ISSN 2096-7071
CN 10-1629/R1

CHINA CDC WEEKLY

Vol. 3 No. 40 Oct. 1, 2021

中国疾病预防控制中心周报

INTERNATIONAL DAY OF OLDER PERSONS ISSUE

ISSN 2096-7071
9 772096 707217 40>

This week's issue was organized by Guest Editor Gong Chen.

Foreword

Building, Integrating, and Sharing Our Aging Society: Improving Older Adults' Health Together

This year marks the 20th anniversary of China becoming an aging society and the follow-up year of the 30th International Year of Older Persons. The key policy of active response to population aging has been elevated to a national strategy (*1*). Thus, now is an important time for *China CDC Weekly* to publish a series of studies on health status and ways to improve the health of older Chinese adults.

Population aging is a common global trend and a major social change happening in China. Developed countries have the most rapidly aging populations. Historically, after France became the first country to become an aging society, other Western and Northern European countries became aging societies. By the 1970s, almost all developed countries were aging societies. Although later than that of developed countries, many developing countries' population became aging and at a faster per-country pace, potentially leading to future global trends toward population aging.

The United Nations' *World Population Prospects 2019* predicts that by 2050, global per capita life expectancy will increase to 77.1 years and that 16% of the world's population will be 65 years of age or older (*2*). In the year 2000, there were 130 million adults aged 60 and above in China — 10.1% of the population. In 2010, this number increased to 180 million, representing 13.3% of the population. The most recent data are from the Seventh National Population Census and show that the number of older adults increased to 260 million in 2020, accounting for 18.7% of the total population (*3*).

The issue of aging societies has been receiving sustained and widespread global attention from policymakers, researchers, and social organizations. This academic attention gives rise to conceptual frameworks for theoretical explanations of aging societies and practical life-course pathways, including productive aging, successful aging, healthy aging, and active aging. Health is a consistent, essential theme of these conceptual frameworks. Definitions, classifications, and determinants of health of older adults are constantly being updated and developed over time. In the past, people narrowly thought that older adults could spend their remaining lives in comfort as long as they were physically healthy. Later, people gradually realized that the mental health is equally important, and nowadays, in addition to physical and mental health, older adults' social capabilities and social capital are also being emphasized.

Aging is an irreversible, natural phenomenon that everyone will experience. Population aging is an inevitable product of socioeconomic development. To actively cope with population aging, we need to take the initiative and seize opportunities to prevent risks and turn crises into opportunities. Responses to population aging require joint effort and conscientious action of the whole society, adhering to basic principles of everyone's responsibility and enjoyment, and forming a good atmosphere for older adults, families, communities, and governments to participate together.

Establishment of an aging society has been integrated into policy systems and, since 1982, has become a focus of programs on aging in the United Nations (UN) (*4*). The year 1999 was designated as the International Year of Older Persons. The UN aging conference that year adopted the theme, "*A Society for All Ages*", meaning a society in which "every member with authority, autonomy, and responsibility" plays an active role. By adding the concept of "a society for all ages" to "a society for all", the strategy becomes significantly more comprehensive and wide-ranging (*5*).

This issue of *China CDC Weekly* contributes important evidence and promotes discussion on aging and health on the International Day of Older Persons. Our research team evaluated the health status of older adults and explored strategies for improving their health status. The first paper describes how social participation can prevent older adults injured by falling from developing depressive symptoms (*6*). The second paper is about the oral health status of older adults and explores the role of good oral health for alleviating depressive symptoms (*7*). The third paper discusses the supply and demand of home-based healthcare services for older adults in China (*8*). Together, these

three studies present empirical evidence to assist building, integrating, and sharing today's aging society.

doi: 10.46234/ccdcw2021.206

Submitted: September 12, 2021; Accepted: September 14, 2021

REFERENCES

1. The State Council. The proposal of the CPC central committee on formulating the 14th Five-year plan for economic and social development and the long-range objectives through the year 2035. 2020. http://www.gov.cn/zhengce/2020-11/03/content_5556991.htm. [2020-11-03]. (In Chinese).
2. United Nations. Department of economic and social affairs population division. 2019. https://population.un.org/wpp/Publications/Files/WPP2019_Volume-II-Demographic-Profiles.pdf. [2021-9-12] .
3. National Bureau of Statistics. The seventh national population census 2020 Brief. 2021. http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/. [2021-5-11]. (In Chinese).
4. United Nations. Report of the world assembly on aging. 1982. https://www.un.org/esa/socdev/ageing/documents/Resources/VIPEE-English.pdf. [2021-9-14].
5. United Nations. Political declaration and Madrid international plan of action on ageing. Second World Assembly of Aging. 2002. https://www.un.org/esa/socdev/documents/ageing/MIPAA/political-declaration-en.pdf. [2021-9-14].
6. Zhang YL, Zhang L, Zhang XH, Sun JJ, Wang Dm, Chen G. Fall injuries and depressive symptoms among older adults and the mediating effects of social participation — China, 2011–2018. China CDC Wkly 2021;3(40):837 – 41. http://dx.doi.org/10.46234/ccdcw2021.207.
7. Sun JJ, Zhang YL, Zhang XH, Song XM, Chen G. Situation, challenges and countermeasures of home-based health care service supply and demand in China. China CDC Wkly 2021;3(40):847 – 53. http://dx.doi.org/10.46234/ccdcw2021.209.
8. Zhang XH, Hu XY, Zhang YL, Sun JJ, Chen G. Longitudinal association between oral status and depressive symptom among Chinese older adults — China, 2014–2018. China CDC Wkly 2021;3(40):842 – 6. http://dx.doi.org/10.46234/ccdcw2021.208.

Gong Chen, PhD
Director and Professor, Peking University Institute of Population Research
Director, Peking University Institute of Ageing Study

Preplanned Studies

Fall Injuries and Depressive Symptoms Among Older Adults and the Mediating Effects of Social Participation — China, 2011–2018

Yalu Zhang[1]; Lei Zhang[1]; Xinhui Zhang[1]; Jingjing Sun[1]; Dongmin Wang[2,#]; Gong Chen[1,#]

Summary

What is already known on this topic?

Prior studies found that fall events were associated with a higher level of depressive symptoms and a lower level of social functioning and social participation. In addition, social participation has also been significantly associated with better conditions of depressive symptoms.

What is added by this report?

This article implemented the literature in three ways. First, it examined the mechanisms of social participation in the association between fall injuries and depressive symptoms among older adults in China. Second, it specified the fall-injured older adults group from those who merely experienced fall events. Third, it compared the results between rural and urban China and discussed policy implications for both groups.

What are the implications for public health practice?

Based on the findings of this study, future policies could consider boosting social participation at both the household and community level while taking into account the challenges of mobilities and social capabilities after fall injuries. Meanwhile, it is essential to accelerate the construction of aging-friendly communities to improve the accessibility of social participation and broaden social services to health management and monitoring.

Falls are the second leading cause of unintentional injury deaths worldwide. Older adults are one of the groups with the highest incidence of fall injuries. Globally, around 30% of socially active older adults (aged 65 and above) and about 50% of the oldest-old (aged 85 and above) experienced at least one fall in a year on average, with 4%–15% of these falls resulting in significant injuries (*1*). The situation is equally concerning in China. The annual rate of falls among older adults was about 11%–34%, and 3.2%–17% of the falls were reported to need medical attention (*2*). Prior studies found that the incidence of falls was associated with depressive symptoms among older adults (*3*), which could then contribute again to repeated falls (*4*). However, few have investigated the role of social interventions in saving fall-injured older adults from experiencing depressive symptoms.

Using the Chinese Health and Retirement Longitudinal Study (CHARLS) 2011–2018 data (*5*), this study examined the potential mediating role of social participation in altering the effect of fall injuries on depressive symptoms. The results show that over 20.24% of older adults (60+) experienced falls, among whom 46.77% needed at least 1 visit seeking medical treatment. Social participation accounted for partial effects of fall injuries on their depressive symptoms for rural older adults only, not their urban counterparts. For the first time, this study specified that the fall-injured older adults group from the group that merely had falls. Findings from this study emphasize the necessity of collective efforts from multiple levels to improve the social engagement of urban older adults who had fall injuries. Future studies could further specify what types of social participation would be more helpful in buffering the intervention effects.

This study used the longitudinal data from the China Health and Retirement Longitudinal Study 2011–2018. The baseline information of the data was collected in 2011 and was followed up in 2013, 2015, and 2018 (4 waves in total). The data were collected through stratified random sampling of about 10,000 households with permanent residents aged 45 years or older in 150 county-level units in 26 provincial-level administrative divisions (PLADs) in China, with a complete sample of about 17,000 people. This study pooled the interviewees who were 60 years old or above and had experienced falls between 2009 and 2018. The total final study sample was 7,980 people, including 3,728 people (46.77%) who needed treatment for falls and 4,243 people (53.23%) who needed no treatment for falls. In terms of the residential location, 2,968 people (37.19%) in the analytical sample were in urban areas and 5,013 people (62.81%) were in rural areas.

Depressive symptoms in this study were measured using the Center for Epidemiologic Studies Depression

(CES-D) scale with ten questions to measure the feelings and behaviors of the interviewees one week before the interview date. Interviewees who missed three or more questions were removed. The mean scores of all answered questions were calculated for respondents who missed one to two questions and imputed for the missing questions for that respondent.

The baseline survey recorded whether the respondent had fallen in the two years prior to the interviews. The follow-up survey recorded whether the respondent had fallen since the last visit and how many severe falls required medical treatment. This study focused on older adults who had fall incidences between 2011 and 2018 and compared those who needed medical treatment and those who did not.

The CHARLS recorded respondents' interactions with family, friends, community, and social involvement in the month before the time of the interview. Respondents reported the frequency of each type of social activity they had attended. In this study, the frequency unit was unified as the day , and the frequencies were summed for each activity participated.

