Original Article

Construction of the health risk assessment index system for assessing the chronic diseases based on the general health

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Abstract

Aims: This study aimed to construct a standardized health risk assessment index system (HRAIS) under the guidance of general health and facilitate the family doctors to carry out chronic disease management. **Methods:** Available chronic disease surveillance systems and indexes were reviewed to identify potential indexes. The Delphi method was performed to establish the HRAIS, and the analytic hierarchy process was used to calculate the index weight. **Results:** HRAIS included four first-level indexes and 38 second-level indexes. The authority coefficient was 0.86. The Kendall's W for the two rounds of Delphi consultation were 0.202 and 0.210 ($p < 0.001$). The weights of the first-level indexes from high to low were physiological health (0.409), psychosocial health (0.290), health-related behaviors (0.205), and environment (0.097). Thus, HRAIS is a multi-dimension and multi-index tool, which can be used as a guideline for family doctors in early screening, early intervention, and classified management of main chronic diseases.

Keywords: Chronic diseases, family doctors, general health, health risk assessment, index system

Introduction

Health is a key element to a prosperous society. In the National Conference on Sanitation and Health in China, the concept of general health was put forward for the first time, which emphasized that the whole society must establish the awareness of the comprehensive health, including physical, psychological, environmental, and moral health, and health in social adaptation.[1] General health is a comprehensive development concept proposed in line with the development of history, reflecting the country's concern for people's health. Currently, main chronic diseases including cardiovascular disease, cancer, diabetes, and chronic respiratory diseases constitute serious threats to human health. Moreover, with the increasing aging population, the impact of chronic diseases on people's health and social economy will further expand. Thus, it is an urgent problem for family doctors (FDs) in the community to monitor the risk factors of chronic diseases and facilitate the primary medical care in China.

In China, FDs could fulfill the gatekeeper duty in the community and play an important role in the prevention and control of chronic diseases.[2-4] Family doctor contract services are essentially the extension and development of community health services based on the services for general practitioners. By signing the contract, the contracted residents are provided with continuous and comprehensive health accountability management.[5]

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However, the uneven distribution of health resources, the low trust of residents in community medical institutions, and the imperfection of relevant policies also seriously restrict the development of community health management in China.[6] Moreover, residents show great reluctance to sign with FDs. One major reason is that contract services lack appeal to residents.[7] Therefore, with the development of family doctor contract services, more services should be provided to meet the growing health needs of residents.

In China, FDs mainly use health records for disease monitoring and health assessment. However, there still exist some problems in health records. For example, some records are either incomplete or untrue or non-standard. Especially, there is a lack of data on risk factors related to chronic diseases.[8,9] Therefore, FDs lack a standardized assessment tool to monitor and evaluate the risk factors of chronic diseases, and it is difficult for them to develop personalized diagnosis and treatment plans for patients.[9]

Although health risk assessment in foreign countries has been gradually improved, because of racial and geographical differences, the direct use of foreign research results may lead to large deviations in China. Therefore, this study aimed to construct a standardized health risk assessment index system (HRAIS) under the guidance of general health so as to provide a guideline for FDs to monitor and evaluate the risk factors related to chronic diseases. On one hand, personalized health risk assessment can enrich the service content and improve the service level of contracted services. On the other hand, it can provide the evidence for early screening, early intervention, and classified management of main chronic diseases among contracted residents.

Methods

In order to construct such a health risk assessment instrument, we undertook a literature review and sought expert consultations. The Delphi method and the analytical hierarchy process (AHP) method were used. The flowchart of the study process is shown in Figure 1.

Literature source and retrieval method

Available health indexes and chronic disease surveillance systems were reviewed to identify potential indexes and evaluation methods. We searched PubMed, MEDLINE, and China National Knowledge Infrastructure databases for eligible studies published from May 2010 to March 2019. Search terms included "chronic noncommunicable disease", "chronic disease", "health indexes", "family doctor contract services", "health assessment", and "health risk assessment". The index selection criteria were as follows: 1) the index was directly relevant to chronic disease prevention and control; 2) the index measuring and data collecting should be convenient and feasible; 3) the index must be consistent with the prioritized areas and priorities of government work.

