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Study on Medical Care-Seeking Behaviors and Chronic Comorbidities Based on the Ecology of the Medical Care Model

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Abstract:

Objective: To describe medical care-seeking behaviors using the ecology of the medical care model and analyze the association between comorbidities and various types of healthcare-seeking behaviors, providing theoretical evidence for the rational allocation of medical care resources. *Methods:* A cross-sectional survey was conducted among residents aged 20 and above from Fangshan District of Beijing and Wuyuan County of Jiangxi Province using multistage stratified sampling between July and September 2023. Descriptive analysis was performed based on the ecology of the medical care model, calculating medical care-seeking behaviors per 1,000 people per month and constructing a medical care ecology diagram. Multivariate logistic regression analysis was used to explore the relationship between comorbidities and medical care-seeking behaviors. *Results:* Valid questionnaires were collected from 6,004 participants (female: 56.4%, mean age 50.4 ± 14.7 years). Per 1,000 people per month, approximately 382 reported discomfort or injury, 162 visited medical institutions for outpatient care (61 visited primary care institutions, 47 visited tertiary hospitals), 62 self-medicated, 10 were hospitalized, five visited emergency departments, four underwent surgical procedures, and one received remote medical care. About 31.9% of participants reported having comorbidities, and their proportion of seeking medical care was higher than those without comorbidities or with single diseases. Multivariate logistic regression analysis showed that compared to individuals without chronic diseases, those with one chronic disease or multiple comorbidities had a higher likelihood of seeking medical care [(OR = 1.67, 95% CI: 1.38–2.02) and (OR = 3.40, 95% CI: 2.83–4.08)], and their likelihood of hospitalization was also higher [(OR = 2.60, 95% CI: 2.04–3.32) and (OR = 5.17, 95% CI: 4.10–6.51)]. *Conclusion:* Among the population with potential healthcare needs, less than half seek medical care, and those with chronic comorbidities have a higher proportion of seeking medical care. Research in the field of population medicine is needed to strengthen coordination and effective healthcare for people with comorbidities at various levels of institutions, thereby reducing unmet health needs.

Keywords:

Ecology of medical care model
Chronic comorbidities
Population medicine
Medical care-seeking behavior
Primary healthcare

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1. Introduction

With the aging of the population and changes in the disease spectrum, the coexistence of multiple diseases has become increasingly common. The World Health Organization defines comorbidity as the presence of two or more chronic health conditions in the same individual that require long-term care [1]. Comorbidity poses significant challenges to both individual health and the healthcare system. Systematic reviews have shown that comorbidity leads to higher medical costs and is associated with increased utilization of primary care resources, emergency department visits, and hospital stays [2]. In mainland China, differences in economic development levels and types of medical insurance measures across administrative regions result in non-negligible inequalities in accessing inpatient and outpatient medical services for patients with chronic comorbidities [3,4]. Currently, medical care is primarily focused on single diseases, and a care model specifically tailored to comorbidity has not been established. This leads to the duplication of limited health resources, resulting in inefficient or even ineffective medical care.

In 1961, White systematically proposed the concept of "medical care ecology," a model that describes the relationships between people's health status, health service utilization, and medical resources within a community [5]. Medical care ecology provides an innovative perspective that combines population-based analysis with individual-centered methods to study the demand and supply of health services. The model also offers a calculation method and visualization tool to reflect the stepwise decrease in health service access and utilization by describing the proportion of individuals using different levels of medical services within a specific period and plotting multiple grids. As an important research tool for implementing the concept of population medicine in the future, it helps researchers and policymakers understand the unmet health needs of the population. Over the past decade, research teams from countries such as Korea [6], Canada [7], and Japan [8,9] have utilized this model to describe the distribution of local medical resources, explore the diversity of healthcare service utilization among different populations and environments, and illustrate the dynamic changes in health service utilization over time. The model has also been applied to various populations, including pregnant women [10], pilots [11], and older adults [12], to describe their specific utilization of health resources.

Currently, although some studies have explored the utilization of health resources among patients with comorbidities, no research has comprehensively evaluated their medical care-seeking behaviors using the medical care ecology model. This study aims to apply the medical care ecology model to describe the medical care-seeking behaviors of patients with chronic comorbidities in two study areas (Fangshan District of Beijing and Wuyuan County of Jiangxi Province) and compare the differences in the utilization of medical and health resources at various levels between patients with single diseases and those with comorbidities. The findings of this study will contribute to understanding the gaps in medical care management and prevention of chronic comorbidities in China and provide an evidence base for improving the rational allocation of healthcare resources.

