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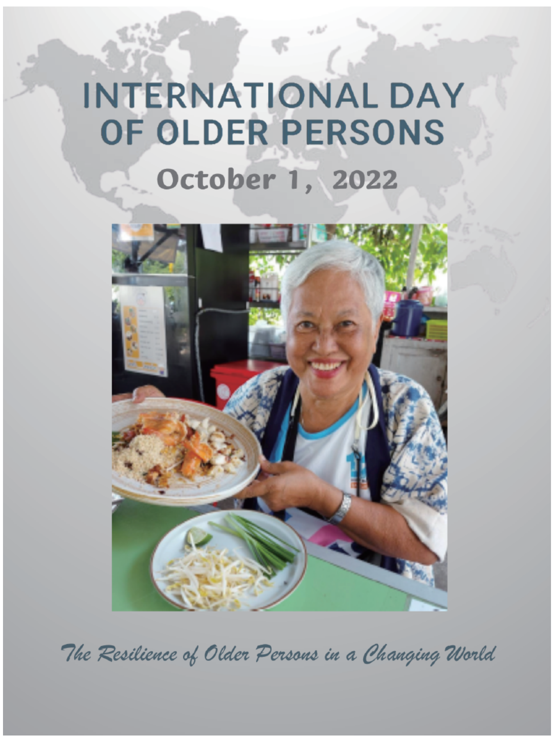

INTERNATIONAL DAY OF OLDER PERSONS ISSUE

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Cover Photo: adapted from the United Nations, https://www.un.org/development/desa/ageing/wp-content/uploads/sites/24/2022/09/Int.-Older-Persons-Day-2022_Poster.pdf.
This week's issue was organized by Guest Editor Xiaoying Zheng.

Foreword

Building a Chronic Diseases Prevention and Rehabilitation System Throughout the Life Span to Proactively Respond to the Challenges of Accelerated Population Aging

Erdan Dong[1,2,3,#]; Xiaoying Zheng[4,5,#]

Population aging has emerged as one of the most pressing global demographic issues. Rapid population aging is being caused by a sharp drop in fertility rates over time, as well as a significant increase in life expectancy in the past decades. The World Health Organization (WHO) estimates that the proportion of those aged 60 years and older in the world's population will almost double from approximately 12% in 2015 to 22% in 2050, with an absolute increase of 900 million to a total of 2 billion older adults (*1*). At the same time, the burden of global disease has changed greatly and the main diseases affecting human health have switched from acute and chronic infectious diseases to chronic non-communicable diseases (NCDs) (*2*). Such changing demographics and disease spectrum will profoundly affect all aspects of human society.

Aging is a decisive risk factor for many chronic diseases. Most NCDs, such as cancer, cardiovascular disease (CVD), Alzheimer's disease, Parkinson's disease, arthritis, diabetes, and obesity, are becoming leading causes of disability and death worldwide. These diseases usually emerge in middle age after long exposure to an unhealthy lifestyle involving tobacco use, alcohol use, stress, lack of regular physical activity, and consumption of a high-fat diet or red meat (*3*). It has been well established that the incidence of chronic diseases rises sharply with age and the majority of patients with a chronic ailment are over the age of 65 years. In China, four major chronic diseases, including CVDs, cancers, chronic respiratory diseases (CRDs), and diabetes, caused most of the deaths. Ample evidence shows that the lack of medical personnel, especially the nursing shortage, has become a problem in China. In the face of an aging population, increasing chronic diseases, anticipated shortages of many types of health care workers, and soaring health care costs, new models of health care delivery are inevitable.

Rehabilitation is also central to geriatric medicine. The WHO defines healthy aging in terms of maintaining functional ability. Disease prevention and early aggressive treatment of conditions such as hip fracture and stroke are important, but multi-professional remedial therapy is also effective when disability is manifest. Rehabilitation has evolved, from being primarily hospital-based to outpatient and community settings, the development of pre-surgical "pre-habilitation," and efforts to reverse frailty and sarcopenia. According to an analysis of data from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019, there were 2.41 billion people (95% uncertainty interval 2.34–2.50 billion) worldwide who would benefit from rehabilitation services in 2019 (*4*). As for China, rehabilitation needs are increasing rapidly due to the accelerated aging of the population and the rising incidence rate of chronic diseases. Health and social systems face huge challenges in meeting the growing rehabilitation needs, and more systematic and comprehensive solutions are needed.

The prevalence of coronavirus disease 2019 (COVID-19) has also brought new challenges to the cause of human health. It has been widely reported that there is a clear association between COVID-19 severity and NCDs. COVID-19 deaths also occur in older people who often have existing comorbidities (*5*). Body-mass index (BMI) might also be associated with the severity of COVID-19; in China, patients with severe COVID-19 and non-survivors typically had a high BMI (>25 kg/m^2) (*6*). These research results remind us that we cannot ignore the new challenges brought by the COVID-19 pandemic when responding to population aging.

Systematic research on aging and health to block the accumulation of health risks in all aspects of life span to the outbreak of old age is one of the most important ways to actively respond to aging. In this special issue, we invited colleagues from the School of Population Medicine and Public Health at the Chinese Academy of Medical Sciences/Peking Union Medical College, Center for Health Statistics and Information at National Health Commission, Department of Cardiology and Institute of Vascular Medicine at Peking University Third Hospital, and School of Public Health at Ghent University to report their latest findings on the system of chronic disease prevention and rehabilitation.

Zheng et al. created an advanced and evolving conceptual framework including the definition, goal, discipline, and scope of human aging omics (HAO) based on the theories and methods of omics science (*7*). Cai et al. described changes in the mortality rates of major chronic diseases among the population aged over 60 years and their contributions to life expectancy increases in China (*8*). Guo et al. presented scientific data and quantitative evaluation of the current state and challenges of rehabilitation needs for the elderly (aged 60 and above) in China (*9*). Finally, Zhang et al. reported the current situation and projections of the population aging in Europe and identified the limited access to healthcare among older adults in Europe due to COVID-19 (*10*).

These findings further expounded the pressures and challenges brought by the accelerated aging of the global population, especially when the COVID-19 pandemic is spreading all over the world. For China, the mortality rate of the four major chronic diseases mentioned above is decreasing, while the incidence rate of chronic diseases is rising. And the rehabilitation needs of the population are also increasing rapidly with the deepening of population aging. At the same time, we also pay attention to the development of foreign medical practice, and the accessibility of healthcare among the European elderly population was found affected by the COVID-19 outbreak in this issue. In addition, we put forward a more comprehensive concept and framework of HAO, which provides a clear direction for further future research and exploration of elderly health.

With the active preparedness for the population aging being elevated to a national strategy in China, the prevention and control of chronic diseases in the elderly and the optimization of the supply of rehabilitation services are topics that we cannot avoid. Aging is a complex and multifactorial process during which molecules, cells, and organs undergo damage over time, resulting in loss of function, increased morbidity, and, eventually, death. Therefore, in addition to research and analysis at the population and macro level, it is also urgent to further explore the mechanism of human aging from the perspective of omics and propose more precise intervention strategies for healthy aging achievement.

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Preplanned Studies

Changes in Mortality Rates of Major Chronic Diseases Among Populations Aged Over 60 Years and Their Contributions to Life Expectancy Increase — China, 2005–2020

Yue Cai[1]; Xiang Cui[2,3]; Binbin Su[4]; Shiyong Wu[1,#]

Summary

What is already known about this topic?

The impacts of population aging have appeared in China, leading to a marked shift in the major contributors to life expectancy. Longevity improvements are now mainly promoted by reductions in mortality rates of the aged.

What is added by this report?

This study systematically evaluates both changes in mortality rates of major chronic diseases among populations aged over 60 years as well as their contributions to life expectancy increases in China, from 2005 to 2020.

What are the implications for public health practice?

The results of this study demonstrate that more attention should be paid to health conditions of the elderly, especially for the prevention and control of major chronic diseases.

The life expectancy (LE) in China increased dramatically from 73.0 years in 2005 to 77.93 years in 2020 (*1*). With the mortality rate of children under 5 years old having dropped to a relatively low level (*2*), the key force for LE increase thus shifts over to the population of those 60 years old and older (*3*). In addition, China has undergone a rapid epidemiological transition in the past few decades: from an infectious-disease-based model to a double-threat model of emerging infectious diseases and chronic diseases. Four major chronic diseases, including circulatory diseases (CDs, I00-I99), cancers (CAs, C00-D48), respiratory diseases (RDs, J00-J99) and diabetes (DM, E10-E14) cause most of the chronic disease deaths in China (*4*). However, comprehensive analysis on mortality rates of the four major chronic diseases, and their contributions to overall LE in China's elderly population, is scarce.

To reveal the impact of the four major chronic diseases on LE in China for those over 60, this study evaluated the trend of the mortality rate of CDs, CAs, RDs and DM. Further, it conducted Arriaga's decomposition method to quantify the impact of disease on LE for those over 60, the results of which were sorted across nationwide, urban and rural areas respectively.

Information of age-specific all-cause mortality was primarily obtained from the death registration system of the National Health Commission (NHC) of China, where mortality records from five administrative organizations (including the death medical certificate information and the total population information from the Department of Health; the registered permanent residence cancellation information from the Department of Public Security; the cremation information from the Department of Civil Affairs; and the termination of social security information from the Department of Social Security) were integrated after the quality control of identification numbers and duplication removal. The underreporting rate of the whole population was 2.0% and 5.1% in 2017 and 2018 respectively. Detailed information was described thoroughly in this study's authors' previous studies (*5*–*6*). This study further obtained the annual population counts by age from the National Bureau of Statistics (NBS). Chiang's method was adopted to estimate the LE at 60, based on period abridged life tables with 19 groups in mostly 5-year age intervals. Then, the overall and cause-specific mortality rates (including circulatory diseases, cancers, respiratory diseases, and diabetes) for both urban and rural areas were estimated by dividing the national all-cause mortality rates by their specific proportions of total deaths from the Chinese Health Statistics Yearbook in 2005, 2010, 2015, and 2020, respectively. The classification criteria of urban/rural areas were consistent with the Chinese Health Statistics Yearbook, where urban areas include municipalities and prefecture-level municipal districts, and rural areas include counties and county-level cities.