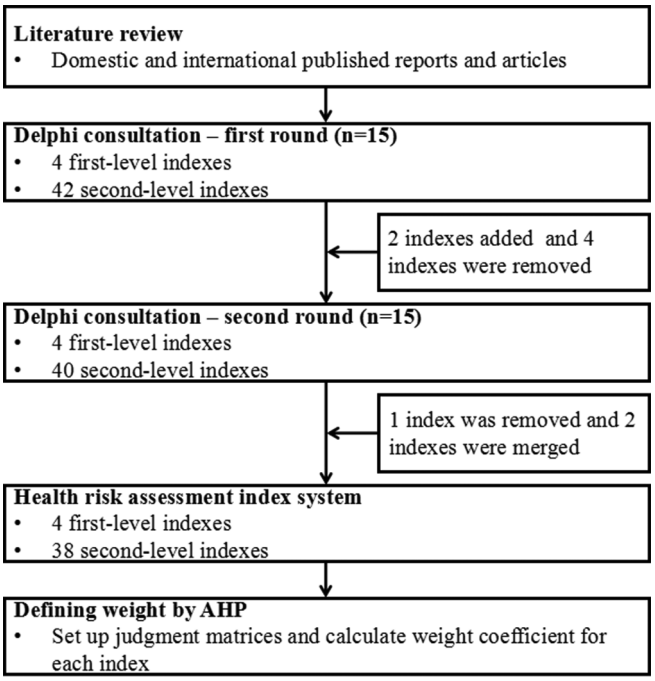

Figure 1: Flowchart of the study process

General health requires health workers to "provide full-cycle health services in an all-round way for people". Based on this concept, we designed a framework of four first-level indexes. The four first-level indexes were physiological health, psychosocial health, health-related behaviors, and environment.

Delphi consultation process

We performed the Delphi method and collected the experts' opinions and suggestions for the index system.[10] First, experts were asked to appraise each index according to the questionnaire, which included three parts: instructions, text content, and general information of experts. The instructions described the purpose and background of this study.

Then, we determined the indexes and their evaluation methods through two rounds of the Delphi method, from May to July 2019. Studies have shown that 10 to 18 experts can ensure adequate contributions.[11,12] Therefore, we invited 15 experts as consultants from medical colleges, centers for disease control and prevention, and medical institutions. The selection criteria for experts were as follows: 1) they should be familiar with the connotation of family doctor contract services; 2) they should be engaged in the fields related to chronic diseases; 3) they should at least possess an intermediate professional title; 4) they should be interested in this study or active in supporting it.

We calculated the mean, standard deviation (SD), and coefficient of variation (CV) for each index. These indexes were screened and modified based on experts' opinions and consensus on the importance of the index, and the index was removed if its CV was ≥0.3.[13] The modified indexes after the first-round consultation were sent to the experts along with the second-round

questionnaire. The Delphi consultation was finished if the experts' authority coefficient (Cr) and the Kendall coefficient of concordance (or Kendall's W) met all the requirements. Cr represented the authority of experts, which was expressed by the mean of the familiarity degree coefficient (Cs) and the judgment basis coefficient (Ca). The formula for the expert authority coefficient was Cr = (Ca + CS)/2. Cr ≥0.7 indicated a high degree of authority among experts. The Kendall's W was used to evaluate the concordance of the responses of experts. SPSS 20.0 (IBM, Armonk, New York, USA) was used for the statistical analysis.

AHP method

We adopted the AHP to determine the weight for each index.[14] First of all, based on the results of the second round of Delphi consultation, the hierarchical structure model was constructed. Then, pairwise comparisons were performed to calculate the relative value of each index and to draw a judgment matrix. In calculating the weights, the elements of each column in a consistent paired comparison matrix were processed through normalization. Finally, the logic of judgment was checked by calculating the consistency of the judgment matrix. The eigenvalue method proposed by Saaty was used to evaluate the weight.[15] Generally, if the random consistency ratio (CR) was less than 0.1, the judgment matrix was regarded as consistent, and the weight coefficient was thought to meet logic consistency. The results were analyzed using YAAHP software.

Results

Development of a framework for the index system

We established the HRAIS including four first-level indexes: physiological health, psychosocial health, health-related behaviors, and environment. We collected the data of the risk factors related to chronic diseases through questionnaire survey, physical measurements, and biochemical detection. Because of the fact that there were no recognized questionnaires for certain indexes, data collection was based on self-reports of residents. Finally, through literature reviews, we selected a total of 42 indexes including evaluation methods and initially developed a framework for the index system.

