The Association Between Frequency of Internet Use and Co-occurring Healthcare Needs among Chinese Residents: A Cross-sectional Study

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Table of Contents

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Abstract

Background: The need for healthcare is the basis of healthcare service provision, as well as the core of service capacity enhancement and resource allocation. Healthcare needs can be affected by health, social and economic conditions and exhibit different characteristics at different time periods. However, previous studies focused merely on a certain group of people or type of need and ignored the diversity and complexity of the healthcare needs of residents. Moreover, with informatisation being a major feature of current social development, whether Internet utilisation can affect the co-occurrence of healthcare needs remains unclear.

Objective: This study aims to determine the co-occurrence of healthcare needs among residents in China, to explore the relationship between Internet use frequency and co-occurring healthcare needs (CHNs) and analyse the potential pathways of influence.

Methods: The data were acquired from the ‘Survey on Chinese Residents’ Health Services Needs in the New Era’, conducted from July to August 2018, which yielded a sample of 12,513 individuals. An association rule learning algorithm was used to analyse the characteristics of the CHNs of the Chinese residents, and a generalised linear model was deployed to investigate the relationship between Internet use frequency and CHNs. Furthermore, a path analysis model was employed to investigate the mediating role of health literacy and health status in the aforementioned relationship.

Results: A substantial proportion (68.74%) of the surveyed population had two or more CHNs, with the rural residents having a lower percentage (66.83%) compared with the urban residents (70.53%). The residents who used the Internet frequently tended to have numerous CHNs (? = 0.895, SE = 0.019, P < .001, 95% CI [0.857–0.934]). Results indicated a positive relationship between Internet use frequency and improved health literacy (? = 0.121, SE = 0.011, P < .001) and health status (? = 0.026, SE = 0.049, P < .001). Notably, a high level of health literacy was associated with increased CHNs (? = 0.087, SE = 0.054, P < .001). By contrast, a notable negative correlation was observed between health status and CHNs (? = -0.787, SE = -0.213, P < .001), which indicated that CHNs decreased as health status improved.

Conclusions: The findings can serve as a reminder for health policymakers and healthcare providers to focus on evolving healthcare needs and the impact of information technology on such needs in the current era. Healthcare providers must adjust their services and service delivery methods to meet the CHNs of residents. Meanwhile, policymakers and service managers should ensure the keeping pace of service delivery with changing needs through resource allocation, health insurance payment reforms and performance incentives. Clinical Trial: The questionnaire design and study protocol were approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology (# IORG0003571).

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Abstract

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Results: A substantial proportion (68.74%) of the surveyed population had two or more CHNs, with

the rural residents having a lower percentage (66.83%) compared with the urban residents (70.53%). The residents who used the Internet frequently tended to have numerous CHNs (β = 0.895, SE = 0.019, P < .001, 95% CI [0.857–0.934]). Results indicated a positive relationship between Internet use frequency and improved health literacy (β = 0.121, SE = 0.011, P < .001) and health status (β = 0.026, SE = 0.049, P < .001). Notably, a high level of health literacy was associated with increased CHNs (β = 0.087, SE = 0.054, P < .001). By contrast, a notable negative correlation was observed between health status and CHNs (β = -0.787, SE = -0.213, P < .001), which indicated that CHNs decreased as health status improved.

Conclusions: The findings can serve as a reminder for health policymakers and healthcare providers to focus on evolving healthcare needs and the impact of information technology on such needs in the current era. Healthcare providers must adjust their services and service delivery methods to meet the CHNs of residents. Meanwhile, policymakers and service managers should ensure the keeping pace of service delivery with changing needs through resource allocation, health insurance payment reforms and performance incentives.

Keywords: Internet use; Co-occurring healthcare needs; Health literacy; Health status; Chinese residents

Introduction

Chinese residents' changing healthcare needs and imbalance in supply and demand

Meeting the healthcare needs of the population is the basis of a country or a region for not only promoting the effective use of medical resources to ensure the reasonable supply of services [1] but also optimising the health level of the population and enhancing social welfare [Error: Reference source not found]. With the development of the social economy and improvements in living standards, the healthcare needs of residents have undergone structural changes that have led to increased diversity and complexity in CHNs [3, 4]. In this research, the concept of co-occurring needs is defined as 'multiple healthcare needs that exist simultaneously in an individual' [5], such as myopia treatment, healthy lifestyle guidance and psychological disorder relief for adolescents and chronic disease management, traditional Chinese medicine and home-based care for the elderly. However, current service provision is unable to match the diversity of needs and tends to concentrate on single aspects, especially medical services in large hospitals. The co-occurring needs of residents, such as health guidance and disease prevention, are not being met, and the corresponding service providers are lagging behind in their development of such services. The findings indicate that