The Arriaga's decomposition method was applied to decompose changes in LE at 60 during 2005–2020 by age and cause of death. In brief, the method decomposed mortality into direct, indirect, and interaction effects. For calculation, the formula could be shown as:

$$ {}_n\Delta_x = \frac{l_x^1}{l_0^1} \times \left(\frac{{}_nL_x^2}{l_x^2} - \frac{{}_nL_x^1}{l_x^1} \right) + \frac{T_{x+n}^2}{l_0^1} \times \left(\frac{l_x^1}{l_x^2} - \frac{l_{x+n}^1}{l_{x+n}^2} \right) \quad (1) $$

where ${}_n\Delta_x$ is the age-specific change of LE between time points 1 and 2; l_x^1 or l_x^2 denotes survivor numbers at age x at time point 1 or 2; ${}_nL_x^1$ or ${}_nL_x^2$ denotes person-years lived between age x and $x+n$ at time point 1 or 2; T_{x+n}^2 denotes person-years lived after age x.

The cause-specific contribution was accordingly calculated as:

$$ {}_n\Delta_x^i = {}_n\Delta_x \times \frac{{}_nm_x^i(2) - {}_nm_x^i(1)}{{}_nm_x(2) - {}_nm_x(1)} \quad (2) $$

where ${}_nm_x^i(1)$ or ${}_nm_x^i(2)$ indicates the mortality rates of disease i at time point 1 or 2, ${}_nm_x(1)$ or ${}_nm_x(2)$ indicates the all-cause mortality rates at time point 1 or 2.

All the statistical analyses were performed with R version 3.6.3 (R Foundation for Statistical Computing, Vienna, Austria) and Microsoft Excel (Version 2008 Build 16.0.15601.20148. Microsoft, Redmond, Washington, United States).

As is shown in Table 1, LE at birth in China reached 77.93 years in 2020, with an increase of 4.83 years from 2005, of which 26.43% was attributed to reductions in mortality rates of children under 5 years and 45.02% was attributed to reductions in mortality rates of those aged over 60 years. More specifically, a remarkable shift in age-specific contributions was observed during the past 15 years, which indicated that the health status of the elderly has an increasingly important impact on LE improvements in China. From 2005 to 2010, the remarkable reduction in child mortality rates accounted for a 39.64% increase in LE, while the contribution was weakened to 7.75% during 2015–2020. On the other hand, older persons aged over 60 years have gradually become the major population contributing to the increased LE, the contribution of which increased from 34.51% during 2005–2010 to 61.21% during 2015–2020.

Moreover, this study observed a sustained downward tendency in mortality rates of respiratory diseases for all age groups over 60 years from 2005 to 2020, and the declining rates slowed down as age increased: from −79% for individuals aged 60–65 years to −56% for those aged over 85 years. The mortality rates of circulatory diseases also declined for those aged 60–85 years, while there was an upward tendency among the elderly over 85 years, which increased from 7,836.86 /100,000 in 2005 to 9,793.69/100,000 in 2020. A similar trend was observed for mortality rates of cancers, which declined in the 60–80 age group while increased among those aged over 80 years. Despite the general decreasing trend in mortality rates of major chronic diseases, a modest rise was found for diabetes in all age groups over 60 years (Figure 1).

Improvements of LE attributed to the four above-mentioned major chronic diseases were presented in Figure 2 and Supplementary Table S1 (available in http://weekly.chinacdc.cn), organized by nationwide and by rural or urban area data. As a whole, reductions in mortality rates for the population aged over 60 years for major chronic diseases contributed to 2.06 years of LE increase at 60 years in the urban areas, which was much larger than that in rural areas (1.20 years). More specifically, reductions in mortality rates of respiratory diseases (1.26 years) contributed the most to the increase in LE, followed by circulatory diseases (0.57 years). Contrastingly, the impacts of diabetes (−0.05 years) and cancers (−0.03 years) were found to be negative during the past 15 years.

Furthermore, we observed a significant shift in cause-specific contributions from 2005 to 2020. During 2005–2010, it was only reductions in the mortality rates of respiratory diseases that accounted for the increase in longevity, while, during the previous 5 years, major chronic diseases (excepting diabetes) contributed to the improvement of LE in China (respiratory diseases: 0.39 years, circulatory diseases: 0.36 years, and cancers: 0.23 years).

DISCUSSIONS

TABLE 1. Contributions of mortality reduction among different age groups to increase in life expectancy from 2005 to 2020 (%).

Age groups	2005–2020	2005–2010	2015–2020
0–	26.43	39.64	7.75
5–	28.55	25.85	31.04
≥60	45.02	34.51	61.21

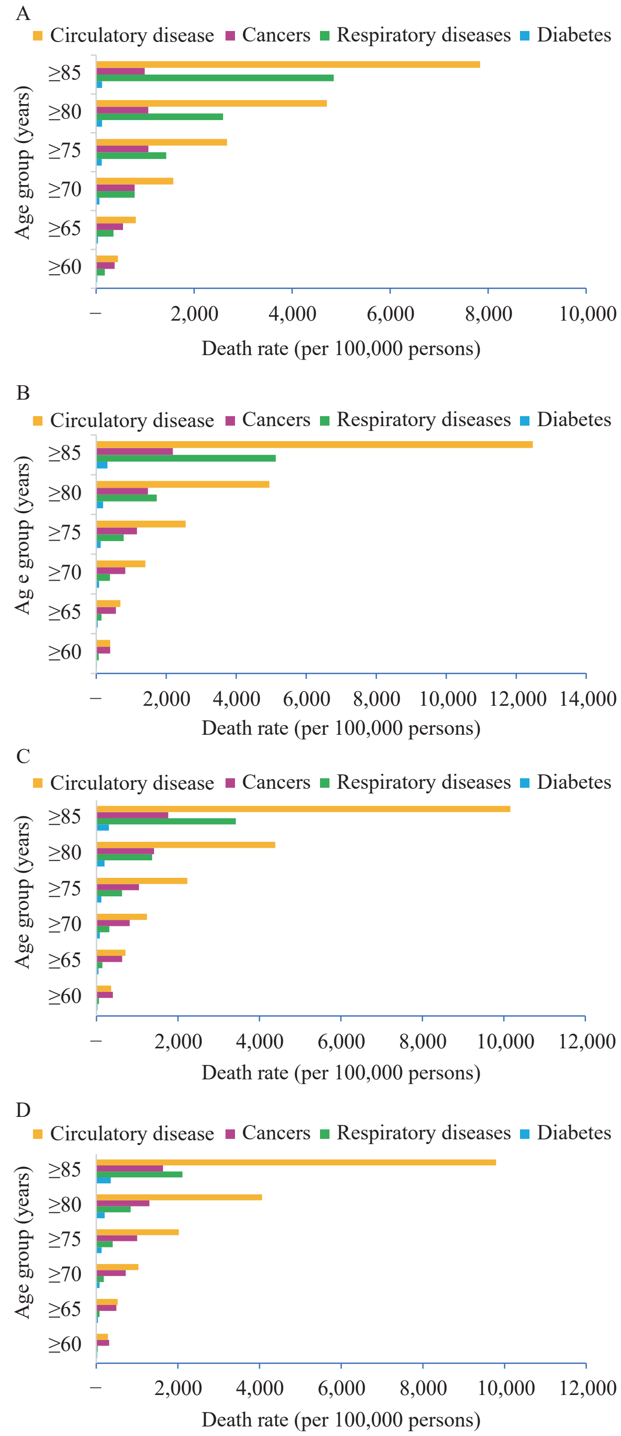

FIGURE 1. Trends in the mortality rates of population aged over 60 years for major chronic diseases in China in (A) 2005, (B) 2010, (C) 2015, and (D) 2020, respectively.

This study provides up-to-date evidence of the temporal trend in mortality of four major chronic diseases and their impact on LE in the Chinese elderly population. A stable decline trend was observed for mortality rates due to RDs during the study period, while DM showed the opposite trend, which was consistent with findings in some developing countries (*7*). Further, the mortality rate of CAs and CDs both showed an uptrend from 2005 to 2010, and then kept descending between 2010 and 2020. The remaining diseases positively contributed to the increase of LE in the nationwide, urban, and rural areas.

The present study also indicates that the association between the four major types of chronic disease deaths and Chinese elder adults' LE was notable. Generally, urban residents have gained more LE growth profit due to the reduction of the mortality of the four major chronic diseases, which was consistent with other studies (*8*).

In addition, this study's comparison shows that the contribution to changes in LE at 60 in China decreased by 0.05 years, due to increase in diabetes-related deaths. The epidemic of diabetes is one of the most alarming public health issues of the 21st century, especially in lower-middle income countries (*9*). It was predicted that from 2010 to 2030, there will be a 67% increase in the prevalence of diabetes in developing countries (*10*). Diabetes is still the second largest factor affecting LE from a global perspective (*11*). To reduce the mortality and impact of diabetes, the population should exercise sensibly and develop healthy eating habits, and the state should provide care and treatment services to help diabetic patients with health management.

The population of China has aged rapidly and the rate will continue accelerating in decades to come. China should therefore pay more attention to the health condition of the elderly. This research's results suggest China should devote more efforts to improve the health condition of elderly adults in China, especially those with chronic diseases. Beyond health spending, healthcare access, and the quality of health care, socio-demographic development may also be a key determinant of health outcomes (*12*). Therefore, a comprehensive health planning strategy is required.