2. Methods and materials

2.1. Study subjects

This study is a cross-sectional survey conducted in Fangshan District of Beijing (urban area) and Wuyuan County of Jiangxi Province (rural area) from July to September 2023. A multistage stratified sampling method was adopted. In the first stage, about four to six townships or streets were randomly selected at each study site based on population size and village quantity. In the second stage, considering factors such as geography, economic level, and population size, about three to six rural villages or urban communities were randomly selected from the chosen townships or streets. In the third stage, 120 participants were drawn from each community or village. Eligible participants were: (1) Chinese citizens aged 20 and above; (2) Residing in the selected community or village for at least six months per year; (3) Willing to participate and provide informed consent. Exclusion criteria included severe disabilities and cognitive impairments preventing participation. The study was promoted through village posters, invitations, and social media groups by local community members, resulting in a total of 6,300 residents participating, with 6,004 finally included.

The study was approved by the Biomedical Research

Ethics Committee of the Chinese Academy of Medical Sciences and Peking Union Medical College (Approval No.: CAMS&PUMC-IEC-2022-076). All participants provided written informed consent before participation.

2.2. Measurement and data collection

Face-to-face surveys were conducted by trained interviewers using tablet computers. The questionnaire covered basic demographic information, lifestyle, chronic disease history, and healthcare service utilization.

2.2.1. Medical care ecology hierarchy definition and measurement

Based on multiple foreign healthcare ecology models and referencing studies like the National Health Service Survey and community healthcare habits, the healthcare ecology hierarchy was adjusted to include six major categories and 11 levels, covering: (1) reported symptoms; (2) medical visits; (3) self-medication; (4) remote healthcare; (5) hospital stays; (6) surgical procedures.

2.2.2. Chronic disease comorbidity

Interviewers asked participants if they had been told by a doctor at a district-level or higher hospital that they had any of 39 chronic diseases significantly affecting the Chinese population or other diseases (open-ended question), and about the diagnosis time. Following the World Health Organization's definition, individuals with two or more chronic diseases were defined as having comorbidities.

2.2.3. Covariates selected in this study

This included gender, age, marital status, education level, household registration type, work type, and medical insurance type.

2.3. Quality control

Multiple quality control methods were used, including (1) two-day training for interviewers on questionnaire content and interviewing skills; (2) an electronic questionnaire system with built-in real-time logic error checking; (3) quality assessment of some interviews through recording reviews.

2.4. Statistical methods

IBM SPSS for Windows (V27.0) was used for statistical analysis. Descriptive analysis was conducted based on the adjusted medical care ecology model. The number of individuals fitting each hierarchy level was calculated per 1,000 people per month. Differences in healthcare behaviors between comorbid and non-comorbid populations were analyzed. Logistic regression was used to explore the relationship between chronic disease status and healthcare behaviors, controlling for variables like age, gender, etc.

3. Results

3.1. Basic characteristics of survey participants

A total of 6,300 participants were recruited, with 6,004 included in the analysis, resulting in a 95.3% effective response rate. The average age was 50.4 ± 14.7 years, with 35.3% aged 50–64. 56.4% were female, 68.7% had an education level of junior high school or below, and 36.5% were non-labor force members. The medical insurance coverage rate was 98.6%, with 70.3% having urban and rural resident insurance. Regarding chronic diseases, 38.3% reported being healthy (no chronic diseases), 29.8% had one chronic disease, and 31.9% had comorbidities (two or more chronic diseases), as presented in **Table 1**.

3.2. Medical care ecology characteristics of survey subjects

Among all survey participants, approximately 382 people per 1,000 reported symptoms (at least one instance of discomfort, illness, or injury) each month, 162 visited a medical institution (including 61 who visited primary care institutions), 62 self-administered medication, 47 visited outpatient clinics at tertiary hospitals, 25 visited traditional Chinese medicine hospitals, 10 were hospitalized (including three in tertiary hospitals), five visited emergency departments, four underwent surgical procedures, and one received remote medical care. **Figure 1** illustrates the medical care ecology of the survey population.