existing service supply systems may not have the capacity to cater to the diverse healthcare requirements of residents in this new era [6]. The imbalance between service supply and demand has become a widespread problem, which can be attributed to our lack of understanding and appreciation of residents' healthcare service needs and healthcare providers and health policymakers, which represent the health resource users and distributors. The investment of substantial resources has yet to be effectively translated into services needed by residents, which can lead to the wastage of valuable health resources and contribute to the reduced accessibility of other necessary services [7]. Healthcare resource distribution and service provision between urban and rural areas and primary institutions and hospitals are uneven, and the imbalance between healthcare service supply and demand has become prominent in China. According to statistical data, though the total government investment in primary health institutions increased by 800.8% from 2008 to 2017, the share of primary care has been declining, and the bed utilisation rate of township health centres was only 61.3% in 2017 [8]. The data indicate that government input resources are not being effectively transformed into outputs to meet the healthcare needs of residents. Therefore, in the context of the 'Healthy China Strategy', the significant changes in residents' healthcare needs should be addressed, research should be conducted on the co-occurrence structure of healthcare needs and the current situation and influencing factors in the new era should be examined. The findings could serve as a useful reference for the development of healthcare service package policies in China to address the healthcare service needs of residents and strike a balance between healthcare service supply and demand.

Internet use and healthcare needs

In the integration of Internet technology into the healthcare domain, the Internet has significantly transformed the life habits and health status of residents in various ways [9, 10]. According to the 51st Statistical Report on China's Internet Development released by the China Internet Network Information Center (CNNIC), the number of Chinese Internet users reached 1.067 billion, with an Internet penetration rate of 75.6%, in December 2022, and showed a year-on-year growth trend [11]. Owing to the rapid development of information technology, the Internet has become an important channel through which residents can obtain knowledge. Based on a report by CNNIC, the number of Chinese online medical service users has surged to 298 million, with a year-on-year increase of 38.7%. This growth rate has made online medical services the fastest-growing service category in terms of usage as of December 2021 [12]. The popularity of the Internet has enabled it to break through traditional healthcare service supply modes and expand how residents access healthcare services. Specifically, the Internet may have increased residents' healthcare needs but also enabled

them to meet such needs by browsing online medical consultation, telemedicine and hospital websites [13]. At the same time, the information technology diffusion functionality of the Internet has shaped health concepts and residents' behaviours by facilitating information dissemination [14, 15]. Such information diffusion has led to the emergence of varying healthcare needs and demands among residents with different levels of Internet usage, which may result in residents requiring differing types of healthcare services.

Previous studies revealed that the Internet has the potential to expand individual needs and drive the evolution of the needs structure [16], including the needs of the elderly, maternal and adolescent populations. A study demonstrated that older adults are using the Internet to access health information from various platforms, which is primarily driven by the convenience and cost effectiveness of such resources. This trend has contributed to the increasing demand for healthcare services, such as preventive care, Chinese medicine provision and lifestyle guidance [17]. Furthermore, Internet usage was found to increase demand for outpatient services and the volume of doctor visits among older adults [18, 19]. Studies on the healthcare needs of maternal residents observed that Internet applications play a vital role in meeting the healthcare needs of the population [20], and the powerful information retrieval capabilities of Internet technology have increased the need for online access to maternal healthcare services in 89% of pregnant women [21]. For the chronic disease population, such as diabetic patients, Internet usage can reduce the need for outpatient services [22]. Other factors, such as demographic characteristics, socioeconomic status and the accessibility of services, have also been found to influence different populations' healthcare needs [23, 24]. However, current research on healthcare needs typically focuses on one aspect of the needs of a particular population and ignores the co-occurrence of multiple healthcare needs across the population. Furthermore, the extent to which Internet use can affect CHNs and the mechanism of the association between Internet use and CHNs have yet to be explored deeply.