This research has some limitations that need to be addressed. First, the results in this dataset are a summary of the number of deaths reported at each monitoring point. No adjustment has been made for under-reporting; therefore, the results of the calculation may be biased. Second, this study's decomposition was based on Arriaga's decomposition method, which did not provide a confidence interval. In addition, the cause-specific mortality rates were from the Chinese Health Statistics Yearbook, and the ICD codes of RDs were from J00 to J99 including acute respiratory infection. Considering the mortality

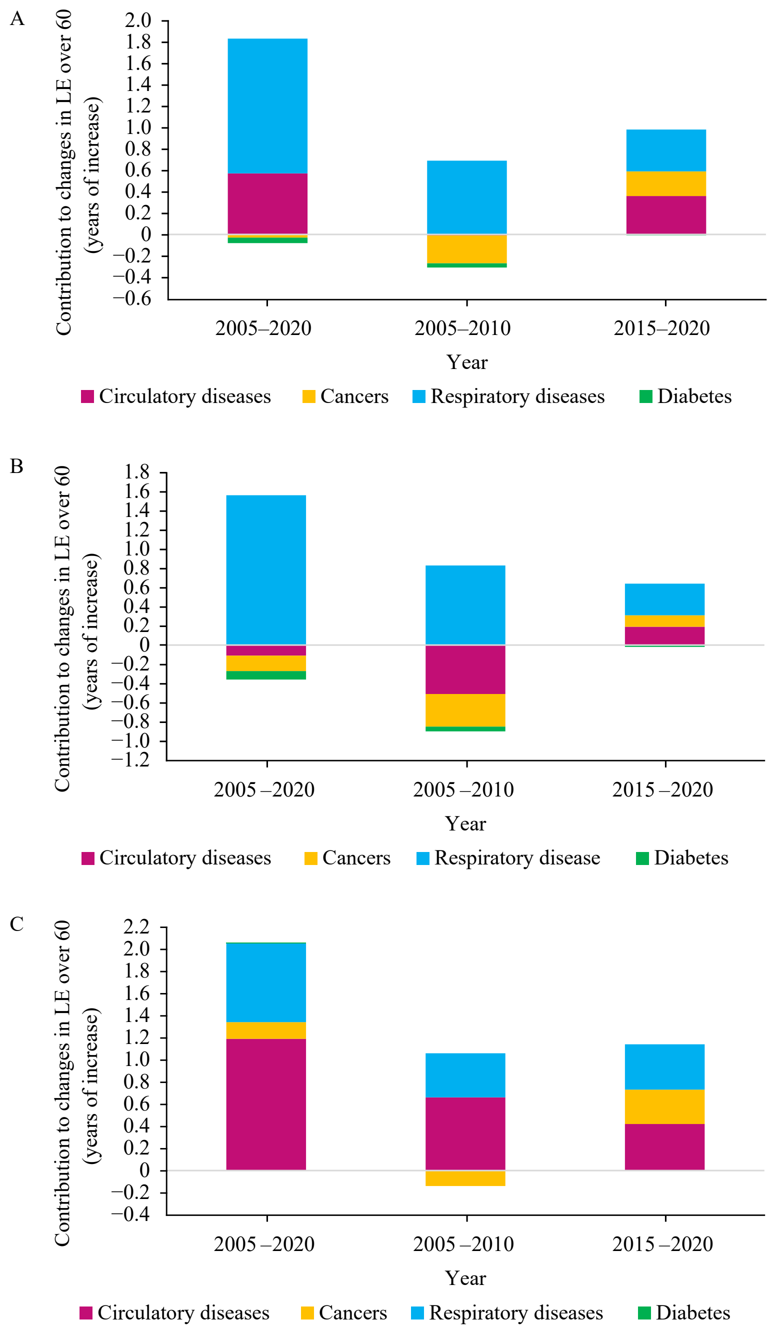

FIGURE 2. Contributions of major chronic diseases to changes in LE at 60 in (A) nationwide, (B) rural, and (C) urban — China, 2005–2020.
Abbreviation: LE=life expectancy.

rate of acute respiratory infection was very low, this study assumed it would not impact the results significantly. Additionally, LE only reflects the length of life, not the quality of life. Therefore, to assess the impact of different diseases on the quality of life or the health of the population, more comprehensive indicators, such as healthy life expectancy (HLE), should be used in future studies.

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SUPPLEMENTARY TABLE S1. Contributions of four major chronic diseases to changes in life expectancy at 60 years in China, 2005–2020.

Diseases	2005–2020			2005–2010			2015–2020		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Respiratory diseases	1.26	0.71	1.56	0.69	0.40	0.83	0.39	0.41	0.33
Circulatory diseases	0.57	1.19	−0.11	−0.01	0.66	−0.51	0.36	0.42	0.19
Cancers	−0.03	0.15	−0.16	−0.26	−0.14	−0.34	0.23	0.31	0.12
Diabetes	−0.05	0.01	−0.09	−0.04	0	−0.05	−0.01	0	−0.02
Residuals	0.34	0.5	0.19	0.18	0.35	0.04	0.05	0.06	0.02

Preplanned Studies

Current State and Challenges of Rehabilitation Needs Among Elderly — China, 1990–2019

Xin Guo[1]; Jiakang Huo[2]; Wanwei Dai[3]; Zhongyan Wang[4]; Jian Du[5,#]; Xiaoying Zheng[6,7,#]; Erdan Dong[1,4,8,#]

Summary

What is already known about this topic?

Rehabilitation is an essential part of achieving health for all, whereas the estimates of rehabilitation needs, especially for elderly individuals in China, are not clear.

What is added by this report?

Compared with 1990, the prevalence and years of life lived with disability for health conditions in need of rehabilitation in China increased by 71.3% and 77.0% in 2019, respectively, at a rate much higher than the global average.

What are the implications for public health practices?

This study mainly presents scientific data and a systematic analysis of the current state and challenges of rehabilitation needs for elderly individuals (aged 60 and above) in China based on the World Health Organization Rehabilitation Need Estimator.

Rehabilitation is an essential part of achieving health for all, but a disability-specific service needed by only a small proportion of the population. Recovery from functional impairment is the primary goal of rehabilitation, including experiencing limitations in everyday physical, mental, and social functioning due to aging or a health condition (*1*). China has an even worse situation than most countries due to its large, rapidly aging population. It is estimated that the number of older adults with multiple diseases and impairment in their functional ability is 46% and 38%, respectively (*2–3*). As the population ages and the proportion of people living with noncommunicable diseases and the consequences of injuries are increasing (*4–5*), however, comprehensive estimates of rehabilitation needs, especially for elderly individuals in China, are not clear. A study in *Lancet* provided a global estimate of the need for rehabilitation of 25 health conditions that would benefit from rehabilitation (*5*). Therefore, this study aimed to provide quantitative evidence for the current state of Chinese elderly rehabilitation needs. Based on the data from the World Health Organization (WHO) Rehabilitation Need Estimator (*6*), an overview of the current rehabilitation needs in China from 1990 to 2019 was presented.

All data for the estimates of the need for rehabilitation in this study are accessible via online data visualization and download tools following the WHO Rehabilitation Need Estimator, which estimated rehabilitation needs by presenting the prevalence and years of life lived with disability (YLDs) of 25 health conditions in need of rehabilitation from 1990 to 2019 by age, sex, year, and location, based on the global burden of disease study 2019. The WHO Rehabilitation Need Estimator estimated the prevalence primarily using data from systematically reviewed studies and survey data on the prevalence of various conditions. YLDs were obtained by multiplying the prevalence by corresponding disability weights and correcting for comorbidity. Focusing on Chinese population data, we obtained the prevalence and YLDs of 25 health conditions related to rehabilitation in 1990 and 2019 by age for this study. First, we examined the rehabilitation needs for each health condition by presenting the prevalence and YLDs of all ages or their age-standardized rates. Standard population age structure is generated by Global Burden of Disease Study 2017 (*7*). Each percentage change was calculated for the relative difference in prevalence or YLDs mean value between 1990 and 2019. Second, we analyzed the rehabilitation needs presented by the rate of YLDs with aging. Third, we explored the characteristics for rehabilitation needs of different health conditions in China compared to those in the global population, which was classified into 3 age groups (under 15, 15–59, and 60 and above).

In 2019, a total of 460 million (95% uncertainty interval 442.6 to 478.6) individuals had conditions that would benefit from rehabilitation, contributing to 63.0 million (47.3 to 80.2) YLDs in China (Supplementary Table S1, available in http://weekly.

chinacdc.cn). Compared with 1990, the prevalence and YLDs for health conditions in need of rehabilitation increased by 71.3% and 77.0% in 2019, respectively, at a rate much higher than the global average. Meanwhile, there has been a modest decrease in the age-standardized rate of prevalence and YLDs since 1990. This result suggested that the increased rehabilitation needs were mainly driven by the aging of the population. Furthermore, the prevalence was highest for hearing loss (affecting 95 million people) in 2019, and cancer has grown at the fastest rate (300.1%) since 1990. In terms of YLDs, the number of people suffering from low back pain was the highest (10.3 million YLDs), and Alzheimer's disease and dementia grew the fastest (302.4%) during the past 30 years. This could possibly be associated with better diagnostic technology, a longer life expectancy, and their higher prevalence in elderly people.

A visual representation of the YLDs rate disease categories of conditions by age groups is shown in Figure 1. There is a significant increase in the burden of diseases that could require rehabilitation as the population ages. Different age populations also have different characteristics of rehabilitation needs. In children under 15 years old, cerebral palsy and developmental intellectual disability are the principal contributors to disability. Musculoskeletal disorders, such as low back pain and neck pain, account for 54% of the YLD rate in those 15 to 59 years old, which is the main labor force. In seniors aged 60 and above, the proportions of cerebrovascular diseases, sensory impairments, chronic respiratory diseases, and cardiovascular diseases increased gradually. With a longer life expectancy, the incidence of chronic diseases, disabilities, and functional impairment is increasing dramatically, posing new challenges to our society's health care system and healthcare resources.