Delphi expert consultation

This study consulted 15 experts from medical colleges, medical institutions, and centers for disease control and prevention. Of the experts, 93.3% hold senior professional titles. The mean age of them was 50.6 ± 7.7 (range: 35–66) years; the mean working duration was 22.5 ± 8.1 (range: 3–33) years. The experts discussed the significance and feasibility of 42 indexes as well as the evaluation methods. At the end of the expert consultation, the recovery rate of the two rounds of questionnaires was 100%.

Based on the experts' self-assessment scores, the expert authority coefficient of Delphi was 0.86 (CS for 0.825, CA for 0.89). It showed that the experts were familiar with these indexes. The value of Kendall's W represented the degree of expert concordance. In this study, the Kendall's W values of the two rounds were 0.202 and 0.210 [Table 1], indicating that the degree of concordance among the experts was acceptable.

Establishment of the index system

In the first round of Delphi consultation, a total of 42 indexes were assessed. The mean score of the importance of these indexes ranged from 3.60 to 4.73, and the CV ranged from 0.1 to 0.33 [Table 2 and S1]. According to experts' advice, we removed body temperature, skin, and residential floor. We also deleted the light environment because the connotation and measurement were difficult to define. However, we added mental stress and psychological stress because they could affect human health to some extent. We categorized these two indexes into the dimension of health-related behaviors. After the panel discussion, we determined the occupational risks by assessing high-risk occupation protection criteria in residents' self-reports. As a result, 40 indexes and their evaluation methods were retained in the second round.

In the second round of Delphi consultation, the mean score of the index importance ranged from 3.87 to 4.86, and the CV ranged from 0.08 to 0.28 [Table 2 and S1]. Based on the results of the current round of consultation, we deleted the residence types. The reason was that there were not enough empirical studies on residence types and it was difficult to standardize the description of the evaluation criteria. We also combined the mental stress and psychological stress into the subjective stress and used Perceived Stress Scale to measure it. The medication safety was evaluated from four aspects: medication types, storage methods, side effects, and medication adherence. The HRAIS was established after the second round of Delphi consultation. It comprised 38 indexes and their evaluation methods [Table 2 and S1].

AHP results

Based on the results of two rounds of Delphi consultation, we performed AHP to check the consistency of HRAIS and

Table 1: Results of experts' opinion coordination degree

	Index importance Kendall's W	χ^2	*P*
First round	0.202	136.373	<0.001
Second round	0.210	135.424	<0.001

Table 2: Results of two rounds of expert consultation

Index	Index importance					
	First round			Second round		
	Mean	SD	CV	Mean	SD	CV
A Physiological health	4.73	0.46	0.10	4.86	0.50	0.10
B Psychosocial health	4.60	0.63	0.14	4.80	0.40	0.08
C Health-related behaviors	4.60	0.63	0.14	4.73	0.68	0.14
D Environment	4.00	0.85	0.21	4.47	0.72	0.16

SD, standard deviation; CV, coefficient of variation

determine the weight of each index. According to the results of consistency test, the CR values of the first-level indexes and second-level indexes were both less than 0.1, indicating that the judgment matrix met the consistency requirement. In the order of weights from high to low, the four first-level indexes were physiological health (0.409), psychosocial health (0.290), health-related behaviors (0.205), and environment (0.097). The weight for each index is listed in Table S2. Within physiological health, blood pressure (0.0455), blood glucose (0.0414), and heart rate (0.0352) accounted for a large proportion. Within psychosocial health, the weight coefficients of secondary indexes from high to low were cognition (0.0821), depression (0.0453), and anxiety (0.0453). Within health-related behaviors, smoking (0.0387), alcohol drinking (0.0387), and medication safety (0.0387) had a greater weight. Within environment, medical insurance (0.0381) had the greatest weight.

Discussion

This study constructed the HRAIS especially for FDs in primary care activity, which could standardize their behavior for health assessment and supply a publicly available code of conduct. In this study, the expert authority coefficient was more than 0.7, and the Kendall's W values were between 0.202 and 0.210, indicating that the degree of concordance between experts was acceptable. That is to say, the HRAIS constructed in this study is reliable and applicable for FDs' health risk assessment.