Health literacy and health status as mediators

Potential pathways that link Internet use to CHNs may be health literacy and health status. Health literacy refers to an individual's ability to access and utilise basic health information and services effectively to maintain and enhance their overall health [25], which includes health knowledge, healthy lifestyle and behaviour and preventive literacy. Health literacy and health status have been proven to be important factors that can influence residents' healthcare needs. For example, the more frequent the participation in physical exercise of an individual, the higher their health literacy and the greater their need for traditional Chinese medicine specialty health management services [26, 27]. Compared with residents who do not engage in physical exercise, residents who regularly engage in

physical exercise may have a higher need for outpatient and mental health services [28, 29]. However, some studies found that the lower the health level, the greater the need for mental health services [30]. Meanwhile, the relationship between Internet use and health level has been examined extensively. Previous research confirmed that the Internet can provide easy access to health-related knowledge and information [31], which can enable residents to optimise their health input mix, improve their physical health in a targeted manner and enhance their health self-management ability [32, 33]. Internet technology can also enable individuals who need medical services to obtain superior treatment outcomes and health outputs [34]. However, some studies argued that excessive Internet use can contribute to the development of unhealthy behaviours and ultimately have a negative impact on an individual's health [35, 36]. Most studies on the relationship between the Internet and health focused on whether or not individuals use the Internet to access health information or services. However, a gap remains in the literature regarding the influence of the frequency of Internet use on health. In addition, whether health literacy and health status are mediating variables in the relationship between Internet use frequency and CHNs remains unclear.

Research objectives and hypotheses

To fill the gaps in the literature, we use survey data from four counties/districts in China to examine residents' CHNs in the context of the information age. Our study aims to explore the relationship between Internet use frequency and CHNs among Chinese residents and whether health literacy and health status moderate the relationship. We hypothesise that the more frequent the Internet use, the higher the incidence of CHNs among the residents. Furthermore, we expect the association to be mediated by health literacy and health status.

Methods

Study design and sample selection

We retrieved the data for this study from the 'Survey on Chinese Residents' Health Service Needs in the New Era', which was conducted by the Chinese Rural Health Services Research Center from July to August 2018 [37]. The survey considered the socioeconomic and cultural factors, customs and geographic environment of two urban districts and two rural counties, namely, Futian District in Eastern China, Xiling District in Central China, Danyang County in Central China and Sinan County in Western China [38].

We conducted multistage stratified random sampling to obtain a representative sample from each district/county and data from four levels: district (county), street (township), community (village) and household. Firstly, we selected five streets that were in close proximity to the district medical

centre from each district, then randomly selected five townships that were in close proximity to the county hospital from each county, which yielded a total of 10 streets and 10 townships. Secondly, we randomly selected six communities from each street and six villages from each township, based on their proximity to the village clinic, which led to the inclusion of 30 communities and 30 villages in our study. Thirdly, by referring to the Fifth National Health Service Survey of China in 2013 [39], we set the prevalence of chronic diseases in the whole population to 21.338%, the design effect to 2.5% and the confidence level to 95% to obtain a minimum sample size of 3,583 residents for each of the surveyed areas. In China, a household is composed of around three members [40]; thus, we planned to survey 1,200 households in each community and village. In the case of the residents' refusal to participate in the survey or invalid responses, we conducted resampling to survey other households to ensure that the final sample size met the estimated requirements. We surveyed all the members of the sampled households through face-to-face interviews and a questionnaire survey.

The survey strictly controlled the onsite research process and required us to confirm that the responding members of a sampled household included the head of the family, and half of the adult population of the household was present before starting the household survey. Otherwise, we set another appointment or selected an alternative household. At the operational level, the self-response rate of the survey was 74%, which indicated a reliable representation of the individuals and their healthcare needs. We carefully monitored the self-response rate of the questionnaire to ensure its accuracy. We double entered the survey data by using EpiData 3.1 and conducted multiple rounds of cleaning. After further screening, based on the study design, we obtained a final sample of 5,547 households and 15,126 respondents. In our research, we screened the individuals aged 15 years or older, and after eliminating the invalid sample individuals and those with missing responses, we obtained a total sample of 12,513 valid respondents.

Ethical considerations

The questionnaire design and study protocol were approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology (# IORG0003571). The research content and procedures conform to national and state biomedical ethical requirements. All the participants gave their written informed consent after fully understanding the study content and results. Participation was voluntary and uncompensated, and all the study data were kept confidential.