There are noticeable differences in the profiles in terms of the health conditions by age group in China compared to those in the global population (Figure 2). For most diseases in the under-15-year-old group, the YLD rates in China are comparable to or lower than the global average, with the exception of cancer, which has more than doubled. In 15 to 59-year-olds, the YLD rate of Parkinson's disease in China is twice the global average. Low back pain and neck pain have the highest YLD rates both worldwide and in China; however, neck pain seems to be more prevalent among Chinese individuals. In addition, young and middle-aged Chinese adults are more likely to suffer from heart failure, Alzheimer's disease and dementia, and osteoarthritis, while multiple sclerosis is less prevalent. Furthermore, stroke has become the leading disease burden among Chinese people over the age of 60, followed by low back pain and hearing loss. It is worth mentioning that there have been significant increases

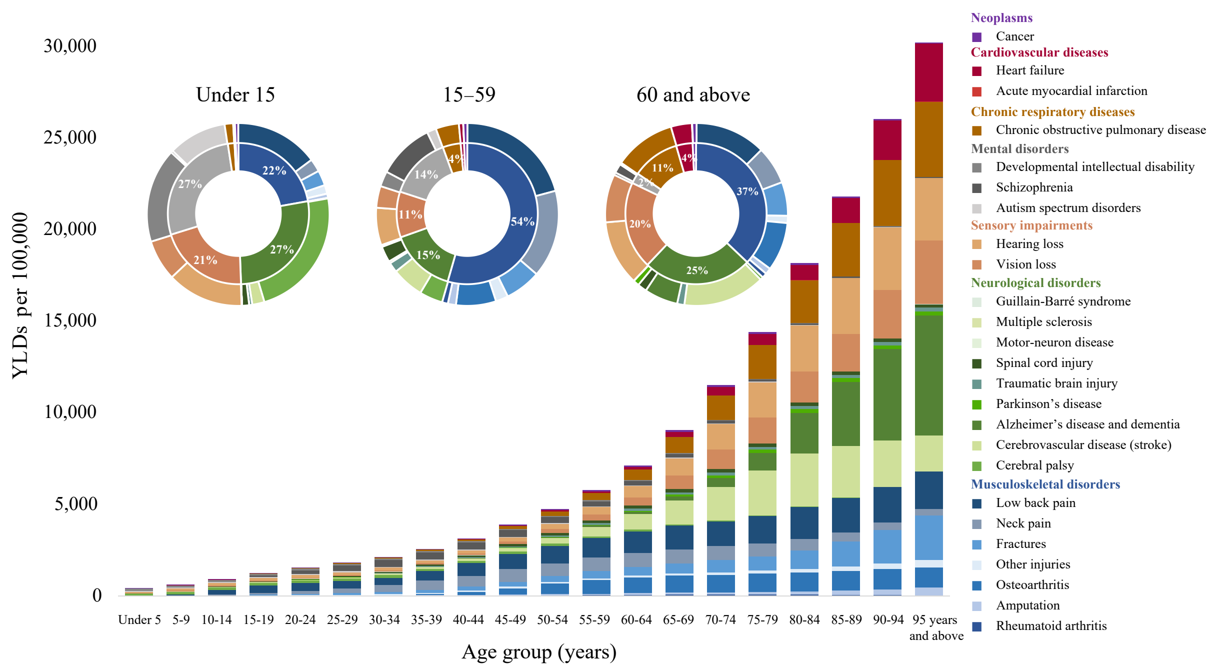

FIGURE 1. Disease categories of conditions that would benefit from rehabilitation in China by age group, 2019.
Abbreviation: YLDs=years of life lived with disability.

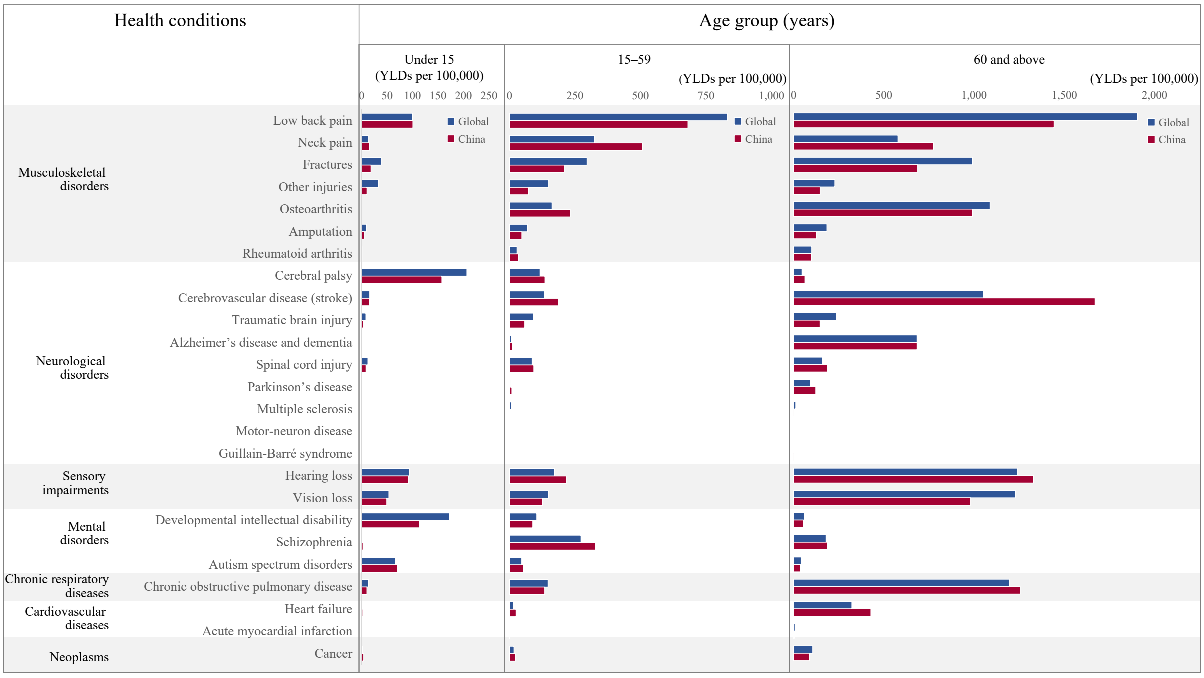

FIGURE 2. The rate of YLDs of health conditions by age group in China and worldwide, 2019.
Abbreviation: YLDs=years of life lived with disability.

in Alzheimer's disease and dementia YLD rates in the elderly by approximately 90 times worldwide and 60 times in China, respectively, compared to young and middle-aged adults.

DISCUSSION

In this paper, the rehabilitation needs for elderly individuals in China were analyzed in detail. The primary findings of this study were that the increase in Chinese rehabilitation needs in China exceeded 70% in the last 30 years, much higher than the world average. This could be mainly driven by rapid aging of the population. We also found the characteristics of rehabilitation needs in China, such as rapid-growth conditions (i.e., cancer, Alzheimer's disease, and dementia), and a higher burden of health conditions (i.e., stroke, neck pain, and heart failure). The increased number could possibly be associated with better diagnostic technology, a longer life expectancy, and a higher prevalence in elderly people, as well as potential risk factors, such as lifestyle and environment.

There were at least three limitations to this study. The first was an unavoidable distortion of the estimation of rehabilitation needs because the data were mainly obtained through the calculation of statistical models, not real-world observations. Second, we did not analyze older age stratification in more detail or sex differences. Third, this study did not provide the data at the provincial level.

In conclusion, this study presented a comprehensive evaluation of the current state and the challenge of meeting the rehabilitation needs of elderly individuals in China. China has become the country with the largest need for rehabilitation of the elderly (aged 60 and above). With the aging trend of the Chinese population intensifying, there is an increasing demand for rehabilitation, which is already quite high. As the population ages and the proportion of people living with noncommunicable diseases and the consequences of injuries are increasing (*4–5*), health and social systems face a huge challenge in meeting these rehabilitation needs.

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SUPPLEMENTARY TABLE S1. The prevalence and YLDs of health conditions in need of rehabilitation, China, 1990–2019.