Furthermore, individual and household characteristics were controlled that may affect both the likelihood of fall injuries and the outcome variable of depressive symptoms. The individual characteristics include educational attainment, self-perceived health status, age, and marital status. The household characteristic includes the number of people living in the same household.

This study used mediation analysis to investigate the possible mechanism of the relationship between the independent variable (fall injuries), dependent variable (depressive symptoms), and the mediating variable (social participation). Baron and Kenny proposed a four-step process for establishing mediation (*6*). Following these steps, first, we investigated whether fall injury was associated with depressive symptoms. Second, we examined the association between fall injury and a potential mediator of social involvement to test the validity of the mediation analysis. Third, we examined the association between potential mediators of social participation and depressive symptoms. To further explore the possible mediating role of social involvement in the association between fall injury and depressive symptoms, we conducted a Sobel-Goodman mediation test using bootstrap replication (Figure 1). The mediation analysis provided evidence not only on whether fall injury had a direct effect and an indirect effect on depressive symptoms in older Chinese adults, but also indicated what proportion of the total effect was accounted for by the mediating factor of social involvement.

All the analyses were conducted within the national sample first and by urban and rural areas. The analytical software of Stata SE 15.0 (released in 2017 by StataCorp, LLC. in College Station, Texas, USA) was utilized to conduct the analyses stated above. The R-squared value was used to measure to what extent the total variability was accounted for by this model. The significance level (α) of 0.05 was used as the cutoff point to indicate the probability of rejecting the null hypothesis in this study.

Two findings from the descriptive analysis should be noted. One is that the average percentage of fall injury incidence dramatically increased as ages increased. On average, nearly 5 people aged between 45 and 49 had fall injuries out of 100 peers. This number was as high as 9.6 among the older adults aged between 70 and 74 and reached up to 15.7 among the group between 85 and 89 years old (Figure 2). Another concerning

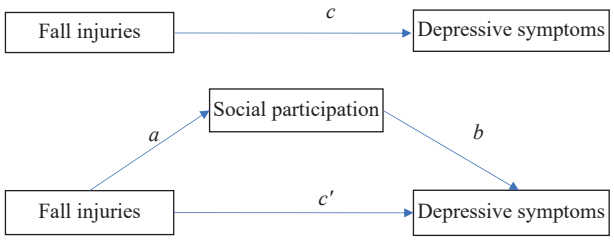


FIGURE 1. The demonstration of hypothesized mediated effects of social participation in the association between fall injuries and depressive symptoms.
Note: In the figure, path *c* represents the total effect, path *c′* represents the direct effect, and the outcome of *a* followed by *b* represents the average causal mediation effect (ACME).

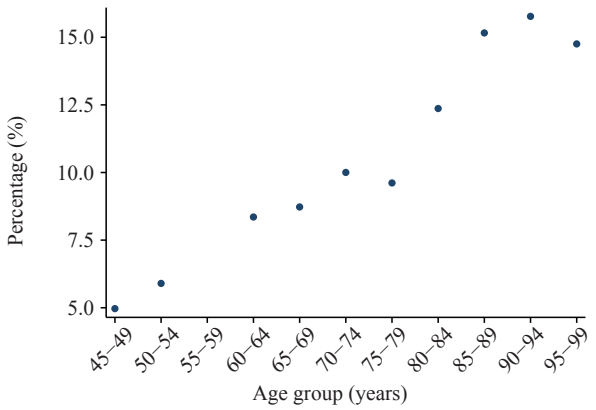


FIGURE 2. The average percentage of fall injury incidence by age groups for adults aged 45 years old and above, China, 2011–2018.

finding was that compared to the urban older adults aged 60 and above, rural older adults were relatively more vulnerable as they were more likely to experience fall injuries, a higher level of depressive symptoms, worse health conditions, and less social participation (Table 1).

Using Baron and Kenny's mediating analytical strategies and the pooled cross-sectional data, the mediation analyses results showed that social participation accounts for a substantial proportion of fall injuries' effects on depressive symptoms among older adults in China (Table 2). More specifically, the likelihood of experiencing a higher level of depressive symptoms reduced from 7.63% to 6.73% for the fall-

TABLE 1. Descriptive statistics of falls, depressive symptoms, social participation, individual and household characteristics among older adults (aged 60 and above), China, 2011–2018.

Variables	National			Rural			Urban		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Fall injury ratio (among people who had fall events)	7,971	0.47	0.50	5,005	0.47	0.50	2,966	0.46	0.50
Fall injury ratio (among all older adults)	39,395	0.09	0.29	23,844	0.10	0.30	15,551	0.09	0.28
Fall incidence	39,424	0.20	0.40	23,868	0.21	0.41	15,556	0.19	0.39
Depressive symptoms	32,637	1.54	0.80	19,569	1.63	0.84	13,068	1.41	0.71
Social participation	46,561	0.62	0.95	27,064	0.54	0.82	19,497	0.74	1.10
Age	46,561	69.48	7.64	27,064	69.48	7.62	19,497	69.49	7.68
Marital status	46,516	0.78	0.41	27,058	0.78	0.42	19,458	0.80	0.40
Health condition	40,931	2.92	0.98	24,623	2.85	0.98	16,308	3.02	0.96
People living in household	46,521	1.49	1.86	27,055	1.64	1.98	19,466	1.27	1.65

Note: The mean fall injury ratio (among people who had fall events) was obtained by dividing the number of people who experienced fall injuries by the number of people who experienced fall events. The mean fall injury ratio (among all the older adults) was obtained by dividing the number of fall injuries by the total analytical sample aged 60 and above. The mean fall incidence was obtained by dividing the number of fall events by the total analytical sample aged 60 and above.
Abbreviations: N=sample size; Std. Dev.=standard deviation.

TABLE 2. The mediating effects of social participation in the associations between fall injuries and depressive symptoms among older adults (aged 60 and above) in the national, urban, and rural sample, respectively, China, 2011–2018.

Variables	National			Urban			Rural		
	SocPart	Depress	Mediated effects	SocPart	Depress	Mediated effects	SocPart	Depress	Mediated effects
		b			*b*			*b*	
SocPart		−0.0781*			−0.0633*			−0.0658*	
		(0.010)			(0.013)			(0.016)	
	a	*c* and *c′*	*c*–*c′*	*a*	*c* and *c′*	*c*–*c′*	*a*	*c* and *c′*	*c*–*c′*
Fall injuries	−0.1157*	0.0763*	0.0091	−0.2075*	0.0583	0.0129	−0.0546†	0.0827§	0.0035§
	(0.026)	(0.040)	(0.004)	(0.050)	(0.064)	(0.007)	(0.027)	(0.055)	(0.003)
		0.0673§	11.85%		0.0454	–		0.0792†	4.18%
		(0.040)			(0.064)			(0.056)	
Individual characteristics controlled for	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household characteristics controlled for	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard error for path *a*, *b*, *c* and *c′* in parentheses; Bootstrapped standard error for mediated effects in parentheses; The third line of each mediated effect indicates the proportion of total effect that is mediated; Depress stands for depressive symptoms; The individual characteristics include age, educational attainment, self-perceived health status, age, marital status; The household characteristic includes the number of people living in the same household; The mediated effect for the urban sample was not reported (noted as "–" in the table).
Abbreviation: SocPart=social participation.
* $P<0.001$.
† $P<0.05$.
§ $P<0.01$.

injured older adults when the older adults increased their social participation by 1% (P<0.01). The mediated effect of social participation accounts for 11.85% [95% Confidence Interval (CI): 7.66%, 25.04%] of the association.

Given that there exist significant variations between rural and urban older adults in terms of the frequency and possibility of experiencing fall injuries and levels of depressive symptoms, social participation, and individual and household characteristics, this study conducted separate mediating analyses for urban and rural older adults. The findings showed that the mechanisms varied across the urban and rural areas as hypothesized. For rural older adults, the probability of experiencing a higher level of depressive symptoms reduced by 3.5% for the fall-injured older adults when the older adults boosted their social participation by 1%. The mediated effect size of social participation accounts for 4.18% (95% CI: 2.53%, 11.98%; P<0.01). However, for urban older adults, the results do not show that social participation altered the likelihood of having depressive symptoms among fall-injured older adults.

DISCUSSION

Previous studies have focused on the impact of fall events on physical and mental health status and social functioning among older adults and findings have shown that fall events are positively associated with depressive symptoms and negatively associated with social functioning and social participation (*7–10*). Additionally, social participation is found to significantly alleviate depressive symptoms (*11*). A few scholars also examined the impacts of fall events on social behaviors, living arrangements, and depressive symptoms (*2,12–13*). Nevertheless, limited studies have differentiated between the concepts of fall events and fall injuries caused by fall events that need medical treatment. In addition to the physical damages, fall injuries, as specific outcomes of the fall event, could also produce physiological damage and warrants further investigation regarding the significant negative impact of older adults' mental health such as depressive symptoms and fears of falling.

Therefore, this study makes contributions in three aspects. First, it investigated the mechanism of social involvement as an essential mediator for the association between fall injuries and depressive symptoms among older adults. Second, it focused on the older adults who experienced fall injuries to provide evidence for future intervention implementation and evaluation for the more severe outcomes of fall events. Third, it tested the mediating effects for both urban and rural older adults to provide more specific evidence for future policymaking and service provision.

This study was subject to at least two limitations. First is that for the purpose of having a larger sample size, this study used the pooled cross-sectional data, which could not examine the long-term mediating effects of social participation. Second is that due to the data limitations, this study did not specify the types of social participation, such as family interactions, community activity participation, social engagement, etc., which could vary the outcomes.

