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Unmet needs for chronic diseases in China

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BMA House, Tavistock Square
London, UK, WC1H 9JR
Email: editor@bmj.com
Tel: + 44 (0) 20 7387 4410
Fax: + 44 (0) 20 7383 6418

BMJ - Beijing
A1203
Tian Yuan Gang Center
East 3rd Ring North Road
Chaoyang District
Beijing 100027
China
Telephone: +86 (10) 5722 7209

BMJ - Hoboken
BMJ Publishing Inc
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BMJ - Mumbai
102, Navkar Chamber, A Wing
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BMJ - Noida
Mindmill Corporate Tower
6th Floor, 24 A, Film City
Sector 16 A
Noida 201301
Telephone: + 91 120 4345733 - 38
Email: sbasu@bmj.com

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Suntec Tower Two
9 Temasek Boulevard, #29-01
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Progress and challenges in NCD prevention and control in China

A BMJ collection highlights the need for an integrated population tailored approach

Jun Lv,[1] professor
Zuo-Feng Zhang,[2] professor
[1]Department of Epidemiology and Biostatistics, School of Public Health, Peking University, Beijing, China
[2]Department of Epidemiology, Fielding School of Public Health, University of California at Los Angeles (UCLA), Los Angeles, California, USA

Correspondence to: J Lv
lvjun@bjmu.edu.cn

Non-communicable diseases (NCDs), such as cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes, account for 91% of all deaths in China.[1] China accounted for 17.9% of the world population in 2021, but 25.9% of global deaths from NCDs.[1 2] The burden of most NCDs has continued to rise over the past two decades,[3-5] driven mainly by population ageing[6] and a failure to fully and effectively tackle major risk factors for NCDs, including use of tobacco and alcohol, physical inactivity, unhealthy diets, and air pollution. A new collection of articles in *The BMJ* (www.bmj.com/collections/chronic-diseases-in-china) attempts to shed light on the current state and challenges of NCD prevention and control in the context of China's population ageing, as well as to discuss strategies and approaches to deal with these issues.

Over the past two decades, China has implemented several NCD prevention and control programmes, such as morbidity and mortality surveillance, public health intervention programmes,[7] and screening for major chronic diseases, primarily through the national basic and major public health service programmes. Among several national health policies, laws, and regulations introduced to improve public health is the prominent Healthy China 2030 Outline, which introduced more proactive approaches to NCD prevention and control that align with the World Health Organization's (WHO) global strategy. The global strategy explicitly acknowledges the primary role and responsibility of governments in responding to NCD challenges and the need for multisectoral engagement, emphasising health in all policies, addressing modifiable risk factors by creating health promoting environments, taking a life course approach to health, and making efforts to improve health equity.

Although China has made considerable progress in its national strategy for NCD prevention and control, challenges remain, as the collection lays out. First, there is insufficient emphasis on evidence in making policies, strategies, and practices for NCD prevention, diagnosis, treatment, and management. For example, because of insufficient studies and effectiveness trials in Chinese populations, good evidence for determining optimal thresholds for the diagnosis and treatment of hypertension, diabetes, and even cancer for the Chinese population is largely lacking.[8] As a result, Chinese NCD policies often follow those of western countries, even though the cost effectiveness of interventions, available resources, and values of people differ hugely in China. This has resulted in poor compliance with NCD policies.[8]

Another challenge pertains to healthcare access and health equity. The implementation of national policies and programmes varies greatly by region, reflecting differences in the local economic development level, culture, healthcare system capacity, and priorities of local governments, including health and non-health sectors. As part of the collection, Lu and colleagues discuss how individual variations in socioeconomic position also result in inequalities in lifestyle factors, exposure to air pollutants, other disease risk factors, and the effectiveness of interventions on risk factor control and disease outcomes.[9] Other articles argue that without a strong effort to address the social determinants of health, even effective policies and programmes, such as digital health solutions to disease prevention and management,[10 11] may exacerbate health inequities.

Importance of leadership

Although the health in all policies approach has been highlighted as a strategy in national and global policy documents, its implementation is also a challenge for China. Strong leadership from the central and local government is critical for successful implementation of policies and programmes that can truly improve health. For example, the Chinese government has issued national action plans to improve air quality since 2013, implementing comprehensive multisectoral actions that resulted in a significant reduction in $PM_{2.5}$ concentrations between 2014 and 2022.[12] In contrast, after 15 years of implementing the WHO Framework Convention on Tobacco Control in China, the best performing of the six recommended tobacco control measures are the monitoring of tobacco use and prevention policies and anti-tobacco mass media campaigns, both of which are primarily led by the health sector.[13 14] Gaps remain in the implementation of other measures that need national or non-health sector's leadership, such as national smoke-free law, health warnings on tobacco packaging, and tobacco tax increases.

NCDs and infectious diseases are not entirely distinct disease categories; rather, they share similar features and also have common interactions.[15] For example, major NCDs increase the risk of severe or fatal outcomes of covid-19, and covid-19 can also lead to long covid, a chronic health condition. Experiences with covid-19 also show that it is important to prevent people with chronic diseases from having infections, particularly during a communicable disease outbreak.[16] Three decades ago, the management of the prevention and control of infectious diseases and NCDs in China was merged into one department, the Department of Disease Control and Prevention of the former Ministry of Health. In May 2021, China inaugurated a new agency under the National Health Commission called the National Disease Control and Prevention Administration, with primary responsibilities for infectious disease prevention and control and public health supervision. However, this new agency is not in charge of NCD prevention and control, which was taken over by the Department of Medical Emergency Response.

The BMJ collection contributes to a growing understanding of NCD prevention and control, not least by showing that successful national prevention and control will depend on strong leadership from the central and local governments, on the integration and collaboration of both health and non-health

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sectors, and on policies made based on evidence relevant to the Chinese population. It will also require a shift from health in all policies to a health for all policies approach—that is, moving from focusing on wins for the health sector to emphasising co-benefits for all sectors.[17]

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1 Liu H, Yin P, Qi J, Zhou M. Burden of non-communicable diseases in China and its provinces, 1990-2021: Results from the Global Burden of Disease Study 2021. *Chin Med J (Engl)* 2024. doi:10.1097/CM9.0000000000003270

2 World Health Organization. Noncommunicable diseases. 2023. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

3 Ma Q, Li R, Wang L, et al. Temporal trend and attributable risk factors of stroke burden in China, 1990-2019: an analysis for the Global Burden of Disease Study 2019. *Lancet Public Health* 2021;6:e897-906. doi:10.1016/S2468-2667(21)00228-0

4 Qi J, Li M, Wang L, et al. National and subnational trends in cancer burden in China, 2005-20: an analysis of national mortality surveillance data. *Lancet Public Health* 2023;8:e943-55. doi:10.1016/S2468-2667(23)00211-6

5 Han B, Zheng R, Zeng H, et al. Cancer incidence and mortality in China, 2022. *J Natl Cancer Cent* 2024;4:47-53. doi:10.1016/j.jncc.2024.01.006

6 Lv Y, Fan L, Zhou J, et al. Burden of non-communicable diseases due to population aging in China: challenges to healthcare delivery and long term care services. *BMJ* 2024;387:e076529. doi:10.1136/bmj-2023-e076529

7 Wu J, Gao X, Yang Z, et al. Shen H. Non-pharmacological interventions for prevention and treatment of non-communicable diseases with experiences from China. *BMJ* 2024;387:e076764. doi:10.1136/bmj-2023-e076764

8 Yang Z, Tang JL. Definitions of chronic disease need to be more patient centred. *BMJ* 2024;387:q1858. doi:10.1136/bmj.q1858

9 Lu J, Xu Y, Bi Y, et al. Ning G. Reducing inequity through tackling social determinants of cardiovascular diseases in China. *BMJ* 2024;387:e079197. doi:10.1136/BMJ-2024-079197

10 Gong E, Wang H, Zhu W, et al. Shao R. Bridging the digital divide to promote prevention and control of non-communicable diseases for all in China and beyond. *BMJ* 2024;387:e076768. doi:10.1136/bmj-2023-076768

11 Tong X, Zu J, Gone E, et al. Frailty as a breakthrough point for multimorbidity management among older adults: challenges and opportunities in China. *BMJ* 2024;387:e076767. doi:10.1136/bmj-2023-076767

12 Zheng H, Kong S, Seo J, et al. Achievements and challenges in improving air quality in China: Analysis of the long-term trends from 2014 to 2022. *Environ Int* 2024;183:108361. doi:10.1016/j.envint.2023.108361

13 Sun D, Pang Y, Lyu J, Li L. Current progress and challenges to tobacco control in China. *China CDC Wkly* 2022;4:101-5. doi:10.46234/ccdcw2022.020

14 World Health Organization. WHO report on the global tobacco epidemic 2021: addressing new and emerging products. WHO, 2021.

15 Remais JV, Zeng G, Li G, Tian L, Engelgau MM. Convergence of non-communicable and infectious diseases in low- and middle-income countries. *Int J Epidemiol* 2013;42:221-7. doi:10.1093/ije/dys135

16 Li Y, Tong X, Jiang M, et al. Chronic disease and infection: lessons from the covid-19 pandemic. *BMJ* 2024;378:q2000.

17 Greer SL, Falkenbach M, Siciliani L, McKee M, Wismar M, Figueras J. From health in all policies to health for all policies. *Lancet Public Health* 2022;7:e718-20. doi:10.1016/S2468-2667(22)00155-4

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Non-pharmacological interventions for prevention and treatment of non-communicable diseases with experiences from China

Non-pharmacological interventions for prevention of non-communicable diseases are undervalued, and clinicians and policy makers need to be more active in implementing them, say **Hongbing Shen and colleagues**

Non-communicable diseases tend to be of long duration and are the result of a combination of genetic, physiological, environmental, and behavioural factors. Non-communicable diseases take an immense and increasing toll on lives, livelihoods, health systems, communities, economies, and societies.[1] Pharmacological interventions use drugs for the prevention and treatment of diseases. However, overdiagnosis and overtreatment of non-communicable diseases, and related over-reliance on and overuse of drugs and medical devices, are important contributors to the high burden of non-communicable diseases.[1 2] Risk factor reduction is an important strategy to control non-communicable diseases. Non-pharmacological interventions are science based, non-invasive interventions for human health that include lifestyle modification, psychological adjustment, and self-management education for patients.[3] Effective non-pharmacological interventions can prevent and control non-communicable diseases and reduce their burden, as evidenced by the successful practices of many countries, including China. However, the complementary relation between non-pharmacological interventions and drugs is still not widely recognised and applied in clinical practice, and the effectiveness of non-pharmacological interventions against non-communicable diseases is often underestimated and underappreciated by patients and clinicians.

KEY MESSAGES

- Non-pharmacological interventions can make important contributions to the prevention and control of non-communicable diseases
- Non-pharmacological interventions can improve clinical outcomes in patients with non-communicable diseases, making clinicians' work more effective and cost effective and improving their reputation among patients
- Pharmacological interventions and non-pharmacological interventions for prevention and treatment of non-communicable diseases are complementary, not antagonistic
- Non-pharmacological interventions, particularly lifestyle targeted interventions, should be given greater emphasis
- Long term, well organised non-pharmacological intervention initiatives and promotion of healthy lifestyles have been shown to be achievable and effective in studies in different countries around the world, including China

Non-pharmacological interventions are important for prevention and treatment of non-communicable diseases

Non-communicable diseases are commonly known as chronic or lifestyle related diseases.[1 4] Non-pharmacological interventions could reduce the incidence of and mortality from the major non-communicable diseases, thereby increasing life expectancy.[1 4 5] Long term, well organised non-pharmacological intervention initiatives and promotion around the world, such as the North Karelia Project, the UK nationwide salt reduction programme, the Da Qing Study, and the Shandong-Ministry of Health Action on Salt and Hypertension programme in China, have provided evidence of long term benefit from non-pharmacological interventions in the prevention and control of diabetes and cardiovascular diseases. The China Motivational Healthy Walking Programme explored a real world model of physical activity promotion suitable for working age people and found positive effects of walking for reducing body mass index and waist circumference and preventing overweight and obesity.[6] Increasing the adoption of healthy lifestyles could also the reduce overall risk of cancer.[1 7] One study suggested that among participants at high genetic risk, the standardised five year incidence of cancer was relatively lower for people with a favourable lifestyle than for those with an unfavourable lifestyle, irrespective of the gender.[7]

Non-pharmacological interventions can improve clinical outcomes and quality of life in people with non-communicable diseases. Non-pharmacological interventions such as smoking cessation, nutritional supplementation, breathing exercises, and inhaler training had positive effects on survival and quality of life in patients with chronic obstructive pulmonary disease.[8 9] Clinicians who accept training on lifestyle intervention and combine it with drug treatment can improve the effect of their treatment and management of non-communicable diseases. Furthermore, this approach could help clinicians to enhance their reputation or avoid some misunderstandings or misinterpretations of clinical treatment processes. For example, trained village doctors were shown to improve blood pressure control in Chinese rural residents by combining antihypertensive drugs with health coaching on home blood pressure monitoring, lifestyle change, and drug adherence.[10] An evaluation of a nationwide diabetes prevention programme suggested that promoting lifestyle advice and counselling in routine care at scale in a national health system can achieve important health improvements.[11] Adding non-pharmacological interventions to guidelines on the prevention and treatment of non-communicable diseases, and promoting training on non-pharmacological interventions for

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clinicians and primary health practitioners, is therefore beneficial.

Pharmacological interventions and non-pharmacological interventions are complementary, not antagonistic

Both pharmacological and non-pharmacological interventions can and should be used for primary prevention of non-communicable diseases. Drugs have been shown to be effective in reducing the risk of non-communicable diseases. A study showed that all cause mortality was reduced after five years of statin treatment (hazard ratio 0.87, 95% confidence interval 0.80 to 0.94), attributable mainly to a 21% decrease in death from cardiovascular disease (0.79, 0.69 to 0.90), with improved survival and a substantial reduction in cardiovascular disease outcomes over a 20 year period, and supported wider adoption of this primary prevention strategy.[12] Pharmacological interventions often quickly and effectively help to manage medical conditions and progression of non-communicable diseases, avoiding acute health damage and even death. Owing to poor adherence, unavailability and unaffordability, and low cost effectiveness, the widespread use of some effective drugs has been limited. The World Health Organization reported that approximately four out of every five people with hypertension are not adequately treated, but 76 million deaths could be averted between 2023 and 2050 if countries can scale up coverage.[13] Drugs and medical devices also pose a significant financial burden to the healthcare system and patients that can impair wellbeing and quality of life.[14] Drugs may not always treat the underlying cause of a condition and may provide only temporary relief of symptoms. Adverse events due to drugs for non-communicable diseases are commonly observed, and some are serious. Although a concerning underuse of some preventive drugs for non-communicable diseases exists (for example, antiplatelet agents, antihypertensives), long term, excessive emphasis on other pharmacological interventions can lead to an increased risk of side effects, drug interactions, and development of drug resistance.[15] Therefore, prevention and treatment of non-communicable diseases should not be over-reliant on drugs and medical devices, especially when mechanisms or therapeutic targets are not fully understood or the efficacy of these treatments is not robustly determined.

For some non-communicable diseases, non-pharmacological interventions may be first line preferences for prevention and treatment, with drugs added only if necessary. Non-pharmacological interventions alone may be effective enough to preclude the need for drugs in many cases. Primary care led weight management, in the absence of antidiabetic and antihypertensive drugs, was found to achieve remission of diabetes in 42% of patients (with odds ratios of remission as high as 19.7).[16] Non-pharmacological interventions can help to reduce daily doses of antihypertensive drugs and delay progression from pre-hypertension to hypertension.[17] Obviously, pharmacological interventions and non-pharmacological interventions are not antagonistic but complementary. Pharmacological interventions may be the top choice for treatment of some non-communicable diseases at certain stages, but a combination of pharmacological and non-pharmacological interventions may achieve the best outcomes.[18] Furthermore, implementing non-pharmacological interventions that are backed with scientific evidence can improve quality of life, slow deterioration, relieve pain, or restore the health of patients with non-communicable diseases, usually at lower cost.

Non-pharmacological interventions should be given more emphasis

Non-pharmacological interventions underpin public health approaches to modification of risk factors for non-communicable diseases. However, these interventions aimed at reducing major risk factors for non-communicable diseases have not received as much attention or funding as pharmacological interventions. This inattention may be due to underestimation and underappreciation of the effectiveness of non-pharmacological interventions.[19 20] Non-pharmacological interventions have often not been well implemented owing to obstacles to inter-professional collaboration or inadequate resources.[21] In some instances, medical staff have insufficient knowledge of non-pharmacological interventions.[22] Some physicians and nurses remain unconvinced of the effectiveness of non-pharmacological interventions or have unfavourable attitudes, despite an expanding base of scientific evidence.[19 20] Furthermore, several studies suggest that patients tend to prefer pharmacological interventions and are generally not interested in non-pharmacological interventions such as exercise and smoking cessation.[20] Non-pharmacological interventions seem to be under-embraced globally by both patients and clinicians.

Other non-pharmacological interventions may be effective, but non-comparable definitions, methodological problems, and lack of standardised assessment practices challenge valid assessment of their effectiveness and limit the practical value of much existing evidence.[23 24] Fortunately, the latest 5×5 framework for prevention and control of non-communicable diseases identified five main risk factors—unhealthy diet, tobacco use, air pollution, harmful use of alcohol, and physical inactivity—and suggested that non-pharmacological interventions are the most reliable and effective means for prevention of non-communicable diseases. Successful practices such as those used in the Da Qing Study provide compelling evidence of the effectiveness of lifestyle interventions, but unfortunately lifestyle intervention has not been effectively implemented in routine clinical practice in some areas.[5] Non-pharmacological interventions should be given greater emphasis, particularly lifestyle targeted interventions.

Challenges of implementation of non-pharmacological interventions and corresponding effort

Long term, well organised implementation of non-pharmacological interventions in large populations is achievable and can improve population lifestyles and physiological indicators and reduce the risk and burden of non-communicable diseases. Only by ensuring accessibility, generalisability, and sustainability of the interventions can they be truly and effectively used for promoting the health of the population. Solving these challenges requires technical support tools with high level mobilisation and multi-departmental cooperation. WHO has provided and promoted several high impact, evidence based technical packages for non-pharmacological intervention in recent years, and nutrition and physical activity related US guidelines have also been developed and widely referenced by other countries.[25] Non-pharmacological intervention related strategies such as the WHO global action plan on physical activity (2018-30), USA Healthy People 2030 plan, and EU4Health programme (2021-27) aim to promote the sustainability of and multi-departmental cooperation on health promotion interventions. Technical

guidelines for non-pharmacological interventions have also recently been developed and promoted in China, such as Dietary Guidelines for Chinese Residents (2022), Physical Activity Guidelines for Chinese Residents (2021), and national guidelines for the prevention and treatment of non-communicable diseases.[7] The Healthy China Initiative (2019-30) was launched as a national strategy in 2019, starting a decade of national disease prevention and health promotion actions, with 15 specific campaigns to improve factors that influence health, protect health across the full life cycle, and prevent and control major diseases.

Relying solely on medical staff is not enough—trained personnel can play an important role in implementation

Only medical staff can prescribe drugs and implement pharmacological interventions, but use of non-pharmacological interventions is not restricted to these professionals; such interventions can also be conducted by volunteers and other types of personnel. The number of non-communicable diseases and high risk groups is extremely large, and reliance on medical staff to implement non-pharmacological interventions for prevention and management in this large population is not enough—the support of other personnel is needed. Health volunteers such as trained community workers and school teachers with professional knowledge and skills can do health consultations, provide lifestyle guidance, and conduct other non-pharmacological intervention related work. Healthy lifestyle instructors, nutrition instructors, and sports instructors have been widely recruited and trained in China. They provide healthy lifestyle services such as education about diet, exercise, and psychological health in communities and primary healthcare institutions. China's Medium-to-Long Term Plan for the Prevention and Treatment of Chronic Diseases (2017-25) and Healthy China Initiative (2019-30) promote teams of such qualified personnel. The efforts of these non-clinician personnel can support clinicians in their effort to improve the quality of life of patients with non-communicable diseases and help to enhance adherence to clinical treatments.