Variables

Explained variable

In this study, the outcome variable was CHE. We recorded all the residents' self-reported healthcare service needs, which covered a wide range of categories, from routine medical needs (e.g. outpatient services) to population-specific needs (e.g. elderly and maternal population and children), to ensure that our study fully captured the healthcare needs of different groups. We measured the residents' healthcare needs by selecting questions from the questionnaire, that is, 'Do you need outpatient services within two weeks?' 'Do you need traditional Chinese medicine?' 'Do you need inpatient services?' 'Do you need health guidance?' 'Do you need physical exercise guidance?' 'Do you need mental health services?' 'Do you need network health information services?' 'Do you need elderly health management services?' 'Do you need chronic disease management services?' 'Do you need rehabilitation services?' 'Do you need maternal health management services?' and 'Do you need child health management services?' The answer to each of the 12 questions was either 'yes', which takes the value of 1, or 'no', which takes the value of 0. We summed all the values to measure the total number of CHNs, and the larger the value, the more the CHNs of the Chinese residents.

Explanatory variable

In this research, the explanatory variable was Internet use frequency. We selected the question 'How often do you use the Internet to obtain health information (including computer and smartphone)?' to measure the variable. We asked the participants to indicate their Internet use frequency by choosing one of three responses: 'never', 'occasionally', or 'frequently'. We categorised the responses into three groups, in which 1 and 3 represented low and high Internet use frequency, respectively.

Mediating variables

In this study, the mediating variables were health literacy and health status. Firstly, we selected the question 'How many times do you exercise in a week?' to measure health literacy. We categorised health literacy into three groups based on the average number of times the respondents participated in physical exercise per week. According to the literature [41], individuals who exercise 2 times a week or fewer can be classified into the low-level group, those who exercise 3–6 times a week can be classified into the medium-level group and those who exercise 7 times a week or more can be classified into the high-level group. Secondly, we measured health status by using the individuals' health evaluation of their mobility, self-care, usual activities, pain/discomfort and anxiety/depression. We calculated the time trade-off based on the EuroQol Five Dimensions Questionnaire index scores

to measure the respondents' health status.

Control variables

By referring to the literature [20, 23], we included other factors that may impact the CHNs of the residents in the analysis, such as their demographic and socioeconomic attributes. For the demographic characteristics, we used the respondents' gender, age, marital status, education level and household registration as the covariates. For the socioeconomic characteristics, we used the respondents' employment status, income level, family type, health insurance availment and access to services to analyse the factors that may influence their CHNs. We categorised income level into five groups based on the average annual income of the respondents: low income (less than RMB 20,000), lower middle income (RMB 20,000–50,000), middle income (RMB 50,000–100,000), upper middle income (RMB 100,000–150,000) and high income (over RMB 150,000). The details of the variables are presented in Table 1.

Table 1. Coding of variables

Variable Name	Variable definition	Attribute
Explained variable		
Co-occurring healthcare needs	Number of health services required by an individual at the same time.	Numerical values, ranging from 1 to 11.
Explanatory variables		
Frequency of internet use	The frequency of individuals accessing health information through internet ways including computer and cell phone.	1=rarely used, 2=occasionally used, 3=frequently used.
Mediating variables		
Health literacy	The calculation was based on the average frequency of physical exercise peer week in the last 30 days.	1=low-level, 2=moderate-level, 3=high-level.
Health status	The EQ-5D TTO value obtained by comprehensive calculation.	1=low-level, 2=moderate-level, 3=high-level.
Control variables		
Gender	Participant's gender.	0=female, 1=male.
Age	Participant's age (range over 15).	1=15-44 years, 2=45-64 years, 3=65 years and above.
Marital status	The spouse status of participant.	0=without spouse, 1= with spouse.
Education level	The education level of participant.	1=uneducated, 2=primary education, 3=secondary education, 4=higher education, 5=postgraduate and above.
Household registration	The household registration type of participant.	0=rural, 1=urban
Employment status	Participant's employment status	1=unemployed, 2=schooled, 3=retired, 4=employed.
Income level	Average annual income of individuals.	1=low-income, 2=lower middle-income, 3=middle-income, 4=upper middle-income, 5=high-income.
Family type	Whether participant's family was certified poor by the government.	0=no, 1=yes.
Health insurance	Whether participant had participated in social health insurance or commercial health insurance.	0=no, 1=yes.
Service accessibility	The duration to the nearest medical facility.	1=within 15 minutes, 2=over 15 minutes.