The findings from this study suggest that improving rural older adults' social participation could be an intervention to prevent the fall injured older adults from higher levels of depressive symptoms. Future policies could consider boosting social participation at both the household and community level, removing barriers for older adults to access online social participation, while taking into account the challenges of mobilities and social capabilities after the fall injuries. Meanwhile, this study provides evidence that it is essential to accelerate the construction of aging-friendly communities to improve accessibility of social participation and broaden the social services such as health management and chronic diseases monitoring.

Based on the findings that social participation does not function as a mediator to the association between fall injuries and depressive symptoms for Chinese urban older adults, future research could consider examining other potential mechanisms for this group of population. Additionally, future studies could decompose the types of social participation into family interactions, community-based activities, internet social participation, and social volunteering activities.

Acknowledgments: The China Health and Retirement Longitudinal Study (CHARLS) team.

Conflicts of interest: No conflicts of interest.

Funding: Funded by the China's National Key Research and Development Program (2018YFC 2000603).

doi: 10.46234/ccdcw2021.207

[#] Corresponding authors: Dongmin Wang, dongmin_wang@pku.edu.cn; Gong Chen, chengong@pku.edu.cn.

[1] Institute of Population Research, Peking University, Beijing, China; [2] Department of Physical Education, Peking University, Beijing, China.

Submitted: September 12, 2021; Accepted: September 22, 2021

REFERENCES

1. World Health Organization. World report on ageing and health. 2015. https://apps.who.int/iris/handle/10665/186463. [2021-9-12].
2. World Health Organization. China country assessment report on ageing and health. 2015. https://www.who.int/publications/i/item/9789241509312. [2021-9-12].
3. Atlas A, Kerse N, Rolleston A, Teh R, Bacon C. Falls and depression in octogenarians-life and living in advanced age: a cohort study in New Zealand. J Prim Health Care 2017;9(4):311 – 5. http://dx.doi.org/10.1071/HC17012.
4. Hoffman GJ, Hays RD, Wallace SP, Shapiro MF, Ettner SL. Depressive symptomatology and fall risk among community-dwelling older adults. Soc Sci Med 2017;178:206 – 13. http://dx.doi.org/10.1016/j.socscimed.2017.02.020.
5. Zhao YH, Hu YS, Smith JP, Strauss J, Yang GH. Cohort profile: the China health and retirement longitudinal study (CHARLS). Int J Epidemiol 2014;43(1):61 – 8. http://dx.doi.org/10.1093/ije/dys203.
6. Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Pers Soc Psychol 1986;51(6):1173 – 82. http://dx.doi.org/10.1037/0022-3514.51.6.1173.
7. Ganz DA, Latham NK. Prevention of falls in community-dwelling older adults. N Engl J Med 2020;382(8):734 – 43. http://dx.doi.org/10.1056/NEJMcp1903252.
8. Hughes CC, Kneebone II, Jones F, Brady B. A theoretical and empirical review of psychological factors associated with falls-related psychological concerns in community-dwelling older people. Int Psychogeriatr 2015;27(7):1071 – 87. http://dx.doi.org/10.1017/S1041610214002701.
9. van der Meulen E, Zijlstra GAR, Ambergen T, Kempen GIJM. Effect of fall-related concerns on physical, mental, and social function in community-dwelling older adults: a prospective cohort study. J Am Geriatr Soc 2014;62(12):2333 – 8. http://dx.doi.org/10.1111/jgs.13083.
10. Zhou XF, Wang JL. Correlation between fear of tumble and anxiety-depression of 480 community elderly people. Chin J Convalescent Med 2010;19(2):189 – 90. http://dx.doi.org/10.3969/j.issn.1005-619X.2010.02.078. (In Chinese).
11. Quach LT, Ward RE, Pedersen MM, Leveille SG, Grande L, Gagnon DR, et al. The association between social engagement, mild cognitive impairment, and falls among older primary care patients. Arch Phys Med Rehabil 2019;100(8):1499 – 505. http://dx.doi.org/10.1016/j.apmr.2019.01.020.
12. Durgun H, Turan N, Kaya H. Relationship between fall behavior and quality of life of elderly individuals. Psychol Health Med 2021;1 – 8. http://dx.doi.org/10.1080/13548506.2021.1883686.
13. Bu FF, Abell J, Zaninotto P, Fancourt D. A longitudinal analysis of loneliness, social isolation and falls amongst older people in England. Sci Rep 2018;10(1):20064. http://dx.doi.org/10.1038/s41598-020-77104-z.

Preplanned Studies

Longitudinal Association Between Oral Status and Depressive Symptoms Among Chinese Older Adults — China, 2014–2018

Xinhui Zhang[1]; Xiyuan Hu[1]; Yalu Zhang[1]; Jingjing Sun[1]; Gong Chen[1,#]

Summary

What is already known about this topic?

Previous studies on the importance of oral health in later life have mainly focused on nutritional and physical health indicators, while the effects of oral status on the mental health of older people, especially on depression, need to be further explored.

What is added by this report?

Longitudinal results show tooth loss was positively associated with depressive symptoms among older adults in the mainland of China, while denture use was associated with a decreased risk of depression. Effect modification by denture use was observed (*P* for interaction <0.001).

What are the implications for public health practice?

Measures should be taken to help Chinese older adults promote oral health and strengthen the care of dentures by expanding basic health insurance coverage to include dental prosthodontics or providing affordable dental insurance for seniors.

Oral status, primarily marked by tooth loss, is critical for maintaining physical, mental, and social wellbeing (*1*), especially in later life. Prevalence and incidence estimates of severe tooth loss increased gradually with age (*2*). Meanwhile, late-life depression is a significant public health problem, which can often result in personal suffering, family disruption, and the deterioration of many medical disorders (*3*). The relationship between oral status and depressive symptoms among older adults, while receiving increasing amounts of attention, has not yet been studied conclusively. Some research based on American adults found that tooth loss was associated with depression (*4*). However, some studies reported that poor dental health was not significantly associated with depressive symptoms among the elderly (*5*). The evidence about the relation between oral status and late-life depression is still limited and inconsistent. Additionally, although there are a few cross-sectional results focusing on Chinese older adults (*6*), more longitudinal studies are still needed to target the association between oral status, including tooth loss and denture use, and depressive symptoms among Chinese older adults.

Therefore, this study aims to explore the relationship between oral status, including tooth loss and denture use, and depressive symptoms among older Chinese adults using data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS). Furthermore, the combined association of tooth loss and denture use with depressive symptoms was explored as well as interaction effects by different demographic and behavioural characteristics.

The data used in this paper came from CLHLS. Focusing on the older population aged 65 and above, the CLHLS was conducted in 1998–2018 from randomly selected counties and cities of 22 out of 31 provincial-level administrative divisions (PLADs) in China (*7*). We used 2 waves of CLHLS data conducted in 2014 and 2018 to analyze how tooth loss and denture use in 2014 influenced depressive symptoms 4 years later (*8*). Overall, 3,310 out of 7,192 eligible participants were included for analyses after excluding cases lost to follow-up and with missing information on key variables (see Supplementary Figure S1 for the variable screening process, available in http://weekly.chinacdc.cn/). We collected the self-reported number of natural teeth and classified the participants into 4 categories (0, 1–9, 10–19, and 20 and above). A five-item scale, which has been applied in several studies to represent depressive symptoms via the CLHLS data (*9*), was adopted in the CLHLS to evaluate depressive symptoms with higher values indicating more depressive symptoms. The definitions of other variables are shown in the Supplementary Materials (available in http://weekly.chinacdc.cn/).

Supplementary Table S1 (available in http://weekly.chinacdc.cn/) shows baseline characteristics of elderly by numbers of natural teeth and denture use. The mean age of the participants was 81.29 (SD=10.32), 46.99% were male, 39.13% had an urban residence,

71.60% of the participants had 19 teeth or less, and 28.40% had completely no teeth. The denture use rate was 39.40%. The mean of depressive symptom scores was 6.78 (SD=3.19) and increased with tooth loss. Participants using dentures had lower depressive symptom scores compared with those without the denture. Supplementary Table S2 (available in http://weekly.chinacdc.cn/) further demonstrate depressive Symptom Scores of the participants in 2018 by Covariates.

This study followed a stepwise approach and applied multivariable linear models to adjust for confounding variables to clarify the effects of oral status on depressive symptoms. Model 1 only included categories of natural teeth numbers and denture use. Model 2 adjusted for the demographic and socioeconomic covariates, such as age, gender, ethnicity, marital status, residence, education, and pension. Model 3 further added the covariates of lifestyle, including smoking, alcohol consumption, fruit intake, vegetable intake, and health conditions including Activities of Daily Living (ADL) and Mini-Mental State Examination (MMSE) score. Model 4 further controlled for variables of social engagement, including playing cards or mahjong, participation in community activities, and travel. Model 4 was identified as a fully adjusted model. Subgroup analysis was conducted to assess differences between groups. The mediation effects were tested by adding interaction terms of the number of natural teeth and age (65–79 years or ≥80 years), gender, ethnicity, smoking, drinking, and denture use. All statistical analyses were performed using the STATA 16 software (MP version16.0, StataCorp LLC, USA). $P<0.05$ was considered to be statistically significant.

Table 1 presented the regression results of the associations of the numbers of natural teeth and status of denture use with depressive symptoms. The depressive symptom scores increased and slightly decreased as the numbers of teeth decreased (P for trend <0.001). For the fully adjusted model, individuals with 10–19, 1–9, and 0 teeth had 0.55, 0.59, and 0.33 point higher scores of depressive symptoms than those with 20+ teeth, respectively (all $P<0.01$). The denture users had an adjusted lower score of 0.27 points ($P<0.01$) compared with people without dentures.