Conclusions

Non-pharmacological interventions are fundamental for the prevention and control of non-communicable diseases. Although rapid development of technology has made treatment of non-communicable diseases with drugs more precise, the current situation of emphasising pharmacological interventions over non-pharmacological interventions has been associated with drastically increasing burdens of non-communicable diseases and adverse effects of drugs that cannot be ignored. Long term, well organised implementation of non-pharmacological interventions in large populations is both achievable and effective. Provision of appropriate technical tools, policy support, and qualified personnel, as well as increased awareness of non-pharmacological interventions in relevant populations, are needed to promote a wider adoption and implementation of non-pharmacological interventions. Only by fully recognising the importance of non-pharmacological interventions can we implement comprehensive strategies for the prevention and reduction of non-communicable diseases. Non-pharmacological interventions should be widely embraced by populations at high risk of non-communicable diseases and by patients, clinicians, policy makers, and the public across the world. Appropriate non-pharmacological interventions should be incorporated into international guidelines and protocols for prevention and treatment of non-communicable diseases and fully applied in clinical practice. More quantitative studies and evaluations of non-pharmacological interventions in clinical practice should be conducted to strengthen assessment of their effectiveness and acceptance.

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Jing Wu, professor[1,2]

Xiang Gao, professor[3]

Zuyao Yang, assistant professor[4]

Yibing Yang, associate professor[2]

Gauden Galea, strategic adviser[5]

Longde Wang, professor[6]

Hongbing Shen, professor[2]

[1]National Center for Chronic and Noncommunicable Disease Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing, China

[2]Chinese Center for Disease Control and Prevention, Beijing, China

[3]Department of Nutrition and Food Hygiene, School of Public Health, Institute of Nutrition, Fudan University, Shanghai, China

[4]The Jockey Club School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, China

[5]The WHO Regional Office for Europe, Copenhagen, Denmark

[6]Chinese Preventive Medicine Association, Beijing, China

Correspondence to: H Shen
shenhb@chinacdc.cn

1 World Health Organization. Noncommunicable diseases. 2023. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases
2 Centers for Disease Control and Prevention. Health and Economic Costs of Chronic Diseases. 2023 https://www.cdc.gov/chronicdisease/about/costs/index.htm
3 Ninot G, Agier S, Bacon S, et al, LaPlateforme CEPS: Une structure universitaire de réflexion sur l'évaluation des interventions non médicamenteuses (INM). *Hegel* 2017;1:53-6.
4 Li Y, Pan A, Wang DD, et al, Impact of healthy lifestyle factors on life expectancies in the US Population. *Circulation* 2018;138:345-55. doi:10.1161/CIRCULATIONAHA.117.032047
5 Gong Q, Zhang P, Wang J, et al,Da Qing Diabetes Prevention Study Group. Morbidity and mortality after lifestyle intervention for people with impaired glucose tolerance: 30-year results of the Da Qing Diabetes Prevention Outcome Study. *Lancet Diabetes Endocrinol* 2019;7:452-61. doi:10.1016/S2213-8587(19)30093-2
6 Li YC, Zhao YF, Yang XZ, Li ZX, Jiang W. [Effects of short-term intervention of walking on body mass index, waist circumference, and related indicators of working population]. *Zhonghua Yu Fang Yi Xue Za Zhi* 2019;53:212-7.
7 Zhu M, Wang T, Huang Y, et al, Genetic Risk for Overall Cancer and the Benefit of Adherence to a Healthy Lifestyle. *Cancer Res* 2021;81:4618-27. doi:10.1158/0008-5472.CAN-21-0836
8 Zysman M, Mahay G, Guibert N, Barnig C, Leroy S, Guilleminault L. Impact of pharmacological and non-pharmacological interventions on mortality in chronic obstructive pulmonary disease (COPD) patients. *Respir Med Res* 2023;84:101035. doi:10.1016/j.resmer.2023.101035
9 Ceyhan Y, Tekinsoy Kartin P. The effects of breathing exercises and inhaler training in patients with COPD on the severity of dyspnea and life quality: a randomized controlled trial. *Trials* 2022;23:707. doi:10.1186/s13063-022-06603-3
10 Sun Y, Mu J, Wang DW, et al,CRHCP Study Group. A village doctor-led multifaceted intervention for blood pressure control in rural China: an open, cluster randomised trial. *Lancet* 2022;399:1964-75. doi:10.1016/S0140-6736(22)00325-7
11 Lemp JM, Bommer C, Xie M, et al, Quasi-experimental evaluation of a nationwide diabetes prevention programme. *Nature* 2023;624:138-44. doi:10.1038/s41586-023-06756-4
12 Ford I, Murray H, McCowan C, Packard CJ. Long-term safety and efficacy of lowering low-density lipoprotein cholesterol with statin therapy: 20-year follow-up of west of Scotland coronary prevention

study. *Circulation* 2016;133:1073-80. doi:10.1161/CIRCULATIONAHA.115.019014
13 World Health Organization. Global report on hypertension: the race against a silent killer. 2023. https://www.who.int/publications/i/item/9789240081062
14 Pisu M, Martin MY. Financial toxicity: a common problem affecting patient care and health. *Nat Rev Dis Primers* 2022;8:7. doi:10.1038/s41572-022-00341-1
15 De Crescenzo F, D'Alò GL, Ostinelli EG, et al, Comparative effects of pharmacological interventions for the acute and long-term management of insomnia disorder in adults: a systematic review and network meta-analysis. *Lancet* 2022;400:170-84. doi:10.1016/S0140-6736(22)00878-9
16 Lean ME, Leslie WS, Barnes AC, et al, Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. *Lancet* 2018;391:541-51. doi:10.1016/S0140-6736(17)33102-1
17 Mahmood S, Shah KU, Khan TM, et al, Non-pharmacological management of hypertension: in the light of current research. *Ir J Med Sci* 2019;188:437-52. doi:10.1007/s11845-018-1889-8
18 Lu Q, Zhang Y, Geng T, et al, Association of lifestyle factors and antihypertensive medication use with risk of all-cause and cause-specific mortality among adults with hypertension in China. *JAMA Netw Open* 2022;5:e2146118. doi:10.1001/jamanetworkopen.2021.46118
19 Leemans G, Vissers D, Ides K, Van Royen P. Perspectives and Attitudes of General Practitioners Towards Pharmacological and Non-Pharmacological COPD Management in a Belgian Primary Care Setting: A Qualitative Study. *Int J Chron Obstruct Pulmon Dis* 2023;18:2105-15. doi:10.2147/COPD.S423279
20 Šedová L, Tóthová V, Olišarová V, et al, Opinions regarding the effectiveness of non-pharmacological measures in prevention of cardiovascular disease in the Czech Republic. *Neuro Endocrinol Lett* 2016;37(suppl 2):32-8.
21 Cipriani A, Furukawa TA, Salanti G, et al, Comparative efficacy and acceptability of 21 antidepressant drugs for the acute treatment of adults with major depressive disorder: a systematic review and network meta-analysis. *Lancet* 2018;391:1357-66. doi:10.1016/S0140-6736(17)32802-7
22 Cohen-Mansfield J, Jensen B, Resnick B, Norris M. Knowledge of and attitudes toward nonpharmacological interventions for treatment of behavior symptoms associated with dementia: a comparison of physicians, psychologists, and nurse practitioners. *Gerontologist* 2012;52:34-45. doi:10.1093/geront/gnr081
23 Abraha I, Rimland JM, Trotta FM, et al, Systematic review of systematic reviews of non-pharmacological interventions to treat behavioural disturbances in older patients with dementia. The SENATOR-OnTop series. *BMJ Open* 2017;7:e012759. doi:10.1136/bmjopen-2016-012759
24 Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet* 2003;362:1225-30. doi:10.1016/S0140-6736(03)14546-1
25 World Health Organization. Global Hearts Initiative, working together to promote cardiovascular health. 2016. https://www.who.int/news/item/15-09-2016-global-hearts-initiative

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Frailty as a breakthrough point for multimorbidity management among older adults: challenges and opportunities in China

Huan Xi and colleagues argue that tailored strategies are needed to seamlessly integrate frailty assessment into multimorbidity management, thereby promoting a shift towards a health oriented management approach

The global population is undergoing a profound demographic transition characterised by a substantial increase in both the absolute number and the proportion of older people. China's ageing population has been especially in the spotlight. One recent projection suggests a twofold escalation in the percentage of people aged 60 years and older in China—an increase from 168 million people, 12.4% of the entire population, in 2010 to 402 million, 28% of the population, by 2040.[1]

As people age, the risk of functional decline and multimorbidity increases. Multimorbidity, defined by the World Health Organization as the concurrent presence of two or more chronic conditions in an individual,[2] affects a significant proportion of the global population at a pooled prevalence of 42.4%.[3] This prevalence increases markedly with age, ranging from 30% among middle aged people to 82% among those aged 85 and above.[4] In addition to multiple chronic conditions, frailty poses another concern for the older population. According to WHO, frailty is characterised as a clinically recognisable state with increased vulnerability resulting from age associated declines in physiological reserve and function across multiple organ systems.[5] A recent review, synthesising data from 240 studies in 62 countries and territories, reported a global weighted prevalence of frailty of 10.7% among people aged 65 and over.[6] Both multimorbidity and frailty affect the health of the older population in China, emphasising the importance of improving their health status in addition to multimorbidity management.

Thus, to tackle the growing challenge of multimorbidity, this analysis highlights the importance of considering frailty as a critical breakthrough point for multimorbidity management; describes the current global landscapes of guidelines, tools, and intervention strategies; discusses the challenges and initiatives for frailty assessment and multimorbidity management in China; and showcases potential opportunities for tackling the multifaceted challenge of multimorbidity around the world.

KEY MESSAGES

- China has an increasingly ageing society; this poses new health challenges of multimorbidity, which has a pooled prevalence of 36.6%
- Managing multimorbidity is an escalating challenge, as the current disease-centric approach is inadequate to tackle the growing health needs of the older population
- Early assessment of and tailored interventions for frailty should be optimised as they have great potential to provide a breakthrough point to enhance the global management of multimorbidity in the older population
- Given the availability of tools and intervention strategies, tailored and localised strategies are needed in China and other countries, in alignment with system preparedness, to promote a shift towards function and health oriented approaches to multimorbidity management

Frailty assessment: a breakthrough point for multimorbidity management

Frailty and multimorbidity often coexist; approximately 72% of frail people also have multimorbidity, and the prevalence of frailty among those with multimorbidity is estimated at approximately 16%.[7] Multimorbidity and frailty are two correlated challenges faced by older people, but with distinct emphases. Multimorbidity involves the accumulation of multiple complex diseases, whereas frailty is characterised by a decline in functional abilities and an increased vulnerability to stressors.[8] Despite the overlap and age related nature of multimorbidity and frailty, researchers emphasise the importance of prioritising both functional improvements and treatment of disease when tackling the complex health conditions seen in older people.

Extensive evidence has highlighted the interconnection between frailty and multimorbidity.[9] On the one hand, among community dwelling older adults, multimorbidity and chronic diseases are key clinical factors that drive the development of frailty. On the other hand, frailty increases the risk of adverse outcomes for people with multimorbidity. A Chinese cohort study involving patients aged 65 and older with multimorbidity showed that frailty was a significant contributor to adverse outcomes, including falls, pressure injury, deep vein thrombosis, cardiac arrest, aspiration, and unplanned intubation.[10] The interconnection between frailty and multimorbidity provides a rationale for linking multimorbidity management with assessment and interventions for frailty. In addition, evidence has highlighted the predictive power of frailty status for clinical outcomes in people with complex health conditions and their mental and physical quality of life.[11 12] Thus, targeted interventions for the assessment and prevention of frailty may assist in the triage of patients with complex health needs and delay, decelerate, or reverse the cascade of functional decline,[13] thereby reducing the risk of multimorbidity and improving quality of life.

Prioritising assessment and intervention for frailty offers a novel perspective and solution for tackling the challenge of multimorbidity. Theoretically, frailty assessments and interventions place individual patients at the centre of prevention and treatment strategies and consider their general health and functional

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status, as well as the vulnerability of the older population. Early assessment and intervention for frailty could provide appropriate care to older people before the onset of severe disease, shifting the focus of disease management from treatment to prevention. This signifies a conceptual transition from disease centred care to person centred and health oriented care. In practice, frailty assessment serves as the initial step in enabling older people to navigate within the healthcare system, facilitating the communication between physicians and patients in decision making about care.[14 15] It also aids triage and priority setting for people with multiple and complex health conditions. By prioritising frailty assessment and intervention, healthcare systems can more effectively allocate resources and tailor interventions to the specific needs of each person, ultimately improving the overall management of multimorbidity in the older population.

Global advancement in frailty assessment and multimorbidity management: guidelines, tools, and strategies

Given the importance of frailty assessment in older adults with multimorbidity and its role as a breakthrough point in multimorbidity management, clinical guidelines have been developed to promote frailty assessment for patients with multimorbidity. A review of international guidelines for multimorbidity showed the importance of interactive assessment, including evaluation of physiological and functional status, nutritional requirements, and mental health status, in the context of multimorbidity management.[16] For example, the multimorbidity guideline from the UK National Institute for Health and Care Excellence (NICE) recommends the integration of frailty assessment with multimorbidity management strategies,[17] and the guidelines developed by the American Geriatrics Society emphasise the importance of meaningful outcomes, such as quality of life, physical function, and independent living, for older adults with multimorbidity.[18]

In addition to guidelines, various tools and strategies have been developed to assess and intervene in frailty in both community and hospital settings, aiming to prevent the development of multimorbidity and improve functional independence. Table 1 provides an overview of the tools used for frailty assessment and their practical implementation. Despite the lack of standardised tools available, some countries have integrated frailty assessment tools into service delivery pathways and provided decision support for physicians. For instance, in the UK, an electronic frailty index, generated on the basis of routine data with robust predictive validity for mortality and hospital admission, has been incorporated for physicians to assess frailty status. To enhance the feasibility of adoption, simplified programmatic assessment methods, such as the use of gait speed as an indicator of frailty, have also been recommended for general practitioners in the UK.[13] Moreover, interventional strategies for frailty and multimorbidity have undergone development and evaluation in clinical trials. Non-drug interventions, notably tailored exercise and nutrition programmes, have been shown to be effective as primary recommended strategies for managing frailty, as well as for preventing and managing chronic diseases.[19 20] Although drug interventions for frailty are still in their nascent stage, emerging research has begun to explore their potential benefits in preventing and reversing frailty.[21]

Efforts and challenges in frailty assessment and multimorbidity management in China

However, despite the availability of guidelines, tools, and intervention strategies aimed at integrating frailty assessment into routine practice for multimorbidity management, real world implementation remains challenging in many countries, including China. Major barriers include the lack of localised guidelines and tools with culturally adapted content and limited capacity and insufficient incentives for physicians to adopt these strategies and tools.

China, with one of the world's largest and most rapidly ageing populations, faces increasing challenges related to multimorbidity. Over the past decade, it has

Table 1 | Widely used tools for frailty screening and assessment

Tools for frailty screening and assessment	Included domains	Country of initial development	Applicable setting (population based/clinical based/both)	Application in Chinese population (verified/adapted/not applied)
Tilburg Frailty Indicator (TFI)	Physical, psychological, and social	Netherlands	Population based	Verified
PRISMA-7	Activities of daily living and social support	Canada	Both	Verified
Gérontopôle Frailty Screening Tool (GFST)	Physical, cognitive, and social	France	Population based	Not applied
Groningen Frailty Indicator (GFI)	Physical, cognitive, social, and psychological	Netherlands	Both	Verified
Kihon Checklist (KCL)	Cognitive, mood, isolation, physical, nutrition, activities of daily living	Japan	Both	Verified
Abbreviated CGA	Cognitive status, functional status, and depression	Netherlands	Both	Adapted
Fried's Frailty Phenotype	Physical	USA	Both	Verified
Frailty Index of Accumulative Deficits (FI-CD)	Physical, psychological, and social	Canada	Both	Verified
Multidimensional Prognostic Index (MPI)	Comorbidity, nutrition, cognition, polypharmacy, pressure sore risk, living status, basic and instrumental activities of daily living	Italy	Both	Not applied
CGA-based frailty index (FI-CGA)	Cognition, mood, communication, mobility, balance, nutrition, basic and instrumental activities of daily living, social, and comorbidity	Canada	Both	Adapted
Edmonton Frail Scale (EFS)	Physical, social, cognitive, and psychological	Canada	Clinical based	Verified
Sherbrooke Postal Questionnaire (SPQ)	Physical, cognitive, and social	Canada	Population based	Not applied

CGA=Comprehensive Geriatric Assessment; PRISMA=Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

drawn on evidence and tools from developed countries to begin the development of localised frailty assessment tools and multimorbidity management guidelines. Moreover, the Chinese government has implemented many policies and initiatives aimed at improving healthcare services for older people.[22] These initiatives include substantial support for research and development to describe the burden and clinical phenotype of multimorbidity, as well as the development of localised tools and guidelines for frailty assessment and multimorbidity management.[23 24]

Another key focus is the development and top down technical diffusion of geriatric medicine and integrated care for older people across China, aligning with broader healthcare reforms.[25] Over the past few years, geriatric medicine departments have been expanded to serve as points of care for older people, including those with multimorbidity. According to China's 14th five year plan for elderly care, approximately 31.8% of general hospitals at the primary level or above had geriatric medicine departments in 2020. This proportion increased to 53.4% by the end of 2021 and is projected to reach 60% by 2025. In primary healthcare facilities, including both community healthcare centres and clinics, healthcare providers administer health screening for major non-communicable diseases and regular health checks for people aged 65 years and older as part of basic public health services.[26] Additionally, training programmes focusing on frailty assessment and integrated care for older people have been implemented, with pilot projects evaluating their feasibility and effectiveness in enhancing the functional status and quality of life of older adults.[27]

Despite notable progress, the adaptation of international guidelines, tools, and interventional strategies to the Chinese context has encountered substantial hurdles. Critical problems remain unresolved, including identifying which patients with multimorbidity should be assessed for frailty, determining who should deliver these assessments, and understanding how to use frailty assessment results to support decision making on multimorbidity treatment. This situation is not unique to China; many countries face similar challenges, necessitating the development of tailored strategies to integrate frailty assessments into routine multimorbidity management effectively. Such strategies seek to prioritise prevention and emphasise functional improvement, reflecting the growing emphasis on holistic approaches to promote healthy ageing.

Looking forward: opportunities

The challenge posed by population ageing has underscored the urgent need to tackle multimorbidity, which is reshaping the demand side of the healthcare landscape regardless of our readiness. This transition requires a shift from merely managing multimorbidity to proactively preventing multimorbidity and enhancing function and quality of life among older people. Reinforcing the healthcare system and identifying effective pathways for implementation are equally crucial to promote a health oriented model of care that prioritises function, using available assessment tools and intervention strategies. Figure 1 illustrates potential strategies for strengthening the key building blocks of the healthcare system in China, including developing culturally adapted guidelines and implementation strategies, building the capacity of healthcare providers, and ensuring financial support. These efforts are essential to balance and sustain services for frailty assessment and interventions, motivating proactive prevention and management of multimorbidity.