According to the HRAIS, FDs should assess the residents from four dimensions: physiological health, psychosocial health, health-related behaviors, and environment.[1] First, of the four first-level indexes, the highest weight one was physiological health (42%), indicating that its importance was approved by experts. It was also in consistence with the high demand of residents for regular physical examinations in China.[16] In terms of physiological health, the weights of blood pressure (0.046), blood glucose (0.041), and glycosylated hemoglobin (0.027) were come out in front. These were the associated factors related to main chronic diseases, reflecting the epidemic trend of high incidence of hypertension, diabetes, and cardio-vascular diseases in China.[17] In addition, obesity, as a chronic metabolic disease, is a risk factor for many chronic diseases.[18,19] Body mass index (BMI) is usually used to judge the degree of obesity.[20] Waist circumference was also used by the China-PAR risk assessment model as an important index for predicting cardio-vascular disease.[21] Therefore, BMI and hip and waist circumference were all included in this study. Previously, obesity rate and abdominal obesity rate were used as metabolic indexes for evaluating cardio-vascular health of the Chinese population.[22] This is in consistence with our study. In short, FDs could appraise the physiological items of residents, according to the HRAIS; thus, they were able to perform the risk assessment comprehensively.

Second, our system included the psychosocial index used to assess the psychological health and social adaptability. The mental health of residents could not be ignored, and FDs should become aware of the influence of psychosocial factors to the general health of residents. In this study, the weight of psychosocial health (0.290) ranked the second, indicating that experts had a high degree of recognition concerning its importance. In this dimension, the index with the highest weight was cognition (0.083). Chronic disease was one of the most important risk factors for cognitive impairment in the elderly. It could damage the blood vessels and nervous system and consequently affected cognitive functions.[23] Cognitive impairment often occurred in the elderly with common chronic diseases such as diabetes and hypertension, which might lead to the decline of the quality of life, the aggravation of depressive symptoms, dementia, and premature death in the elderly.[24] In addition, the weights of anxiety and depression were both 0.051. Previous studies indicated that anxiety and depression could affect the occurrence, prognosis, and development of chronic diseases.[25,26] Meanwhile, chronic diseases could also lead to depression or anxiety.[27] FDs are the initial point of contact for anxiety and depression.[28] In this study, we put forward this dimension, which could help FDs identify the common psychological problems of residents.

Third, this system also focused on health-related behaviors. FDs should encourage people to adopt the healthy lifestyle and healthy environment, thus preventing chronic diseases in primary health care services. The results showed that the weight of health-related behaviors was 0.205. Within this dimension, the weight of alcohol drinking, smoking, and medication safety was 0.040, ranking the first, followed by activities of daily living (0.025), sleep and rest (0.025), dietary nutrition (0.018), and physical activity (0.013). Positive modification in habits (changes in diet and lifestyle) and treatment adherence are essential for the control of chronic diseases.[29] Previous studies found that 80% of heart disease and type 2 diabetes could be avoided by four interventions: tobacco control, salt reduction, dietary intervention, and increased exercise.[30,31] Besides, the International Olympic Committee consensus meeting pointed out that the prevention and management of chronic diseases required the new programs focusing on physical activity, diet, and lifestyle.[32] It was consistent with our study design. In addition, the results in this dimension showed that the weight of medication safety was the highest. Medication safety includes a set of indexes to evaluate the drug-use process, including medication types, storage methods, side effects, and medication adherence.[33] It is common for residents with chronic diseases to take the long-term medication at home. However, there were some problems, such as poor compliance, the occurrence of adverse drug reactions, and improper use of medication and polypharmacy, especially for the elderly.[34,35] Especially, the poor medication compliance was a global problem, and medication compliance among patients with chronic disease in developed countries was only about 50%.[36] Thus, to keep medication safety in the residents, it is a daily duty for FDs to encourage and supervise the rational medication.