Statistical analysis

We conducted the data analysis by using Stata 15 and SPSS 25. Firstly, we employed the association rule learning algorithm to analyse the residents' CHNs. In calculating the CHE items, we intercepted

the combination of needs with an Internet use frequency of more than 100 visits. Secondly, we conducted descriptive analysis to present the characteristics of sample and compared the differences between the urban and rural groups in the sample. Thirdly, we used a generalised linear model to empirically analyse the relationship between Internet use frequency and CHE and reported the regression coefficients, standard errors, *P*-values and 95% confidence intervals (CIs). Lastly, we used a path analysis model to verify the mediating effects of health literacy and health status on the relationship between Internet usage frequency and CHE.

Results

Current state of CHNs

The sample distribution of the CHE items is shown in Fig. 1. For the general population, multiple types of CHNs arose from the combination of eight general healthcare services. Among the total population with CHNs, 49.71% (n = 2189) had two CHNs, 36.61% (n = 1611) had three CHNs, 11.59% (n = 510) had four CHNs and only 2.07% (n = 91) had five or more CHNs. Moreover, after we considered the critical groups, that is, the elderly, the individuals who required maternal postnatal health management and the individuals who required chronic disease management, we determined that 3,122 individuals required concurrent dual health interventions, which represented 33.32% of the total population. In addition, 2,880 individuals required three types of concurrent healthcare services, which accounted for 30.84% of the sample. Furthermore, 1,767 individuals, or 18.92% of the sample, required four types of concurrent health interventions, and 1,580 individuals required five or more concurrent healthcare services, which accounted for 16.92% of the sample population.

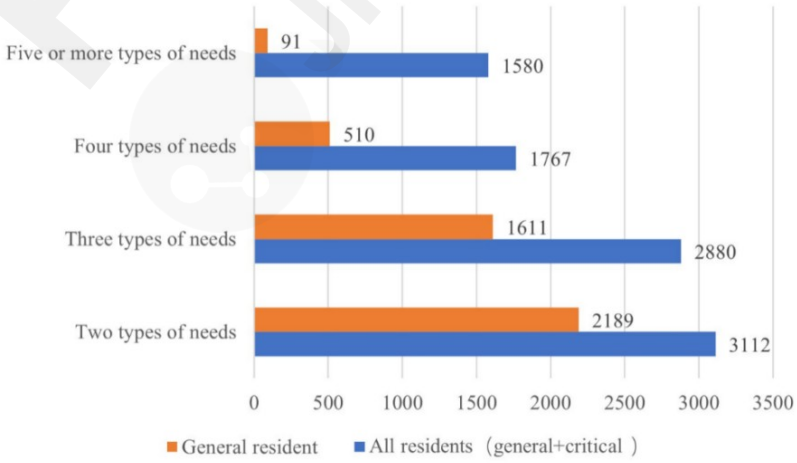
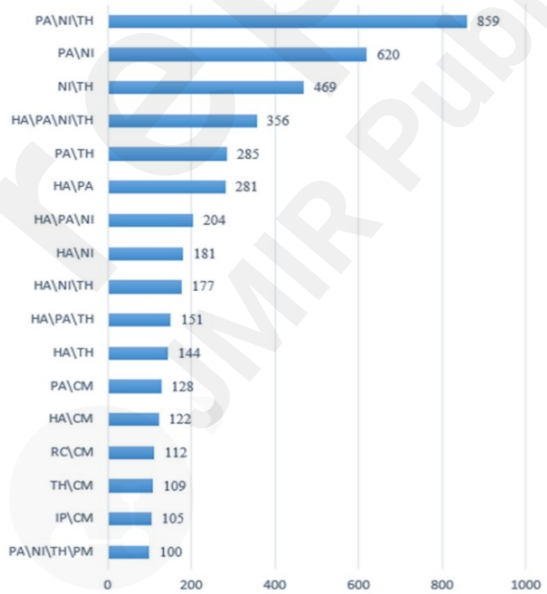


Fig. 1. Sample distribution of CHE items

Fig. 2 depicts the collective items and the internal correlation structure of the healthcare service needs of the residents. The most common healthcare service combination among the respondents was ‘physical exercise guidance + network health information service + traditional Chinese medicine’ (n = 859), followed by ‘physical exercise guidance + network health information service’ (n = 620). The third most common healthcare service combination was ‘network health information service + traditional Chinese medicine’ (n = 469). In addition, the relatively common healthcare service combinations were ‘health guidance + physical exercise guidance + network health information service + traditional Chinese medicine’ (n = 356), ‘physical exercise guidance + traditional Chinese medicine’ (n = 285), ‘health guidance + physical exercise guidance’ (n = 281) and ‘health guidance + physical exercise guidance + network health information service’ (n = 204). Among the healthcare service needs with a co-occurrence frequency ranging from 100 to 200, the combinations with a high co-occurrence frequency were ‘health guidance service + network health information service’ (n = 181), ‘health guidance service + network health information service + traditional Chinese medicine’ (n = 177) and ‘health guidance service + physical exercise guidance service + traditional Chinese medicine’ (n = 151).