Practical pathways for assessing frailty and managing multimorbidity are clearly

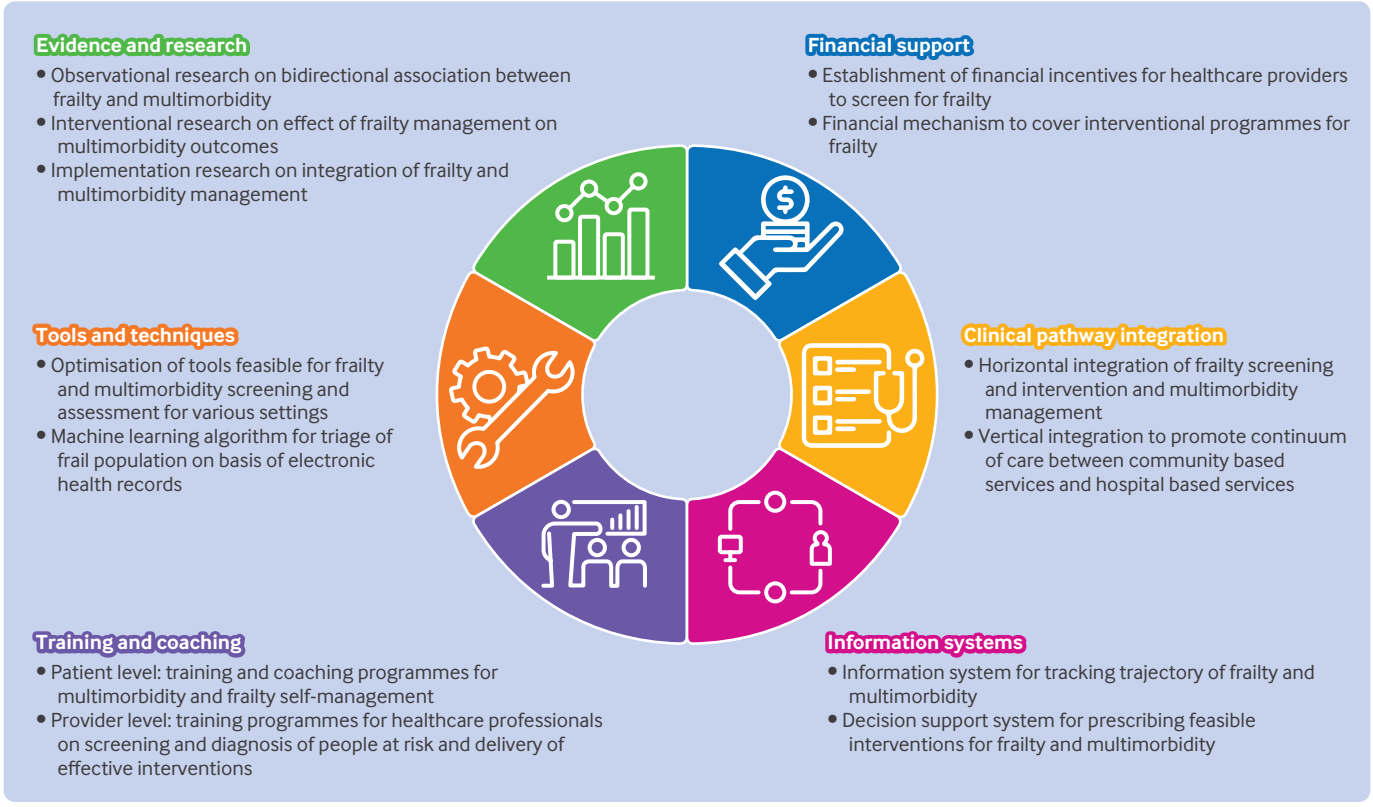

Fig 1 | Six dimensions to promote multimorbidity management in China

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needed. China's response to the covid-19 pandemic showed its unique ability to deliver healthcare services and monitor diseases by using community resources and digital health technologies. On the one hand, community based initiatives, given their extensive population reach, should spearhead efforts to tackle multimorbidity. This requires training and incentivising community based health workforces, as well as enhancing the referral system between communities and hospitals to ensure timely and proper assessment, triage, and interventions within communities. On the other hand, leveraging digital health technologies, such as decision support systems, wearable devices, and mobile health applications, can facilitate long term monitoring and assessment of functional decline and disease management.[28] Similar opportunities have emerged in many other countries where community empowerment and digital health solutions are used to enhance access to and quality of care.

Conclusions

Embracing the concept of healthy ageing, we advocate the seamless integration of frailty assessment into routine care for people with multimorbidity. This innovative strategy offers a potential solution for many countries, including China, with limited healthcare resources and escalating demands due to multimorbidity. Tailored implementation strategies are needed to facilitate the widespread adoption and integration of frailty assessment into routine care, thereby promoting a shift from disease centred to health centred care.

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Xunliang Tong, attending physician[1]
Jian Xu, chief physician[2]
Enying Gong, associate researche[3,4]
Xinyue Zhang, doctoral candidate[1]
Yanming Li, chief physician and professor[1]
Ruitai Shao, professor[3,4]
Huan Xi, chief physician and professor[5]

[1]Department of Pulmonary and Critical Care Medicine, Beijing Hospital, National Gerontology Center, Institute of Gerontology, Chinese Academy of Medical Sciences Beijing, China
[2]Department of Elderly Health Management, Shenzhen Center for Chronic Disease Control, Shenzhen, China
[3]School of Population Medicine and Public Health, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China
[4]State Key Laboratory of Respiratory Health and Multimorbidity, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China
[5]Department of Geriatrics, National Clinical Research Center for Geriatrics, Beijing Hospital, National Center of Gerontology, Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, Beijing, China

Correspondence to: H Xi
xih@bjhmoh.cn

1 World Health Organization. China country assessment report on ageing and health. 2015. https://apps.who.int/iris/handle/10665/194271.
2 World Health Organization. Multimorbidity. 2016. https://iris.who.int/handle/10665/252275.
3 Ho ISS, Azcoaga-Lorenzo A, Akbari A, et al. Variation in the estimated prevalence of multimorbidity: systematic review and meta-analysis of 193 international studies. *BMJ Open* 2022;12:e057017. doi:10.1136/bmjopen-2021-057017
4 Skou ST, Mair FS, Fortin M, et al. Multimorbidity. *Nat Rev Dis Primers* 2022;8:48. doi:10.1038/s41572-022-00376-4
5 WHO Clinical Consortium on Healthy Ageing. *Report of consortium meeting 1-2 December 2016 in Geneva (WHO/FWC/ALC/17.2)*. World Health Organization, 2017.
6 O'Caoimh R, Sezgin D, O'Donovan MR, et al. Prevalence of frailty in 62 countries across the world: a systematic review and meta-analysis of population-level studies. *Age Ageing* 2021;50:96-104. doi:10.1093/ageing/afaa219
7 Vetrano DL, Palmer K, Marengoni A, et al. Joint Action ADVANTAGE WP4 Group. Frailty and Multimorbidity: A Systematic Review and Meta-analysis. *J Gerontol A Biol Sci Med Sci* 2019;74:659-66. doi:10.1093/gerona/gly110
8 Hoogendijk EO, Afilalo J, Ensrud KE, Kowal P, Onder G, Fried LP. Frailty: implications for clinical practice and public health. *Lancet* 2019;394:1365-75. doi:10.1016/S0140-6736(19)31786-6
9 Villacampa-Fernández P, Navarro-Pardo E, Tarín JJ, Cano A. Frailty and multimorbidity: Two related yet different concepts. *Maturitas* 2017;95:31-5. doi:10.1016/j.maturitas.2016.10.008
10 Lv J, Li R, Yuan L, et al. Research on the frailty status and adverse outcomes of elderly patients with multimorbidity. *BMC Geriatr* 2022;22:560. doi:10.1186/s12877-022-03194-1
11 Kojima G, Iliffe S, Jivraj S, Walters K. Association between frailty and quality of life among community-dwelling older people: a systematic review and meta-analysis. *J Epidemiol Community Health* 2016;70:716-21. doi:10.1136/jech-2015-206717
12 Ritt M, Gaßmann K-G, Sieber CC. Significance of frailty for predicting adverse clinical outcomes in different patient groups with specific medical conditions. *Z Gerontol Geriatr* 2016;49:567-72. doi:10.1007/s00391-016-1128-8
13 Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: opportunities, challenges, and future directions. *Lancet* 2019;394:1376-86. doi:10.1016/S0140-6736(19)31785-4
14 Kraiss LW, Brooke BS. Frailty Assessment and shared decision-making. *JAMA Surg* 2021;156:889-90. doi:10.1001/jamasurg.2021.1467
15 Boreskie KF, Hay JL, Boreskie PE, Arora RC, Duhamel TA. Frailty-aware care: giving value to frailty assessment across different healthcare settings. *BMC Geriatr* 2022;22:13. doi:10.1186/s12877-021-02722-9
16 Muth C, Blom JW, Smith SM, et al. Evidence supporting the best clinical management of patients with multimorbidity and polypharmacy: a systematic guideline review and expert consensus. *J Intern Med* 2019;285:272-88. doi:10.1111/joim.12842
17 National Institute for Health and Care Excellence. Multimorbidity: clinical assessment and management. 2016. https://www.nice.org.uk/guidance/ng56/.
18 Guiding principles for the care of older adults with multimorbidity: an approach for clinicians. Guiding principles for the care of older adults with multimorbidity: an approach for clinicians: American Geriatrics Society Expert Panel on the Care of Older Adults with Multimorbidity. *J Am Geriatr Soc* 2012;60:E1-25.
19 Angulo J, El Assar M, Álvarez-Bustos A, Rodríguez-Mañas L. Physical activity and exercise: Strategies to manage frailty. *Redox Biol* 2020;35:101513. doi:10.1016/j.redox.2020.101513
20 Liao CD, Chen HC, Huang SW, Liou TH. The role of muscle mass gain following protein supplementation plus exercise therapy in older adults with sarcopenia and frailty risks: a systematic review and meta-regression analysis of randomized trials. *Nutrients* 2019;11:1713. doi:10.3390/nu11081713
21 Pazan F, Petrovic M, Cherubini A, et al. Current evidence on the impact of medication optimization or pharmacological interventions on frailty or aspects of frailty: a systematic review of randomized controlled trials. *Eur J Clin Pharmacol* 2021;77:1-12. doi:10.1007/s00228-020-02951-8
22 Ye P, Jin Y, Er Y, et al. A Scoping Review of National Policies for Healthy Ageing in Mainland China from 2016 to 2020. *Lancet Reg Health West Pac* 2021;12:100168. doi:10.1016/j.lanwpc.2021.100168
23 Dong L, Liu N, Tian X, et al. Reliability and validity of the Tilburg Frailty Indicator (TFI) among Chinese community-dwelling older people. *Arch Gerontol Geriatr* 2017;73:21-8. doi:10.1016/j.archger.2017.07.001
24 Zhu M, Liu X, Dong B, Qin M, Chen Q. Chinese expert consensus on management of elderly patients with multimorbidity (2023). *Zhongguo Linchuang Baojian Zazhi* 2023;26:577-84.
25 Meng Q, Mills A, Wang L, Han Q. What can we learn from China's health system reform? *BMJ* 2019;365:l2349. doi:10.1136/bmj.l2349
26 Li X, Lu J, Hu S, et al. The primary health-care system in China. *Lancet* 2017;390:2584-94. doi:10.1016/S0140-6736(17)33109-4
27 Yan Wang N, Liu X, Kong X, et al. Implementation and impact of the World Health Organization integrated care for older people (ICOPE) program in China: a randomised controlled trial. *Age Ageing* 2024;53:afad249. doi:10.1093/ageing/afad249
28 Chen C, Ding S, Wang J. Digital health for aging populations. *Nat Med* 2023;29:1623-30. doi:10.1038/s41591-023-02391-8

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Burden of non-communicable diseases due to population ageing in China: challenges to healthcare delivery and long term care services

China has made substantial progress in healthcare delivery to reduce the burden of non-communicable diseases due to population ageing, although challenges and opportunities in long term care services have been under-recognised, argue **Xiaoming Shi and colleagues**

Despite a substantial improvement in understanding of the risk factors, no definitive solution for managing the care needs arising from the ageing population and the accompanying rise in non-communicable diseases yet exists, posing significant challenges to healthcare and long term care services in China over the past few decades.[1] Although efforts have been made to enhance healthcare delivery and reduce inequalities, long term care services lag significantly behind, particularly as population ageing is progressing rapidly in China. This analysis provides an overview of the challenges in both healthcare delivery and long term care services, as well as current responses, and pinpoints significant gaps in actual care delivery that need urgent attention, aiming to offer insights for other nations facing similar demographic and societal shifts.

KEY MESSAGES

- Over the past few decades, although age specific, disability adjusted life years have been significantly reduced by the control of modifiable risk factors, the burden of non-communicable diseases is still increasing owing to the fast growing ageing population.
- China's burgeoning older demographic and the increasing prevalence of non-communicable diseases not only present a formidable challenge to the healthcare delivery system but also demand greater preparedness for the long term care sector.
- With the establishment of the world's largest healthcare insurance system and the implementation of basic public health services policies, China has made commendable strides in promoting equitable healthcare services and tackling the drivers of non-communicable diseases
- To effectively fulfil the diverse needs of healthcare and long term care services, China needs to develop tailored and collaborative healthcare systems, with a primary focus on medical services and robust long term care provisions

Population ageing in China

The number of older adults aged 65 years and over in China reached 191 million in 2020, accounting for 13.5% of the total population,[2] and is predicted to reach 29.8% by 2050, almost twice the global level of 16.4%.[3] China's ageing population has several outstanding characteristics. Firstly, the number of older adults in China, especially the oldest people aged 80 years and over, is unparalleled in scale. The population aged 80 and over reached 35.8 million in 2020 and is projected to be 115 million in 2050, accounting for 13.6% and 31.5% of older adults, respectively,[2 3] leading to a dramatic increase in the demand for healthcare in China. Secondly, with an unparalleled speed of ageing, the proportion of older adults has doubled in the past two decades. This situation is expected to worsen in the coming years, leading to a pagoda shaped population structure in 2050 (fig 1). The rapid ageing process and shortage of young people pose a great challenge to the unprepared long term care service system. Thirdly, regional inequalities have escalated. Recent decades of rapid social and economic change have widened regional gaps in access to healthcare, leaving underdeveloped areas with burgeoning older populations, posing broad challenges to the current insurance system.

Burden of non-communicable diseases due to population ageing

Ageing of the population, emerging new risk factors, and more sensitive diagnostic methods contribute to the increase in the burden of non-communicable diseases. In 2019 deaths from non-communicable diseases reached 9.5 million in China, accounting for 90.1% of all deaths, higher than the global level of 74.3%, and this number is projected to double over the next 30 years.[4] The major non-communicable diseases, including cardiovascular diseases, chronic obstructive pulmonary disease, and tracheal, bronchus, and lung cancer, have been the leading causes of death in China, corresponding to 43.1%, 9.7%, and 7.1% of mortality, respectively (estimated by Global Burden of Disease Compare).[5]

The burden of non-communicable diseases is closely associated with the age structure of the population. The ageing population and increasing age related diseases largely contribute to the increasing burden. In ageing countries, crude mortality rates of non-communicable diseases are higher than the corresponding rates adjusted for population structure. In China, a fast ageing population and growing health loss resulted in about 92.8 million increments in age specific, disability adjusted life years, although disability adjusted life years have been decreasing during the past three decades.[6] In China, half of all disability adjusted life years can be attributed to 92 age related diseases (for example, stroke, chronic obstructive pulmonary disease, lung cancer, diabetes, and Alzheimer's disease).[7] Dementia, an age related disease, affected 15.1 million older adults in China,[8] increasing by more than 50% in the past decade.[8] The number of people with Parkinson's disease is expected to increase from 3.3 million to 4.8 million in the next decade.[9] Furthermore, the burden of non-communicable diseases will increase by more than two fifths in the coming decades owing to population ageing,[10] posing a considerable challenge to China.

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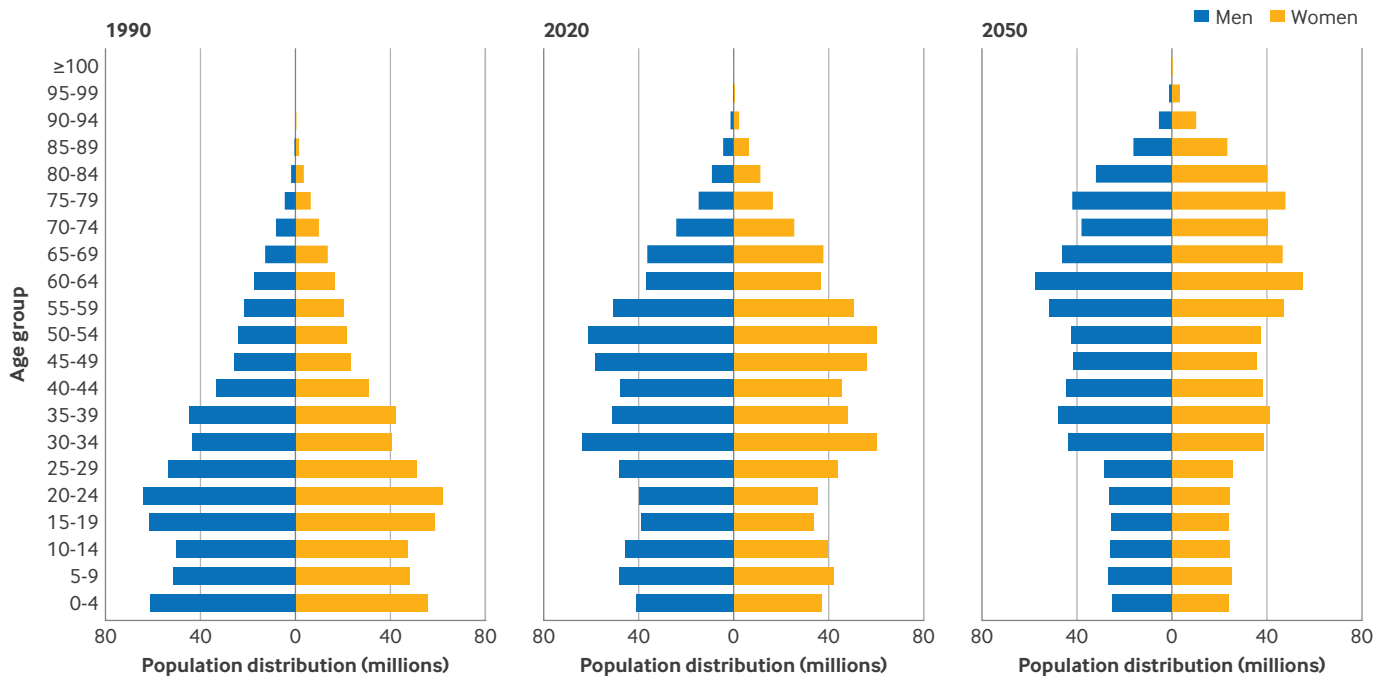

Fig 1 | Population distribution by gender and age in 1990, 2020, and 2050 in China. Data source: The 4th and 7th National Census of China and the World Population Prospects of the UN

Challenges to healthcare delivery and long term care services

In response to the control and prevention of non-communicable diseases resulting from population ageing, healthcare delivery and long term care serve different purposes and target distinct populations. Healthcare services are medical services in hospitals, which are mainly aimed at the diagnosis, management, and treatment of non-communicable diseases. Long term care services are primarily provided by nursing homes or residential care facilities,[10] aiming to meet people's needs for assistance in daily activities, nursing care, functional rehabilitation, and so on (table 1). Facing the dual burden of the rising epidemic of non-communicable diseases and rapid population ageing, the demands for delivery of healthcare for the treatment and management of non-communicable diseases, as well as the need for long term care services for functional maintenance, have increased significantly. This also leads to increasing demand for funding and shortages in the long term care workforce and underscores the urgent need for innovative solutions such as age friendly environments.