Health condition	Prevalence						YLDs					
	All ages (millions)			Age-standardized rate (per 1,000)			All ages (millions)			Age-standardized rate (per 1,000)		
	1990	2019	Change (%)	1990	2019	Change (%)	1990	2019	Change (%)	1990	2019	Change (%)
Overall total	268.4 (257.3–281.8)	460.0 (442.6–478.6)	71.3	260.0 (249.9–271.4)	253.5 (244.3–264.0)	−2.5	35.7 (26.6–45.6)	63.1 (47.3–80.2)	77.0	36.3 (27.3–46.0)	35.2 (26.6–44.6)	−3.0
Musculoskeletal disorders												
Total	186.0 (173.7–199.2)	322.1 (301.7–343.0)	73.2	179.7 (168.0–191.4)	172.3 (162.1–183.2)	−4.1	17.6 (12.5–23.3)	28.1 (19.9–38.5)	59.5	17.1 (12.3–22.7)	15.0 (10.7–20.3)	−12.3
Low back pain	75.3 (66.0–85.1)	91.3 (80.5–104.1)	21.3	72.5 (63.9–81.7)	51.3 (45.5–57.9)	−29.1	8.6 (6.0–11.4)	10.3 (7.3–14.0)	20.8	8.2 (5.8–10.9)	5.8 (4.1–7.8)	−29.0
Neck pain	37.9 (29.9–48.6)	68.0 (53.7–87.2)	79.6	35.3 (28.0–44.9)	35.7 (28.7–45.2)	1.2	3.8 (2.5–5.6)	6.8 (4.4–9.8)	78.1	3.5 (2.3–5.2)	3.6 (2.3–5.2)	1.5
Fractures	27.8 (25.6–30.0)	65.5 (61.0–69.9)	135.9	28.2 (26.2–30.3)	35.1 (32.8–37.4)	24.8	1.7 (1.2–2.4)	3.8 (2.5–5.4)	121.4	1.7 (1.2–2.4)	2.0 (1.4–2.9)	18.5
Other injuries	22.6 (20.5–25.5)	40.1 (36.4–45.0)	77.3	20.9 (19.0–23.5)	22.2 (20.1–25.1)	6.3	0.78 (0.55–1.1)	1.1 (0.70–1.6)	38.9	0.71 (0.50–0.97)	0.60 (0.39–0.90)	−14.9
Osteoarthritis	33.2 (26.2–40.8)	85.9 (67.6–105.3)	158.5	37.9 (29.8–46.3)	41.0 (32.4–50.1)	8.2	1.8 (0.90–3.6)	4.7 (2.3–9.5)	159.7	2.1 (1.0–4.1)	2.2 (1.1–4.5)	8.9
Amputation	14.2 (13.0–15.5)	27.2 (25.2–29.5)	91.4	13.3 (12.3–14.5)	15.0 (14.0–16.3)	12.8	0.65 (0.47–0.87)	0.78 (0.52–1.12)	19.1	0.64 (0.47–0.84)	0.43 (0.28–0.61)	−33.1
Rheumatoid arthritis	1.5 (1.3–1.6)	3.1 (2.8–3.5)	114.2	1.5 (1.3–1.7)	1.6 (1.4–1.7)	5.2	0.27 (0.19–0.36)	0.57 (0.39–0.77)	112.5	0.27 (0.19–0.37)	0.29 (0.20–0.39)	5.8
Neurological disorders												
Total	20.6 (19.4–21.8)	57.3 (53.5–61.4)	178.8	23.6 (22.1–25.2)	32.6 (30.4–35.0)	38.0	4.7 (3.4–5.9)	12.4 (8.9–15.9)	166.7	5.2 (3.8–6.6)	7.1 (5.1–9.0)	35.0
Cerebral palsy	2.9 (2.4–3.5)	8.4 (7.0–10.5)	193.4	2.3 (2.0–2.8)	6.3 (5.2–7.8)	170.5	0.63 (0.42–0.87)	1.8 (1.2–2.5)	184.3	0.50 (0.34–0.70)	1.3 (0.89–1.9)	163.6
Stroke	10.0 (9.0–11.0)	25.0 (22.1–28.1)	149.9	11.2 (10.1–12.5)	12.9 (11.5–14.4)	15.0	2.4 (1.7–3.1)	6.1 (4.3–7.8)	152.2	2.7 (1.9–3.5)	3.1 (2.2–4.1)	15.9
Traumatic brain injury	2.2 (2.1–2.3)	6.5 (6.2–7.0)	199.3	2.1 (2.0–2.3)	3.4 (3.2–3.7)	60.6	0.31 (0.22–0.42)	0.93 (0.65–1.3)	199.1	0.30 (0.21–0.41)	0.49 (0.34–0.66)	62.2
Alzheimer's disease and dementia	3.3 (2.8–3.9)	13.2 (11.0–15.3)	292.6	6.1 (5.2–7.1)	7.9 (6.6–9.1)	29.2	0.46 (0.33–0.63)	1.9 (1.3–2.5)	302.4	0.88 (0.62–1.2)	1.1 (0.80–1.5)	29.0
Spinal cord injury	2.1 (2.0–2.3)	5.1 (4.8–5.5)	138.2	2.0 (1.8–2.1)	2.7 (2.6–2.9)	38.7	0.73 (0.52–0.93)	1.4 (1.0–1.8)	87.8	0.66 (0.47–0.84)	0.74 (0.52–1.0)	11.4
Parkinson's disease	0.37 (0.29–0.44)	1.3 (1.1–1.6)	260.0	0.50 (0.40–0.60)	0.67 (0.55–0.82)	35.8	0.11 (0.07–0.16)	0.40 (0.26–0.55)	258.3	0.15 (0.10–0.21)	0.20 (0.13–0.28)	36.5
Multiple sclerosis	0.017 (0.013–0.021)	0.033 (0.025–0.041)	97.0	0.014 (0.011–0.018)	0.018 (0.014–0.023)	23.3	0.006 (0.004–0.009)	0.012 (0.008–0.017)	97.0	0.005 (0.003–0.008)	0.007 (0.004–0.009)	23.3
Motor-neuron disease	0.025 (0.020–0.031)	0.036 (0.029–0.044)	42.7	0.021 (0.017–0.026)	0.024 (0.020–0.029)	14.3	0.006 (0.004–0.009)	0.009 (0.006–0.012)	42.7	0.005 (0.004–0.007)	0.006 (0.004–0.008)	14.3
Guillain–Barré syndrome	0.005 (0.004–0.007)	0.008 (0.006–0.010)	45.0	0.005 (0.003–0.006)	0.005 (0.004–0.007)	11.3	0.002 (0.001–0.002)	0.002 (0.001–0.003)	45.0	0.001 (0.001–0.002)	0.002 (0.001–0.002)	11.3

TABLE S1. (Continued)

Health condition	Prevalence						YLDs					
	All ages (millions)			Age-standardized rate (per 1,000)			All ages (millions)			Age-standardized rate (per 1,000)		
	1990	2019	Change (%)	1990	2019	Change (%)	1990	2019	Change (%)	1990	2019	Change (%)
Sensory impairments												
Total	72.7 (67.0–79.0)	142.0 (130.5–153.3)	95.3	80.9 (75.3–86.8)	78.1 (72.3–83.8)	−3.5	5.3 (3.6–7.3)	9.5 (6.6–13.0)	78.4	6.0 (4.1–8.1)	5.4 (3.7–7.4)	−9.4
Hearing loss	50.5 (44.2–56.7)	95.2 (83.7–107.5)	88.3	56.7 (50.6–62.8)	52.2 (46.4–57.9)	−8.1	3.4 (2.3–4.8)	5.7 (3.8–7.9)	65.9	3.7 (2.5–5.1)	3.3 (2.2–4.6)	−10.5
Vision loss	26.8 (24.6–29.4)	59.3 (53.5–65.6)	121.0	31.8 (29.1–34.6)	33.1 (30.2–36.2)	4.1	1.9 (1.3–2.6)	3.8 (2.7–5.3)	100.8	2.3 (1.6–3.1)	2.1 (1.5–2.9)	−7.5
Mental disorders												
Total	20.4 (16.5–24.5)	25.4 (22.2–29.0)	24.5	16.9 (13.6–20.3)	18.0 (15.6–20.6)	6.5	3.8 (2.9–4.8)	5.5 (4.2–6.9)	44.6	3.2 (2.4–4.0)	3.5 (2.6–4.4)	9.8
Developmental Intellectual disability	12.7 (8.8–16.7)	15.1 (12.1–18.4)	19.1	10.4 (7.2–13.7)	11.3 (9.0–13.8)	8.4	0.85 (0.52–1.3)	1.2 (0.80–1.7)	42.7	0.70 (0.43–1.0)	0.91 (0.59–1.3)	30.8
Schizophrenia	3.6 (3.1–4.0)	5.5 (4.9–6.1)	54.8	3.0 (2.7–3.4)	3.1 (2.7–3.5)	3.1	2.3 (1.7–2.9)	3.6 (2.6–4.4)	53.9	2.0 (1.4–2.4)	2.0 (1.5–2.5)	3.8
Autism spectrum disorders	4.3 (3.5–5.2)	5.0 (4.1–6.0)	15.6	3.6 (2.9–4.3)	3.7 (3.1–4.5)	4.1	0.66 (0.43–1.0)	0.76 (0.50–1.1)	14.5	0.55 (0.36–0.81)	0.57 (0.37–0.84)	4.4
Chronic respiratory diseases												
Total	14.7 (12.8–16.6)	23.6 (20.0–27.4)	60.7	17.3 (14.9–19.6)	12.6 (10.6–14.5)	−27.4	2.8 (2.3–3.2)	4.5 (3.7–5.3)	61.7	3.3 (2.7–3.8)	2.4 (2.0–2.8)	−27.2
Chronic obstructive pulmonary disease	14.7 (12.8–16.6)	23.6 (20.0–27.4)	60.7	17.3 (14.9–19.6)	12.6 (10.6–14.5)	−27.4	2.8 (2.3–3.2)	4.5 (3.7–5.3)	61.7	3.3 (2.7–3.8)	2.4 (2.0–2.8)	−27.2
Cardiovascular diseases												
Total	4.5 (3.6–5.6)	11.9 (9.6–14.7)	163.3	6.9 (5.6–8.5)	6.6 (5.4–8.1)	−4.1	0.51 (0.34–0.76)	1.4 (0.88–2.0)	163.8	0.78 (0.51–1.1)	0.75 (0.49–1.1)	−3.4
Heart failure	4.4 (3.6–5.5)	11.7 (9.4–14.6)	163.2	6.8 (5.5–8.4)	6.5 (5.3–8.0)	−4.3	0.51 (0.33–0.75)	1.3 (0.87–2.0)	163.8	0.77 (0.50–1.1)	0.74 (0.48–1.1)	−3.5
Acute myocardial infarction	0.068 (0.060–0.077)	0.19 (0.16–0.21)	172.4	0.092 (0.081–0.103)	0.10 (0.09–0.12)	11.6	0.006 (0.004–0.009)	0.017 (0.012–0.024)	167.2	0.008 (0.006–0.012)	0.009 (0.007–0.013)	10.5
Neoplasms												
Total	0.87 (0.77–0.98)	3.5 (3.0–4.0)	300.1	0.95 (0.85–1.1)	1.7 (1.5–2.0)	82.3	0.12 (0.08–0.16)	0.45 (0.31–0.63)	282.4	0.12 (0.09–0.17)	0.23 (0.16–0.32)	85.3
Cancer	0.87 (0.77–0.98)	3.5 (3.0–4.0)	300.1	0.95 (0.85–1.1)	1.7 (1.5–2.0)	82.3	0.12 (0.08–0.16)	0.45 (0.31–0.63)	282.4	0.12 (0.09–0.17)	0.23 (0.16–0.32)	85.3

Note: change stands for percentage change from 1990–2019. Numbers in parentheses represent 95% uncertainty interval.

Abbreviation: YLDs=years of life lived with disability.

Perspectives

Strengthening Systematic Research on Aging: Reflections from an Omics Perspective

Xiaoying Zheng[1,&,#]; Chao Guo[2,&]

ABSTRACT

Population aging has become a global concern in population development. Challenges to good health in older ages are more complex than at any other age and require a comprehensive framework to move the science of aging and health forward. In this paper, we describe an advanced and evolving conceptual framework that includes definitions, goals, disciplines, and a scope of human aging omics (HAO) based on theories and methods of omics science. The development of HAO will bring a paradigm shift in research related to aging and health by systematic identification, characterization, and quantification of all sets of health conditions and their complex relationships with the internal biomolecules and the external environment in the whole aging process of human beings from birth to death throughout the lifespan.

Population aging has become a key issue to be addressed urgently in global population development. According to World Population Prospects 2022, the share of the global population 65 years and older is expected to increase from 10% in 2022 to 16% in 2050. By then, the number of people 65 years or older will be twice the number of children under 5 years old and roughly equal to the number of children 12 years and under (*1*). China, with the world's largest number of older adults (190 million people aged 65 years or older in 2020) and an extremely fast population aging rate (older people increasing from 8.87% of the population in 2010 to 13.50% in 2020), is facing an even more serious challenge. At the same time, human life expectancy has been increasing. In 2019, the global life expectancy at birth was 72.8 years, an increase of nearly 9 years of life since 1990. Further reduction in mortality is expected to increase the global average life expectancy to 77.2 years in 2050 (*1*). The increase in human life expectancy allows us to pursue a higher goal — an increase in healthy life expectancy, which will not only improve the quality of life but also reduce the overall economic and disease burden, thereby jointly contributing to social development.