3.3. Comparison of medical care-seeking behaviors based on the number of chronic diseases

Figure 2 shows the medical care behaviors of populations

Table 1. Basic information of survey population aged 20 and above (n = 6,004)

Basic characteristics		Number of people	Constituent ratio (%)
Gender	Male	2617	43.6
	Female	3387	56.4
Age (years)	20~34	1070	17.8
	35~49	1708	28.4
	50~64	2118	35.3
	≥ 65	1108	18.5
Marital status	Unmarried	445	7.4
	Married	5018	83.6
	Divorced or widowed	541	9.0
Household registration type	Agricultural household registration	4215	70.2
	Non-agricultural household registration	1789	29.8
Work type	Agricultural production and support personnel	841	14.0
	Social production or service personnel	1801	30.0
	Public or professional technical personnel	1179	19.5
	Non-labor force personnel	2191	36.5
Medical insurance	Urban and rural resident medical insurance	4222	70.3
	Urban employee medical insurance	1604	26.7
	Public health insurance	47	0.8
Education level	Primary school and below	1757	29.3
	Junior high school	1765	29.4
	High school or technical secondary school	1134	18.9
	University or above	1348	22.4
Insurance	Other insurance	45	0.7
	No insurance	86	1.4
Number of chronic diseases	0	2299	38.3
	1	1790	29.8
	≥ 2	1915	31.9

with and without comorbid chronic diseases. The study found that compared to the non-comorbid population, the comorbid population had higher rates of seeking medical care (at primary care facilities, tertiary hospitals, and traditional Chinese medicine hospitals), self-medication, emergency visits, hospitalizations, and surgical treatments. The differences were particularly significant in terms of visits to medical institutions, outpatient visits and hospitalizations at tertiary hospitals, and surgical treatments, with the rates for the comorbid population being more than double those for the non-comorbid population.

3.4. Utilization of health services by patients with different numbers of chronic diseases

The results of multivariate logistic regression analysis showed that after adjusting for other demographic and social factors, the comorbid population had a higher

likelihood of seeking medical care compared to those who were not ill or had only one disease. The likelihood of reporting symptoms was 1.26 times (95% CI: 1.10–1.45) and 2.48 times (95% CI: 2.16–2.86) higher for those with one disease and the comorbid population, respectively, compared to those without diagnosed chronic diseases. The likelihood of visiting a medical institution was 1.67 times (95% CI: 1.38–2.02) and 3.40 times (95% CI: 2.83–4.08) higher, and the corresponding likelihood of hospitalization was 2.60 times (95% CI: 2.04–3.32) and 5.17 times (95% CI: 4.10–6.51) higher, respectively. There were no significant differences in visits to primary care facilities and self-medication between patients with a single disease and those without chronic diseases, but the likelihood of seeking medical care and self-medication increased significantly for the comorbid population ($P < 0.01$). **Table 2** shows the details.

4. Discussion and conclusion

Based on the medical care ecosystem model, this study analyzed the monthly reported symptoms and medical care-seeking behaviors per 1,000 individuals in the survey population. The study found that 382 individuals per 1,000 reported symptoms each month, reflecting potential health needs. Compared to previous research, this proportion is slightly lower than the summary analysis of studies from developing countries (506 individuals) [13,14] and significantly lower than studies conducted in developed countries such as Japan (794 individuals) [9], South Korea (763 individuals) [6], and Belgium (763 individuals) [15]. This study included both urban and rural areas, and the self-reported symptoms were also lower than those reported in a study conducted in Shanghai, China [16].

The study also revealed that the proportion of individuals seeking medical care at primary healthcare institutions per 1,000 was 6.1%, which is only slightly higher than the proportion seeking outpatient care at tertiary hospitals (4.7%). This ratio differs somewhat from previous review studies [14] examining both developed and developing countries, reflecting the relatively weak primary healthcare and the heavy burden on emergency and inpatient care at tertiary hospitals in China's healthcare ecosystem. Previous research has also identified issues such as the current lag in the primary healthcare system, unsatisfied high demand for health among patients, and low trust in China's primary healthcare institutions [17]. This study innovatively included new types of healthcare such as remote medical services, but only one individual per 1,000 reported using remote medical services, indicating that the implementation and utilization of such models still need to be explored post-pandemic.