As the association of the interaction of tooth loss and denture use with depressive symptoms was significant (Table 2; P for interaction <0.001), we showed the combined effects of tooth loss and denture use on depressive symptoms in Table 3. Among non-denture users, scores of depressive symptoms compared with those who had 20+ teeth with/without dentures were 0.64 and 0.61 points higher for older adults with 10–19 teeth and 1–9 teeth, respectively (all $P<0.001$). Denture users had a lower score than non-users in the category of 1–9 teeth. However, there was no significant difference between denture/non-denture users with 20 teeth and denture users with 10–19 teeth, as well as non-denture users with 0 teeth. It is worth noting that denture users with 0 teeth as compared with those with 20+ teeth still had a significantly higher score of depressive symptoms

TABLE 1. Association between number of natural teeth, denture use, and depressive symptom scores among Chinese older adults — China, 2014–2018.

Item	Coefficient (95% CI) for depressive symptom (N=3,310)			
	Model 1	Model 2	Model 3	Model 4
Number of natural teeth				
20+	Reference	Reference	Reference	Reference
10–19	0.95 (0.90, 1.25)***	0.62 (0.35, 0.71)***	0.57 (0.34, 0.70)***	0.55 (0.32, 0.68)***
1–9	1.21 (1.29, 1.60)***	0.69 (0.42, 0.77)***	0.60 (0.32, 0.67)***	0.59 (0.30, 0.65)***
0	1.15 (1.25, 1.57)***	0.47 (0.21, 0.59)***	0.37 (0.06, 0.44)**	0.33 (0.03, 0.41)**
P for trend	<0.001	<0.001	<0.001	<0.001
Denture use				
No	Reference	Reference	Reference	Reference
Yes	−0.83 (−0.96, −0.71)***	−0.40 (−0.50,−0.24)***	−0.24 (−0.36, −0.09)***	−0.27 (−0.32, −0.06)**

Abbreviation: CI=confidence interval.
* $P\leq0.05$.
** $P\leq0.01$.
*** $P\leq0.001$.

(coefficient=0.20, $P<0.05$).

No significant interaction effects were found in subgroup analyses for the number of natural teeth by ethnicity, smoking, and drinking (Table 3). Of note is that older adults with 1–9 teeth were associated with a higher depressive symptom score in the older elderly of

TABLE 2. The combined effects of tooth loss and denture use on depressive symptom scores among Chinese older adults — China, 2014–2018.

Oral status	Coefficient (95% CI) for depressive symptom (N=3,310)			
	Model 1	Model 2	Model 3	Model 4
20+ teeth	Reference	Reference	Reference	Reference
10–19 teeth with dentures	0.15 (−0.22, 0.53)	0.17 (−0.12, 0.71)	0.15 (−0.12, 0.69)	0.18 (−0.12, 0.69)
10–19 teeth without dentures	1.10 (0·99, 1·38)***	0.71 (0.40, 0.79)***	0.66 (0.39, 0.79)***	0.64 (0.40, 0.87)***
1–9 teeth with dentures	0.42 (0.12, 0.73)**	0.32 (0.02, 0.62)*	0.35 (0.26, 0.98)**	0.37 (0.23, 0.96)*
1–9 teeth without dentures	1.37 (1.15, 1.59)***	0.76 (0.52, 0.99)***	0.64 (0.40, 0.87)***	0.61 (0.38, 0.85)***
0 teeth with dentures	0.49 (0.25, 0.72)***	0.18 (−0.06, 0.42)	0.22 (0.11, 0.79)*	0.20 (0.04, 0.45)*
0 teeth without dentures	1.21 (0.93, 1.48)***	0.43 (0.13, 0.56)**	0.25 (−0.11, 0.33)	0.23 (−0.13, 0.31)

Abbreviation: CI=confidence interval.
* $P\leq0.05$.
** $P\leq0.01$
*** $P\leq0.001$.

TABLE 3. Subgroup analysis of the association between number of natural teeth and depressive symptom scores among Chinese older adults — China, 2014–2018.

Subgroup	Number of natural teeth (95% CI)				*P* for interaction
	0	1–9	10–19	20+	
Age					<0.001
65–79 years	0.48 (0.17, 0.79)**	0.31 (0.05, 0.58)*	0.55 (0.32, 0.78)***	Reference	
≥80 years	0.16 (−0.11, 0.44)	0.54 (0.28, 0.80)***	0.49 (0.20, 0.77)**	Reference	
Gender					0.021
Women	0.14 (−0.14, 0.42)	0.42 (0.15, 0.68)***	0.53 (0.26, 0.80)***	Reference	
Men	0.29 (0.02, 0.55)*	0.51 (0.28, 0.75)***	0.42 (0.18, 0.66)***	Reference	
Ethnicity					0.548
Han	0.28 (0.01, 0.41)*	0.58 (0.30, 0.67)***	0.57 (0.29, 0.66)***	Reference	
Minorities	0.59 (−0.16, 1.19)	0.62 (−0.21−0.95)*	0.97 (0.12, 1.29)**	Reference	
Smoking					0.107
Never smoke	0.19 (−0.21, 0.58)	0.78 (0.34, 1.21)***	0.47 (0.24, 0.70)***	Reference	
All the time	0.18 (−0.21, 056)	0.78 (0.35, 1.21)***	0.48 (0.26, 0.71)***	Reference	
Stop smoking	0.35 (−0.06, 0.76)	0.36 (−0.11, 0.83)	0.18 (−0.07, 0.43)	Reference	
Drinking					0.309
Never drink	0.39 (−0.02, 0.80)	0.90 (0.42, 1.39)**	0.44 (0.22, 0.67)***	Reference	
All the time	0.19 (−0.22, 0.60)	0.64 (0.18, 1.10)**	0.53 (0.31, 0.75)***	Reference	
Stop drinking	0.29 (−0.16, 0.75)	0.24 (−0.29, 0.76)	0.23 (−0.01, 0.47)*	Reference	
Denture use					<0.001
Yes	0.60 (−0.15, 0.65)**	0.71 (0.21, 0.95)	0.48 (0.07, 0.77)	Reference	
No	0.11 (0.35, 0.75)***	0.51 (0.24, 0.65)***	0.56 (−0.15, 0.33)*	Reference	

Note: Coefficients were based on linear regression model 4. Effect modification by age (*P* for interaction <0.001), gender (*P* for interaction =0.021), and denture use (*P* for interaction <0.001).
Abbreviation: CI=confidence interval.
* $P\leq0.05$.
** $P\leq0.01$.
*** $P\leq0.001$.

80+ (coefficient=0.54, P<0.001) than in the younger elderly of 65–79 years (coefficient=0.31, P<0.05), while there existed inverse relationship among people with no teeth and those with 10–19 teeth (P for interaction <0.001). In addition, the depressive symptom scores of men were higher than those of women with regard to people with 9 teeth or less, and the scores of women were higher than those of men for participants with 10–19 teeth (P for interaction =0.021).

DISCUSSION

The primary findings of this prospective study were that there was a significant association between oral status and depressive symptoms of Chinese older adults at 4-year follow-up, which meant that participants with fewer teeth left (<20) and those who were non-denture users were associated with severer depressive symptoms. We also found that the association between tooth loss and depressive symptoms seemed to be mitigated by wearing dentures in each tooth loss category, considering the combined effects of tooth loss and denture use on depressive symptom scores. Subgroup analysis showed that young older adults (65–79 years) and men with tooth loss were more likely to suffer from depressive symptoms.

Our findings were consistent with prior studies (*9*–*12*). A prospective longitudinal study found that older adults in Brazil who experienced tooth loss were at greater risk of exhibiting depressive symptoms (*9*). In a Japanese longitudinal study, having no teeth could play a role in worsening depressive symptoms in individuals aged 65 years and older (*10*). Another study pointed out that a deterioration in oral health increased the risk of depressive symptoms among a group of older adults in England (*11*). In addition, a cross-sectional study of the Republic of Korea reported that the use of dental prosthesis in patients with the loss of multiple teeth was expected to reduce the likelihood of severe depression (*12*). Nevertheless, a limited number of studies have investigated the independent and combined effects of both tooth loss and denture use on later life depression using large-scale longitudinal data.

Several mechanisms could explain the association between oral health, referring to the number of natural teeth and denture use, and depressive symptoms. First, oral status can affect dietary intake and nutritional status (*13*). Several studies have suggested that diet and nutrition play an important role in preventing and managing depression (*14*). Denture use can contribute to the decrease of depressive symptoms by helping people keep good nutritional condition. Second, oral health is not only related to the ability of speaking, smiling, smelling, tasting, touching, chewing, and swallowing but also undertaking social functions such as expressing multiple feelings (*15*). Older adults may feel less confident and unnatural because of the changes in their face and way of speaking caused by tooth loss. Denture use can relieve their mental stress and depression by maintaining their previous status. Third, poor dental health predicted becoming homebound among older adults (*6*), and the elderly's social engagement is thus restricted. Social involvement is especially associated with depressive symptoms among the elderly.

Oral health, effectively marked by tooth loss, is of great significance to the psychological wellbeing of older adults. However, Chinese older adults who suffer tooth loss do not pay enough attention to oral health due to the financial burden of dental care and poor oral health literature. It is urgent to take measures to help senior citizens promote oral health and strengthen the care of dentures by expanding basic health insurance coverage to include dental prosthodontics or by providing affordable dental insurance for seniors.

The study was subject to some limitations. First, the relationship between oral status and depressive symptoms could only be concluded as an association rather than causation because the study design was observational. Second, misclassification bias could arise from the loss of detailed information, such as time of tooth loss and type of denture use. Third, residual confounding may exist as a result of the presence of unmeasured or unknown factors. Fourth, the quality of adopted 5-item scale of depressive symptoms might have been worse than other depression scales such as the Geriatric Depression Scale (GDS) or Center for Epidemiologyical Studies Depression Scale (CES-D). Last, self-reported information of numbers of teeth may lead to imprecise measurements.

Acknowledgements: All CLHLS participants and relevant staff.

Conflicts of interest: No conflicts of interest.

Funding: The National Social Science Foundation (N20ZDA076).

doi: 10.46234/ccdcw2021.208

[#] Corresponding author: Gong Chen, chengong@pku.edu.cn.