In the context of global aging, the promotion of health for older adults is undoubtedly a very urgent and challenging task for a wide range of medical-related policymakers, medical workers, and industry professionals. This is because health for older adults is a complex, three-dimensional, dynamic issue. Externally, it involves policy systems, cultural concepts, economic development, and natural and social environments at the macro level; family and social support at the meso level; and individual behavior, experience, psychology, etc., at the micro level. Internally, it is the cumulative result of the aging of an individual during the lifespan. The aging status at each stage of life is related to health, disease, disability, and death at the next stage. Internal and external interactions form an invisible network of time and space around an individual's health at each age stage, making health at old age present obvious systematic characteristics. For example, in the context of the most pressing current health challenge — the coronavirus disease 2019 (COVID-19) pandemic, older adults show particular vulnerability in terms of susceptibility, death, and secondary diseases after acquiring severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection (*2*). This is not a matter of age per se, but of the underlying health disadvantages and vulnerability to risk resistance caused by increasing age.

The challenge of health in older age, which is more complex than health issues at any other stage of life, requires a more comprehensive framework to guide all aspects of the work. The emerging field of population medicine, which integrates basic medicine, clinical medicine, public health and preventive medicine, and rehabilitation medicine, and coordinates individual preventive health care, medical rehabilitation, and the overall health actions of the population to maximize health benefits of the population (*3*), provides a macroscopic choice for this purpose. From a microscopic view, the systematic concept of omics is in line with population medicine.

In the past four decades, "omics" has become a research mechanism and methodology for systematically studying scientific fields such as the life sciences and medicine. In 1920, the botanist Hans Winkler created the term "genome" and then became the first person to use the term "omics" (*4*). In 1986, geneticist Thomas H. Roderick coined the term "genomics" to refer to the study of the structure and function of the entire genome of a living organism by mapping, sequencing, and characterizing genomes (*5*), integrating previous gene-level studies in the life sciences into a systematic scientific system. Subsequently, "transcriptomics", "proteomics", and "metabolomics" came into being, and the use of "omics"-terms continued to expand, forming more macroscopic applications such as "environmental omics" (*6*) and multi-staged data-integrated multi-omics (MS-DIMO) that integrates multiple types of omics data in a single study (*7*). Although, methodologically, the development and application of omics in biomedicine rely on high throughput molecular technologies, in theoretical thinking, the primary goal of various omics is to try to completely describe and understand the structure, function, and dynamics of a given level of research objects (*4*). The maturity and foundation of various types of omics research give important enlightenment to the overall aging and health of human beings; that is, all conditions, including health, disease, and death from the beginning to the end of life, as well as their complex relationships with internal biomolecules and the external environment that form an interlocking systematic "omics" throughout the lifespan, i.e., human aging omics (HAO). This is consistent with the goal of "OMICS 2.0," which promotes omics technologies and their applications in diverse and complementary global settings (*8*).

HAO is an advanced and evolving concept that can be defined as the identification, characterization, and quantification of all sets of the rules of growth, development, maturity, aging, health, disease, injury, disability, rehabilitation, and death and their complex relationships with the internal biomolecules and the external environment in the whole aging process of human beings from birth to death throughout the lifespan. The goals of HAO are to bring people to a better grasp of the laws of life change and aging, to promote a steady increase in health reserves throughout the lifespan, and to improve the ability at an older age to respond to the consequences of health risks accumulated since early life.

The basic discipline of HAO is the combination of biomedicine, which is committed to exploring the laws of aging at the microscopic level, demography that explores the laws of age change from a macroscopic perspective, and medicine and public health, that focus on health outcomes. HAO benefits from the contributions of archaeology, anthropology, psychology, management, and related disciplines. Correspondingly, the research theories and methods involved come from an interdisciplinary system supported by the interaction between the natural and social sciences. HAO can be divided into sub-HAOs according to the characteristics of life periods, such as embryonic development aging omics and puberty aging omics. It can be integrated with other omics to form a more targeted research field, such as embryonic development aging metabolomics. More focused and in-depth research on specific issues can be conducted, such as research on cognitive development aging omics.

The research scope of HAO includes but is not limited to:

Molecular-level measurement of physiological age using omics data. Age is a key risk factor for disease and disability in older adults. To tackle age-related diseases and increase a healthy lifespan requires molecular-level measures of biological age and aging rates that target the aging process to "rejuvenate" physiological functions (*9*). Using high-throughput omics technologies to measure biological aging, exploring the quantitative characterization of aging at molecular resolution, and further determining controllable factors related to physiological aging is the basic work of HAO.

Individual-level research on the health trajectory of aging throughout the lifespan. This is the ultimate exploration of the relationship between aging and health outcomes. The systematic research idea of HAO is the basis for the realization of this research content.

Population-level identification of age-specific risk imprints on lifespan. From the perspective of HAO, the systematic identification of aggregation points of health status and risk categories with age as the context can reveal the aggregation mode, aggregation intensity, risk factors, and their contributions and can change the rules of health reserves of the population. This is conducive to developing of precise health risk control and intervention throughout the lifespan and exploring policy directions for improvement of healthy life expectancy.

Temporal-level evaluation of the health resilience of the population at multiple time points. Exploring the dynamic changes in health reserves and risk defense capabilities from the temporal dimension by taking the whole population of a region or a country as a unit is a macro embodiment of HAO. Researchers can build appropriate indicators to analyze dynamic changes, for example, by using the average annual percent change (AAPC) of the utilization of health services in a population of a certain age and characteristic (*10*) as an indicator to evaluate the health resilience of the population. An increase in AAPC indicates an increase in health resilience.

Policy-level integration of strategies to actively respond to population aging. Health promotion of older adults requires organic cooperation of disease prevention, disease diagnosis, disease and injury treatment, disability rehabilitation, risk control, health education, and other related disciplines. More detailed strategies should especially be taken in areas where socioeconomic development is uneven. This work needs to be systematically integrated from the perspective of HAO to form an organic chain, starting from early life, to improve both high-quality lifespan and health.

With the continuous development of scientific and technological progress, biomedicine, public health, demography, and other disciplines have laid a certain scientific foundation for establishing HAO. Further integrating theories, methods, information, data, and the experiences of omics such as genomics, transcriptomics, proteomics, and metabolomics can expand the scope of omics science to a higher level of research and over a longer time range to carry out aging omics research according to the systematic state of human life. This will undoubtedly contribute to the scientific basis for health management throughout the lifespan and may provide some assistance for human reproduction and survival to better adapt to the environment. At present, the concept of HAO is only in an initial stage, and its definition, content, and research scope need to be continuously enriched and improved. The construction of its preliminary framework (Figure 1) in this paper is precisely to achieve this purpose. Nevertheless, for aging and

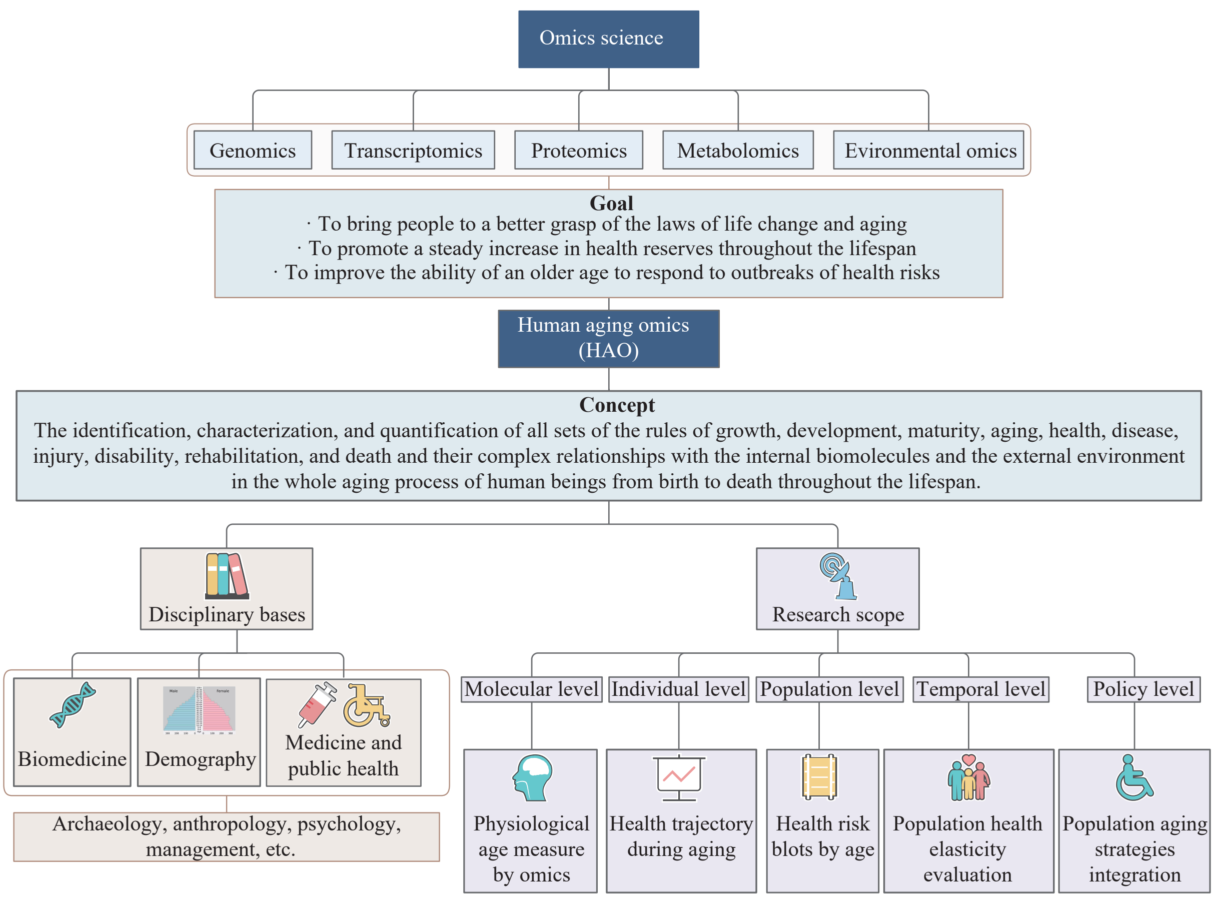

FIGURE 1. A conceptual framework of human aging omics.

health, the most complex, three-dimensional, and dynamic research object, HAO is undoubtedly an innovation in theory and application. The development of HAO will allow the application scope of "omics" not to be confined only to the natural sciences but to encompass systematic, homogeneous unit sets of social sciences and related disciplines and bring about a paradigm shift in research related to aging and health.