Fourth, in the dimension of environment, the occupational exposure (weight 0.026), acoustic environment (weight 0.026), and indoor air environment (weight 0.016) were included. Similarly,[11] we also put forward the housing conditions as an

important index to assess the health of the European population. The difference was that they focused on the dampness and water leakage of the living conditions rather than acoustic and indoor air environments. The possible cause was the diversity of study sites and civilization. Besides, medical insurance accounted for the highest weight (0.044) in the dimension of environment[37] and investigated the medical behaviors of rural patients with diabetes and hypertention in Cambodia. In China, the medical insurance system would influence individuals' health care-seeking behaviors.[38] Therefore, it is vital for FDs to make an optimized treatment plan based on the patients' medical insurance.

This study had three limitations. First, the value of Kendall's W coefficient was not high (0.202–0.210), and it was statistically significant verified by a Chi-squared test. It indicated that the degree of concordance between experts was acceptable, and there was still some degree of inconsistent views on different indexes. Second, the questionnaires were sent to experts by e-mails, instead of a face-to-face consultation. Third, all the experts came from Hebei Province in this study. Thus, the HRAIS cannot be generalized in the whole country. In the future, we would recruit more experts from multiple regions in China to gather more comprehensive suggestions.

In summary, HRAIS is a comprehensive index system designed for FDs to carry out health risk assessment in the community. It contains 38 indexes in four dimensions, which can be used to evaluate chronic diseases and their risk factors from physiological health, psychosocial health, health-related behaviors, and environment. It would help FDs to monitor and assess risk factors associated with chronic diseases and to implement personalized interventions.

Key points

1. Based on the concept of general health, the HRAIS included four first levels: physiological health, psychosocial health, health-related behaviors, and environment.
2. We established the HRAIS through the Delphi method, and it contained 38 indexes and evaluation methods of the indexes.
3. We determined the index weights by the analytic hierarchy process, and the weights of the first-level indexes from high to low were physiological health (0.409), psychosocial health (0.290), health-related behaviors (0.205), and environment (0.097).
4. Our results would help family doctors monitor and assess risk factors associated with chronic diseases, collect health data in an all-round way, and implement personalized interventions.
5. It is recommended that HRAIS would be applied to put the general health into effect and establish the large-scale database of chronic diseases and risk factors.

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Conflicts of interest

There are no conflicts of interest.

References

1. Liu DP. The people jointly build and share the "Massive Health". Chinese Health 2016;10:26-7.
2. Kelly JT, Su G, Zhang L, Qin X, Marshall S, González-Ortiz A, *et al.* Modifiable lifestyle factors for primary prevention of ckd: A systematic review and meta-analysis. J Am Soc Nephrol 2021;32:239-53.
3. Fortin M, Chouinard MC, Bouhali T, Dubois MF, Gagnon C, Bélanger M. Evaluating the integration of chronic disease prevention and management services into primary health care. BMC Health Serv Res 2013;13:132.
4. Mendis S, Johnston SC, Fan W, Oladapo O, Cameron A, Faramawi MF. Cardiovascular risk management and its impact on hypertension control in primary care in low-resource settings: A cluster-randomized trial. Bull World Health Organ 2010;88:412-9.
5. Liu S, Wang L, Zhang T, Liu C, Liang H, Zhang Y, *et al.* Factors affecting the work competency and stability of family doctors in Shanghai: A tracking study. BMC Fam Pract 2019;20:95.
6. Liu HY, Mu, YQ, Feng, ZY. Implications of American managed care on the community-based health management in China. Med Philoso 2015;36:74-7.
7. Li ZY. How to solve the problem of signing instead of contract for family doctor service. Rural Health in China 2019;11:8-10.
8. Xiong J, Lipsitz O, Nasri F, Lui LMW, Gill H, Phan L, *et al.* Impact of COVID-19 pandemic on mental health in the general population: A systematic review. J Affect Disord 2020;277:55-64.
9. Chen YL, Geng JS, Shi LL. Exploration of family doctor's contract services based on electronic health files. Chinese Journal of Medical Library and Information 2017;26:8-12.
10. McKenna HP. The Delphi technique: A worthwhile research approach for nursing? J Adv Nurs 1994;19:1221-5.
11. Sun ZQ. Comprehensive Evaluation Method of Medicine and its Application. Beijing: Chemical Industry Press; 2006.
12. Mullen PM. Delphi: Myths and reality. J Health Organ Manag 2003;17:37-52.
13. Kim M, Jang YC, Lee S. Application of Delphi-AHP methods to select the priorities of WEEE for recycling in a waste management decision-making tool. J Environ Manage 2013;128:941-8.
14. Karayalcin I. The analytic hierarchy process - Planning, priority setting, resource-allocation - SAATY TL. Eur J Oper Res 1982;9:97-8.