With the ageing of the population, the demand for long term care services in China will increase by 2.5 times between 2015 and 2050. However, the home and community based services system, which is supported by government subsidies to provide older adults with services such as living assistance, healthcare, and social support, offered ageing care services to only 5.35 million of the 264 million older adults in 2020.[11] Regarding demand for financial support, the individual contribution to health expenditure increased from ¥68 CNY (£7.3; €8.7; $9.4) in 2012 to ¥274 in 2020 per capita, with its share of total insurance increasing from 22% in 2012 to 36% in 2020.[12] Meanwhile, long term care insurance covers only 49 pilot cities in 2024, serving 2.4 of 40 million people with disabilities. Considering the limited provision and providers of ageing care, an estimated 10 million plus elderly caregivers will be needed by 2025, whereas fewer than 0.5 million certified caregivers were present in China at the end of 2020 (fig 2).[13] Rapid urbanisation, socioeconomic shifts, and changes in family structures are weakening the traditional family based elder care model. Age friendly environments, designed to support older people to promote health and maximise their functional abilities when experiencing capacity loss, and smart aged care technology, are far from satisfying the growing demand with the transition from family support to a social services model. Specifically, in China, the proportion of high rise dwellings without elevators exceeds 60% in urban areas, and only 54 smart ageing care products such as wearable devices and health monitoring devices, as well as 25 smart ageing care services, have been screened to the national recommendation catalogue.[14] Furthermore, fewer than 35% of older adults actually use a smartphone, although 77% had a smartphone in 2021, creating technological barriers to medical services for non-communicable diseases (for example, registration, checking examination results, remote medical consultation).

China's responses to the challenges

To alleviate the burden of non-communicable diseases attributed to factors such as population ageing, the Chinese government has implemented a series of proactive measures, which may offer insights for other developing countries facing similar challenges in combating population ageing. To overcome the challenges in growing services and their inequities, China has made great achievements in implementing the National Basic Public Health Service Program (NBPHSP) to mitigate healthcare inequalities, establishing the world's most comprehensive healthcare insurance system to meet growing funding demands, and preliminarily applying the concept of whole life course approach to manage modifiable driving factors of non-communicable diseases.

Table 1 | Functional positioning and inadequate preparation for healthcare delivery and long term care services

Category	Healthcare delivery	Long term care services
Institutions		
Functional position	Healthcare system reform prioritises transforming hospital centred treatment to integrated and continued care through a three tier healthcare delivery system*: tier 3 includes county and city hospitals; tier 2 includes township health centres and community health centres/stations; tier 1 includes village and community clinics	Three main types include public social welfare facilities, nursing homes, and other residential care facilities (eg, senior apartments, assisted living facilities, and retirement communities)
Characteristic	Changing from treatment oriented to rehabilitation and prevention oriented	Growing residential (institutional) care sector, slow development of HCBS, and insufficient organised funding
Challenges	Ageing adds burdens on primary healthcare institutions (including tier 2 and tier 1). Primary healthcare institutions account for 94.8% of all three tier healthcare institutions, which account for only 53.2% of treatment visits and 16.1% of hospital admissions for all institutions†	New family structures, rapid urbanisation, and increased labour mobility, which increased the burden of care from relatives have weakened the family based long term care model of China‡
Workers		
Provider	Professional doctors or nurses	Nursing or social work staff
Challenges	Inadequate professional and technical skills, qualifications, and incentives of workers in primary healthcare institutions. The education level in primary healthcare institutions is much lower than in tier 3 healthcare institutions. Professional training in geriatrics and nursing provided by medical schools is limited. The incentive mechanism for primary healthcare institutions is relatively weak (eg, income is not linked with jobs) and relies more on the number of patients seen and medicine used	Shortage of long term care workers. Qualification certification, professional title evaluation, and promotion ladders. Challenges remain to improve working conditions and management systems and to increase the social values and reputation of the profession
Care and services		
Services	Diagnosis and treatment of diseases, training and guidance. Tier 3 healthcare institutions: diagnosis and treatment of diseases, training and guidance to workers of primary medical institutions, public health, and emergency medical services. Primary medical institutions: basic public health services, diagnosis and treatment services for common diseases, rehabilitation and nursing services for some diseases, and transferring patients with critical and difficult cases beyond their own service capabilities to hospitals§	Daily care, nursing care, risk prevention, and guide function maintenance. Daily care: cleaning, food/water assistance, etc. Nursing care: health guidance, blood glucose monitoring, etc. Risk prevention: prevention of pressure sores, choking, falls, burns, etc. Guide function maintenance: rolling training and guiding passive joint activities, etc
Challenges	Ageing has brought diverse overuse and overprovision of health services. Patients with NCDs bypass primary health facilities and seek perceived good quality of care in high level hospitals. For patients in the recovery period, community and home based rehabilitation services are more important but less used. For comorbidities, the use of traditional Chinese medicine could reduce the side effects of combined western medication	Professional long term care services are underdeveloped in China, and NCDs due to ageing put a higher demand on specialised and professional services. Long term care services are still not easily accessible or of high quality. Insufficient utilisation of beds in professional long term care institutions

HCBS=home and community based services; NCD=non-communicable disease.
*Meng Q, Mills A, Wang L, Han Q. What can we learn from China's health system reform? *BMJ* 2019;365:l2349.
†National Health Commission of the People's Republic of China. Statistical Bulletin of China's Health Development in 2020. https://www.gov.cn/guoqing/2021-07/22/content_5626526.htm.
‡Fang EF, Scheibye-Knudsen M, Jahn HJ, et al. A research agenda for ageing in China in the 21st century. *Ageing Res Rev* 2015;24:197-205.
§Office of the State Council. National healthcare policy announcement of strategic plan on national healthcare service system (2015–2020). 2015. https://www.gov.cn/zhengce/content/2015-03/30/content_9560.htm.

Managing non-communicable diseases is a prioritised target in basic public health services policies

To tackle the dual burden of infectious diseases and non-communicable diseases, China launched the NBPHSP in 2009. The NBPHSP includes population based services for women, children, and older adults, as well as group specific services for patients with non-communicable diseases, including hypertension, hyperlipidaemia, diabetes, overweight or obesity, and fatty liver. In the past decade, the number of beds per thousand people has increased from 4.83 in 2014 to 6.92 in 2022. Health management services were provided to 127 million older adults aged 65 and above in 2022, constituting 14.9% of the total population, at primary healthcare institutions.[15] The five year survival rate for cancer has increased from 40.5% in 2015 to 43.7% in 2022 with improving diagnosis and treatment. Significant improvements have been observed in the treatment of hypertension and diabetes between 2004 and 2018, with average annual percentage changes in patients treated of 3.3% and 3.9%, respectively.[13] In the next few decades, the prevention and control of non-communicable diseases are among the most important national targets: "achieving hypertension and diabetes management rates up to 70% and 69% by 2050, respectively."[16]

Establishing the world's largest social health insurance system

Owing to healthcare reform in 2009, China has become the country with the world's largest social health insurance system, covering 95% of the population. The system includes the urban employee basic medical insurance programme, the urban-rural resident basic medical insurance programme, and medical assistance tailored to low income households.[17] In addition, to ensure reasonable medical expenses, the government is involved in price determination and drug procurement supervision. These schemes collectively cover 37% of healthcare spending in China, and the coverage will continue to increase; the range of non-communicable diseases covered by medical insurance has also expanded, accompanied by an increase in the reimbursement ratio compared with total expenses.

Integrating the whole life course approach into the management of non-communicable diseases

China has proposed a whole life course approach to managing driving factors of non-communicable diseases from early stages to older adults, which aims to foster healthy ageing. Increasing attention is being paid to health management in children (under 6 years), maternal health care and free contraceptive provision

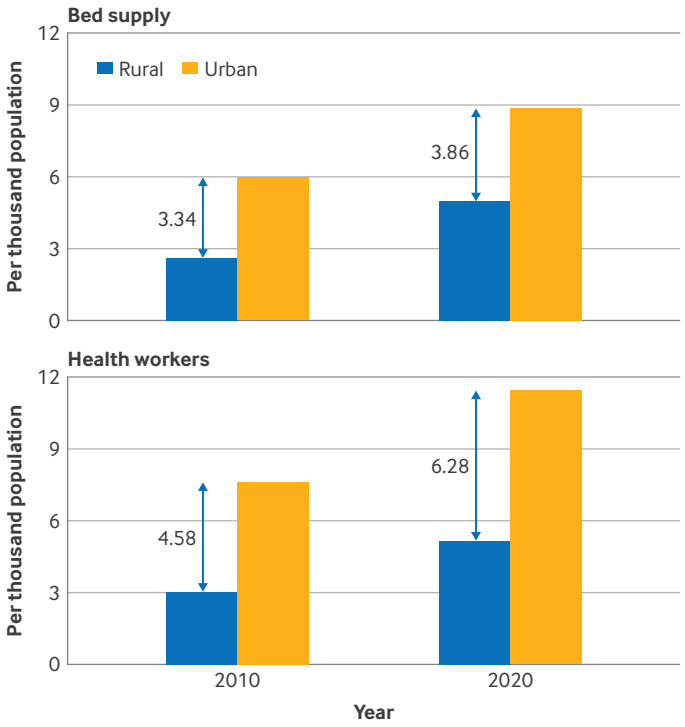

Fig 2 | Inequalities in bed supply and health workers between urban and rural areas in China. Data source: Chinese Health Statistical Yearbook (2021)

for adults, and health management for older adults. Whole population management focusing on healthy lifestyles, environmental risk factors, health education, health literacy promotion, and vaccination has also been shown to be most effective when prevention and control of non-communicable diseases are tackled at the earliest stages.[18] For instance, air quality management efforts from 2013 to 2020 resulted in a decrease in years of life lost due to exposure to $PM_{2.5}$ (fine particulate matter), from 28.87 million to 22.62 million years of life lost.[19]

What is the way forward?

Although China has taken initiatives to prevent and control non-communicable diseases in light of the World Health Organization's global targets, monitoring of indicators of progress shows that the improvement has been only partially achieved. To achieve sustainable development, China needs to more effectively overcome challenges to healthcare delivery and long term services arising from non-communicable diseases. Several critical recommendations exist to find a way out of the dilemma (box 1).

Developing differentiated functioning systems for integrated aged care

To effectively tackle the diverse needs of healthcare and long term care services, China needs to develop tailored and collaborative healthcare systems, with a primary focus on medical services and robust long term care provision. Specialised long term care institutions can collaborate with hospitals to meet needs for functional rehabilitation, daily activities assistance, and social support while conducting comprehensive assessments of functional status and monitoring transitions in older adults with non-communicable diseases. This collaborative approach ensures timely and appropriate care delivery, especially for people with limited life expectancy or when treatment efficacy is constrained.

Establishing a sustainable long term care insurance system

Drawing from the experiences of countries such as the US, Japan, and Germany, integrating long term care insurance with existing health insurance is proposed to cover basic medical and long term care needs across different economic strata.[20] To achieve sustainable solutions, insurance funds for long term care should not rely only on the surplus of medical insurance funds and government appropriations but also work with commercial insurance as a complementary option. Furthermore, leveraging the "silver economy" market can enhance the sustainability of long term care by offering diverse insurance options and financial products tailored to the needs of older people.

Strengthening the management of modifiable risk factors for non-communicable diseases

Non-communicable diseases are often characterised by interconnected cause and effect chains, so identifying a specific factor is very difficult and challenging. Four prioritised modifiable risk factors proposed by WHO—namely, tobacco use, alcohol use, physical inactivity (failure to meet ≥150 min/week of moderate activity, ≥75 min/week of vigorous activity, or a combination), and unhealthy diets—have not been fully controlled in China (for example, prevalence rates of tobacco use and physical inactivity are 49.7% (men) and 44.1%, respectively). Encouraging

Box 1: Recommendations for healthcare delivery and long term care services for non-communicable diseases due to population ageing

Developing differentiated functioning systems for integrated aged care
- Developing clear functional positioning systems for providing integrated care for older adults
- Further strengthening the integration of healthcare delivery and long term care services
- Establishing differentiated, innovative, and collaborative healthcare and long term care systems

Establishing a sound and sustainable long term care insurance system
- Integrating long term care insurance with existing health insurance
- Encouraging commercial insurers
- Developing the "silver economy" market

Strengthening the management of modifiable risk factors for non-communicable diseases
- Improving education and economic equity in early life
- Promoting healthy lifestyles across early life, midlife, and late life courses

Accelerating the development of age friendly products and environments
- Accelerating technological progress and the application and construction of age friendly products and environments
- Facilitating the translation of discoveries into practical healthcare tools
- Enabling social participation, chance of volunteer work, or employment

healthy lifestyles across all age groups is particularly important to eliminate the factors driving non-communicable diseases. Additionally, an air quality management effort was more pertinent and effective at specific stages of life, so ensuring its continued implementation is crucial.

Accelerating the development of age friendly products and environment

Development of new technologies is necessary to reduce the escalating burden of non-communicable diseases and connect recent research findings with clinical practice. Technologies such as robots and artificial intelligence have a promising future in medical research, aiding the translation of discoveries into practical tools in healthcare and long term care management. Moreover, enhancing opportunities for social participation among the ageing population (for example, through voluntary work, employment, digital access, and social media engagement) is essential to improve their overall well being.

Conclusion

Over the past few decades, China has faced a substantial rise in the burden of non-communicable diseases that is partly attributable to population ageing, which poses challenges not only in healthcare delivery but also in long term care services, such as inadequate system preparation, increasing demands for funding, shortages in the long term care workforce, and insufficient age friendly environmental support. With the establishment of the world's largest healthcare insurance system and the implementation of basic public health services policies, China has made commendable strides in promoting equitable healthcare services and tackling the drivers of non-communicable diseases. Considering the challenges and gaps, we have made several critical recommendations to find a way out of the dilemma; China needs to develop tailored and collaborative healthcare systems, with a primary focus on medical services and robust long term care provisions.

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Yuebin Lv, associate professor[1,2]

Lin Fan, assistant professor[1,2]

Jinhui Zhou, assistant professor[1,2]

Enmin Ding, postdoctoral researcher[1,2]

Ji Shen, professor[3]

Song Tang, professor[1,2]

Yao He, professor[4]

Xiaoming Shi, professor[1,2]

[1]China CDC Key Laboratory of Environment and Population Health, National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, China

[2]National Key Laboratory of Intelligent Tracking and Forecasting for Infectious Diseases, National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, China

[3]Beijing Institute of Geriatrics, Beijing Hospital, National Center of Gerontology, Beijing, China

[4]Institute of Geriatrics, Beijing Key Laboratory of Aging and Geriatrics, Chinese PLA General Hospital, Beijing, China

Correspondence to: X Shi
shixm@chinacdc.cn

1 Eaton S, Roberts S, Turner B. Delivering person centred care in long term conditions. *BMJ* 2015;350:h181. doi:10.1136/bmj.h181
2 State Council for the Seventh National Population Census. China population census yearbook 2020. https://www.stats.gov.cn/sj/ndsj/2020/indexch.htm.
3 United Nations Department of Economic and Social Affairs. World population prospects. https://population.un.org/wpp/Download/Standard/CSV/.
4 Liu J, Jiang B, Fu Y, et al. The future challenges of population health in China: a projection of the major health problems and life expectancy - China, 2015-2050. *China CDC Wkly* 2022;4:276-9.
5 Institute for Health Metrics and Evaluation. Global Burden of Disease Compare. https://vizhub.healthdata.org/gbd-compare/#.
6 Li R, Cheng X, Schwebel DC, et al. Disability-adjusted life years associated with population ageing in China, 1990-2017. *BMC Geriatr* 2021;21:369. doi:10.1186/s12877-021-02322-7
7 Chang AY, Skirbekk VF, Tyrovolas S, Kassebaum NJ, Dieleman JL. Measuring population ageing: an analysis of the Global Burden of Disease Study 2017. *Lancet Public Health* 2019;4:e159-67. doi:10.1016/S2468-2667(19)30019-2
8 Chan KY, Wang W, Wu JJ, et al. Global Health Epidemiology Reference Group (GHERG). Epidemiology of Alzheimer's disease and other forms of dementia in China, 1990-2010: a systematic review and analysis. *Lancet* 2013;381:2016-23. doi:10.1016/S0140-6736(13)60221-4
9 Chen F, Chen S, Si A, et al. The long-term trend of Parkinson's disease incidence and mortality in China and a Bayesian projection from 2020 to 2030. *Front Aging Neurosci* 2022;14:973310. doi:10.3389/fnagi.2022.973310
10 World Health Organization. Long-term care Q&A. 2022. https://www.who.int/europe/news-room/questions-and-answers/item/long-term-care.
11 Meng Q, Mills A, Wang L, Han Q. What can we learn from China's health system reform? *BMJ* 2019;365:l2349. doi:10.1136/bmj.l2349
12 Zhong Y, Zhang J. *China Medical Security Statistical Yearbook*. China Statistics Press, 2021.
13 Zhou Y, Wu Q, Li C, Meng P, Ding L. Inequalities in non-communicable disease management in China and progress toward universal health coverage: an analysis of nationwide household survey data from 2004 to 2018. *Lancet Reg Health West Pac* 2023;44:100989. doi:10.1016/j.lanwpc.2023.100989
14 The Ministry of Industry and Information Technology of China. Catalogue of Smart Health and Elderly Care Products and Services Promotion (2022 Edition). 2023. https://wap.miit.gov.cn/zwgk/wjgs/art/2023/art_f6f7f2f5dd454afa81276687db9f5c44.html.
15 China National Health Commission. Statistical bulletin on the development of health care in 2022. 2023. https://www.gov.cn/lianbo/bumen/202310/content_6908686.
16 General Office of the State Council of China. China's medium - and long term plan for the prevention and treatment of chronic non-communicable diseases (2017-2025). 2017. https://www.gov.cn/zhengce/content/2017-02/14/content_5167886.htm.
17 Yip W, Fu H, Chen AT, et al. 10 years of health-care reform in China: progress and gaps in Universal Health Coverage. *Lancet* 2019;394:1192-204. doi:10.1016/S0140-6736(19)32136-1
18 Mavrodaris A, Lafortune L, Brayne CE. The future longevity: designing a synergistic approach for healthy ageing, sustainability, and equity. *Lancet Healthy Longev* 2022;3:e584-6. doi:10.1016/S2666-7568(22)00145-3
19 Xue T, Wang R, Wang M, et al. Health benefits from the rapid reduction in ambient exposure to air pollutants after China's clean air actions: progress in efficacy and geographic equality. *Natl Sci Rev* 2023;11:nwad263. doi:10.1093/nsr/nwad263
20 Ikegami N. Financing long-term care: lessons from Japan. *Int J Health Policy Manag* 2019;8:462-6. doi:10.15171/ijhpm.2019.35

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Bridging the digital divide to promote prevention and control of non-communicable diseases for all in China and beyond

Ruitai Shao and colleagues argue that the digital divide may exacerbate global disparities in prevention and control of non-communicable diseases and enlarge health inequity when effective digital health solutions are unevenly distributed

Digital health can be broadly defined as an umbrella term referring to the systematic application of information and communication technologies, smart and wearable devices, computer sciences, and electronic data for health purposes.[1] This evolving field spans telemedicine, mobile health, electronic health records and big data, wearable devices, artificial intelligence, and so on, empowering patients, healthcare providers, and health system managers.[2] Many studies have highlighted the great potential of digital health solutions in overcoming barriers to accessing healthcare and facilitating the management of non-communicable diseases.[3] Recognised as pivotal innovations and public goods, digital health solutions have been increasingly adopted globally, including in China, with the commitment to achieving sustainable development goals by advancing universal health coverage and improving prevention and control of non-communicable diseases.[1 4]

However, as with any innovation, digital health solutions have emerged along with risks and bottlenecks, such as concerns about privacy, data security, and high investment cost. Of these concerns, special consideration is warranted for the digital divide, reflected as the uneven global distribution of information and communication technologies. The digital divide raises concerns about health inequities, as disadvantaged populations remain disconnected from the digital world and are excluded from sharing its benefits. Although this challenge affects the prevention and control of both infectious diseases and non-communicable diseases, the enduring impact on non-communicable diseases warrants special attention. In this paper, we present existing evidence on digital health for the prevention and control of non-communicable diseases, illustrate the multifaceted effects of the digital divide on disparities in non-communicable disease outcomes, showcase strategies implemented in China to correct the digital divide, and propose future directions for maximising the collective value of digital health solutions to promote health for all.