Note: PA on behalf of exercise guidance service need; NI on behalf of network health information service need; TH on behalf of traditional Chinese medicine need; HA on behalf of health guidance service need; CM on behalf of chronic disease management service need; PM on behalf of maternal health management service need.

Fig. 2. Healthcare service combinations with co-occurrence frequency of more than 100

Descriptive analysis of key variables and sample characteristics

Table 2 presents the characteristics of the respondents. Among the 12,513 participants in this study, 68.74% had more than two concurrent healthcare needs (8,601 of 12,513). The rural residents

exhibited a lower CHE percentage (4,045 of 6,053, 66.83%) compared with the urban residents (4,556 of 6,460, 70.53%). In addition, more than half of the residents did not use the Internet (7,186 of 12,513, 57.43%), whereas 14.91% used the Internet frequently (1,866 of 12,513), and 27.66% used the Internet occasionally (3,461 of 12,513). Moreover, the proportion of the rural residents who did not use the Internet (4,840 of 6,053, 79.96%) was significantly higher than that of the urban residents who did not use the Internet (2,346 of 6,460, 36.32%). Meanwhile, the proportion of the high-frequency Internet users among the rural residents (391 of 6,053, 6.46%) was much lower than that among the urban residents (1,475 of 6,460, 22.83%). The overall health literacy of the sample population was normal, with the health literacy of the urban population being significantly higher than that of the rural population. The proportion of the respondents who rarely exercise was 45.34% (5,673 of 12,513), whereas the proportion of those who exercise frequently was 32.94% (4,122 of 12,513). Among the rural residents, the proportion of those who rarely exercise (4,301 of 6,053, 71.05%) was higher than that among the urban residents (1,373 of 6,460, 21.23%), whereas the proportion of those who exercise frequently (984 of 6,053, 16.26%) was significantly lower than that among the urban residents (3,138 of 6,460, 48.58%). In terms of their health status, 83.81% of the respondents were in good health (10,414 of 12,513), and only 0.76% reported having poor health (94 of 12,513). A comparison of the two groups showed statistically significant differences in CHE ($P < .001$), Internet use frequency ($P < .001$), health literacy ($P < .001$) and health status ($P < .001$). Table 2 presents the demographic and socioeconomic characteristics of the respondents. Among the respondents, 51.40% were female (6,432 of 12,513), and 81.05% were married (10,142 of 12,513). The majority of the respondents was between the ages of 45 and 64 years (4,966 of 12,513, 39.69%) and 15 and 44 years (4,394 of 12,513, 35.12%). Nearly half of the respondents attained secondary education (5,879 of 12,513, 46.98%), whereas only 1.69% received postgraduate education or higher (211 of 12,513). In terms of their socioeconomic characteristics, the majority of the respondents was employed at the time of the survey (7,750 of 12,513, 61.94%). In addition, among the respondents, 22.62% (2,831 of 12,513) belonged to the middle-income group, 20.75% (2,474 of 12,513) belonged to the low-income group and only 17.84% (2,232 of 12,513) belonged to the upper middle-income group. More than 90% of the respondents were from nonpoor households (11,347 of 12,513, 90.91%) and had health insurance (12,365 of 12,513, 99.09%). The majority of the respondents had access to a healthcare provider within 15 minutes or less (11,177 of 12,513, 89.55%). A comparative analysis of the two groups revealed statistically significant differences in age ($P < .001$), marital status ($P < .001$), household registration type ($P < .001$), employment status ($P < .001$), income level ($P < .001$) and access to services ($P < .001$). However, no statistically significant differences were

observed in gender (P = .63) and family type (P = .21).

