043	15.2	57,107	26.0	74,724	35.0
All	9,508	1.6	50,669	7.4	182,052	26.4	226,181	33.9

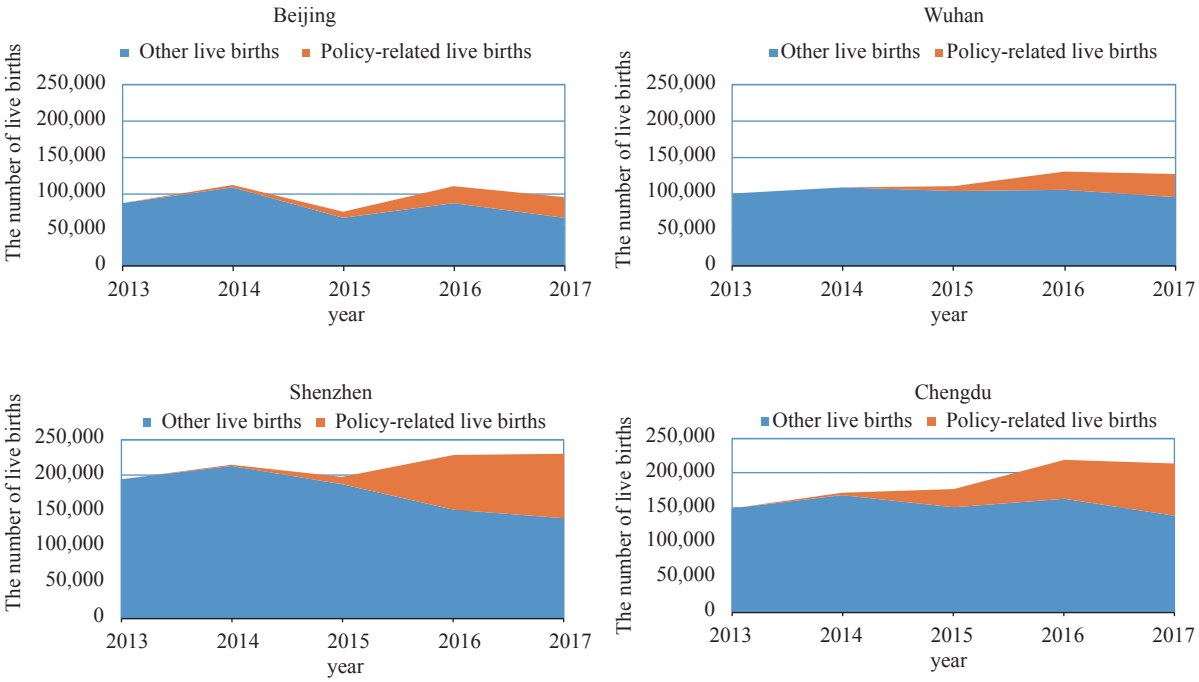

FIGURE 1. Number of policy-related live births in the four monitoring cities from 2013 to 2017.

investigate the proportion of policy-related live births in more developed areas of China. Our results showed that the number of live births in the four cities has increased overall since 2014, which was especially evident after the universal two-child policy in 2016. The change in the number of live births showed that the implementation of the newly adjusted family planning policy alleviated the decreases in the total number of live births and started increasing. The cities were located in four relatively developed cities whose provinces also showed a similar pattern of growth in the number of live births according to the national report (*3*–*4*). Our results confirmed the previous prediction of the slow growth of total live birth rates in China, and the newly adjusted family planning policy will therefore not result in a baby boom (*2*). We could foresee that the new policy will be conducive to a rebound in the number of live births and to alleviating the population crisis. The increased proportion of policy-related live births also showed that the implementation of universal two-child policy resulted in more decisions from couples to have a second child.