Among the survey population, over 30% (31.9%) of individuals aged 20 and above were found to have multiple chronic conditions. Although this study included self-reported data on 39 diseases, which is a relatively

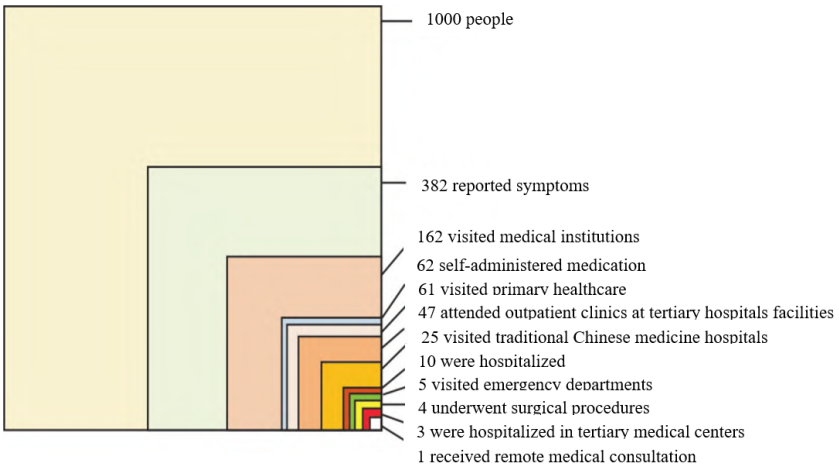

Figure 1. The ecology of medical care per 1,000 participants per month. Note: This framework uses a calculation unit of 1,000 people per month, and there is no explicit inclusive relationship between each framework.

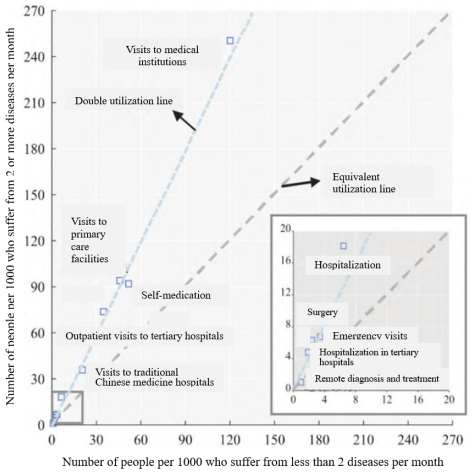

Figure 2. Medical care-seeking behavior by number of chronic diseases

Table 2. Multivariate logistic regression analysis of the association between the number of chronic diseases and health symptoms and medical care-seeking behaviors