[1] Institute of Population Research, Peking University, Beijing, China.

Submitted: September 14, 2021; Accepted: September 28, 2021

REFERENCES

1. Sischo L, Broder HL. Oral health-related quality of life: what, why, how, and future implications. J Dent Res 2011;90(11):1264 – 70. http://dx.doi.org/10.1177/0022034511399918.
2. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global Burden of severe tooth loss: a systematic review and meta-analysis. J Dent Res 2014;93(S7):20S – 8S. http://dx.doi.org/10.1177/0022034514537828.
3. Alexopoulos GS. Depression in the elderly. Lancet 2005;365 (9475):1961 – 70. http://dx.doi.org/10.1016/s0140-6736(05)66665-2.
4. Matsuyama Y, Jürges H, Dewey M, Listl S. Causal effect of tooth loss on depression: evidence from a population-wide natural experiment in the USA. Epidemiol Psychiatr Sci 2021;30:e38. http://dx.doi.org/10.1017/s2045796021000287.
5. Koyama S, Aida J, Kondo K, Yamamoto T, Saito M, Ohtsuka R, et al. Does poor dental health predict becoming homebound among older Japanese? BMC Oral Health 2016;16(1): 51. http://dx.doi.org/10.1186/s12903-016-0209-9.
6. Woo J, Ho S, Lau J, Yuen YK. Chewing difficulties and nutritional status in the elderly. Nutr Res 1994;14(11):1649 – 54. http://dx.doi.org/10.1016/S0271-5317(05)80319-7.
7. Zeng Y. Chinese longitudinal healthy longevity survey and some research findings. Geriatr Gerontol Int 2004;4(S1):S49 – 52. http://dx.doi.org/10.1111/j.1447-0594.2004.00147.x.
8. Kunrath I, Ribeiro Silva AE. Oral health and depressive symptoms among older adults: longitudinal study. Aging Ment Health 2020. http://dx. doi.org/10.1080/13607863.2020.1855104.
9. Shen K, Zhang B, Feng QS. Association between tea consumption and depressive symptom among Chinese older adults. BMC Geriatr 2019;19(1):246. http://dx.doi.org/10.1186/s12877-019-1259-z.
10. Yamamoto T, Aida J, Kondo K, Fuchida S, Tani Y, Saito M, et al. Oral health and incident depressive symptoms: JAGES project longitudinal study in older Japanese. J Am Geriatr Soc 2017;65(5):1079 – 84. http://dx.doi.org/10.1111/jgs.14777.
11. Rouxel P, Tsakos G, Chandola T, Watt RG. Oral health-a neglected aspect of subjective well-being in later life. J Gerontol Ser B Psychol Sci Soc Sci 2018;73(3):382 – 6. http://dx.doi.org/10.1093/geronb/gbw024.
12. Shim J, Lee Y, Hong SJ, Noh K, Pae A, Kim HS, et al. Relationship between usage of removable denture and depression in Korean adults with loss of multiple teeth: A cross-sectional study using the seventh Korea national health and nutrition examination survey. J Korean Acad Prosthodont 2021;59(1):1 – 10. http://dx.doi.org/10.4047/jkap.2021.59.1.1.
13. Nowjack-Raymer RE, Sheiham A. Numbers of natural teeth, diet, and nutritional status in US adults. J Dent Res 2007;86(12):1171 – 5. http://dx.doi.org/10.1177/154405910708601206.
14. Upton N. Developing our understanding of nutrition in depression. Br J Nutr 2021. http://dx. doi.org/10.1017/S0007114521001744.
15. Glick M, Williams DM, Kleinman DV, Vujicic M, Watt RG, Weyant RJ. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. Br Dent J 2016;221(12):792 – 3. http://dx.doi.org/10.1038/sj.bdj.2016.953.

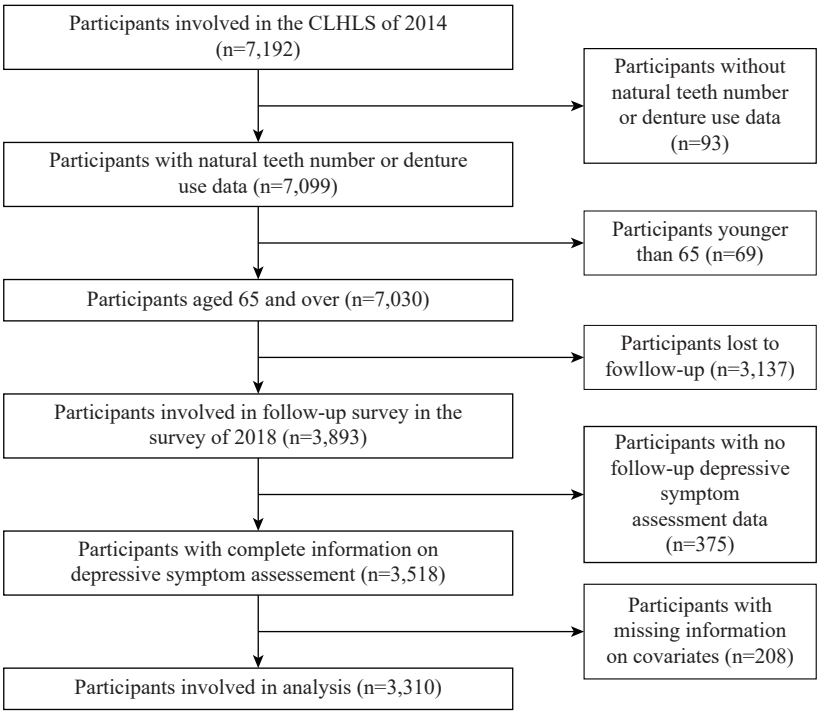
SUPPLEMENTARY MATERIALS

Supplementary Information of Sample Selection and Variables

Self-reported number of natural teeth and the use of dentures were collected by use of the questions of "A: how many natural teeth (teeth that are naturally grown) do you still have?" and "B: do you have false teeth? (false teeth referred to any type of non-natural teeth, including partial or complete, removable, or implant-retained fixed dentures)." The remaining teeth were classified into four categories: (0, 1–9, 10–19, and 20 plus). We assessed the combined effects by sorting the participants into eight categories based on teeth number and denture use.

A five-item scale, which has been applied in several studies to represent depressive symptoms via the Chinese Longitudinal Healthy Longevity Survey (CLHLS) data (*1–2*), was adopted in CLHLS to evaluate depressive symptoms. Two questions, including "do you look on the bright side of things?" and "are you as happy now as when you were young?" measured positive feelings while three questions measured negative feelings, including the following: "do you often feel anxious or fearful ?" "do you often feel lonely and isolated?" and "do you feel the older you get, the more useless you are?". The interviewees answered those questions by choosing from five frequency options of "Always," "Often," "Sometimes," "Seldom," and "Never." Each response was assigned a value from 0 to 4, and a higher frequency of negative feeling indicated a higher value. Then the summed value varied from 0 to 20. Cronbach α coefficient assessed the internal consistency reliability based on the 2014 sample is 0.84, which is higher than the acceptable values of 0.6. We operated principal component analysis to generate one factor explaining 93% of the total variance with eigenvalues ≥1.

We controlled for three groups of covariates that could be significantly associated with depression of older adults according to previous studies (*3–5*). The first group consisted of the demographic and socioeconomic factors, including age, gender (male or female), ethnicity (Han or minority groups), marital status (married or non-married), residence (urban or rural), years of education, and pension status (having a pension or not). The second group included lifestyle and health characteristics, including smoking (current smoker, former smoker or non-smoker),



SUPPLEMENTARY FIGURE S1. Flow chart of sample selection.
Abbreviation: CLHLS=Chinese Longitudinal Healthy Longevity Survey.

SUPPLEMENTARY TABLE S1. Baseline characteristics of the included participants.

Item	Number of natural teeth (N=3,310)					
	Overall	20+	10–19	0–9	0	*P*-value
Number of participants, n (%)	3,310(100.00)	846(25.56)	654(19.76)	870(26.28)	940(28.40)	
Number of natural teeth, mean (SD)	10.56(10.30)	25.69(3.94)	13.71(2.89)	4.68(2.69)	0.00(0.00)	<0.001
Denture usage (%)						
Yes	1,304(39.40)	158(18.68)	219(33.49)	322(37.01)	605(64.36)	<0.001
No	2,006(60.60)	688(81.32)	435(66.51)	548(62.99)	335(35.64)	
Depressive symptom, mean (SD)	6.78(3.19)	6.09(3.10)	6.97(3.15)	7.20(3.22)	6.85(3.17)	<0.001
Age, mean (SD)	81.29(10.32)	74.21(8.10)	79.10(8.90)	84.54(9.45)	86.23(9.90)	<0.001
Male, n (%)	1,576(46.99)	490(57.36)	323(48.04)	369(44.15)	394(39.33)	<0.001
Married, n (%)	1,639(46.92)	549(68.97)	367(50.87)	366(36.95)	357(33.57)	<0.001
Urban residence, n (%)	1,426(39.13)	387(41.26)	291(39.7)	370(37.20)	378(39.16)	0.093
Years of education, mean (SD)	2.53(3.65)	3.87(4.02)	2.66(3.75)	1.88(3.27)	1.86(3.18)	<0.001
Have pension, n (%)	1,191(35.98)	367(43.38)	254(38.84)	311(35.75)	259(27.55)	<0.001
Smoking, n (%)						
Current smoker	586(20.98)	17226.78)	112(18.82)	141(19.41)	161(18.75)	<0.001
Former smoker	385(15.66)	121(16.84)	81(16.79)	88(14.75)	95(14.66)	
Non-smoker	2,319(63.36)	549(56.38)	459(64.39)	635(65.84)	676(66.59)	
Drinking, n (%)						
Current drinker	558(20.43)	174(24.60)	111(20.86)	128(18.50)	145(18.20)	<0.001
Former drinker	289(13.05)	91(14.89)	56(13.81)	73(13.38)	69(10.34)	
Non-drinker	2,425(66.52)	571(60.52)	480(65.33)	656(68.12)	718(71.46)	
Frequent fruit intake, n (%)	487(13.12)	134(16.49)	85(10.61)	119(10.39)	149(14.77)	<0.001
Frequent vegetable intake, n (%)	521(22.13)	162(24.50)	87(25.24)	129(20.27)	143(19.52)	<0.001
Restricted ADL, n (%)	300(5.61)	45(2.53)	41(3.27)	85(6.54)	129(9.35)	<0.001
MMSE score, mean (SD)	25.95(4.87)	27.73(3.18)	26.59(4.11)	25.04(5.38)	24.75(5.52)	<0.001
Playing card/mahjong, n (%)	276(7.84)	106(10.80)	52(7.41)	59(6.89)	59(6.36)	<0.001
Community activity, n (%)	125(3.38)	45(4.89)	26(3.49)	28(2.69)	26(2.60)	<0.001
Travel, n (%)	287(7.00)	113(11.09)	55(6.83)	65(5.22)	54(5.14)	<0.001