KEY MESSAGES

- The rapid and uneven global trend of digitisation highlights a pervasive challenge of digital divide, encompassing limitations in digital access, digital literacy, and digital assimilation
- Existing disparities in non-communicable disease outcomes may be exacerbated if effective digital health solutions are unevenly distributed; this impact on health inequity exists at individual, institutional, and societal levels
- Efforts have been made in China to narrow the extent of the digital divide by tackling different levels of barriers, which exemplify practical strategies for other countries
- To harness the power of digital health solutions and promote prevention and control of non-communicable diseases for all, enhancing reach, extending the impact beyond users, and promoting system integration are crucial

Leveraging digital health across the continuum of care for non-communicable diseases

Digital health solutions have emerged as transformative tools in healthcare, holding the promise to enhance the continuum of care for non-communicable diseases. Despite heterogeneity in design and effectiveness, a growing number of reviews show the benefits of digital health solutions in preventing and managing non-communicable diseases, across the care continuum (as depicted in figure 1), from health promotion and prevention,[5] through diagnosis, treatment,[3] and long term control,[6 7] to rehabilitation.[8] Interestingly, the focus of digital health solutions varied among the four major non-communicable diseases represented in the global agenda for their prevention and control. Modest evidence highlights the beneficial role of digital health solutions in lifestyle modifications and self-management support for hypertension, diabetes, and cardiovascular diseases[6 7]; however, the evidence leans more towards active treatment and survivorship support for cancer,[9] as well as personal physiological monitoring for the chronic respiratory diseases.[10]

Moreover, digital health solutions are increasingly recognised as tools to tackle healthcare system challenges and improve universal health coverage. Telemedicine, for instance, plays a distinctive role in mitigating barriers to accessing healthcare services by extending care and health consultation to remote areas. Evolving evidence suggests that digital health solutions, enabled by electronic medical records, big data, and artificial intelligence, can enhance the efficiency of healthcare systems and bolster population level surveillance and management of non-communicable diseases.[11]

Emerging challenges of the digital divide caused by the irreversible trend of digitalisation

No doubt exists about the ongoing trend of digitalisation in healthcare in this information era. By 2021 global mobile cellular subscriptions per 100 people had increased to 107 from 76 in 2010, with a doubling from 64 per 100 people in 2010 to 122 in 2021 in China.[12] Additionally, about 300 000 health and wellness mobile apps are available worldwide.[13] The covid-19 pandemic acted as a catalyst, accelerating

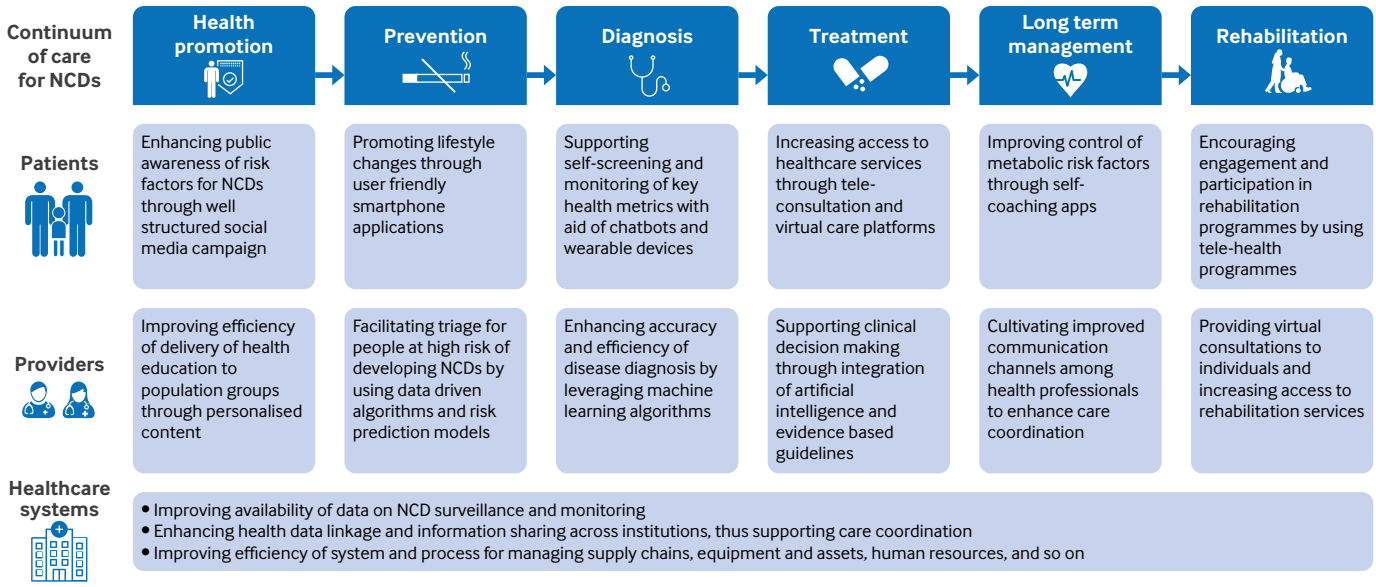

Fig 1 | Potential benefit of digital health on the continuum of care for non-communicable diseases (NCDs)

the global embracement of digital health solutions, and this transformation is expected to be irreversible post-pandemic. Nevertheless, increasing evidence indicates that the scale and speed of digitalisation has varied across settings and among different populations,[14 15] leaving the problem of a digital divide. For instance, a post-pandemic national survey in the US showed a sustained increase in internet usage and almost doubling of the likelihood of electronic communication with healthcare providers, with notably higher growth observed among more highly educated groups.[16]

The digital divide was originally conceptualised as disparities in accessibility of modern information and communication technologies across demographics and regions, and it has now been further delineated into three tiers of digital access, digital literacy, and digital assimilation.[15] Digital access is obvious, manifesting as unequal access to the internet and mobile subscriptions across population groups. Notably, women, older people, and those with lower socioeconomic status experience relatively limited access to information and communication technologies, and such gaps are more pronounced in low and middle income countries.[17-19] The second and third tiers of the digital divide refer to varying levels of digital literacy and engagement, especially prominent among older people. Despite greater health needs and potential benefits, older people face complex and multifaceted barriers in engaging with digital health solutions, including declines in sensory and functional abilities, learning curves in adoption, lack of motivation to change, and inadequate supporting environments.[20-22] These three tiers of the digital divide highlight disparities in the accessibility, adoption, and utilisation of digital health solutions and are misaligned with the goals of equitable spread of innovations.

Will the digital divide exacerbate health disparities in prevention and control of non-communicable diseases?

The potential exists to narrow health disparities through digital health innovations, if digital health technologies are harnessed effectively to overcome major barriers in health equity and deployed widely to all disadvantaged populations. Telemedicine, for instance, plays a pivotal role in diminishing health disparities by overcoming geographical barriers and ensuring that people in underserved and remote areas receive timely and equitable medical care.

However, in reality, digital health innovations have evolved disproportionately at a rapid speed, incapable of resolving all challenges plaguing fractured healthcare systems or underlining inequities. Although difficult to measure systematically, wider gaps in the provision of digital health solutions have been observed,[16 18 19] translating into increasing health inequities across populations and settings. The first two columns of table 1 summarise the manifestation of the digital divide and its potential intermediate and long term effects on the prevention and control of non-communicable diseases from three perspectives: the individual level, the healthcare providers and institutional level, and the societal and global perspective.

At the individual level, the digital divide intertwines with demographic and social factors, such as gender, age, and poverty, recognised as the "causes of causes" of health inequity.[23] In resonance with the principles of the "inverse care law,"[24] people with fewer resources need more but receive fewer digital health solutions. Beyond grappling with the root causes of non-communicable diseases, they confront additional impediments, including limited awareness of innovations and lower capacity to utilise timely and convenient support facilitated by digital health solutions.[15] Moreover, the underrepresentation of disadvantaged groups in the research and development of digital health solutions engenders inequities in the acquisition of health related big data, introducing bias that hampers overall effectiveness.[14] This unequal access and imbalanced effectiveness amplify the pre-existing disparities in mobility, disability, and mortality caused by non-communicable diseases.

Among healthcare providers and institutions, the digital divide is evident in varying levels of adoption and integration of digital health solutions in clinical settings, potentially affecting the efficiency and quality of care delivery for non-communicable diseases. Reviews highlight the heterogeneous nature of trust, digital literacy, and adoption behaviours among healthcare providers,

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Table 1 | Effects of digital divide on prevention and control of non-communicable diseases (NCDs) and potential compensatory measures

Uneven uptake of digital health solutions	Potential intermediate or long term effects on disparities in NCD prevention and control	Compensatory measures to tackle digital divide	Examples from regional and international strategies for reducing digital divide
Individual perspective			
Limited access to information and communication technologies among socially deprived groups	Disparities in access to evidence based information and self-management support for NCDs	Enhancing broadband accessibility; implementing tailored subsidies to facilitate physical access for disadvantaged groups	Widening Digital Participation programme and Reboot UK programme were conducted in UK to offer peer support and home access to digital health technologies for the most vulnerable people*
	Diminished awareness of and adherence to lifestyle and self-management behaviours among individuals lacking essential support		
	Reduced risk factor control among individuals devoid of support and unable to effectively manage their complex conditions		
Variation in health literacy and technology literacy	Challenges in effectively navigating information and resources, coupled with limited access to timely and convenient care	Providing training and awareness programmes for enhancing digital skills; improving usability and user friendliness of digital health solutions; co-design with and for specific population groups, such as older people, disabled people, and illiterate people	The EDISON Alliance†, a consortium of public and private organisations committed to promote digital inclusion worldwide, initiated digital literacy programmes to educate citizens on online safety, digital skills, and the benefits of internet use
	Greater vulnerability to the adverse consequences stemming from unreliable information or low quality digital health solutions		
Differences in motivations and engagement with digital health solutions	Reduced adherence to care plans and inadequate support for long term NCD management	Developing tailored content relevant for socially deprived groups; clear and culturally sensitive communication strategies to ensure that the benefits of digital health solutions are accessible and understood by all segments of the population; promoting full integration of ICT into social and user environments	Seven online platforms that assess and identify evidence based health apps were identified by researchers‡. These platforms inform the public about the quality and reliability of health apps
	Escalated frequency of emergency visits and hospital admissions due to diminished preference for remote services and care		
Healthcare provider and organisational perspective			
Uneven availability and accessibility of digital health solutions	Absence of electronic medical record use leading to reduced efficiency in routine healthcare services	Implementing a top down approach to incentivise infrastructure development and availability of the information system; building up joint data infrastructure containing data from diverse domains	Infrastructure building within healthcare settings was encouraged in many countries to facilitate adoption of digital health solutions by institutions and by healthcare providers§
	Deficiencies in coordination care pathways for NCDs due to lack of communication across healthcare providers		
	Inability to offer personalised NCD care due to the absence of clinical decision support and lack of information linkage		
Variation in general digital literacy of healthcare providers	Varied levels of trust in digital health solutions	Offering training programmes and incentives for healthcare providers to effectively utilise digital health solutions; developing comprehensive guidelines for healthcare providers to improve their general acceptance	Education and training programmes for clinicians with relevant evidence on impact were identified from five countries by researchers. These programmes focused on the terminology, clinical applications, the evidence base, and technological aspects of digital health solutions
	Diminished adoption of solutions that may improve the accuracy of diagnosis and treatment, possibly leading to lower quality in NCD care		
	Limited access to timely and convenient communications with other healthcare providers, leading to a lack of coordination in care		
Insufficient integration with healthcare system	Limited access to assistance in supply chain, equipment, and asset management that underpins the delivery of services for NCDs	Fostering the promotion of data linkage and the establishment of platforms for data sharing; enhancing the integration of digital health solutions into routine care delivery pathways	
	Aggravation of disparities in resource allocation		
Societal and global perspective			
Inequities in infrastructure building to facilitate digitalisation	Variation in the availability of data to underpin vital statistics and disease registration, thereby impeding effective monitoring and surveillance of NCD burdens	Promoting research and initiatives aimed at expanding the availability of data and establishing data linkage for the monitoring and surveillance of NCDs	A report** by the Broadband Commission showcased that an investment of US$100bn is needed to double connectivity of internet access in Africa and achieve internet access for all by 2030. The roadmap for universal access to affordable and good quality broadband emphasised collaboration among private sectors, reduction of non-economic cost and risk of market entry and investment, increased commercial viability, and promotion of long term sustainability
Disparities in policy environment concerning the integration of health solutions within the agenda to enhance NCD control	Escalated disparities in investment directed towards the research and development of innovations tailored to NCD control	Exploring viable and enduring financial mechanisms to bolster investment in tailored innovations for NCDs; advocating for translational research endeavours to provide insights for policymaking regarding the utilisation of digital health in NCD prevention and control.	
	Diminished priority of the role of innovations in NCD prevention and control		

ICT=information and communication technologies.
*Aldridge S. Improving Digital Health Inclusion: evidence scan. NHS Midlands and Lancashire Commissioning Support Unit, 2020.
†EDISON Alliance. Bridging the digital divide in the European Union. 2023. https://www.weforum.org/agenda/2023/08/how-to-bridge-the-digital-divide-in-the-eu/.
‡Mathews SC, McShea MJ, Hanley CL, et al. Digital health: a path to validation. *NPJ Digit Med* 2019;2:38.
§Yan LL, Xiong S, Lu H, et al. Strengthening primary health care for the prevention and management of cardiometabolic disease in low-and middle-income countries. World Health Organization, 2019.
¶Edirippulige S, Armfield NR. Education and training to support the use of clinical telehealth: A review of the literature. *J Telemed Telecare* 2017;23:273-82.
**Broadband Commission for Sustainable Development, 2019. Connecting Africa Through Broadband- A strategy for doubling connectivity by 2021 and reaching universal access by 2030. 2019. https://www.broadbandcommission.org/Documents/working-groups/DigitalMoonshotforAfrica_Report.pdf.

Box 1: Major strategies in China for bridging the digital divide and promoting NCD prevention and control

Tackling barriers to digital access

- Expanding broadband networks in remote settings and increasing internet penetration rates to improve the accessibility of digital devices and the internet.[12] This includes efforts to bridge the urban-rural divide and ensure connectivity in underserved areas
- Overcoming financial barriers to adoption of virtual care by releasing medical reimbursement regulations that supported online consultations for NCDs during the covid-19 pandemic

Tackling barriers to digital literacy

- Enhancing the awareness, capacity, and skills of patients with NCDs in using digital technologies through campaigns and training programmes. These initiatives specifically targeted older people to improve their familiarity and proficiency with digital tools
- Supporting the establishment of "internet hospitals" to mobilise healthcare resources into digital platforms with easy navigation and integration between online services and community based services

Tackling barriers to digital assimilation

- Creating supportive ecosystems for deeper engagement with technologies: introduced the "Internet Plus" initiative in 2015, with encouragement of investment, research, and development of digital ecosystems
- Issuing policies and guidelines, such as "Guiding opinions on promoting information accessibility" and "Action plan for supporting easy transformation of internet applications among the elderly," with aims to support older adults in obtaining and using internet application information in an equal and convenient manner
- Providing alternative solutions and promoting digital inclusion through the delivery of community based services that offer support and assistance in utilising digital technologies

[7]NCD=non-communicable disease

closely linked to clinical decision making performance and patient centred care delivery for non-communicable diseases.[25] Notably, the velocity of digitalisation varies across institutions, reflected as divergence in the adoption and integration of major health information systems, such as electronic health records and decision support systems. Institutions with limited resources lag in this transformation, owing to financial constraints, inadequate infrastructure, limited leadership motivations, and low provider capacities.[15 18 26 27] Such uneven institution level adoption of digital health solutions may affect the efficiency of supply chain and workflow management, which underpins service delivery for non-communicable diseases.

The digital divide may also exacerbate the existing global disparity in the burden of non-communicable diseases across countries. The global fight against non-communicable diseases is marked by considerable disparities, with about 80% of premature deaths related to non-communicable diseases occurring in low and middle income countries.[28] Substantial barriers to infrastructure, financial investment, and policy environment hinder low and middle income countries from implementing non-communicable disease related digital public health practices, as well as digitalised surveillance and monitoring platforms.[22 23] In a vicious circle, the scarcity of evidence poses additional concerns for policy making, slowing down the integration of digital health solutions into the national non-communicable disease agenda.

Bridging the digital divide to promote prevention and control of non-communicable diseases for all: lessons from China

Given the inevitable impact of the digital divide on disparities in non-communicable diseases, identifying key strategies to diminish its negative effect on health inequities is crucial. Enhancing digital inclusion, a focal point to propel global digital health strategies,[29 30] is crucial for alleviating the disproportionate burden of non-communicable diseases among disadvantaged populations. Effective solutions to tackle each level of digital divide, summarised in table 1 (last column), are validated in studies, recommended by guidelines, or implemented in various settings.[4 30 31] China, as a key player leading the embracement and innovation of digitalisation, has significantly narrowed the extent of digital divide. Several impactful initiatives to enhance digital inclusion, detailed in box 1, have effectively improved digital inclusion in China. Notably, the gender parity score, calculated as the proportion of women who use the internet compared with men, has improved from 0.8 in 2014 to 0.95 in 2022. People aged 60 years and above accounted for 14.3% of netizens by the end of 2022, a substantial increase from 2.1% in mid-2014.[12]

China's efforts in narrowing the digital divide serve as an example of overcoming barriers at various levels through multisectoral efforts. Nevertheless, different countries need to tailor digital health solutions strategies to their distinct context, considering the political and culture environment, healthcare system structure, and so on. Thus, no "one size fits all" solution exists for tackling the digital divide globally. Moreover, acknowledging that digital health is not a "panacea" for every challenge confronting healthcare systems in the prevention and control of non-communicable diseases is essential. Instead, we view digital health solutions as useful tools for overcoming these challenges to achieve a more cost effective and sustainable impact on health outcomes.

Ways forward to maximise the benefit of digital health solutions

To harness the power of digital health solutions for prevention and control of non-communicable diseases, actions are needed from all stakeholders, including both public and private sectors and multi-sectorial partnerships, to improve equitable reach, enhance effectiveness, and promote holistic integration. Firstly, we need to acknowledge the existence and significance of the digital divide in non-communicable diseases and health disparities, assess its current extent, and formulate tailored strategies.

Secondly, we should improve the effectiveness of digital health solutions. Involving healthcare providers, researchers, and potential consumers, especially those from socially deprived groups, in the development stage can enhance the credibility, equal adoption, and suitability of digital health solutions. This can increase the direct benefit for service users. Attention should also be given to the spillover effects on non-users, such as families or peers of users, who may benefit from digital health solutions through social contagions and shared behaviour change strategies. Such spillover effects have the potential to mitigate the negative impact of the digital divide.