Characteristics	Adjusted OR (95% CI)						
	Reported symptoms	Medical care-seeking behaviors	Visited primary medical institutions	Visited outpatient clinics in tertiary hospitals	Self-medication	Hospitalization behavior	Surgical treatment
Number of chronic diseases							
0	1	1	1	1	1	1	1
1	1.26[b] (1.10~1.45)	1.67[a] (1.38~2.02)	1.31 (0.97~1.76)	1.42[c] (1.01~2.01)	1.30 (0.97~1.72)	2.60[a] (2.04~3.32)	2.61[a] (1.78~3.84)
≥ 2	2.48[a] (2.16~2.86)	3.40 (2.83~4.08)	2.39[a] (1.80~3.17)	3.24[a] (2.37~4.45)	1.81[b] (1.38 ~2.39)	5.17[a] (4.10~6.51)	4.49[a] (3.13~6.46)
Covariates: Age(years)							
20~34	1	1	1	1	1	1	1
35~49	0.78[b] (0.65~0.92)	0.86 (0.70~1.06)	0.52[a] (0.36~0.77)	0.74 (0.52~1.05)	1.56[c] (1.01~2.42)	0.80 (0.58~1.10)	0.95 (0.65~1.40)
50~64	0.65[a] (0.54~0.78)	1.00 (0.82~1.21)	0.62[c] (0.41~0.93)	0.79 (0.57~1.09)	2.11[b] (1.32~3.38)	0.75 (0.54~1.04)	1.10 (0.76~1.58)
≥ 65	0.78[c] (0.62~0.98)	1.06 (0.85 ~1.32)	0.68 (0.43~1.09)	0.85 (0.58~1.24)	3.01[a] (1.77~5.13)	0.82 (0.56 ~1.19)	1.29 (0.86~1.92)
Gender							
Male	1	1	1	1	1	1	1
Female	1.34[a] (1.20~1.50)	1.26[b] (1.09 ~1.46)	0.99 (0.80~1.23)	1.60[a] (1.23~2.07)	1.12 (0.91~1.38)	1.07 (0.91~1.25)	1.09 (0.85~1.39)
Marital status							
Unmarried	1	1	1	1	1	1	1
Married	0.87 (0.71~1.06)	1.31 (0.98~1.74)	1.73 (0.99~3.00)	0.89 (0.57~1.38)	0.79 (0.46 ~1.37)	1.42 (0.89~2.25)	1.55 (0.88~2.74)
Divorced or widowed	1.16 (0.90~1.50)	1.35 (0.95 ~1.93)	1.68 (0.87~3.22)	1.04 (0.59 ~1.82)	1.10 (0.59 ~2.06)	1.37 (0.81~2.34)	1.75 (0.89 ~3.43)
Education level							
Primary school or below	1	1	1	1	1	1	1
Junior high school	0.95 (0.82~1.10)	1.22[c] (1.01~1.49)	1.07 (0.81~1.42)	1.76[b] (1.17~2.64)	1.75[a] (1.30~2.36)	0.74[b] (0.60~0.92)	1.06 (0.78~1.45)
High school or technical secondary school	1.08 (0.91~1.28)	1.27[c] (1.01~1.60)	1.02 (0.73~1.42)	1.95[b] (1.25 ~3.03)	1.52[c] (1.06~2.19)	0.76[c] (0.58 ~0.98)	0.90 (0.66~1.24)
University or above	1.40[c] (1.08~1.83)	1.54[b] (1.19~2.00)	0.72 (0.47~1.11)	2.65[a] (1.64~4.28)	2.14[a] (1.38~3.32)	0.67 (0.42 ~1.06)	0.62 (0.36~1.08)
Type of household registration							
Agricultural account	1	1	1	1	1	1	1
Non-agricultural account	1.07 (0.95~1.20)	1.11 (0.93~1.33)	0.90 (0.70~1.14)	1.79[a] (1.33~2.41)	1.21 (0.92~1.58)	0.89 (0.75~1.06)	1.15 (0.88~1.49)
Type of work							
Agricultural production and auxiliary personnel	1	1	1	1	1	1	1
Social production or service staff	0.86 (0.71~1.04)	1.07 (0.83~1.37)	0.87 (0.60~1.27)	0.79 (0.47~1.33)	0.71 (0.49~1.01)	1.01 (0.77~1.32)	0.97 (0.66~1.41)

Table 2 (Continued)

Characteristics	Adjusted OR (95% CI)						
	Reported symptoms	Medical care-seeking behaviors	Visited primary medical institutions	Visited outpatient clinics in tertiary hospitals	Self-medication	Hospitalization behavior	Surgical treatment
Public or professional technical staff	0.85 (0.67~1.08)	1.12 (0.82~1.53)	1.42 (0.92~2.19)	0.90 (0.50~1.61)	0.54[b] (0.35~0.85)	1.09 (0.75~1.58)	0.78 (0.49~1.22)
Non-labor personnel	0.88 (0.73~1.07)	1.15 (0.91~1.46)	1.03 (0.75~1.42)	1.16 (0.69~1.94)	0.72[c] (0.52 ~0.99)	1.07 (0.85~1.35)	0.87 (0.61~1.25)
Medical insurance							
Medical insurance for urban and rural residents	1	1	1	1	1	1	1
Medical insurance for urban employees	1.07 (0.93~1.24)	1.41[a] (1.16~1.71)	0.88 (0.69~1.12)	2.45[a] (1.78~3.34)	1.94[a] (1.47 ~2.58)	0.84 (0.67~1.05)	0.91 (0.68 ~1.21)
Free medical services	0.90 (0.49~1.67)	1.46 (0.70~3.03)	0.99 (0.31~3.22)	1.54 (0.46~5.21)	0.79 (0.19~3.34)	1.39 (0.59 ~3.26)	1.44 (0.44~4.68)
Other insurance	0.40[c] (0.19~0.84)	1.08 (0.47~2.48)	0.33 (0.05~2.41)	3.48[c] (1.30 ~9.34)	1.22 (0.37~4.05)	1.70 (0.76 ~3.80)	2.06 (0.73~5.81)
Uninsured	1.19 (0.76~1.86)	1.06 (0.55~2.04)	0.35 (0.09 ~1.42)	2.21 (0.86~5.71)	1.31 (0.52~3.31)	0.60 (0.24~1.53)	0.25 (0.03~1.79)