Table 2. Description of sample characteristics

Variables	Overall (N=12513)	Rural (N=6053)	Urban (N=6460)	*P* value
Co-occurring healthcare needs, n (%)				<.001
No	3912 (31.26)	2008 (33.17)	1904 (29.47)	
Yes	8601 (68.74)	4045 (66.83)	4556 (70.53)	
Frequency of internet use, n (%)				<.001
Rarely used	7186 (57.43)	4840 (79.96)	2346 (36.32)	
Occasionally used	3461 (27.66)	822 (13.58)	2639 (40.85)	
Frequently used	1866 (14.91)	391 (6.46)	1475 (22.83)	
Health literacy, n (%)				<.001
Low-level	5673(45.34)	4301 (71.05)	1372 (21.23)	
Moderate-level	2718 (21.72)	768 (12.69)	1950 (30.19)	
High-level	4122 (32.94)	984 (16.26)	3138 (48.58)	
Health status, n (%)				<.001
Low-level	94 (0.76)	71 (1.18)	23 (0.36)	
Moderate-level	1917 (15.43)	1586 (26.31)	331 (5.18)	
High-level	10414 (83.81)	4372 (72.52)	6042 (94.47)	
Gender, n (%)				.63
Female	6081 (48.60)	2970 (49.07)	3111 (48.16)	
Male	6432 (51.40)	3083 (50.93)	3349 (51.84)	
Age, n (%)				<.001
15-44 years	4394 (35.12)	1523 (25.16)	2871 (44.44)	
45-64 years	4966 (39.69)	2846 (47.02)	2120 (32.82)	
65 years and above	3153 (25.20)	1684 (27.82)	1469 (22.74)	
Marital status, n (%)				.21
Without spouse	2371 (18.95)	1170 (19.33)	1201 (18.59)	
With spouse	10142 (81.05)	4883 (80.67)	5259 (81.41)	
Education level, n (%)				<.001
Uneducated	1282 (10.25)	1068 (17.64)	214 (3.31)	
Primary education	2650 (21.18)	2095 (34.61)	555 (8.59)	
Secondary education	5879 (46.98)	2707 (44.72)	3172 (49.10)	
Higher education	2491 (19.91)	176 (2.91)	2315 (35.84)	
Postgraduate and above	211 (1.69)	7 (0.12)	204 (3.16)	
Employment status, n (%)				<.001
Unemployed	1606 (12.83)	1048 (17.31)	558 (8.64)	
Schooled	567 (4.53)	303 (5.01)	264 (4.09)	
Retired	2590 (20.70)	364 (6.01)	2226 (34.46)	
Employed	7750 (61.94)	4338 (71.67)	3412 (52.82)	
Income level, n (%)				<.001
Low-income	2596 (20.75)	2433 (40.19)	163 (2.52)	
Lower middle-income	2427 (19.40)	2009 (33.19)	418 (6.47)	

Middle-income	2831 (22.62)	1183 (19.54)	1648 (25.51)	
Upper middle-income	2232 (17.84)	337 (5.57)	1895 (29.33)	
High-income	2427 (19.40)	91 (1.50)	2336 (36.16)	
Family type, n (%)				<.001
Poor family	11347 (90.91)	4979 (82.43)	6368 (98.85)	
Non-poor family	1135 (9.09)	1061 (17.57)	74 (1.15)	
Health insurance, n (%)				<.001
No	113 (0.91)	29 (0.48)	84 (1.30)	
Yes	12365 (99.09)	6004 (99.52)	6361 (98.70)	
Service accessibility, n (%)				<.001
Within 15 minutes	11117 (89.55)	4834 (80.49)	6283 (98.05)	
Over 15 minutes	1297 (10.45)	1172 (19.51)	125 (1.95)	

Association between Internet use frequency and CHE

Table 3 reports the regression results of the factors that may impact CHE. Firstly, a positive correlation was observed between Internet use frequency and CHE (β = 0.895, SE = 0.019, P < .001, 95% CI [0.857–0.934]). As the respondents' Internet use frequency increased, their CHNs increased proportionately. In terms of the demographic attributes, being male (β = 0.185, SE = 0.038, P = .001, 95% CI [0.110–0.261]), relatively old (β = 0.296, SE = 0.046, P < .001, 95% CI [0.206–0.386]) and married (β = 0.106, SE = 0.030, P = .001, 95% CI [0.046–0.167]) may indicate having CHNs. Moreover, household registration had a negative impact on CHE (β = -0.440, SE = 0.036, P = .002, 95% CI [0.512–0.369]).