Thirdly, seamless integration and better penetration of digital health solutions

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within the healthcare and community ecosystem can benefit individuals, communities, and societies as a whole in monitoring and control of non-communicable diseases. Strategies should combine a top down approach shaped by regional, national, and local policies, alongside a bottom up approach driven by consumer groups and private sectors. Further research on implementation is needed to translate these recommendations into practice, along with other concerns surrounding digital health solutions such as confidentiality, security, open sharing, cost, and regulatory factors, either in general or for non-communicable disease management in particular.

Conclusion

The digital divide, far from being solely a social problem, represents a pressing health concern that demands urgent actions. That we might never eliminate the digital divide simply by enabling the accessibility of technologies for everyone or ensuring internet connectivity in every corner of the globe seems inevitable. Rather, greater emphasis should be placed on harnessing a collective and more equitable power of digital health solutions, especially for vulnerable populations untouched by the digital world. Through fostering a society valuing effective technology and humanity, we can improve health for all.

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Enying Gong, associate researcher[1,2]

Hui Wang, professor[3]

Weiguo Zhu, chief physician[4,5]

Gauden Galea, strategic advisor[6]

Jian Xu, chief physician[7]

Lijing L Yan, professor[8,9]

Ruitai Shao, distinguished professor[1,2]

[1]School of Population Medicine and Public Health, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

[2]State Key Laboratory of Respiratory Health and Multimorbidity, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

[3]School of Public Health, Shanghai Jiao Tong University School of Medicine, Shanghai 20025, China

[4]Department of Primary Care and Family Medicine, State Key Laboratory of Complex Severe and Rare Diseases, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

[5]Department of Medical Insurance Management, State Key Laboratory of Complex Severe and Rare Diseases, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

[6]World Health Organization Representative Office in China, Beijing, China

[7]Department of Elderly Health Management, Shenzhen Center for Chronic Disease Control, Shenzhen, China

[8]Global Health Research Center, Duke Kunshan University, Kunshan, Jiangsu, China

[9]Peking University Institute for Global Health and Development, Beijing, China

Correspondence to: R Shao
shaoruitai@cams.cn

1 World Health Organization. Digital Implementation Investment Guide: integrating digital interventions into health programmes. 2020. https://www.who.int/publications/i/item/9789240010567.
2 World Health Organization. Classification of digital health interventions v1.0: A shared language to describe the uses of digital technology for health. 2018. https://www.who.int/publications/i/item/WHO-RHR-18.06.
3 Xiong S, Lu H, Peoples N, et al. Digital health interventions for non-communicable disease management in primary health care in low-and middle-income countries. *NPJ Digit Med* 2023;6:12. doi:10.1038/s41746-023-00764-4
4 World Health Organization. Global strategy on digital health 2020-2025. 2021. https://www.who.int/docs/default-source/documents/gs4dhdaa2a9f352b0445bafbc79ca799dce4d.pdf
5 Ferguson T, Olds T, Curtis R, et al. Effectiveness of wearable activity trackers to increase physical activity and improve health: a systematic review of systematic reviews and meta-analyses. *Lancet Digit Health* 2022;4:e615-26. doi:10.1016/S2589-7500(22)00111-X
6 Moschonis G, Siopis G, Jung J, et al. DigiCare4You Consortium. Effectiveness, reach, uptake, and feasibility of digital health interventions for adults with type 2 diabetes: a systematic review and meta-analysis of randomised controlled trials. *Lancet Digit Health* 2023;5:e125-43. doi:10.1016/S2589-7500(22)00233-3
7 Siopis G, Moschonis G, Eweka E, et al. DigiCare4You Consortium. Effectiveness, reach, uptake, and feasibility of digital health interventions for adults with hypertension: a systematic review and meta-analysis of randomised controlled trials. *Lancet Digit Health* 2023;5:e144-59. doi:10.1016/S2589-7500(23)00002-X
8 Wongvibulsin S, Habeos EE, Huynh PP, et al. Digital Health Interventions for Cardiac Rehabilitation: Systematic Literature Review. *J Med Internet Res* 2021;23:e18773. doi:10.2196/18773
9 Shaffer KM, Turner KL, Siwik C, et al. Digital health and telehealth in cancer care: a scoping review of reviews. *Lancet Digit Health* 2023;5:e316-27. doi:10.1016/S2589-7500(23)00049-3
10 Dunn J, Coravos A, Fanarjian M, Ginsburg GS, Steinhubl SR. Remote digital health technologies for improving the care of people with respiratory disorders. *Lancet Digit Health* 2024;6:e291-8. doi:10.1016/S2589-7500(23)00248-0
11 Kruse CS, Stein A, Thomas H, Kaur H. The use of Electronic Health Records to Support Population Health: A Systematic Review of the Literature. *J Med Syst* 2018;42:214. doi:10.1007/s10916-018-1075-6
12 China Internet Network Information Center. The statistical report on China's internet development, 2014-2022.
13 Carlo AD, Hosseini Ghomi R, Renn BN, Areán PA. By the numbers: ratings and utilization of behavioral health mobile applications. *NPJ Digit Med* 2019;2:54. doi:10.1038/s41746-019-0129-6
14 Ibrahim H, Liu X, Zariffa N, Morris AD, Denniston AK. Health data poverty: an assailable barrier to equitable digital health care. *Lancet Digit Health* 2021;3:e260-5. doi:10.1016/S2589-7500(20)30317-4
15 Litchfield I, Shukla D, Greenfield S. Impact of COVID-19 on the digital divide: a rapid review. *BMJ Open* 2021;11:e053440. doi:10.1136/bmjopen-2021-053440
16 Zeng B, Rivadeneira NA, Wen A, Sarkar U, Khoong EC. The Impact of the COVID-19 Pandemic on Internet Use and the Use of Digital Health Tools: Secondary Analysis of the 2020 Health Information National Trends Survey. *J Med Internet Res* 2022;24:e35828. doi:10.2196/35828
17 World Bank. International Telecommunication Union World Telecommunication Indicators Database. 2021. https://data.worldbank.org/indicator/
18 Manyazewal T, Ali MK, Kebede T, et al. Mapping digital health ecosystems in Africa in the context of endemic infectious and non-communicable diseases. *NPJ Digit Med* 2023;6:97. doi:10.1038/s41746-023-00839-2
19 International Telecommunication Union. Measuring digital development: Facts and Figures, 2022. https://www.itu.int/hub/publication/d-ind-ict_mdd-2022/
20 Lyles CR, Nguyen OK, Khoong EC, Aguilera A, Sarkar U. Multilevel Determinants of Digital Health Equity: A Literature Synthesis to Advance the Field. *Annu Rev Public Health* 2023;44:383-405. doi:10.1146/annurev-publhealth-071521-023913
21 Urban M. 'This really takes it out of you!' The senses and emotions in digital health practices of the elderly. *Digit Health* 2017;3:2055207617701778. doi:10.1177/2055207617701778
22 Wei KK, Teo HH, Chan HC, Tan BCY. Conceptualizing and testing a social cognitive model of the digital divide. *Inf Syst Res* 2010;22:170-87. doi:10.1287/isre.1090.0273
23 Marmot M, Allen JJ. Social determinants of health equity. *Am J Public Health* 2014;104(Suppl 4):S517-9. doi:10.2105/AJPH.2014.302200

24 The Lancet. 50 years of the inverse care law. *Lancet* 2021;397:767. doi:10.1016/S0140-6736(21)00505-5
25 Borges do Nascimento IJ, Abdulazeem HM, Vasanthan LT, et al. The global effect of digital health technologies on health workers' competencies and health workplace: an umbrella review of systematic reviews and lexical-based and sentence-based meta-analysis. *Lancet Digit Health* 2023;5:e534-44. doi:10.1016/S2589-7500(23)00092-4
26 Murthy S, Kamath P, Godinho MA, et al. Digital health innovations for non-communicable disease management during the COVID-19 pandemic: a rapid scoping review. *BMJ Innov* 2023;9:3-18. doi:10.1136/bmjinnov-2021-000903
27 Natalia G. An inverted digital divide during Covid-19 pandemic? Evidence from a panel of EU countries. *Telemat Inform* 2022;72:101856. doi:10.1016/j.tele.2022.101856
28 Murray CJ, Abbafati C, Abbas KM, et al. GBD 2019 Viewpoint Collaborators. Five insights from the global burden of disease study 2019. *Lancet* 2020;396:1135-59. doi:10.1016/S0140-6736(20)31404-5
29 Rodriguez JA, Shachar C, Bates DW. Digital Inclusion as Health Care - Supporting Health Care Equity with Digital-Infrastructure Initiatives. *N Engl J Med* 2022;386:1101-3. doi:10.1056/NEJMp2115646
30 Labrique A, Agarwal S, Tamrat T, Mehl G. WHO Digital Health Guidelines: a milestone for global health. *NPJ Digit Med* 2020;3:120. doi:10.1038/s41746-020-00330-2
31 Odone A, Buttigieg S, Ricciardi W, Azzopardi-Muscat N, Staines A. Public health digitalization in Europe. *Eur J Public Health* 2019;29(Supplement_3):28-35. doi:10.1093/eurpub/ckz161

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Reducing inequity through tackling social determinants of cardiovascular diseases in China

Guang Ning and colleagues underline the importance of tackling social determinants and associated inequity in prevention and management of cardiovascular diseases

Cardiovascular disease (CVD) has become a great health challenge worldwide, contributing appreciably to morbidity and mortality.[1] Rapid urbanisation, sedentary lifestyles, dietary changes, and population ageing in China have considerably increased the prevalence of CVD, including ischaemic heart disease and stroke. Social determinants of health have been increasingly recognised as an important contributor to health outcomes, given their association with about half of all-cause mortality.[2]

However, as in many other economically less developed countries, China's current health policies have only recently started to recognise and tackle the importance of social determinants, particularly the urban-rural inequality in health.[3] This analysis examines the achievements and challenges related to social determinants of health and associated inequity in CVD prevention and management in China over the past two decades, with a particular focus on socioeconomic status, healthcare accessibility, and affordability (fig 1).

KEY MESSAGES

- Socioeconomic status influences CVD in China through complex pathways, including educational inequalities, regional variations, and lifestyle determinants such as solid fuel use
- Rural-urban inequalities in allocation of healthcare resources, including hospital bed capacity, healthcare personnel, and timely medical accessibility, persist but have gradually decreased
- Establishing national standardised cardiometabolic disease centres has effectively enhanced medical capabilities and raised the overall quality of cardiometabolic healthcare
- Near-universal medical insurance coverage highlights the considerable progress made towards health equity in China, although geographic gaps in healthcare affordability may continue to impact cardiovascular health inequalities, emphasising the need for ongoing reform

Socioeconomic status and cardiovascular health

Socioeconomic status generally refers to an individual's position in a hierarchical social structure. At an individual level, socioeconomic status is determined mainly by a person's education, income, and occupation.[4] Evidence from the United States and Europe showed wide variations in social determinants of health,[5 6] and suggested that socioeconomic inequity might be equally important, if not more, as a contributor to human health than biomedical interventions.[2] Although education, occupation, and income are inter-related, because education has more potential for intervention and can motivate subjects, it is commonly believed that education affects occupation and income, subsequently determining one's lifestyle. In Europeans, educational attainment, rather than income and occupation, is the main socioeconomic indicator of longevity and CVD risk.[7] The important effect of education on CVD risk and mortality was also explored in two nationwide prospective cohort studies in China: the China Cardiometabolic Disease and Cancer Cohort (4C) Study and the China Health Evaluation And risk Reduction through nationwide Teamwork (ChinaHEART).[8 9] The 4C study of 193 846 adults found that education attainment below high school (versus high school or further education) accounted for roughly 14% of population attributable risk for CVD mortality.[8] The ChinaHEART study of 1 283 774 adults reported that compared with college or above educational attainment, educational attainment at primary school or below was associated with a 44% to 101% increased risk of mortality across generations born between 1940 and 1979 in China, independent of income, health insurance, and occupation.[9]

Educational attainment is associated with a number of lifestyle behaviours (eg, cigarette smoking, alcohol use, physical activity, and diet) and diseases or disorders (eg, obesity, diabetes, hypertension, and dyslipidemia), which in turn increase the risk of CVD or CVD related mortality.[7 10] A good example is the relation between education and obesity. Data from the China Chronic Disease and Risk Factors Surveillance of six nationally representative surveys between 2004 and 2018 showed that women with higher educational attainment had lower body mass indexes compared with women with lower education levels, while the inverse was true among men.[11] Data from the China Health and Nutrition Survey (1991-2011) of 21 133 adults indicated that lower socioeconomic status, as determined by individual (education, income, and occupation) and area level (urbanisation index) was associated with higher mortality and shorter life expectancy; this was slightly mediated by lifestyle, including smoking, physical activity, diet, and bodyweight.[12] This evidence suggests that the entire chain encompassing socioeconomic status and its associated lifestyle behaviours is critical for the prevention of CVD.

In recent decades, China has adopted a range of interventions to improve health literacy, including developing national basic public health services, health education and promotion, tobacco control, continuous health literacy monitoring, and holding special revenue funds. Health literacy of the population increased from 6.48% in 2008 to 23.15% in 2020.[13] Notably, education was closely associated with health literacy, as the proportion with college or higher educational attainment gradually increased in China from 3.6% in women and 5.8% in men in 2000 to 18.2% in women and 19.0% in men in 2020.[14] Future investigations are warranted to quantify the subsequent improvement in cardiovascular health in the Chinese population.

Besides universal social determinants, China has unique socioeconomic determinants of the CVD burden. Use of

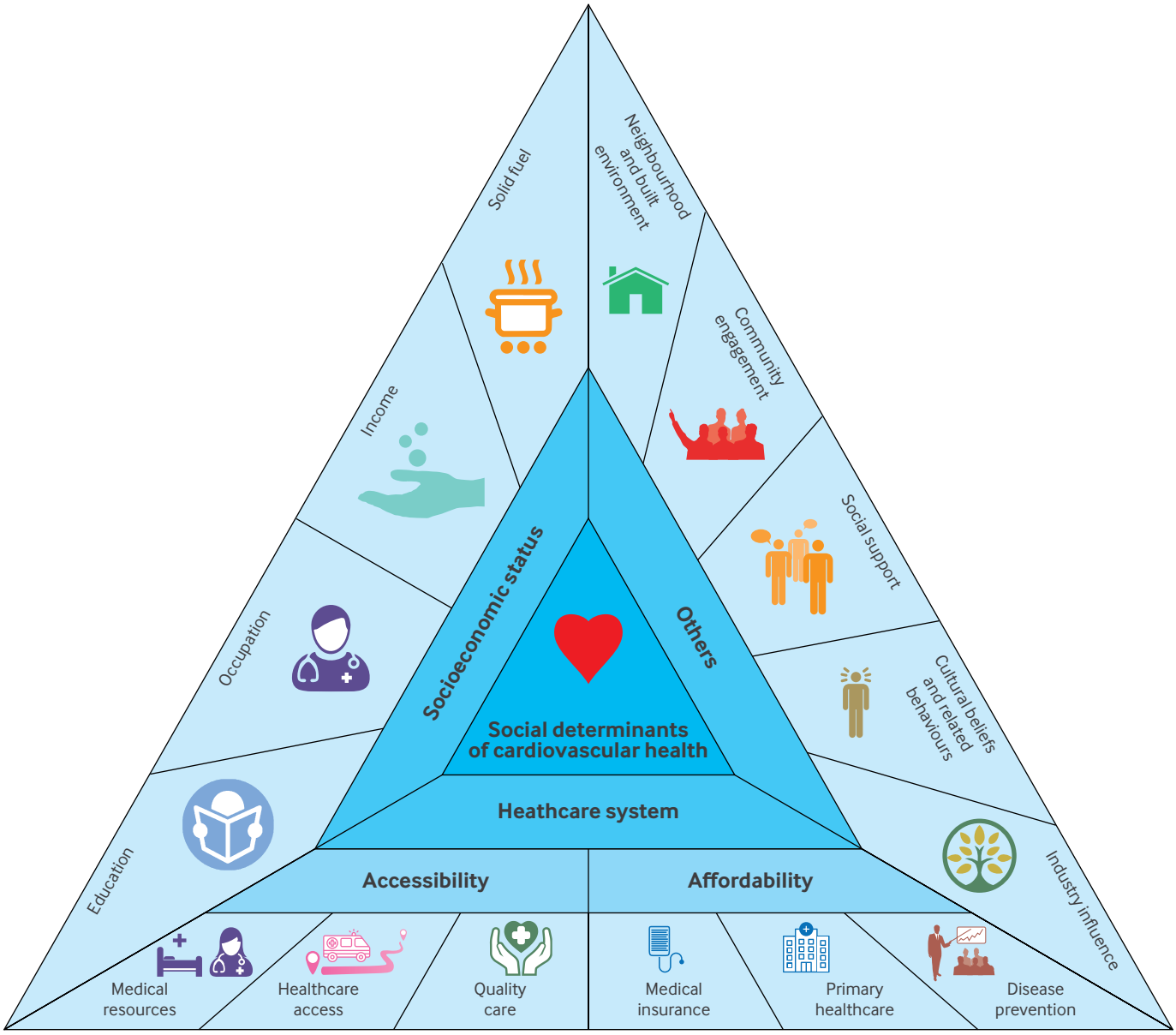

Fig 1 | Social determinants of cardiovascular health

solid fuel is an important one, which is less well studied. As a common source of household energy in China and many other low and middle income countries, solid fuel is a family or community level indicator of socioeconomic status, reflecting the cooking and heating style closely related to the economic development and energy source. One nationwide prospective cohort study which recruited 271 217 participants from five rural areas across China found that using solid fuel for cooking and heating was associated with an increased risk of cardiovascular and all-cause mortality in rural China.[15] Other evidence from the China Kadoorie Biobank showed that in urban China, the excess risks of all-cause and cardiopulmonary mortality from use of solid cooking fuels decreased by more than 60% five years after cessation, and good ventilation could also reduce CVD mortality even among people who persistently use clean fuels.[16] Notably, the associations between solid fuel use on CVD and mortality were independent of traditional risk factors, including lifestyle, socioeconomic indicators, and stove ventilation.[15 16]

Healthcare system and cardiovascular health

Aside from the socioeconomic status of an individual, a healthcare system that promotes delivery of efficient and high quality healthcare and optimises healthcare accessibility and affordability is of crucial importance in achieving population cardiovascular health.

Healthcare accessibility

Healthcare accessibility, namely the convenience and opportunity for individuals or communities to access and use healthcare services, is an important social determinant. Understanding the intricate relation between accessibility and health is crucial, considering its profound impact on the wellbeing of a population.[17]

Accessibility is influenced mainly by the structure of the healthcare system in a country or region. The publicly funded National Health Service in the United Kingdom since 1948 exemplifies a model of universal healthcare coverage, efficiently tackling nearly 95% of healthcare needs with 10% of the national gross domestic product (GDP). In contrast, the United

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States has a market driven healthcare model, incorporating both private and public insurance, allocating over 18% of GDP to healthcare but facing persisting inequalities, especially for racial and ethnic minorities. China's healthcare system has undergone radical transformation over the past decades aimed at improving quality, accessibility, and equality, yet challenges persist, notably in inequalities in access to healthcare resources in rural and urban areas (fig 2).