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Commentary

Older European Adults and Access to Healthcare During the COVID-19 Pandemic

Yushan Yu[1]; Mirko Petrovic[2]; Wei-Hong Zhang[1,3,#]

In Europe, population ageing poses a challenge. Given accelerating population ageing in Europe, long-term care (LTC) is a growing concern. Unmet healthcare needs varied among European countries during the coronavirus disease 2019 (COVID-19) pandemic, and greater attention should be paid to ensuring that the healthcare needs of vulnerable populations are met. Notably, developing common and comparable indicators is useful for monitoring the LTC and healthcare of older adults at the national and international levels, and understanding the reasons for the differences in indicators between European countries could shed light on how to improve the health of older adults. As such, in engaging with this challenge, this study uses a compilation of statistics that presents together, for the first time, three types of indicators relating to socioeconomic characteristics for population ageing, long-term care, and access to healthcare during the COVID-19 pandemic among the older adults in Europe (particularly in Belgium, Germany, Spain, France, Italy, and the Netherlands).

INDICATORS OF SOCIOECONOMIC CHARACTERISTICS FOR POPULATION AGEING IN EUROPE

Indicators of socioeconomic characteristics for population ageing included older adults (65 years and over) as the percentage of total population, old-age dependency ratio and economic old-age dependency ratio (Table 1). In 2019, older adults aged 65 years and over comprised 20.4% of the total population in EU-27 countries, and this is predicted to increase to 29.6% by 2050. The old-age dependency ratio in EU-27 countries was 34.4% in 2019 and is estimated to rise to 56.9% by 2050. The economic old-age dependency ratio was 44.7% in 2019: which will likely increase to 69.5% by 2050. Among the 6 selected Western European countries, Italy has the highest share of older adults aged 65 years and over relative to the total population, as well as the highest old-age dependency ratio and economic old-age dependency ratio (*1*).

Figure 1 shows the distribution of older adults aged 65 years and over according to their household type in selected European countries and in the EU for 2016–2020. At the average level across the EU-27 in 2019, the majority of such households consisted of either a single older adult (32.9%) or a couple living alone (47.9%), with a couple living with other people representing only 10% of over-65 households on average. In 2020, Germany had the highest percentage of households consisting of a single older adult (34.7%), the Netherlands had the highest percentage of households consisting of a couple living alone (63.7%), and Spain had the highest percentage of households consisting of a couple living with another person (18.6%) (*2*).

The average retirement age for women and men across the EU-27 was approximately 65 years. As of 2022, the average retirement age was 62 years in France; 65 years in Belgium; 65 years and 3 months in Spain; 65 years and 7 months in Germany; 66 years and 4 months in the Netherlands; and 67 years in Italy. Additionally, the retirement age in Belgium, Spain, and Germany will rise to 67 years in 2030, 2027, and 2029 respectively (*3*).

INDICATORS OF LONG-TERM CARE IN EUROPE

LTC encompasses a variety of services designed to meet the health and personal care needs of older adults, with the goal of enabling them to live as independently and safely as possible (*4*). Indicators related to LTC are categorized in terms of need, access, workforce, and expenditure, according to the European Commission Social Protection Committee, and are summarized in Table 2 (*5*). In 2014, 27.3% of older adults aged 65 years and over needed LTC in the EU-27. In 2019, 9.4% of older adults received LTC, with 3.6% receiving care in LTC facilities, 5.8% receiving care at home, and 8.8% receiving LTC cash benefits. Of the 45.4% who needed home care services but did not

TABLE 1. Main indicators of population ageing at average level in the EU and in selected countries in 2019–2070 (*1*).

Indicator/year	2019	2030	2040	2050	2060	2070
Older adults (65 years and over) as the percentage of total population						
EU-27	20.4	24.4	27.7	29.6	30.3	30.3
BE	19.0	22.8	25.2	26.4	27.4	28.0
DE	21.7	25.6	27.9	28.1	28.3	28.4
ES	19.5	24.0	29.4	32.7	32.5	32.0
FR	20.3	24.1	26.8	27.8	28.3	28.7
IT	23.0	27.3	32.2	33.7	33.4	33.3
NL	19.3	23.7	26.3	26.4	27.3	28.6
Old-age dependency ratio						
EU-27	34.4	43.1	51.4	56.9	59.2	59.2
BE	32.5	40.5	46.0	49.2	51.8	53.3
DE	36.1	46.4	52.2	52.8	54.3	54.6
ES	32.1	40.9	54.0	64.7	64.1	62.5
FR	32.1	40.9	54.0	64.7	64.1	62.5
IT	38.9	48.0	61.4	66.5	65.5	65.6
NL	32.9	42.4	49.3	49.3	51.4	55.2
Economic old-age dependency ratio						
EU-27	44.7	53.9	63.3	69.5	71.9	71.7
BE	45.0	53.6	61.2	65.9	69.7	71.9
DE	41.9	52.4	59.8	60.7	62.1	62.7
ES	46.1	53.0	66.2	77.9	77.9	75.6
FR	46.1	53.0	66.2	77.9	77.9	75.6
IT	58.5	65.8	81.0	87.0	84.2	82.2
NL	37.6	48.2	56.5	56.0	57.0	60.5

Note: Old-age dependency ratio: population aged 65 years and over as a percentage of the population aged 20–64 years. Economic old-age dependency ratio: inactive population aged 65 years and over as a percentage of the employed population aged 20–64 years.
Abbreviation: BE=Belgium; DE=Germany; ES=Spain; FR=France; IT=Italy; NL=The Netherlands; EU-27=European Union with 27 Member States.

receive them, for 35.7% this was due to financial reasons, while for 9.7% it was because the services were unavailable. The number of employees in LTC was 3.8 per 100 older adults aged 65 years and over in the EU-27 in 2016, while 10.3% of the population provided informal care for older adults. EU-27 public expenditure on LTC was 1.7% of gross domestic product (GDP) in 2019 and is projected to reach 3.4% of GDP by 2050.

There are some differences between countries. For instance, the proportion of older adults in Belgium aged 65 years and over requiring LTC (29.9%) was higher than in other selected European nations. In addition, in 2019 a greater proportion of older adults in Belgium received LTC in LTC facilities (6.2%) or at home (15.7%) than in other countries. In 2019, the number of LTC beds per 100,000 residents in both the Netherlands and Belgium exceeded 1,200, which was significantly higher than in other nations. In comparison to other nations, the Netherlands had 8 LTC employees for every 100 older adults aged 65 years and over. Moreover, in 2019, the Netherlands had the highest public expenditure on LTC, accounting for 3.7% of GDP.

INDICATORS OF UNMET HEALTHCARE NEEDS DURING THE COVID-19 PANDEMIC IN EUROPE

Unmet healthcare needs are defined as the difference between the quantity of care received and the quantity of care desired or required, which typically take three forms: giving up, postponement, and inaccessibility (*6*). The indicators for unmet healthcare needs during the COVID-19 pandemic included refusing healthcare

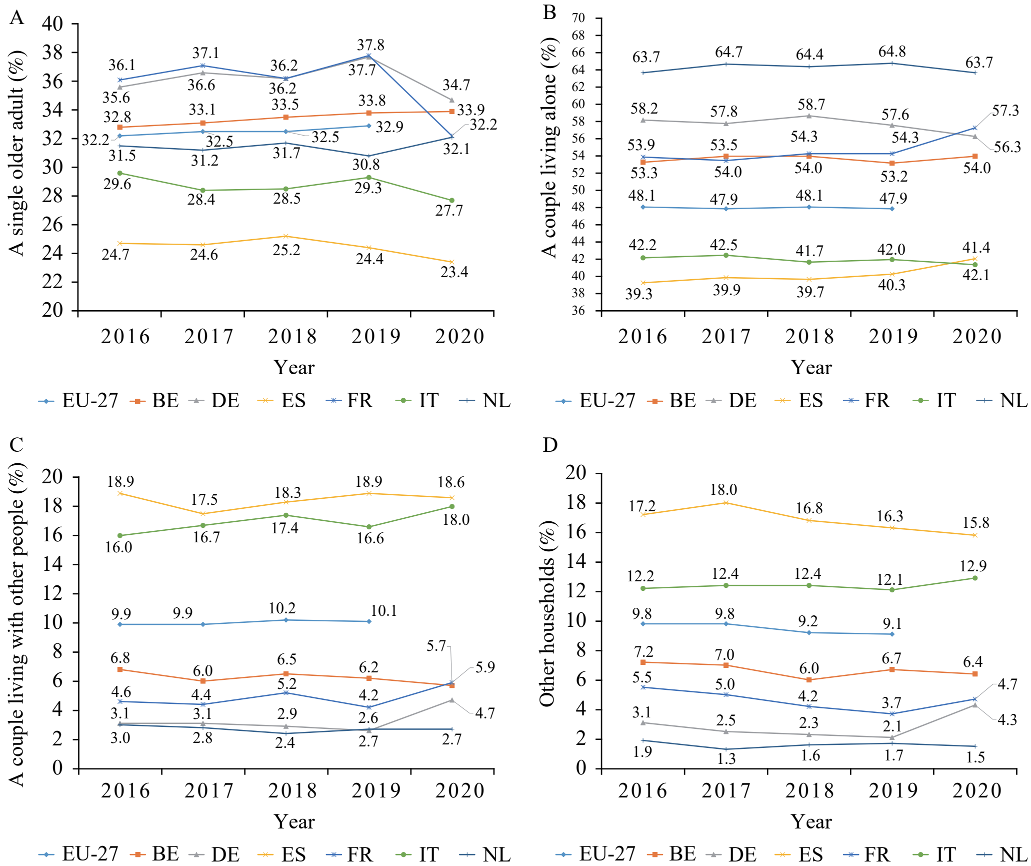

FIGURE 1. Distribution of older adults aged 65 years and over according to household type in selected European countries and in the EU from 2016–2020. (A) Percentage of household type in a single older adult by year; (B) Percentage of household type in a couple living alone by year; (C) Percentage of household type in a couple living with other people by year; (D) Percentage of household type in other households by year (*2*).