Our findings suggested that the newly adjusted family planning policy was a highly desirable action that will be beneficial for population size and low fertility in China, and it was likely to remove some oppressive elements of the previous policy (*1*–*2*). However, this increase will create new challenges in the field of obstetrics, neonatology, and related health facilities. It should be noted that the preconception health risks, pregnancy complications and adverse birth outcomes increased with age (*5*). From 2015 to 2018, the proportion of newborns delivered by older females (35 years and above) increased year by year, reaching its peak in 2017 (13.4%) (*6*). The proportion of older females in our study was similar to this estimate, but

much higher in women who gave birth to their second child. Methods for dealing with these challenges for mothers with their second child should be developed as experience in addressing this issue is lacking. The health facilities in China should develop more sophisticated prenatal, peripartum, and neonatal healthcare to overcome this challenge (*7*).

This study was subject to some limitations. First, the surveillance data were collected in four relatively developed cities of China, so the results maybe not suitable to explain the policy effect to the selected regions or nationally in China. Second, rural areas may be subject to significantly different conditions due to differences in policy and traditional expectations. Nevertheless, future studies should also focus on remote, rural areas because of the higher caesarean delivery rate and the more advanced ages of the mothers, which may have further value for the policy makers.

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Profiles

Xi Jin, China CDC's Chief Expert of Maternal and Child Health

Peter Hao[1,&]; Xi Jin[2,&]; Xiaoqi Wang[1]; Zhenjun Li[1]; Jingjing Xi[1,#]; Feng Tan[1,#]

Editorial Our new column *Profiles* is a new series that aims to introduce China CDC's chief experts, major decisionmakers, and key contributors that ensure the high standard of operation of China CDC. These articles are meant to present high-achieving individuals of China CDC and will describe the background, achievements, and paths to success of the eponymous individuals.

To start, *Profiles* will first cover individuals from China CDC's Chief Expert System. To strengthen the establishment of a team of public health talent, China CDC expanded the career development capacity for its most well-known experts under Director-General George F. Gao's directive: "To further perfect the system of chief experts and continuously expand the influence of chief experts". In December 2019, China CDC selected the nominations of chief experts based on the needs of key areas of public health and the academic level and professional influence of the experts. After domestic peer review and comprehensive evaluation by China CDC's academic committee, 13 individuals (in no particular order) were appointed to lead 13 major public health fields: 1) Guizhen Wu, Chief Expert of Biosafety; 2) Yiming Shao, Chief Expert of AIDS; 3) Weiping Wu, Chief Expert of Parasitic Diseases; 4) Huaqing Wang, Chief Expert of Immunization Planning; 5) Zunyou Wu, Chief Expert of Epidemiology; 6) Linhong Wang, Chief Expert of Chronic Diseases; 7) Xu Su, Chief Expert of Radiation Protection; 8) Wenhua Zhao, Chief Expert of Nutrition; 9) Tao Li, Chief Expert of Occupational Health; 10) Liubo Zhang, Chief Expert of Disinfection; 11) Jiaqi Ma, Chief Expert of Health Informatics; 12) Xi Jin, Chief Expert of Maternal and Child Health; and 13) Qiyong Liu, Chief Expert of Vector Biology.

In response to the prevention and control of the coronavirus disease 2019 (COVID-19) pandemic, the chief experts were dispatched to the front lines and highly-affected areas to supervise the response, tasked with leading scientific research to shape the response and the preparation of technical documents for prevention and control, and were responsible for promptly supporting government decisionmaking and responding to social concerns as the scientific authorities. The voices of these chief experts has played an important role in the effective management of the epidemic in their respective professional fields.

China CDC plans to dynamically adjust the fields represented by the chief experts based on the country's major public health needs by enriching the chief expert's system and guiding the chief experts to play the role of "public opinion leaders" in academic communication and health communication at home and abroad.

Our first publication in *Profiles*, therefore, is China CDC's Chief Expert of Maternal and Child Health, Jin Xi, who has over 30 years of experience in developing and managing maternal and child healthcare (MCH) institutions. With the advent of the 31st World Population Day on July 11, 2020, the public health community needs to prioritize MCH as a fundamental basis for the improvement of health globally.