Firstly, substantial inequalities in the availability of medical and healthcare resources were evident in 1999, with urban areas having 3.49 hospital beds per 1000 people compared with only 0.8 beds per 1000 people in rural areas —a nearly fivefold difference. Similarly, the number of healthcare staff per 1000 people was 5.17 in urban areas and 1.45 in rural areas, resulting in a nearly 3.6-fold difference.[14] By 2021, the number of hospital beds had increased overall to 6.70 per 1000 people, with urban areas having 7.47 beds and rural areas 6.01 beds per 1000 people.[14] Additionally, the number

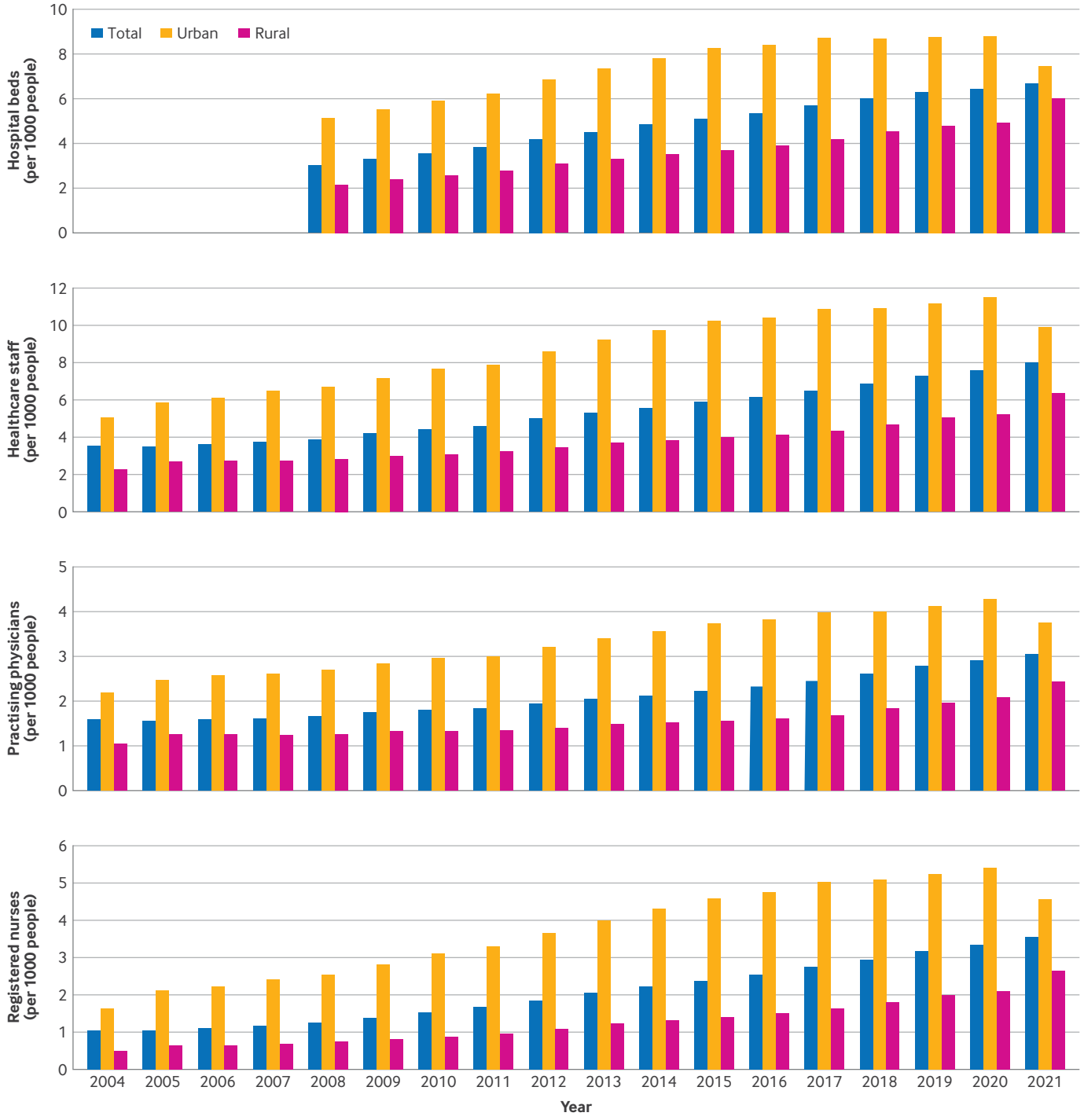

Fig 2 | Numbers of hospital beds, healthcare staff, practising physicians, and registered nurses per 1000 people from 2004 to 2021 in urban and rural China.[14] Note, the downturn in medical resources within urban areas from 2020 to 2021 is linked to national directives regulating hospital scale, the covid-19 pandemic, and the widespread adoption of internet based healthcare facilities

of healthcare staff improved overall to 7.97 per 1000 people, with 9.87 in urban areas and 6.27 in rural areas.[14] This indicates a considerable narrowing of the urban-rural gap in healthcare resources in China. Since 2017, the annual growth of hospital beds has slowed, mainly the result of national policies controlling hospital development.

Secondly, urban-rural inequalities persist in timely healthcare access, crucial for tackling CVD. In 2008, 4.2% of households took over 30 minutes to reach medical facilities: 0.7% of households in urban areas compared with 5.7% in rural areas. An estimated 59.76 million people in China lack timely medical access, largely in rural areas (70%, or 44.35 million people). Efforts to improve accessibility have shown progress, with the proportion of households taking over 30 minutes in 2018 reduced to 1.3% (0.6% in urban households compared with 2.1% in rural areas).[18]

Thirdly, accessibility of quality care is what matters. In China, the historical dual economic structure and the policy in favour of urban areas have resulted in substantial inequality in allocation of healthcare resources. In the 1950s, the famous barefoot doctor programme was initiated to tackle rural healthcare needs by training paramedics. Economic growth during the 1980s spurred increased healthcare expenditure and a gradual phasing out of the barefoot doctor programme. Subsequent initiatives, such as the family doctor system in the 1980s to 1990s and the 2009 proposal for a tiered healthcare system sought to promote a more rational development of the healthcare system.[19] Management led by non-physician, community healthcare providers has also been effective in reducing CVD and deaths.[20] While these systems have had some success in improving primary healthcare, chronic disease management, and the efficient use of medical resources, more effort is needed for better resource allocation, enhancing doctor training, and improving the quality of medical services.

Guided by the National Health Commission, the establishment of national chest pain centres and stroke centres, aligned with the Healthy China Action Plan 2030, signals a new round of extra initiatives. Following accreditation of the chest pain centre, there was a 22% decrease in major adverse cardiovascular events and a 29% reduction in all-cause mortality among patients with acute myocardial infarction.[21] Stroke centre certification resulted in a doubling of thrombolysis rates, with a 50% decrease in complications in hospital and a 30% reduction in the three month disability rate.[22] The metabolic management centre has considerably improved control of glycated haemoglobin A_{1c} levels, indicating a positive impact on diabetes management and the potential to enhance overall cardiometabolic healthcare quality in the future.[23] Financial constraints, workforce shortages, and infrastructure limitations are big challenges that need to be tackled to ensure the long term success and impact of these initiatives, particularly in rural and underserved areas.

Healthcare affordability

Healthcare affordability refers to the ability with which a person or organisation can afford or pay for the costs of healthcare services.[24] Total health expenditure in China, including government, social, and out-of-pocket health expenditure as a percentage of total GDP increased from 5.03% in 2009 to 6.43% in 2018,[14] although it is still below the world average.[25]

As part of social health expenditure, comprehensive healthcare insurance is important in achieving wide affordability in healthcare. By 2011, China achieved near universal medical insurance coverage for its 1.4 billion population. To safeguard equal healthcare, in 2016 the New Rural Cooperative Medical Scheme merged with the Urban Resident Basic Medical Insurance to improve equity in health insurance benefits between rural and urban areas. The China Health and Retirement Longitudinal Study reported that the merging has considerably improved benefits such as the amount of compensation and reimbursement ratio for rural residents, particularly those in western China.[26] In addition, during the latest round of healthcare reform, China's government health expenditure has more than tripled, increasing from ¥482bn (£52bn; $67bn; €61bn) in 2009 to ¥1640bn in 2018, and the percentage of out-of-pocket expenditure accounting for total health expenditure dropped from 37.5% in 2009 to 28.6% in 2018.[14]

For CVD, the total expenditure in China in 2018 was ¥597.6bn, accounting for 16.92% of all disease expenditure. The basic medical insurance covered ¥331.2bn for the treatment of CVD, ranking top among all disease types. Out-of-pocket expenditure accounted for 23.95% of the total expenditure for CVD management.[27] These numbers highlight the enormous burden management of CVD places on the healthcare system. Therefore, aside from increasing government and social financial investment, other methods are needed to improve healthcare affordability for CVD in China, such as primary healthcare and CVD prevention.

Notably, less than 11% of CVD medical expenditure occurred in primary healthcare settings in China.[27] Even for diseases such as hypertension, one of the commonest conditions for people to consult a primary care physician about, only a quarter of medical expenditure for treatment occurred in primary healthcare institutions. Barriers may include insufficient and underqualified primary healthcare personnel and equipment and patients' low trust. Improving the primary healthcare system is essential for building an affordable healthcare system. The Chinese government has substantially increased funding for primary healthcare as part of the new healthcare reforms, but many challenges still lie ahead—for example, the suboptimal training of primary healthcare providers and their preference for testing and treatment over prevention. These challenges call for fundamental reforms to improve continued education and training, and to build a system incentivising high quality and high value preventive care.[28]

CVD prevention achieved largely by population methods, such as health education and promotion and creation of a healthy environment and agriculture, could benefit people unselectively. For example, studies of hypertension show that it may cost ¥125m a year to fill the awareness gaps in Chinese adults aged 35-75 years, but achieving that goal, by health education and population screening and so on, could save ¥486m annually from treating cardiovascular diseases and increase productivity worth ¥2691m a year.[28] Meanwhile, nutrition is an important driver of cardiovascular risk. The successful implementation of the national salt reduction programme has considerably reduced cooking salt intake, leading to a decreased prevalence of hypertension in Chinese adults since 2010.[29] In particular, efforts are needed to increase the awareness and control of cardiovascular risk factors in people in rural areas or minority ethnicity, and in people without employment.[30]

Other social determinants and cardiovascular health

Emerging evidence from the US has shown that factors such as neighbourhood

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environmental burden[31] as well as social and community determinants of health, such as community engagement, social support, and cultural beliefs and related behaviours,[32] also showed significant associations with health outcomes, including CVD. Although the characteristics of these social determinants may vary between the US and China, these investigations underline the need to elucidate these relations in China.

Furthermore, it is important to note the influence of industry on health outcomes, which constitutes an often overlooked but crucial aspect of social determinants independent of socioeconomic status. For example, the tobacco and alcohol industries have considerable economic influence and benefit from low tax rates and ineffective package warnings in China. Additionally, public awareness and institutional mechanisms have not yet fully tackled the impact of the food industry (eg, sugar sweetened drinks and ultra-processed food) on food safety and healthy food governance.[33] Effective policies are required to tackle the adverse influence of industry, including implementing taxes for tobacco and alcohol, improving hazard warnings on tobacco and alcohol labels, refining food nutrition labels, and restricting the marketing of unhealthy foods to vulnerable populations, which warrant the involvement of nearly all sectors well beyond health.

Conclusions and recommendations

More than half of cardiovascular health is determined by social factors. China has made considerable efforts to tackle the social determinants of CVD over the past two decades through various means, including enhancing socioeconomic status, healthcare systems, and so on. However, there remains substantial room for improvement, and prioritising social determinants on the national agenda is crucial. This necessitates implementing comprehensive strategies dealing with immediate health concerns and the underlying social determinants. Initiatives should focus on reducing urban-rural inequalities, enhancing healthcare access in underserved areas, and tackling socioeconomic inequalities related to cardiovascular risk factors. By wisely mapping our efforts and resources, we can establish a more equitable and inclusive healthcare system that empowers individuals, promotes preventive measures, and ensures timely and affordable access to cardiovascular care for all.

Jieli Lu, professor[1,2]
Yu Xu, professor[1]
Yufang Bi, professor[1,2]
Tiange Wang, professor[2]
Ruizhi Zheng, senior research fellow[2]
Weiqing Wang, professor[1,2]
Guang Ning, professor[1,2]

[1]Department of Endocrine and Metabolic Diseases, Shanghai Institute of Endocrine and Metabolic Diseases, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China

[2]National Clinical Research Center for Metabolic Diseases (Shanghai), Key Laboratory for Endocrine and Metabolic Diseases of the National Health Commission of the PR China, National Research Center for Translational Medicine, Shanghai Key Laboratory for Endocrine Tumor, State Key Laboratory of Medical Genomics, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China

Correspondence to: G Ning
gning@sibs.ac.cn

Contributors and sources: GN had the idea for the article; JL, YX, YB, TW, and RZ did the literature searches. All authors contributed to the writing of this manuscript and have reviewed and approved the final version. JL, YX, and YB contributed equally and are joint first authors.

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1 Roth GA, Mensah GA, Johnson CO, et al. GBD-NHLBI-JACC Global Burden of Cardiovascular Diseases Writing Group. Global burden of cardiovascular diseases and risk factors, 1990-2019: update from the GBD 2019 Study. *J Am Coll Cardiol* 2020;76:2982-3021. doi:10.1016/j.jacc.2020.11.010
2 Kaplan MR. *More than medicine:the broken promise of American health.* Harvard University Press, 2019.
3 Wang Z, Yang G, Guo Y. Harnessing the opportunity to achieve health equity in China. *Lancet Public Health* 2021;6:e867-8. doi:10.1016/S2468-2667(21)00211-5
4 Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annu Rev Public Health* 1997;18:341-78. doi:10.1146/annurev.publhealth.18.1.341
5 Mackenbach JP, Stirbu I, Roskam AJ, et al. European Union Working Group on Socioeconomic Inequalities in Health. Socioeconomic inequalities in health in 22 European countries. *N Engl J Med* 2008;358:2468-81. doi:10.1056/NEJMsa0707519
6 Mackenbach JP, Kulhánová I, Artnik B, et al. Changes in mortality inequalities over two decades: register based study of European countries. *BMJ* 2016;353:i1732. doi:10.1136/bmj.i1732
7 Ye CJ, Kong LJ, Wang YY, et al. Mendelian randomization evidence for the causal effects of socio-economic inequality on human longevity among Europeans. *Nat Hum Behav* 2023;7:1357-70. doi:10.1038/s41562-023-01646-1
8 Lu J, Li M, He J, et al. 4C Study Group. Association of social determinants, lifestyle, and metabolic factors with mortality in Chinese adults: A nationwide 10-year prospective cohort study. *Cell Rep Med* 2024;5:101656. doi:10.1016/j.xcrm.2024.101656
9 Lu J, Wu C, Zhang X, et al. Educational inequalities in mortality and their mediators among generations across four decades: nationwide, population based, prospective cohort study based on the ChinaHEART project. *BMJ* 2023;382:e073749. doi:10.1136/bmj-2022-073749
10 Allen L, Williams J, Townsend N, et al. Socioeconomic status and non-communicable disease behavioural risk factors in low-income and lower-middle-income countries: a systematic review. *Lancet Glob Health* 2017;5:e277-89. doi:10.1016/S2214-109X(17)30058-X
11 Wang L, Zhou B, Zhao Z, et al. Body-mass index and obesity in urban and rural China: findings from consecutive nationally representative surveys during 2004-18. *Lancet* 2021;398:53-63. doi:10.1016/S0140-6736(21)00798-4
12 Zhang YB, Li Y, Geng TT, et al. Overall lifestyles and socioeconomic inequity in mortality and life expectancy in China: the China health and nutrition survey. *Age Ageing* 2022;51:afac167. doi:10.1093/ageing/afac167
13 Li Y, Lv X, Liang J, Dong H, Chen C. The development and progress of health literacy in China. *Front Public Health* 2022;10:1034907. doi:10.3389/fpubh.2022.1034907
14 National Bureau of Statistics of China.*China statistical yearbook 2022.* China Statistics Press, 2022. https://www.stats.gov.cn/sj/ndsj/2022/indexch.htm.
15 Yu K, Qiu G, Chan KH, et al. Association of solid fuel use with risk of cardiovascular and all-cause mortality in rural China. *JAMA* 2018;319:1351-61. doi:10.1001/jama.2018.2151
16 Yu K, Lv J, Qiu G, et al. China Kadoorie Biobank Study. Cooking fuels and risk of all-cause and cardiopulmonary mortality in urban China: a prospective cohort study. *Lancet Glob Health* 2020;8:e430-9. doi:10.1016/S2214-109X(19)30525-X
17 Aday LA, Andersen R. A framework for the study of access to medical care. *Health Serv Res* 1974;9:208-20.
18 National Health Commission of China. *The China healthcare statistical yearbook.* 2022. http://www.nhc.gov.cn/mohwsbwstjxxzx/tjtjnj/202305/6ef68aac6bd14c1eb9375e01a0faa1fb.shtml
19 Meng Q, Yin D, Mills A, Abbasi K. China's encouraging commitment to health. *BMJ* 2019;365:l4178. doi:10.1136/bmj.l4178
20 He J, Ouyang N, Guo X, et al. CRHCP Study Group. Effectiveness of a non-physician community health-care provider-led intensive blood pressure intervention versus usual care on cardiovascular disease (CRHCP): an open-label, blinded-endpoint, cluster-randomised trial. *Lancet* 2023;401:928-38. doi:10.1016/S0140-6736(22)02603-4
21 Fan F, Li Y, Zhang Y, et al. CCC-ACS Investigators. Chest pain center accreditation is associated with improved in-hospital outcomes of acute myocardial infarction patients in China: Findings from the CCC-ACS Project.

J Am Heart Assoc 2019;8:e013384. doi:10.1161/JAHA.119.013384
22 Chao BH, Tu WJ, Wang LD, Stroke Prevention Project Committee, National Health Commission of the People's Republic of China. Initial establishment of a stroke management model in China: 10 years (2011-2020) of Stroke Prevention Project Committee, National Health Commission. *Chin Med J (Engl)* 2021;134:2418-20. doi:10.1097/CM9.0000000000001856
23 Liu J, Bloomgarden Z. The Chinese Metabolic Management Centers. *J Diabetes* 2022;14:362-4. doi:10.1111/1753-0407.13290
24 Axene D. Health care affordability: A valuable concept in understanding our health care system challenges. *Health Section News* 2003;45:20-22. https://www.soa.org/globalassets/assets/library/newsletters/health-section-news/2003/april/hsn-2003-iss45-axene.pdf.
25 Chen S, Kuhn M, Prettner K, Bloom DE, Wang C. Macro-level efficiency of health expenditure: Estimates for 15 major economies. *Soc Sci Med* 2021;287:114270. doi:10.1016/j.socscimed.2021.114270
26 Ren Y, Zhou Z, Cao D, et al. Did the integrated urban and rural resident basic medical insurance improve benefit equity in China?*Value Health* 2022;25:1548-58. doi:10.1016/j.jval.2022.03.007
27 Chai P, Zhai T, Wan Q, Zhang Y. [Accounting and analysis of curative expenditure and basic medical insurance fund expenditure on CCDs in China]. *China Health Insurance* 2021;1:72-7.
28 Li X, Krumholz HM, Yip W, et al. Quality of primary health care in China: challenges and recommendations. *Lancet* 2020;395:1802-12. doi:10.1016/S0140-6736(20)30122-7
29 Zhang M, Shi Y, Zhou B, et al. Prevalence, awareness, treatment, and control of hypertension in China, 2004-18: findings from six rounds of a national survey. *BMJ* 2023;380:e071952. doi:10.1136/bmj-2022-071952
30 Wei J, Mi Y, Li Y, Xin B, Wang Y. Factors associated with awareness, treatment and control of hypertension among 3579 hypertensive adults in China: data from the China Health and Nutrition Survey. *BMC Public Health* 2021;21:423. doi:10.1186/s12889-021-10417-4
31 Liu M, Patel VR, Salas RN, et al. Neighborhood environmental burden and cardiovascular health in the US. *JAMA Cardiol* 2024;9:153-63. doi:10.1001/jamacardio.2023.4680
32 Gao Q, Bone JK, Bu F, Paul E, Sonke JK, Fancourt D. Associations of social, cultural, and community engagement with health care utilization in the US Health and Retirement Study. *JAMA Netw Open* 2023;6:e236636. doi:10.1001/jamanetworkopen.2023.6636
33 Pan XF, Wang L, Pan A. Epidemiology and determinants of obesity in China. *Lancet Diabetes Endocrinol* 2021;9:373-92. doi:10.1016/S2213-8587(21)00045-0

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Chronic disease and infection in China: lessons from the covid-19 pandemic

The covid-19 pandemic is over but provided many lessons for population health and chronic diseases, say **Luzhao Feng and colleagues**

The harms from covid-19 during the pandemic extended beyond the disease itself. Older people with a chronic or non-communicable disease were among the most vulnerable to SARS-CoV-2 and at the highest risk of death.[1 2] The interplay between chronic disease and infection can exacerbate each condition, highlighting the importance of preventing infection in people with chronic disease and increasing the challenges of caring for patients with comorbidity.[3 4] For instance, during the omicron outbreak in Hong Kong excess deaths occurred not only from covid-19 infections but from chronic diseases, including cerebrovascular disease and kidney disease.[5] This may be because the healthcare system was heavily overwhelmed, leading to low quality healthcare services and longer waits for some interventions for non-covid illness. Moreover, patients with chronic diseases may face increased risks of complications and severe outcomes after covid-19 infection.