Abbreviation: BE=Belgium; DE=Germany; ES=Spain; FR=France; IT=Italy; NL=The Netherlands; EU-27=European Union with 27 Member States.

out of fear of COVID-19, postponing planned healthcare, and inability to obtain medical treatment or appointment, as developed by the Survey of Health, Ageing and Retirement in Europe (SHARE) Corona Survey (*7*). Figure 2 shows the unmet healthcare needs during the first wave of the pandemic among adults aged 50 years and over. The majority of unmet healthcare needs in Europe resulted from postponing planned care, which accounted for 25%, followed by refusal of medical care due to fear of COVID-19 (12%) and inability to obtain medical treatment or an appointment (5%). There were differences across the selected countries. In France and Belgium, 36% and 35% of those aged 50 years and over postponed planned healthcare, respectively. In both Germany and Italy, 17% of those aged 50 years and over refused healthcare out of fear of COVID-19, which was higher than in other countries. In France and Belgium, 10% and 9% of those aged 50 years and over were unable to obtain medical treatment or an appointment, respectively. Additionally, frail populations were more likely to have unmet healthcare needs. For example, individuals aged 85 years and over were more likely to have unmet healthcare needs. Women were more likely to forgo healthcare for fear of COVID-19 and to postpone planned care. Populations who were economically vulnerable and self-rated as having poor health were also more likely to forgo healthcare for fear of COVID-19 and to postpone planned care (*7*).

THE NEED FOR – AND CHALLENGE OF – DEVELOPING COMMON INDICATORS ON OLDER ADULTS' CARE

To the best of our knowledge, this is the first time that these three types of indicators, including

TABLE 2. Need, access, workforce, and expenditure of long-term care for older adults for the EU population and selected European countries in 2019 (*5*).

Item	EU-27	BE	DE	ES	FR	IT	NL
Need of long-term care							
A1	27.3*	29.9	15.2*	28.8	21.5	28.7	26.9
Access to long-term care							
B1	3.6	6.2	4.3	1.2	4.9	3.2	5.6
B2	5.8	15.7	3.6	3.9	6.2	4.7	19.1
B3	8.8	7.8	11.3	4.4	0	10.9	1.2
B4	51.8*	NA	72.1*	47.9	38.7	44.2	24.5
B5	11.0*	25.1	6.3*	10.8	15.1	9.5	18.0
B6	35.7†	24.4	19.2†	54.1	16.4	36.9	30.3†
B7	9.7†	5.8	3.8†	7.3	3.6	30.3	8.3†
B8	*NA*	1276.6	1152.2	830.3	981.5	415.8	1370.7
Long-term care workforce							
C1	3.8†	4.8†	5.1†	4.5†	2.3†	1.9†	8.0†
C2	10.3†	11.6†	6.8†	11.5†	14.1†	5.8†	36.7†
C3	22.2†	15.0†	15.0†	52.9†	10.5†	40.5†	3.3†
Public long-term care expenditure as the percentage of GDP							
D1	1.7	2.2	1.6	0.7	1.9	1.7	3.7
D2	2.1	2.7	1.9	1.0	2.3	2.0	4.7
D3	3.4	4.4	2.8	2.1	3.7	3.1	6.7
D4	48.1	62.5	35.7	50.2	69.6	28.2	51.0
D5	25.5	26.8	23.5	25.9	24.8	19.5	16.4
D6	26.4	10.7	40.8	23.9	5.6	52.3	32.6

Note: A1 = The percentage of population aged 65 years and over requiring long-term care.
B1 = The percentage of population aged 65 years and over receiving care in long-term care facilities.
B2 = The percentage of population aged 65 years and over receiving care at home.
B3 = The percentage of population aged 65 years and over receiving long-term care cash benefits.
B4 = The percentage of population aged 65 years and over in need of long-term care with a lack of assistance in personal care or household tasks.
B5 = The percentage of population aged 65 years and over who have used home care services for personal needs in the past 12 months.
B6 = The percentage of population aged 65 years and over in need of long-term care, but not using (more) professional home care services due to the financial reason.
B7 = The percentage of population aged 65 years and over in need of long-term care, but not using (more) professional home care services because the services needed are not available.
B8 = Beds for long-term care per 100,000 residents.
C1 = Number of long-term care (formal care) workforce per 100 older adults aged 65 years and over.
C2 = The percentage of population providing informal care, which is the proportion of respondents who provide care or assistance to one or more individuals requiring assistance due to long-term physical or mental illness, physical weakness, or old age. Only unpaid, volunteer assistance is considered.
C3 = The percentage of informal carers providing more than 20 hours informal care per week.
D1 = Public long-term care expenditure as % of gross domestic product (GDP) in 2019.
D2 = Public long-term care expenditure as % of GDP projected for 2030.
D3 = Public long-term care expenditure as % of GDP projected for 2050.
D4 = Public expenditure on institutional care as % of total public long-term care expenditure.
D5 = Public expenditure on home care as % of total public long-term care expenditure.
D6 = Public expenditure on cash benefits as % of total public long-term care expenditure.
Abbreviation: BE=Belgium; DE=Germany; ES=Spain; FR=France; IT=Italy; NL=The Netherlands; EU-27=European Union with 27 Member States; NA indicates that data were unavailable.
* Indicates that the data came from 2014.
† Indicates that the data came from 2016.

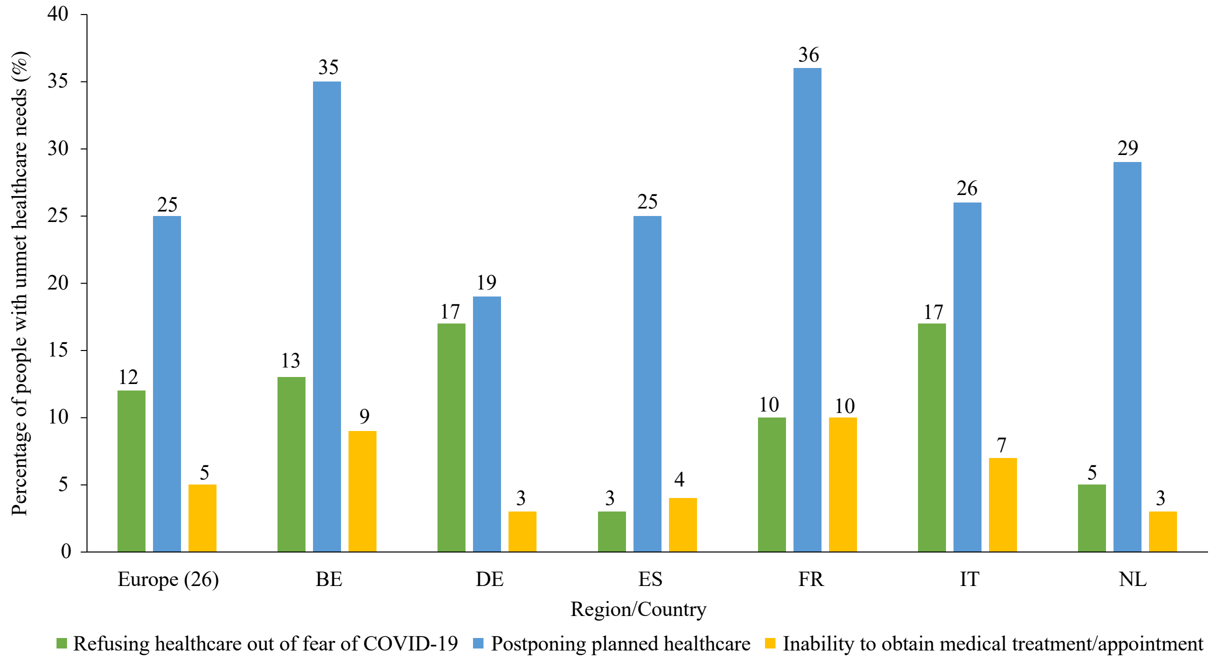

FIGURE 2. Unmet healthcare needs during the first wave of the pandemic among adults aged 50 years and over in Europe and selected European countries. (*7*)

Note: Europe including Member States: Germany, Sweden, The Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Israel, Czech Republic, Poland, Luxemburg, Hungary, Slovenia, Estonia, Croatia, Lithuania, Bulgaria, Cyprus, Finland, Latvia, Malta, Romania and Slovakia.

Abbreviation: BE=Belgium; DE=Germany; ES=Spain; FR=France; IT=Italy; NL=The Netherlands.

population ageing, long-term care, and unmet healthcare needs during the COVID-19 pandemic, have been examined together. Developing common and comparable indicators is useful for monitoring the healthcare of older adults at the national and international level. For example, Europe has summarized an evaluation index system for healthcare and LTC, which can be used for international comparisons, as well as by developing nations to allocate medical resources for older adults and monitor and enhance their care. As another example, LTC expenditures as a percentage of GDP, the ratio for LTC employees, and LTC beds in Europe were all much higher than in developing nations (*5*,*8*), and developing nations could use these indicators as a benchmark for allocating and enhancing healthcare and LTC for older adults. In addition, understanding the reasons for the differences in indicators between European countries can provide insight into ways to improve older adults' health.

Developing indicators to monitor and improve care for older adults is a global challenge. Several indicators have been developed, but they do not fully meet the requirements for monitoring and enhancing care in Europe (*9*). In addition, the World Health Organization recommends that a global agreement on a standard set of care indicators be reached (*10*). Future development of a set of international and comparable indicators will be a crucial step in enhancing the quality of care for older adults worldwide, and this study helps contribute towards laying the groundwork for such a setup.

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