Note: *P* values are calculated with analysis of variance (ANOVA) for continuous variables and Chi-squared test for categorical variable.
Abbreviations: ADL=Activities of daily living; MMSE=Mini-mental state examination.

drinking (current drinker, former drinker or non-drinker), frequent fruit intake (yes or no), frequent vegetable intake (yes or no), Activities of daily living (ADL) (restricted or not), and mini-mental state examination (MMSE) score. The third group were made up of social engagement variables, including playing cards or mahjong (yes or no), participation in community activities (yes or no), and travel (yes or no).

SUPPLEMENTARY TABLE S2. Depressive symptom scores by covariates (N=3,310).

Item	Depressive symptoms, mean (SD)
Sex	
Female	6.57(3.28)
Male	5.75(3.19)
Age, years	
65–74	5.90(3.11)
75+	6.27(3.31)
Ethnicity	
Han	6.12(3.20)
Minority	6.19(3.30)
Marital status	
Married	5.74(3.11)
Unmarried or widowed	6.66(3.35)
Pension	
Yes	5.83(3.23)
No	6.36(3.26)
Residence	
Urban	5.72(3.32)
Rural	6.51(3.17)
Denture usage	
Yes	5.95(3.27)
No	6.29(3.25)
Smoking	
Current smoker	5.92(3.20)
Former smoker	5.24(3.27)
Non-smoker	6.39(3.24)
Drinking	
Current drinker	5.56(3.17)
Former drinker	5.54(3.32)
Non-drinker	6.38(3.25)
Frequent fruit intake	
Yes	4.87(3.19)
No	6.39(3.22)
Frequent vegetable intake	
Yes	5.77(3.33)
No	6.24(3.25)
Restricted ADL	
Yes	6.83(3.17)
No	6.10(3.27)
Playing card/mahjong	
Yes	4.64(2.93)
No	6.31(3.25)
Community activity	
Yes	4.89(3.10)
No	6.22(3.26)
Travel	
Yes	4.51(2.92)
No	6.34(3.25)

Abbreviation: ADL=Activities of daily living.

REFERENCES

1. Yi Z, Vaupelly JW. Association of late childbearing with healthy longevity among the oldest-old in China. Popul Stud 2004;58(1):37 – 53. http://dx.doi.org/10.1080/0032472032000175437.
2. Shen K, Zhang B, Feng QS. Association between tea consumption and depressive symptom among Chinese older adults. BMC Geriatr 2019;19(1):246. http://dx.doi.org/10.1186/s12877-019-1259-z.
3. Li J, Xu HZ, Pan W, Wu B. Association between tooth loss and cognitive decline: a 13-year longitudinal study of Chinese older adults. PLoS One 2017;12(2):e0171404. http://dx.doi.org/10.1371/journal.pone.0171404.
4. Yang HL, Li FR, Chen PL, Cheng X, Mao C, Wu XB. Tooth Loss, denture use, and cognitive impairment in Chinese older adults: a community cohort study. J Gerontol Ser A Biol Sci Med Sci 2021. http://dx. doi.org/10.1093/gerona/glab056.Yuan JQ, Lv YB, Kraus VB, Gao X, Yin ZX, Chen HS, et al. Number of natural teeth, denture use and mortality in Chinese elderly: a population-based prospective cohort study. BMC Oral Health 2020;20(1):100. http://dx.doi.org/10.1186/s12903-020-01084-9.

Perspectives

Situation, Challenges, and Countermeasures of Home-Based Healthcare Service Supply and Demand in China

Jingjing Sun[1]; Yalu Zhang[1]; Xinhui Zhang[1]; Xinming Song[1]; Gong Chen[1,#]

According to the Seventh National Census of China, the population of adults aged 65 and above will be 190 million in 2020 (13.5% of the total population). As the "post-60s" group born at the second childbirth peak reaches retirement age, the growth rate of the population of older adults will accelerate significantly. By 2030, the proportion of older population (aged 65 and above) will reach about 17%, and the growth rate of the population aged 80 and above will be even more pronounced. Greater age is associated with more comorbidities and chronic diseases. It is estimated that 46% of older adults in China suffer from multiple diseases and 38% suffer from functional impairment (*1–2*). With a rapidly aging population and longer life expectancy, the incidence of chronic diseases, disabilities, and functional impairment are increasing dramatically, posing new challenges to our society's healthcare system and healthcare expenditures.

THE CURRENT SITUATION OF HOME-BASED HEALTHCARE SERVICE IN CHINA

Home-based healthcare is a response to the need for healthcare services for the special groups (e.g., the oldest-old population or older adults with disabilities, with chronic diseases, or with needs of follow-up healthcare services after being discharged from the hospitals). Studies have shown that home-based healthcare in Japan and the United States can effectively alleviate the shortage of inpatient beds in hospitals, save medical insurance funds, and reduce the cost of seeking medical treatment for patients living in remote areas (*3–4*).

In China, home-based healthcare services have been provided in Beijing, Shanghai, Shenzhen, Jinan and other places, including three types of services — home visits, home care, and home sickbeds* provided by community health service centers, public hospitals, and private medical institutions (*5*). These medical institutions differ in their service delivery, service recipients, and payment methods. According to the Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2018 data, 34.3% of older adults (aged 65 and above) were able to access home visiting services, while as many as 81.8% of older adults desired home visiting services that their communities provided. As shown in Table 1, such significant gaps of unmet needs existed across genders, age groups, types of household registration (*hukou*), living arrangements, daily living functioning, health insurance coverage, and residential area.

In 2020, the National Health Commission and the National Administration of Traditional Chinese Medicine issued the Notice on Strengthening Home-Based Healthcare Services for The Older Adults, which called for further increasing the supply of home-based healthcare services for the older adults and precisely matching the diverse urgent medical service needs of the older adults. However, compared with the countries in Europe, the United States, Japan, and many other countries, China's home healthcare services are still in their exploratory stage, and face a series of challenges. The rest of this paper will explicitly discuss the challenges from both the demand and the supply sides, and in the end provide some recommendations for future policymaking in China.

THE CHALLENGES FROM DEMAND

First, the demand for home-based healthcare services for the older adults is diverse. At present, offered services are mostly limited to basic services such as injection, medication change, urinary catheterization, blood pressure (blood glucose) monitoring, etc. In addition to the above services, psychological counselling, remote health monitoring, home sickbeds,

* Notes: Home sickbed is a bed designed to help patients recover according to the treatment needs and living habits of patients and uses the family and home as the treatment and nursing place, which can meet various treatment, rehabilitation, and nursing needs.

TABLE 1. Supply and demand of home healthcare for Chinese older adults in 2018 (N=15,720).

Variables		Home visiting services			
		Available in community (%)	*P*	Expect community to provide (%)	*P*
Overall		34.26		81.84	
Gender	Male	34.33	0.977	81.44	0.837
	Female	34.21		82.15	
Age, years	65–74	33.66	0.870	82.25	0.328
	75–84	32.08		80.23	
	≥85	35.63		82.51	
Household registration	Urban	28.88	<0.001	76.24	<0.001
	Rural	36.23		83.93	
Living arrangement	With family member(s)	34.08	<0.001	81.64	<0.050
	Living alone	32.16		82.27	
	In an institution	46.65		82.27	
Limited in activities	Strongly limited	36.27	0.235	80.76	0.235
	Limited	37.68		83.59	
	Not limited	32.53		81.41	
Basic medical Insurance coverage	Yes	34.73	<0.001	82.42	<0.001
	No	31.42		76.86	
Commercial medical insurance	Yes	44.86	<0.001	82.08	0.446
	No	34.28		81.7	
Area	East	38.05	<0.001	81.31	<0.001
	Central	36.70		85.77	
	West	27.73		83.61	
	Northeast	16.77		62.74	

Note: The Chinese Longitudinal Healthy Longevity Survey gives the data of 2018, which is the latest publicly available data so far. With the introduction of policies and the development of the older adults' healthcare services in recent years, the data analysis results are likely to be underestimated.

and medical patrol are also in high demand by the home-based older adults (*6*).

Second, older adults may have a lower level of knowledge about home healthcare service but a high willingness to accept them. A survey on the demand for home-based healthcare services in Chaoyang District, Beijing Municipality showed that only 26.8% of older adults were aware of at least one home-based health service, while the proportion of older adults who were supportive of home-based health services were more than 70% (*7*). It is evident that older adults have high expectations for home healthcare services, but the lower awareness rate may have resulted in lower service utilization. The practice of Kumamoto City, Japan is worth referencing. The relevant medical administrative units are responsible for investigating the scope of home-based medical services and the receiving capacity of various medical institutions and then printing brochures according to the survey results to help patients understand the scope of home services and disposal process of various medical institutions (*3*).