Note: [a]$P < 0.001$, [b]$P < 0.01$, [c]$P < 0.05$.

high number compared to other studies, the prevalence of comorbidity was slightly lower than that reported in community-based studies in mainland China (36.3%) [18], and the average level in low- and middle-income countries (36%) [19]. It was also lower than the self-reported prevalence of comorbidity among adults in high-income countries (44.3%) [20]. The lower self-reported prevalence may be related to disease awareness and health consciousness in relatively disadvantaged areas.

The study found significant differences in medical care-seeking behaviors at various levels of the medical care ecosystem between individuals with and without comorbidity. Specifically, those with comorbidity had a significantly higher likelihood of seeking care at primary healthcare institutions, outpatient clinics at tertiary hospitals, and being hospitalized. These findings align with previous research [8,21] and highlight the increased healthcare needs of individuals with comorbidity, who require multi-level and multi-type healthcare. Comorbidity is closely associated with increased utilization of outpatient and inpatient medical services. Previous studies have also shown that comorbidity can lead to catastrophic health expenditures, resulting in issues such as polypharmacy and repeated medical visits [22], posing significant challenges to the healthcare system.

With increasing life expectancy and the expected rise in comorbidity rates, there is a need for more extensive healthcare resources and a more comprehensive three-tiered medical service system to provide accessible, efficient, and integrated medical care to meet the health needs of individuals with comorbidity.

This study demonstrates innovativeness by considering the characteristics of China's healthcare system and conducting a hierarchical evaluation of multi-level and emerging healthcare models [23], based on previous research on the healthcare ecosystem. It covers a broader and more comprehensive healthcare environment, more realistically reflecting the current situation of China's healthcare ecosystem. Furthermore, this study explores the relationship between comorbidity and medical care-seeking behaviors at various levels, providing valuable insights into the situation and proportions of healthy individuals, those with comorbidity, and those receiving medical care. This helps to understand how limited medical resources can better meet substantial health needs and provides theoretical evidence for evaluating health policy objectives.

The study has some potential limitations. Firstly, the survey questionnaire set different recall periods for the

past month and the past 12 months to help participants better recall their medical care-seeking behaviors. However, the results may still be affected by recall bias, and the data was primarily collected from July to September. The shorter recall period may not fully reflect seasonal differences in healthcare-seeking behaviors. Additionally, this study adopted a cross-sectional design, and while some covariates were controlled, it was not possible to exclude all potential factors that could influence medical care-seeking behaviors. Therefore, the study can only explore correlations. Furthermore, the reasons for differences in medical care-seeking patterns between patients with and without comorbidity cannot be fully revealed, and further research is needed to explore the underlying reasons and provide support for forming policy recommendations.

The findings of this study fully reflect the fact that patients with healthcare needs do not always seek care at medical institutions. This also highlights the potentially unmet health needs of the population beyond those who actively seek medical care, as emphasized by the population health perspective [24]. With the aging of the population and changes in the disease spectrum, comorbidity will bring more health needs and utilization of health services. Governments and relevant departments need to further improve the healthcare ecosystem, strengthen the capabilities of primary healthcare institutions, and form an integrated care model across different levels of medical institutions to effectively and actively respond to the new demands and challenges posed by comorbidity to the health system.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] World Health Organization, 2016, Technical Series on Safer Primary Care: Multimorbidity, March 17, 2024, https://www.who.int/publications/i/item/9789241511650

[2] Soley-Bori M, Ashworth M, Bisquera A, et al., 2021, Impact of Multimorbidity on Healthcare Costs and Utilization: A Systematic Review of the UK Literature. The British Journal of General Practice, 71(702): e39–e46.

[3] Cai C, Xiong S, Millett C, et al., 2023, Health and Health System Impacts of China's Comprehensive Primary Health Care Reforms: A Systematic Review. Health Policy and Planning, 38(9): 1064–1078.