Before beginning her long and fruitful career with China CDC, Xi Jin was working in the Beijing Municipal Child Health Institute. Fifteen years of work had given her a deeper understanding of China's maternal and child health network system and the foundation of individual clinical services. She won the United Arab Emirates Health Foundation Prize from the World Health Organization in her capacity as a representative of maternal and child health in China, in which she had been working fifteen years as the Deputy Director of the National Center for Women and Children's Health (NCWCH), China CDC. As one of the founders, Jin's expertise in maternal and child healthcare (MCH) allowed her to help establish national MCH institutions and start the process of building and developing China's robust MCH systems.

China has the largest population of women and children in the world, which poses huge demands and challenges for MCH. Jin frequently reorients her strategies on answering the question: "How do we meet this huge demand of women and their children in China?" She believes that a complete MCH system and institution is the most fundamental step for providing high quality services to meet the population's needs. Therefore, with keen technical anticipation and clarity of thought, Jin led her team to establish and perform a series of studies on the departments of MCH institutions including human resources allocation standards, construction standards, equipment configuration standards, bed settings in obstetric departments, and service item cost accounting, which were then utilized to build construction standards for MCH institutions. Based on these studies, her team has developed 27 management documents and over 20 clinical guidelines, which covered almost all aspects of MCH services. Jin also introduced advanced concepts of international medical quality and safety management in China and compiled a series of books on MCH quality and safety management. These accomplishments mentioned above were all pioneering initiatives in the world. As the first prize winner of the government-ministry-level MCH award, Jin has made substantial contributions to accelerate the standardized construction and management process of MCH institutions and of the MCH service network in China.

Based on the improved Chinese MCH system, many important MCH programs including the prevention of mother-to-child transmission of HIV, syphilis, and hepatitis B (PMTCT) program, have made remarkable achievements in the world. As the team leader, Jin has been deeply committed to the PMTCT program and led her team to actively commit to the elimination of mother-to-child transmission in China. She was responsible for cooperative projects between China's National Health Commission (NHC) and the United Nations International Children's Fund (UNICEF) on PMTCT and special research projects on HIV/AIDS-related issues funded by China's Ministry of Science and Technology. These works provided comprehensive technical support for China's action to eliminate mother-to-child transmission of HIV/AIDS, syphilis, and hepatitis B. Therefore, in 2016, she was invited as the only national-level observer to participate in the WHO's accreditation for the elimination of mother-to-child transmission of HIV/AIDS in Thailand.

As one of the think tank experts of the Women and Children's Working Committee in the State Council of China and a member of national technical groups of various national MCH programs, Jin is extensively involved in the development of national MCH policies and also stays open-minded and actively looking for opportunities on the introduction, localization, training, and implementation of new MCH technologies. She pays attention to research on key, difficult, and current issues in MCH in order to promote management capacity. The many areas of MCH covered by this research include emergency obstetric care, neonatal intensive care, neonatal asphyxia resuscitation, early essential newborn care (EENC), newborn healthcare, early childhood development, adolescent health and development, sexual and reproductive health, health education, and health promotion. The research of these subjects has significantly promoted the comprehensive development of maternal and child health care service in China.

Jin loves her job very much. "The MCH work is very meaningful," she always says. "It's something that matters for everyone, including individuals and families. I enjoy this job which brings them health and happiness, and I feel very lucky for having the chance to contribute my lifetime to a career that I love and can always be passionate about." To now, Jin has been engaged in maternal and child health work for more than 30 years and dedicated to MCH for her entire career life with a persistent work attitude and a strong sense of professionalism and responsibility. She has gained respect and recognition worldwide. In view of her outstanding contributions and great achievements, she has won the award of National Advanced Individual for the Protection of Women and Children's Rights, the Development Contribution Award for Public Health and Preventive Medicine, the 2018 Influential Figures of Health Communication, and many other awards for her scientific and technological achievements.

As a part of the field of public health, MCH plays an important role in promoting the health of women and children, and, as a member of the China CDC, NCWCH has played an important role in ensuring the quality and availability of MCH. Now and in the future, Jin and her colleagues will continue to commit to the development and progress of China's MCH and to progress towards the goals of Healthy China 2030 Plan and the United Nations Sustainable Development Goals.

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