15. Saaty TL. How to make a decision: The analytic hierarchy process. Eur J Oper Res 1990;48:9-26.
16. Shang X, Huang Y, Li B, Yang Q, Zhao Y, Wang W, *et al.* Residents' awareness of family doctor contract services, status of contract with a family doctor, and contract service needs in Zhejiang Province, China: A cross-sectional study. Int J Environ Res Public Health 2019;16:3312.
17. Zeng XY, Li YC, Liu SW, Wang LJ, Liu YN, Liu JM, *et al.* [Subnational analysis of probability of premature mortality caused by four main non-communicable diseases in China during 1990-2015 and " Health China 2030" reduction target]. Zhonghua Yu Fang Yi Xue Za Zhi 2017;51:209-14.
18. Janssen I, Katzmarzyk PT, Ross R. Waist circumference and not body mass index explains obesity-related health risk. Am J Clin Nutr 2004;79:379-84.
19. Bendor CD, Bardugo A, Pinhas-Hamiel O, Afek A, Twig G. Cardiovascular morbidity, diabetes and cancer risk among children and adolescents with severe obesity. Cardiovasc Diabetol 2020;19:79.
20. Feng RN, Zhao C, Wang C, Niu YC, Li K, Guo FC, *et al.* BMI is strongly associated with hypertension, and waist circumference is strongly associated with type 2 diabetes and dyslipidemia, in northern Chinese adults. J Epidemiol 2012;22:317-23.
21. Yang X, Li J, Hu D, Chen J, Li Y, Huang J, *et al.* Predicting the 10-year risks of atherosclerotic cardiovascular disease in Chinese population: The China-PAR project (Prediction for ASCVD Risk in China). Circulation 2016;134:1430-40.
22. Jiang Y, Mao F, Li Y, Liu J, Zhang Y, Jiang Y, *et al.* Construction of China cardiovascular health index. BMC Public Health 2018;18:937.
23. Li W, Sun L, Xiao S. Prevalence, incidence, influence factors, and cognitive characteristics of amnestic mild cognitive impairment among older adult: A 1-year follow-up study in China. Front Psychiatry 2020;11:75.
24. Lyu J, Burr JA. Socioeconomic status across the life course and cognitive function among older adults: An examination of the latency, pathways, and accumulation hypotheses. J Aging Health 2016;28:40-67.
25. Pumar MI, Gray CR, Walsh JR, Yang IA, Rolls TA, Ward DL. Anxiety and depression-important psychological comorbidities of COPD. J Thorac Dis 2014;6:1615-31.
26. Liu RH, Pan JQ, Tang XE, Li B, Liu SF, Ma WL. The role of immune abnormality in depression and cardiovascular disease. J Geriatr Cardiol 2017;14:703-10.
27. Jiang CH, Zhu F, Qin TT. Relationships between chronic diseases and depression among middle-aged and elderly people in China: A prospective study from CHARLS. Curr Med Sci 2020;40:858-70.
28. Craven MA, Bland R. Depression in primary care: Current and future challenges. Can J Psychiatry 2013;58:442-8.
29. Pisano González MM, González Pisano A. [Modifying habits and treatment adherence, essential for controlling the chronic disease]. Enferm Clin 2014;24:59-66.
30. Asaria P, Chisholm D, Mathers C, Ezzati M, Beaglehole R. Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. Lancet 2007;370:2044-53.
31. Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, *et al.* Priority actions for the non-communicable disease crisis. Lancet 2011;377:1438-47.
32. Matheson GO, Klügl M, Engebretsen L, Bendiksen F, Blair SN, Börjesson M, *et al.* Prevention and management of non-communicable disease: The IOC consensus statement, Lausanne 2013. Sports medicine (Auckland, NZ) 2013;43:1075-88.
33. Ascione FJ, Kirscht JP, Shimp LA. An assessment of different components of patient medication knowledge. Med Care 1986;24:1018-28.
34. Chan FW, Wong FY, So WY, Kung K, Wong CK. How much do elders with chronic conditions know about their medications? BMC Geriatr 2013;13:59.
35. Liang CB, Zhong, SE, Wang, ZT. Analysis on the current situation and influencing factors of safe drug use in the families of residents in a town of Dongguan City. J Nurs 2013;20:28-31.
36. Burkhart PV, Sabaté E. Adherence to long-term therapies: Evidence for action. J Nurs Scholarsh 2003;35:207.
37. Bigdeli M, Jacobs B, Men CR, Nilsen K, Van Damme W, Dujardin B. Access to treatment for diabetes and hypertension in rural Cambodia: Performance of existing social health protection schemes. PLoS One 2016;11:e0146147.
38. Jin Y, Yuan B, Zhu W, Zhang Y, Xu L, Meng Q. The interaction effect of health insurance reimbursement and health workforce on health care-seeking behaviour in China. Int J Health Plann Manage 2019;34:900-11.