[4] Ahn S, Bartmess M, Lindley LC, 2022, Multimorbidity and Healthcare Utilization among Black Americans: A Cross-Sectional Study. Nursing Open, 9(2): 959–965.

[5] White KL, Williams TF, Greenberg BG, 1961, The Ecology of Medical Care. The New England Journal of Medicine, 265: 885–892.

[6] Lee J, Choi YJ, Ryu DH, 2022, The Ecology of Medical Care in Korea: The Association of a Regular Doctor and Medical Care Utilization. BMC Health Services Research, 22(1): 1423.

[7] Stewart M, Ryan B, 2015, Ecology of Health Care in Canada. Canadian Family Physician, 61(5): 449–453.

[8] Aoki T, Matsushima M, 2022, The Ecology of Medical Care During the COVID-19 Pandemic in Japan: A Nationwide

Survey. Journal of General Internal Medicine, 37(5): 1211–1217.

[9] Fukui T, Rahman M, Ohde S, et al., 2017, Reassessing the Ecology of Medical Care in Japan. Journal of Community Health, 42(5): 935–941.

[10] Chang CP, Chou CL, Chou YC, et al., 2014, The Ecology of Gynecological Care for Women. International Journal of Environmental Research and Public Health, 11(8): 7669–7677.

[11] Gordon B, Levy Y, Yemini T, et al., 2016, The Ecology of Medical Care Among Israeli Military Aviators. Aerospace Medicine and Human Performance, 87(12): 1036–1040.

[12] Kaneko M, Shimizu S, Kuroki M, et al., 2022, Ecology of Medical Care for 90+ Individuals: An Exhaustive Cross-Sectional Survey in an Aging City. Geriatrics & Gerontology International, 22(6): 483–489.

[13] Shao S, Zhao F, Wang J, et al., 2013, The Ecology of Medical Care in Beijing. PLoS One, 8(12): e82446.

[14] Zhang ZY, Wang ZZ, Zhang J, et al., 2024, Current Status and Implications of the Ecology of Medical Care Model in Health Service Research: A Scoping Review. Chinese General Practice, 27(4): 391–399.

[15] Vo TL, Duchesnes C, Vögeli O, et al., 2015, The Ecology of Health Care in a Belgian Area. Acta Clinica Belgica, 70(4): 280–286.

[16] Xiong XC, Cao XL, Luo L, 2021, The Ecology of Medical Care in Shanghai. BMC Health Services Research, 21(1): 51.

[17] Li LQ, Zhu LY, Zhou XG, et al., 2022, Patients' Trust and Associated Factors Among Primary Care Institutions in China: A Cross-Sectional Study. BMC Primary Care, 23(1): 109.

[18] He L, Zhang YF, Shen XC, et al., 2023, Prevalence Trends of Multimorbidity Among Residents in Mainland China: A Meta-Analysis. Chinese General Practice, 26(29): 3599–3607.

[19] Asogwa OA, Boateng D, Marzà-Florensa A, et al., 2022, Multimorbidity of Non-Communicable Diseases in Low-Income and Middle-Income Countries: A Systematic Review and Meta-Analysis. BMJ Open, 12(1): e049133.

[20] Ho ISS, Azcoaga-Lorenzo A, Akbari A, et al., 2022, Variation in the Estimated Prevalence of Multimorbidity: Systematic Review and Meta-Analysis of 193 International Studies. BMJ Open, 12(4): e057017.

[21] Zhang ZY, Yuan MQ, Shi KL, et al., 2023, Association Between Multimorbidity Trajectories, Healthcare Utilization, and Health Expenditures Among Middle-Aged and Older Adults: China Health and Retirement Longitudinal Study. Journal of Affective Disorders, 330: 24–32.

[22] van Oostrom SH, Picavet HS, de Bruin SI, et al., 2014, Multimorbidity of Chronic Diseases and Health Care Utilization in General Practice. BMC Family Practice, 15: 61.

[23] Lv Q, Jiang YT, Qi J, et al., 2019, Using Mobile Apps for Health Management: A New Health Care Mode in China. JMII Health and Uhealth, 7(6): e10299.

[24] Wang C, Chen S, Shan G, et al., 2022, Strengthening Population Medicine to Promote Public Health. Chinese Medical Journal, 135(10): 1135–1137.