THE CHALLENGES FROM SUPPLY

Compared to the challenges from demand, the challenges from supply are more complicated. First, the risk management system of home-based healthcare services is imperfect. The complex home environment imposes higher requirements for medical skills and improvisational abilities on medical personnel. The change of medical treatment location brings legal and safety risks beyond traditional medical treatment. Medical personnel are reluctant to provide services at home due to the lack of protection from laws and regulations. For example, due to the tension of the doctor-patient relationship and the fact that the current enforced Physician Law (2009 version) does not apply to home healthcare, medical professionals are

concerned that some home healthcare practices may violate the law (*8*). Even if the revised draft of the Physician Law (2021 version) has been issued, most of the revised parts are related to the prevention of infectious diseases, and some situations may still not be suitable for home medical treatment. Referring to the relevant series of home care laws and systems of the United States, Canada, the Netherlands, and other countries, the Physicians Act should be revised according to China's local circumstances.

Second, there is a lack of institutions or organizations responsible for communication between various institutional departments, resulting in barriers to information transmission among hospitals, medical insurance institutions, and primary medical institutions. The provision of home-based healthcare services require close collaboration among relevant local government departments, hospitals, community health service centers, community resident committees, and other institutions. If the cooperation is not smooth, problems can arise, such as lack of understanding of patients' daily living habits by doctors, mismatch between the equipped medical personnel and the medical needs of residents, and inadequate understanding of the guidelines and policies of higher authorities. Japan's government has set up home-based health cooperation stations in each region, which are responsible for leading communication and cooperation between various departments, conveying the policies and guidelines of superior departments, and finding appropriate local implementation methods (*3*). Furthermore, the cooperation stations accurately grasp the local healthcare resources and establish a mechanism for mobile services in the region. These practices can be used as a reference for China.

Third, the economic security of home-based healthcare services is insufficient. For the service recipients, the lack of economic security is reflected in the fact that the provision of home medical services by hospitals is not covered by medical insurance and is paid for by the demand side (*9*). Innovative programs should be developed that can be used as models for other jurisdictions. The experience in Beijing can be used as a reference. Beijing Municipal Government has included medical expenses for on-site service in the medical insurance reimbursement program. At the same time, medical insurance reimbursement can be obtained by using home sickbeds, and the starting line of the reimbursement is reduced by 50%. In the case of home care services, we can refer to the practice of Japan, which connects care insurance with home care service and prioritize the use of care insurance to pay the expenses incurred by home care. Moreover, there is insufficient incentive for the medical personnel to provide home-based healthcare services. For example, such services in a community in the Bailong Street District of Fuzhou City are provided by the medical personnel from a nearby Chinese medicine hospital. These personnel regard home-based health visits and care as a public service activity and did not receive additional compensation for the service provision.

Fourth, the information-sharing mechanism of home-based healthcare services is insufficient. In 2013, the National Basic Public Health Service Program proposed to establish electronic health records for permanent residents in the jurisdiction. As of 2020, the filing rate of electronic health records exceeded 90%. However, there is still a certain distance from the ideal information-sharing mechanism. For example, the information-sharing between electronic health records and hospital electronic medical records is inconvenient, resulting in the low utilization of electronic records. Some practices of local governments in China and valuable experiences from abroad are worth referencing. Chaoyang District of Beijing has built a regional information-based medical service platform to provide older adults, especially empty nesters whose children have left the home, with integrated continuous services including chronic disease management, medical treatment, rehabilitation, and healthcare. The platform helps to monitor older adults' health conditions and greatly improves the work efficiency of the community physicians. Additionally, the Japanese government has actively used information and communication technology (ICT) to build an interconnected information support system. Medical and professional nursing staff can use the platform to record or view the diagnosis, care plan, daily temperature change chart, and medication status of patients in home care at any time, which significantly improved service quality and the communication efficiency between medical and nursing staff and patients (*10*). Meanwhile, government departments can use the platform to achieve real-time supervision and effectively curb illegal acts such as abuse of older adults' personal and property rights.

Fifth, the personnel supply of home-based medical care services is insufficient. With the promotion of community family physician model, home-based healthcare services provided by primary medical institutions for the older adults and disabled at home

are gradually increasing. According to the statistics of the National Health Commission, the number of general practitioners in China increased from 252,000 in 2017 to 365,000 in 2019, with an average annual growth rate of 20%. According to the long-term goal of having 5 general practitioners per 10,000 residents in 2030, it is expected to achieve this goal before 2025 (anticipated based on that China's total population will reach 1,450 million in 2030 estimated by the United Nations). China has significantly increased the number of general practitioners in poor areas through the implementation of the special post plan for general practitioners and the targeted admission medical education program for rural students. However, there is still a certain gap with the growing demand for health management. Meanwhile, the current personnel management system of medical and health institutions in China adopts a fixed staffing and work position system (according to the tasks undertaken by the government, enterprises, and institutions, determine the establishment of institutions and the number of personnel to streamline institutions and improve efficiency), which would further aggravate shortages of primary medical personnel if medical institutions are required to carry out home healthcare services (*11*). In addition to general practitioners and registered nurses, the family physician team needs more rehabilitation physicians, public health physicians, community nursing staff, and other medical staffs. However, due to the reasons of low wages, high labor intensity, low social recognition, and imperfect protection mechanisms (*12*), healthcare staff are not willing to engage in onsite medical and nursing services. The salary incentive to prevent personnel loss can learn from the practice of the United States, which takes 10% of the medical insurance quota as a subsidy for medical personnel (*13*).

Sixth, there are regional differences in the provision of home-based healthcare services. The provision of home healthcare services is closely related to socioeconomic development. More home-based health services are provided in economically developed areas. But it is difficult for older adults in remote areas to obtain such resources (Table 1). Regional differences are a global problem, even for Japan and the United States, where home-based care service have been relatively well developed. Telemedicine is recognized as the best way to solve this problem and achieve some medical equity. In 2015, with the guidance of the State Council on actively promoting the "Internet plus initiative" action, some companies providing telemedicine have gradually developed in China. For example, the website named "Good Doctor Online" can provide a number of remote services such as hospital/doctor information query, online consultation, post-diagnosis disease management, family medicine, and disease knowledge education. Although great improvements have been achieved, a series of problems, such as the inability to use medical insurance to pay for online consultations with doctors and the long delivery time of medications remains unresolved.

VISION FOR HOME-BASED HEALTHCARE SERVICE IN CHINA

The theme of the Plan of Health China 2030 is "Contribution and Shared Benefits, Achieve National Health". The provision of home-based healthcare services is one of the important ways to realize the strategy of healthy China. In the future, we should provide home-based healthcare for the entire population throughout their life cycle to improve national health. The core thought is to prioritize prevention, paying equal attention to traditional Chinese and western medicine.

There is a long way to go to implement home-based healthcare in China. However, it can be seen from the introduction of the strengthening care policy for older adults that China's government has been paying much attention to and committing to encouraging the development of home-based healthcare. Furthermore, based on the Plan of Health China 2030, the vision for home healthcare services should adhere to the following principles.

An excellent home-based healthcare system should focus on people's health. The idea of taking people's health as the central priority emphasizes the transformation from "treatment first" to "prevention first". Thus, home-based healthcare systems should focus on keeping people healthy by preventing illness and injury, postponing illness, and providing medical and nursing services to reduce the impact of disease and improve quality of life.

It is necessary to provide home healthcare services for the whole life cycle of the entire population. This goal needs to be achieved step by step. At present, we need to prioritize the limited resources to meet the needs of vulnerable groups. In the future, we hope to provide home healthcare services that meet the diversified health needs of the whole population across

the entire life cycle through the government and the market to promote the health literacy of the entire people.

It is time to realize the scientific development of home-based healthcare services. We need to grasp the development rules of health to provide health services. Furthermore, we should build a home-based healthcare service supply coordinated with the national medical and health service system to promote the quality and efficiency of home healthcare services.

We will promote the equalization of essential home healthcare services. We expect to make full use of technological innovation and information technology to gradually narrow the differences in essential home healthcare services between urban and rural areas, regions, and groups, and move towards universal coverage and promote health equity.

RECOMMENDATIONS FOR IMPROVEMENT OF HOME-BASED HEALTHCARE SERVICE IN CHINA

At present, the main obstacles encountered in developing home-based healthcare services in China can be summarized as follows: (1) The inaccurate identification of effective demand; (2) The imbalance of the supply structure; (3) The lack of integration of factors.

Focused on the vision of home healthcare that we are trying to establish, the construction of a home-based healthcare service system with local situations needs to make efforts from both sides of supply and demand at the same time.

First, a deep understanding of effective demand is a prerequisite for providing accurate home-based healthcare services. It is necessary to establish a comprehensive evaluation standard for home-based healthcare service needs, to strengthen the collection of such service information for older adults, regularly carry out older adults' home service needs assessment, to specify the quantity and type of need, to allocate related resources and services according to requirements, and to improve the accuracy of services supply and subsidies.

Second, the system of home-based healthcare services needs to be improved. China urgently needs to improve the medical risk management mechanism and set up intermediary agencies responsible for inter-agency communication and cooperation. The relevant industry norms, service standards, price mechanism, and risk quality control need to be further clarified and unified to become a legal guarantee and code of conduct for medical personnel to provide home healthcare. In addition, the health administration department should establish a particular institution to strengthen the communication and collaboration among various departments.

Third, the supply of home healthcare services needs to be significantly improved to meet the effectual demand. Its development focuses on improving talent allocation and economic security.