Table S1: Results of two rounds of expert consultation

Index	Index importance					
	First round			Second round		
	Mean	SD	CV	Mean	SD	CV
A1Body temperature†	4.00	1.20	0.30	NA	NA	NA
A2 Pulse	4.27	0.80	0.19	4.66	0.60	0.13
A3 Respiration	4.20	0.94	0.22	4.53	0.62	0.14
A4 Blood Pressure	4.73	0.46	0.10	4.80	0.54	0.11
A5 Pain	4.47	0.64	0.14	4.47	0.62	0.14
A6 Heart rate	4.47	0.64	0.14	4.67	0.60	0.13
A7 Vital capacity	4.00	1.07	0.27	4.07	1.12	0.28
A8 BMI	4.60	0.63	0.14	4.40	0.80	0.18
A9 Waist	4.47	0.64	0.14	4.13	0.72	0.17
A10 Hip circumference	4.33	0.72	0.17	3.87	0.88	0.23
A11 Defecation	4.20	1.01	0.24	4.40	0.61	0.14
A12 Glycated hemoglobin	4.60	0.51	0.11	4.60	0.61	0.13
A13 Blood sugar	4.73	0.46	0.10	4.73	0.57	0.12
A14 Hyperuricemia	4.40	0.51	0.12	4.47	0.72	0.16
A15 Homocysteine	4.40	0.63	0.14	4.40	0.71	0.16
A16 Blood lipid	4.67	0.49	0.10	4.60	0.61	0.13
A17 Serum calcium	4.13	0.83	0.20	4.13	0.72	0.17
A18 Red blood cell count	4.13	0.83	0.20	4.13	0.88	0.21
A19 White blood cell count	4.00	0.93	0.23	4.07	0.93	0.23
A20 Bone density	4.33	0.82	0.19	4.07	0.85	0.21
A21 Skin†	3.73	1.22	0.33	NA	NA	NA
A22 Eyesight	4.47	0.64	0.14	4.07	0.85	0.21
B1 Cognition	4.67	0.82	0.18	4.80	0.40	0.08
B2 Depression	4.53	0.83	0.18	4.67	0.47	0.10
B3 Anxiety	4.53	0.83	0.18	4.67	0.47	0.10
B4 Life events	4.40	0.99	0.23	4.60	0.49	0.11
B5 Social support	4.47	0.74	0.17	4.67	0.47	0.10
B6 Mental stress‡,§	NA	NA	NA	4.67	0.47	0.10
B7 Psychological stress‡	NA	NA	NA	4.67	0.47	0.10
C1 Physical activity	4.40	0.74	0.17	4.47	0.62	0.14
C2 Dietary nutrition	4.53	0.52	0.11	4.53	0.62	0.14
C3 Alcohol drinking	4.53	0.52	0.11	4.73	0.57	0.12
C4 Smoking	4.53	0.52	0.11	4.73	0.57	0.12
C5 Sleep and rest	4.47	0.64	0.14	4.67	0.60	0.13
C6 Medication safety	4.73	0.46	0.10	4.73	0.57	0.12
C7 Gait and balance	4.47	0.83	0.19	4.40	0.61	0.14
C8 Activities of daily living	4.60	0.83	0.19	4.67	0.60	0.13
D1 Residence type§	3.67	0.98	0.27	4.00	0.89	0.22
D2 Residential floor†	3.60	1.12	0.31	NA	NA	NA
D3Acoustic environment	3.93	0.88	0.22	4.40	0.61	0.14
D4 Light environment†	3.93	0.88	0.22	NA	NA	NA
D5 Indoor air environment	3.87	0.83	0.21	4.33	0.70	0.16
D6 Occupational Exposure	3.93	1.03	0.26	4.40	0.71	0.16
D7 Medical security	4.27	0.88	0.20	4.47	0.62	0.14