At the onset of the pandemic, public health measures such as wearing masks, maintaining social distancing, and proactive health education, were crucial in controlling the spread of epidemics and buying more time to prepare health resources[6] and develop vaccines and antiviral drugs. This approach minimised harm to the entire population, particularly vulnerable people with chronic diseases. The vulnerability to infection of people with chronic diseases highlighted the need for research into treatment of not only covid-19 but also chronic diseases. New technology was developed to promote efficient and convenient management of chronic diseases. Telehealth and digital health provide real time video consultations, enabling primary care triage and interventions such as counselling, prescription management, long term treatment management, and post-discharge coordination, all supported by remote monitoring capabilities.[7 8]

Another problems that emerged during the pandemic was inadequate medical resources during disease outbreaks, which increased the risk of nosocomial infection in hospitals and nursing homes. This highlights the need to improve the ability to prevent and control infections.

Healthy systems and populations

A flexible strategy for optimising allocation of health resources should therefore be established to integrate efforts during both pandemic and non-pandemic periods. During non-pandemic times, the focus is primarily on general preparations, including research into better prevention, detection, control, and treatment methods and tools, as well as capacity building for preparedness and response against a target pathogen, infection prevention in people with chronic diseases, and the care of those with comorbidity. During an outbreak, prevention and control methods take precedence. For example, implementing public health measures at the peak of the epidemic is crucial. Meanwhile, hospital preparations and managing influxes of patients are urgent, especially with regard to intensive care capacity, timely communication of nursing experience, and drug distribution strategies. Additionally, planning to convert existing public venues, such as stadiums and exhibition centres, into healthcare facilities and leveraging community and family doctors can help improve healthcare access.

The pandemic highlights that challenges persist with the management of chronic diseases. Initially, population approaches should be used to prevent chronic diseases, and high risk groups should be urged to have regular health screenings and adopt lifestyle interventions. Older adults, who are often affected by chronic diseases, should be prioritised for vaccination against covid-19, influenza, pneumococcus, and herpes zoster to reduce the severity of infection related outcomes.[9] Other vulnerable groups such as children and pregnant women should be also protected. Furthermore, it is crucial to ascertain the size and distribution of the population affected by chronic diseases and to optimise the allocation of medical resources, such as care facilities for older adults. The scarcity and uneven distribution of medical resources pose a challenge in China, as it does in many other densely populated countries.

Collaborative approach required

Management of people with chronic diseases is a long term endeavour that requires collaboration across multiple departments and staff. A fundamental principle for enhancing treatment processes is to bolster the capacity of the healthcare system, including the reserve staff from other departments, when additional support is needed. Moreover, improving management does not suggest neglect of infectious diseases. Some infections can lead to cancer,[10] and, conversely, other infections exacerbate chronic diseases, causing severe outcomes and even death.[2] Implementing management based on the levels of patient risk is advisable. Therefore, rapid pathogen detection, infection prevention as much as technically feasible, and standardised application of antimicrobial drugs should be integral to management of chronic diseases. The availability of healthcare services is crucial in achieving social and health equity.

Optimising the management of chronic diseases necessitates integrating prevention and control measures within communities alongside clinical practices in hospitals. Covid-19 has shown that experiences from pandemic management can enhance control and prevention of chronic diseases. This includes improving surveillance systems, building resilient health systems, strengthening public health, and promoting vaccinations against infection related cancers such as cervical and liver cancer. From a mechanistic perspective, the response to covid-19 offers new insights into the interactions between the immune system and non-communicable diseases, potentially improving their management.

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Yanming Li, chief physician[1]

Xunliang Tong, attending physician[1]

Mingyue Jiang, postdoctoral fellow[2]

Zeni Wu, assistant professor[2]

Yuping Duan, PhD candidate[2]

Li Zhang, assistant professor[2]

Shengjie Lai, principal research fellow[3]

Weizhong Yang, professor[2]

Luzhao Feng, professor[2]

[1]Department of Pulmonary and Critical Care Medicine, Beijing Hospital, National Gerontology Center, Institute of Gerontology, Chinese Academy of Medical Sciences Beijing, China

[2]School of Population Medicine and Public Health, Chinese Academy of Medical Sciences and Peking Union Medical College, State Key Laboratory of Respiratory Health and Multimorbidity, Key Laboratory of Pathogen Infection Prevention and Control (Peking Union Medical College), Ministry of Education, Beijing, China

[3]School of Geography and Environmental Science, University of Southampton, Southampton, UK

Correspondence to: L Feng v fengluzhao@cams.cn

1 Xie Y, Xu E, Bowe B, Al-Aly Z. Long-term cardiovascular outcomes of COVID-19. *Nat Med* 2022;28:583-90. doi:10.1038/s41591-022-01689-3

2 Liu J, Zhang L, Yan Y, et al. Excess mortality in Wuhan city and other parts of China during the three months of the covid-19 outbreak: findings from nationwide mortality registries. *BMJ* 2021;372:n415. doi:10.1136/bmj.n415

3 Li J, Wang H, Geng C, et al. Suboptimal declines and delays in early breast cancer treatment after COVID-19 quarantine restrictions in China: A national survey of 8397 patients in the first quarter of 2020. *EClinicalMedicine* 2020;26:100503. doi:10.1016/j.eclinm.2020.100503

4 Hanna TP, King WD, Thibodeau S, et al. Mortality due to cancer treatment delay: systematic review and meta-analysis. *BMJ* 2020;371:m4087. doi:10.1136/bmj.m4087

5 Chong KC, Chan PK, Hung CT, et al. Changes in all-cause and cause-specific excess mortality before and after the Omicron outbreak of COVID-19 in Hong Kong. *J Glob Health* 2023;13:06017. doi:10.7189/jogh.13.06017

6 Sabbatini CE, Pullano G, Di Domenico L, Rubrichi S, Bansal S, Colizza V. The impact of spatial connectivity on NPIs effectiveness. *BMC Infect Dis* 2024;24:21. doi:10.1186/s12879-023-08900-x

7 Curigliano G, Banerjee S, Cervantes A, et al,Panel members. Managing cancer patients during the COVID-19 pandemic: an ESMO multidisciplinary expert consensus. *Ann Oncol* 2020;31:1320-35. doi:10.1016/j.annonc.2020.07.010

8 Hartmann-Boyce J, Morris E, Goyder C, et al. Diabetes and COVID-19: Risks, management, and learnings from other national disasters. *Diabetes Care* 2020;43:1695-703. doi:10.2337/dc20-1192

9 Anderson RM, Vegvari C, Truscott J, Collyer BS. Challenges in creating herd immunity to SARS-CoV-2 infection by mass vaccination. *Lancet* 2020;396:1614-6. doi:10.1016/S0140-6736(20)32318-7

10 de Martel C, Georges D, Bray F, Ferlay J, Clifford GM. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. *Lancet Glob Health* 2020;8:e180-90. doi:10.1016/S2214-109X(19)30488-7

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Definitions of chronic disease need to be more patient centred

Early, small abnormal changes should be defined as disease only if there are effective interventions that can make an important difference to patients, argue **Zu-Yao Yang** and **Jin-Ling Tang**

The proposal for new diagnostic criteria for hypertension in November 2022 caused heated debate in China. The recommendations, from a guideline group of leading Chinese clinicians,[1] followed changes to the American hypertension guideline in 2017 to reduce the cut-off blood pressure for diagnosing hypertension from 140/90 mm Hg to 130/80 mm Hg.[2] Adoption of this new diagnostic cut-off value for the Chinese population would have created around 350 million new patients with hypertension and increase the total number with the diagnosis by 130%.[3] The new recommendation quickly caused intense nationwide debates, and the National Health Commission finally said no to it.[4]

The controversy over the diagnostic criteria of hypertension, which has also occurred for other non-communicable diseases, raises a fundamental question for medicine: what should count as a chronic disease? Historically, disease was known as sickness or illness, which is defined and diagnosed according to symptoms and signs and is in essence the patient's current experience of their health. In some sense, it is patients who decide what a disease is. This has all been changed since medicine started coupling with modern science and technology.

Expanded definitions

Over the past few decades, physiological, biochemical, histological, and imaging technologies have greatly extended our ability to "see" within the body. This led to the discovery that disease begins with small changes at the cellular, molecular, biochemical, or physiological level and that symptoms and signs become apparent only later, when these changes are sufficiently severe. As a result, the definition of disease has been considerably expanded. Today, more and more diseases are defined at a cellular, molecular, biochemical, physiological, and structural level and can exist independent of patients' current experience. This is particularly true for chronic diseases. For example, diabetes mellitus is defined biochemically according to the blood sugar concentration, cancer histologically according to the morphological structure of cells, and hypertension physiologically according to blood pressure.

Traditionally, these early abnormalities are considered risk factors for future diseases and real symptoms—for example, hypertension is a risk factor for cardiovascular events. A large, long term follow-up study in China estimated the lifetime risk of cardiovascular disease in patients with hypertension (blood pressure ≥140/90 mm Hg) was 26%, 12% higher than that in normotensive people,[5] implying that 86% of patients with hypertension will not develop a cardiovascular event in their lifetime. Similarly, the small mortality:incidence ratio of thyroid cancer and prostate cancer detected in screening programmes implies that most patients who have early stage cancer detected will not eventually die from the cancer.[6 7] Thus, early stage cancer could also be viewed as a risk factor for symptomatic disease and death.

What is an appropriate threshold for diagnosis?

The probabilistic relation between a risk factor and the risk of future disease raises a second important question: how far from normal values should a risk factor or a probability of disease be considered and treated as a real disease? For hypertension, the core issue is the cut-off blood pressure for diagnosis, but there are similar decisions for other chronic diseases. Diagnosis of conditions such as hyperlipidaemia, type 2 diabetes, renal failure, coronary artery disease, and aortic aneurysm, for example, all rely on an "arbitrary" cut-off value. Cancer is not exempt from this problem, although it is less conspicuous. The diagnostic cut-off value in the size of cancer is seldom debated but is being pushed down by the fast progress in imaging and histological technologies, and any "visible" cancer is clinically diagnosed as cancer. What cut-off value should be used?

Some may argue that any increased risk of future disease should be medically diagnosed and corrected. However, a small change in a diagnostic cut-off value will create massive numbers of new patients, and interventions in these patients are often of small benefit or ineffective. For example, changes to the cut-off values for diagnosing hypertension, hyperlipidaemia, and diabetes in China around the beginning of the century doubled the total number of patients and created 359 million new patients between 2002 and 2009.[8] If all these new patients had been treated with drugs of average price in 2010, it would have consumed 56% of the government's total health expenditure of ¥480bn in that year.[8] It is simply not affordable. Furthermore, prescribing antihypertensive drugs, for example, in these new cases can prevent only two out of 100 patients from developing a major cardiovascular event within five years, whereas 98 patients have to pay the cost, bear the risk of harms, but have no benefits.[9]

To make the situation worse, the spectrum of chronic disease can be, and in fact has already been, further expanded by applying different (eg, diabetes) or more sensitive methods (eg, cancer) or by creating pre-disease conditions (eg, diabetes). However, randomised controlled trials show that cancer screening programmes, treatment of early hypertension, comprehensive cardiovascular screening, and general health checks often have small or no benefits,[10-15] suggesting that many efforts targeted at early, small abnormalities or risk factors are futile. This raises questions about the value of unchecked expansion of technology based diagnoses of diseases in terms of patient care.

Effect on patients

Another important consequence of defining an abnormal test or examination result as disease is that patients will lose, and in fact have often already lost, their say in whether they are sick, whether they need a treatment, and whether the treatment is

effective. This loss is of no small matter. As a result, their health and rights cannot be adequately protected partly because of the competing interests of other stakeholders in the business of healthcare. Furthermore, interventions cannot make patients truly satisfied if they cannot sense what is wrong with their body and the benefit of interventions on it. Lastly, making small abnormal changes a disease may also increase overdiagnoses, cause health inequity,[16 17] and compromise care quality and safety. Even the best evidence based policies will fail if clinicians do not have sufficient time to follow them, not to say the unsubstantiated recommendations, as clinicians have already been overloaded.[18 19]

It is now evident that disease is not a black and white entity and ever earlier or smaller forms always exist. Undoubtedly, health technology will continue to advance so that in the future we can see even smaller changes in the body. Early detection and treatment are certainly beneficial for many diseases. The question is whether we should make a small abnormality a disease for which early diagnosis has little or no benefit and how much further we should go in this direction. Given the widely existent overdiagnosis and ever increasing health expenditure, we argue, for the purpose of patient care that is medicine's fundamental goal, we should rethink the way we define chronic diseases and make early, small abnormal changes a disease only if there are effective interventions that can make a clinical difference that is worthwhile to patients. To this end, the interventions' absolute benefit and cost effectiveness in the newly labelled patients should be highly emphasised and carefully evaluated before changing a diagnostic cut-off point or modifying a disease definition.

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Zu-Yao Yang,[1] assistant professor

Jin-Ling Tang,[2,3] professor

[1]JC School of Public Health and Primary Care, Chinese University of Hong Kong, Hong Kong, China

[2]Shenzhen University of Advanced Technology, Shenzhen, Guangdong Province, China

[3]Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

Correspondence to: J_L Tang tangjinling@suat-sz.edu.cn

1 National Center for Cardiovascular DiseasesChinese Medical Doctor AssociationHypertension Committee of the Chinese Medical Doctor AssociationChinese Society of CardiologyChinese Medical AssociationHypertension Committee of CrossStraits Medicine Exchange Association. Clinical practice guidelines for the management of hypertension in China. *Zhonghua Xin Xue Guan Bing Za Zhi* 2022;50:1050-95.

2 Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Hypertension* 2018;71:1269-324. doi:10.1161/HYP.0000000000000066

3 Jiao Y, Sun Z, Xie Y, et al. Potential impacts of the 2017 American College of Cardiology/American Heart Association high blood pressure guideline on Chinese adults and how to address them. *BMC Cardiovasc Disord* 2020;20:237. doi:10.1186/s12872-020-01523-z

4 The National Health Commission of China. We have not changed the diagnostic criteria for hypertension. Health China. 15 Nov 2022. https://mp.weixin.qq.com/s/FNT_FY8f_zymnQnly7j1fg

5 Peng X, Jin C, Song Q, Wu S, Cai J. Stage 1 hypertension and the 10-year and lifetime risk of cardiovascular disease: a prospective real-world study. *J Am Heart Assoc* 2023;12:e028762. doi:10.1161/JAHA.122.028762

6 Welch HG, Black WC. Overdiagnosis in cancer. *J Natl Cancer Inst* 2010;102:605-13. doi:10.1093/jnci/djq099

7 Martin RM, Donovan JL, Turner EL, et al,CAP Trial Group. Effect of a low-intensity PSA-based screening intervention on prostate cancer mortality: the CAP randomized clinical trial. *JAMA* 2018;319:883-95. doi:10.1001/jama.2018.0154

8 Hu XF, Han XR, Yang ZY, Hu YH, Tang JL. [The impact of broadened diagnostic criteria on the prevalence of hypertension, hyperlipidemia and diabetes mellitus in China]. *Zhonghua Yu Fang Yi Xue Za Zhi* 2017;51:369-77.

9 Blood Pressure Lowering Treatment Trialists' Collaboration. Pharmacological blood pressure lowering for primary and secondary prevention of cardiovascular disease across different levels of blood pressure: an individual participant-level data meta-analysis. *Lancet* 2021;397:1625-36. doi:10.1016/S0140-6736(21)00590-0

10 Saquib N, Saquib J, Ioannidis JPA. Does screening for disease save lives in asymptomatic adults? Systematic review of meta-analyses and randomized trials. *Int J Epidemiol* 2015;44:264-77. doi:10.1093/ije/dyu140

11 Menon U, Gentry-Maharaj A, Burnell M, et al. Ovarian cancer population screening and mortality after long-term follow-up in the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS): a randomised controlled trial. *Lancet* 2021;397:2182-93. doi:10.1016/S0140-6736(21)00731-5

12 Bretthauer M, Løberg M, Wieszczy P, et al, NordICC Study Group. Effect of colonoscopy screening on risks of colorectal cancer and related death. *N Engl J Med* 2022;387:1547-56. doi:10.1056/NEJMoa2208375

13 Brunström M, Carlberg B. Association of blood pressure lowering with mortality and cardiovascular disease across blood pressure levels: a systematic review and meta-analysis. *JAMA Intern Med* 2018;178:28-36. doi:10.1001/jamainternmed.2017.6015

14 Lindholt JS, Søgaard R, Rasmussen LM, et al. Five-year outcomes of the Danish cardiovascular screening (DANCAVAS) trial. *N Engl J Med* 2022;387:1385-94. doi:10.1056/NEJMoa2208681

15 Krogsbøll LT, Jørgensen KJ, Grønhøj Larsen C, Gøtzsche PC. General health checks in adults for reducing morbidity and mortality from disease: Cochrane systematic review and meta-analysis. *BMJ* 2012;345:e7191. doi:10.1136/bmj.e7191

16 Le Couteur DG, Doust J, Creasey H, Brayne C. Political drive to screen for pre-dementia: not evidence based and ignores the harms of diagnosis. *BMJ* 2013;347:f5125. doi:10.1136/bmj.f5125

17 Albarqouni L, Arab-Zozani M, Abukmail E, et al. Overdiagnosis and overuse of diagnostic and screening tests in low-income and middle-income countries: a scoping review. *BMJ Glob Health* 2022;7:e008696. doi:10.1136/bmjgh-2022-008696

18 Johansson M, Guyatt G, Montori V. Guidelines should consider clinicians' time needed to treat. *BMJ* 2023;380:e072953. doi:10.1136/bmj-2022-072953

19 Albarqouni L, Montori V, Jørgensen KJ, Ringsten M, Bulbeck H, Johansson M. Applying the time needed to treat to NICE guidelines on lifestyle interventions. *BMJ Evid Based Med* 2023;28:354-5. doi:10.1136/bmjebm-2022-112225

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