It is crucial to fully realize and develop existing human resources and improve the management norms of medical personnel. In order to increase the number of personnel, we should fully utilize the doctors and nurses in secondary hospitals, industrial hospitals (plants for coal, steel, etc.), and traditional Chinese medicine hospitals with few patients to form a family doctor team; in addition, medical institutions should establish salary and position promotion incentive mechanisms to prevent personnel loss. Regarding personnel quality, it is necessary to divide the types of home healthcare services and the operational functions of medical staff based on needs and give general practitioners the right of two-way referral (not only transfer patients from lower-level hospitals to higher-level hospitals but also transfer patients from higher-level hospitals to lower-level hospitals) and green channel for medical treatment (a service package that includes expert outpatient services, hospitalization arrangements, operation arrangements, post-treatment follow-ups, expert return visits, etc., to facilitate patients with urgent medical needs to enjoy medical resources first) to improve the social status of family doctors. Meanwhile, we should pay attention to the role of nurses and encourage them to undertake door-to-door nursing, team management, and other work.

Home-based healthcare service programs should be linked with basic medical insurance and long-term care insurance to strengthen financial protection of home-based healthcare. It is also necessary to improve people's utilization of primary health services appropriately (e.g., properly reducing the starting line of the reimbursement).

Fourth, it is crucial to improve the information-sharing mechanism and the development of Internet medicine to promote health equality. The ideal information-sharing mechanism should contain the health monitoring data reported by patients and their family members, the living environment and health information provided by the community, and patient's

medical records in hospitals. It is urgent to use modern information technology to build a health information-sharing platform based on electronic health records and hospital electronic medical records, which can not only help the community physicians to monitor older adults' health conditions and dramatically improve the work efficiency but also help governmental departments to implement real-time supervision. Meanwhile, it is necessary to promote the development of telemedicine, which can improve the uneven distribution of regional medical resources. Relevant policy-making and patient demand are the two determinants of the development of telemedicine. Policymakers need to clarify the types of diseases to set up treatment norms to promote the participation of physical hospitals and internet enterprises. Patients' needs include people's needs for health maintenance (especially living in remote areas), the need for medical insurance to cover internet medical expenses, and the use habits and convenience of internet medical treatment. Solving the above problems can further promote the development of Internet medicine.

As an essential part of primary medical services and a way to actively deal with population aging, home-based healthcare services have effectively met the people's multilevel medical and health needs. Therefore, we hope to keep people healthy at home as much as possible by promoting home-based healthcare services.

Conflicts of Interest: No conflicts of interest declared.

Funding: National Social Science Fund of China (Grant No.20ZDA076).

doi: 10.46234/ccdcw2021.209

[#] Corresponding author: Gong Chen, chengong@pku.edu.cn.

[1] Peking University Institute of Population Research, Beijing, China.

Submitted: September 12, 2021; Accepted: September 22, 2021

REFERENCES

1. Chen H, Cheng ML, Zhuang Y, Broad JB. Multimorbidity among middle-aged and older persons in urban China: prevalence, characteristics and health service utilization. Geriatr Gerontol Int 2018; 18:1447 – 52. http://dx.doi.org/10.1111/ggi.13510.
2. Zhang R, Lu Y, Shi LY, Zhang SL, Chang F. Prevalence and patterns of multimorbidity among the elderly in China: a cross-sectional study using national survey data. BMJ Open 2019;9(8):e024268. https://bmjopen.bmj.com/content/9/8/e024268.
3. Li NN, Zhao J. The regional integration of home medical care under the comprehensive medical care system in Japan. J Jpn Language Study Res 2019;(3):39–46. https://kns.cnki.net/KXReader/Detail?TIMESTAMP=637669628156307621&DBCODE=CJFD&TABLEName=CJFDLAST2018&FileName=XNLX201804025&RESULT=1&SIGN=rm%2bQojPMcWlmG%2bU3ZgY0dVduujE%3d. (In Chinese).
4. Yang XJ, Ding HS, Du LX. Implication from the American program of all-inclusive care for the elderly. Chin Health Resour 2016;19(4):354 – 7. http://dx.doi.org/10.13688/j.cnki.chr.2016.15377. (In Chinese).
5. Yao NL. Research on the service mode of home care medicine in China. Chin Gener Pract 2020;23(12):1455 – 8. http://dx.doi.org/10.12114/j.issn.1007-9572.2019.00.487. (In Chinese).
6. Xiao P, Song S, Zhu L, Wu X, Wang S, Gao YJ. Analysis on the status-quo of demand and supply of community-based medical services under the mode of medical integration. Health Econom Res 2019;36(6):28–31. https://kns.cnki.net/KXReader/Detail?TIMESTAMP=637669634495952201&DBCODE=CJFD&TABLEName=CJFDLAST2019&FileName=WSJJ201906010&RESULT=1&SIGN=DooZlXUow93Clxrk7px5fHpXYS0%3d. (In Chinese).
7. Hu SX, Bai X, Rao FY, Zhang S, Lv CH, Zuo YP, et al. Demand of elderly for home-based medical care services and its influencing factors in Chaoyang district of Beijing City. Med Soc 2018;31(7):77 – 80, 86. http://dx.doi.org/10.13723/j.yxysh.2018.07.025. (In Chinese).
8. Chen T, Yao NL, Su MZ, Nong S, Bai M, Ma ZY. Challenges of home-based medical care in China: a telephone interview from the perspectives of home care providers. Chin Gener Pract 2020;23(12):1459 – 65. http://dx.doi.org/10.12114/j.issn.1007-9572.2020.00.214. (In Chinese).
9. Bai M, Ge HT, Yao NL, Chen T, Wu BX. Home health care delivery models in China: an exploratory comparative study. Chin Gener Pract 2021;24(19):2379 – 84. http://dx.doi.org/10.12114/j.issn.1007-9572.2021.00.229. (In Chinese).
10. Ren Y, Liu L, Shi J. Japan's Integration of Medical Care and Long-Term Care: Mechanism, Characteristics and Inspiration. Journal of Tianjin Administration Institute, 2021,23(4):87–95. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2021&filename=TJXZ202104009&uniplatform=NZKPT&v=cPh4Th%25mmd2BemjPPiuyM2DqJ3D6vRvsf5I%25mmd2Fke3OTJz6pEUGMJ0zXfQo%25mmd2BjwFFY%25mmd2FeeLSl7. (In Chinese).
11. Hao XN, Bo T, Zheng YH, Liu Z. Analysis of the status and development path of home medical care services. Health Econom Res 2020;37(2):7–9. https://kns.cnki.net/KXReader/Detail?TIMESTAMP=637669637625696391&DBCODE=CJFD&TABLEName=CJFDLAST2020&FileName=WSJJ202002004&RESULT=1&SIGN=pPX0TPOg5vd3AMVtgX6PhDayjD4%3d. (In Chinese).
12. Xie WY. Ethical advantage, problem analysis and countermeasures of family doctor service mode of the "medical-nursing combined" model. Chin Med Ethics 2018;31(4):519 – 24. http://dx.doi.org/10.12026/j.issn.1001-8565.2018.04.24. (In Chinese).
13. Qiu S, Liu JR, Wu SJ. Historical evolution and enlightenment of the patient-centered medical home in America. Chin Gener Pract 2015;18(22):2623 – 7. http://dx.doi.org/10.3969/j.issn.1007-9572.2015.22.002. (In Chinese).

Notifiable Infectious Diseases Reports

Reported Cases and Deaths of National Notifiable Infectious Diseases — China, July, 2021

Diseases	Cases	Deaths
Plague	0	0
Cholera	0	0
SARS-CoV	0	0
Acquired immune deficiency syndrome*	3,373	1,675
Hepatitis	139,343	46
Hepatitis A	1,038	0
Hepatitis B	112,287	34
Hepatitis C	22,940	11
Hepatitis D	19	0
Hepatitis E	2,140	0
Other hepatitis	919	1
Poliomyelitis	0	0
Human infection with H5N1 virus	0	0
Measles	80	0
Epidemic hemorrhagic fever	467	1
Rabies†	12	13
Japanese encephalitis	17	1
Dengue	3	0
Anthrax	66	1
Dysentery	6,982	0
Tuberculosis	76,648	131
Typhoid fever and paratyphoid fever	939	0
Meningococcal meningitis	4	0
Pertussis	820	0
Diphtheria	1	0
Neonatal tetanus	3	0
Scarlet fever	2,430	0
Brucellosis	9,222	2
Gonorrhea	11,747	0
Syphilis	51,531	9
Leptospirosis	28	0
Schistosomiasis	2	0
Malaria	92	2
Human infection with H7N9 virus	0	0
COVID-19§	1,213	0
Influenza	24,604	0
Mumps	9,367	0

Continued

Diseases	Cases	Deaths
Rubella	102	0
Acute hemorrhagic conjunctivitis	2,566	0
Leprosy	43	0
Typhus	101	0
Kala azar	23	0
Echinococcosis	306	1
Filariasis	0	0
Infectious diarrhea[¶]	123,462	0
Hand, foot and mouth disease	162,987	0
Total	**628,584**	**1,882**

[*] The number of deaths of Acquired immune deficiency syndrome are the number of all-cause deaths reported in the month by cumulative reported AIDS patients.
[†] Among the 13 death cases of rabies reported in July 2021, 7 cases were reported in July, the other 6 cases were reported before.
[§] 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.

doi: 10.46234/ccdcw2021.186

The inauguration of *China CDC Weekly* is in part supported by Project for Enhancing International Impact of China STM Journals Category D (PIIJ2-D-04-(2018)) of China Association for Science and Technology (CAST).

CCDC weekly

Vol. 3 No. 40 Oct. 1, 2021

Responsible Authority
National Health Commission of the People's Republic of China

Sponsor
Chinese Center for Disease Control and Prevention

Editing and Publishing
China CDC Weekly Editorial Office
No.155 Changbai Road, Changping District, Beijing, China
Tel: 86-10-63150501, 63150701
Email: weekly@chinacdc.cn

CSSN
ISSN 2096-7071
CN 10-1629/R1