NA, not assessed. SD, standard deviation; CV, coefficient of variation. †indexes deleted in the first round; ‡indexes added in the first round; §indexes deleted in the second round

Table S2: Final indexes and weight of each index

First-level index and weight	Second-level index	Assessment method or content	Weight
Physiological health (0.409)	Pulse	Physical examination	0.035
	Respiration	Physical examination	0.023
	Blood Pressure	Physical examination	0.046
	Pain	*Numeric rating scale*	0.020
	Heart rate	Physical examination	0.035
	Vital capacity	Physical examination	0.007
	BMI	BMI=weight (kg)/height $(m)^2$	0.013
	Waist circumference	Physical examination	0.007
	Hip circumference	Physical examination	0.013
	Defecation	Self-report whether you often find it difficult to defecate or defecate less than three times a week	0.017
	Glycated hemoglobin	Laboratory examination	0.027
	Blood glucose	Laboratory examination	0.041
	Hyperuricemia	Laboratory examination	0.020
	Homocysteine	Laboratory examination	0.017
	Blood lipid	Laboratory examination	0.027
	Serum calcium	Laboratory examination	0.010
	Red blood cell count	Laboratory examination	0.010
	White blood cell count	Laboratory examination	0.008
	Bone density	Laboratory examination	0.008
	Eyesight	*Standard logarithmic visual acuity chart*	0.008
Psychosocial health (0.290)	Cognition	*The Montreal Cognitive Assessment*	0.083
	Depression	*Self-rating depression scale*	0.051
	Anxiety	*Self-rating Anxiety Scale*	0.051
	Life events	*Life Event Scale*	0.029
	Social support	*Social support revalued scale*	0.051
	Psychological stress	*Perceived Stress Scale*	0.029
Health-related behaviors (0.205)	Physical activity	*Chinese adult physical activity guidelines*	0.013
	Dietary nutrition	*Food frequency questionnaire*	0.018
	Alcohol drinking†	Self-reported behaviors of drinking types, drinking frequency, drinking volume and harmful drinking	0.040
	Smoking‡	Self-reported behaviors of smoking history, current smoking status and passive smoking status	0.040
	Sleep and rest	*Pittsburgh sleep quality index*	0.025
	Medication safety	Self-reported knowledge of medication types, storage, side effects, and the behavior of medication compliance	0.040
	Gait and balance	*Tinetti scale*	0.010
	Activities of daily living	*Activity of Daily Living Scale*	0.025
Environment (0.097)	Acoustic environment	Self-reported degree of noise disturbance	0.026
	Indoor air environment	Self-reported status of room ventilation, household fuel and kitchen smoke exhaust equipment	0.016
	Occupational exposure	Self-report whether protective measures for high-risk occupations are adequate	0.026
	Medical security	Self-reported types of participation in medicare, such as medical insurance, new rural cooperative medical care, free medical care, commercial insurance and not participating	0.044

Physical examination and laboratory examination refer to the examination items carried out by hospitals or physical examination centers, with or without clinical diagnostic significance as the evaluation criteria. In the questionnaire survey, we preferred mature and effective measurement tools at home and abroad, which were expressed in italics text. For another part of the index, we used a self-designed questionnaire to describe the specific content of risk assessment. †Alcohol drinking was assessed in four ways: (1) frequency of drinking, (2) alcohol consumed, (3) drinking types and (4) harmful drinking. Harmful drinking refers to the number of days in which men drank more than 5 standard drinking units at a single time in the past 12 months, and women drank more than 4 standard drinking units at a single time. ‡Smoking was assessed in three ways: (1) daily smokers report the number of cigarettes smoked every day; other smokers report the average amount of smoking in a week, (2) the age when one started smoking and the age when one started smoking every day and (3) days of exposure to secondhand smoke per week.