With regard to the socioeconomic characteristics, employment status significantly increased CHE among the residents (β = 0.290, SE = 0.072, P = .001, 95% CI [0.148–0.433]), that is, the employed residents had more CHNs than the unemployed residents. The high-income individuals (β = 0.121, SE = 0.048, P = .011, 95% CI [0.028–0.215]) and upper middle-income individuals (β = 0.365, SE = 0.051, P < .001, 95% CI [0.266–0.464]) had more CHNs than the lower-income individuals, and the individuals from poor families (β = 0.746, SE = 0.128, P < .001, 95% CI [0.494–0.997]) had more CHNs than the individuals from rich families. Furthermore, having health insurance (β = 0.249, SE = 0.125, P = .05, 95% CI [0.003–0.495]) and considerable access to medical services (β = 0.151, SE = 0.178, P < .001, 95% CI [0.114–0.187]) was positively associated with numerous CHNs among the residents.

Table 3. Regression results of effect of Internet use frequency and other covariates on CHE

Variables	β	SE	P value	95% CI	
Frequency of internet use	0.895	0.019	<.001	0.857	0.934

Gender	0.185	0.038	.001	0.110	0.261
Age	0.296	0.046	<.001	0.206	0.386
Marital status	0.106	0.030	.001	0.046	0.167
Education level[a]					
Primary education	0.145	0.087	.09	-0.026	0.317
Secondary education	0.020	0.092	.83	-0.201	0.161
Higher education	0.071	0.114	.53	-0.152	0.294
Postgraduate and above	0.166	0.207	.42	-0.240	0.572
Household registration	-0.440	0.036	.002	-0.512	-0.369
Employment status[b]					
Schooled	0.069	0.079	.39	-0.086	0.223
Retired	0.172	0.114	.13	-0.397	0.052
Employed	0.290	0.072	<.001	0.148	0.433
Income level[c]					
Lower middle-income	0.034	0.038	.38	-0.041	0.109
Middle-income	0.070	0.041	.09	-0.010	0.150
Upper middle-income	0.121	0.048	.011	0.028	0.215
High-income	0.365	0.051	<.001	0.266	0.464
Family type	0.746	0.128	<.001	0.494	0.997
Health insurance	0.249	0.125	.05	0.003	0.495
Service accessibility	0.151	0.178	<.001	0.114	0.187

Path analysis between Internet use frequency and CHE

Table 4 presents the influence path of the association between Internet use frequency and CHE. Firstly, gender (β = 0.087, SE = 0.011, P < .001), marital status (β = 0.060, SE = 0.014, P < .001), education level (β = 0.214, SE = 0.008, P < .001), household registration (β = 0.257, SE = 0.016, P < .001) and income level (β = 0.046, SE = 0.087, P < .001) had a noteworthy positive correlation with Internet use frequency. The residents who were male, married, had a high education level, had an urban household registration and had a high income level used the Internet frequently. However, age was negatively correlated with Internet use frequency (β = -0.192, SE = 0.008, P < .001), that is, the older the residents, the less frequent the use of the Internet. Secondly, in terms of the effect of Internet use frequency on health literacy and health status, a significant positive correlation was observed between Internet use frequency and health literacy (β = 0.121, SE = 0.011, P < .001). That is, as the residents' Internet use frequency increased, the number of times they exercise in a week increased significantly, which meant that their health literacy improved. Similarly, a positive correlation was observed between Internet use frequency and health status, that is, high Internet use frequency was linked with improved health status among the residents (β = 0.026, SE = 0.049, P < .001). In addition, health literacy had a positive effect on CHE (β = 0.087, SE = 0.054, P < .001), that is, the higher the health literacy level, the more the CHE. However, a significant negative

correlation was observed between health status and CHE (β = -0.787, SE = -0.213, P < .001), that is, the better the health status, the fewer the CHE (Fig. 3).

Table 4. Regression coefficients of path analysis

Explanatory variables	→ Explained variables	$B1^a$	$B2^b$	SE	P value
Gender	→ Frequency of internet use	0.087	0.059	0.011	<.001
Age	→ Frequency of internet use	-0.192	-0.200	0.008	<.001
Marital status	→ Frequency of internet use	0.060	0.033	0.014	<.001
Education level	→ Frequency of internet use	0.214	0.268	0.008	<.001
Household registration	→ Frequency of internet use	0.257	0.174	0.016	<.001
Income level	→ Frequency of internet use	0.046	0.006	0.087	<.001
Frequency of internet use	→ Health literacy	0.148	0.121	0.011	<.001
Frequency of internet use	→ Health status	0.026	0.049	0.005	<.001
Frequency of internet use	→ Co-occurring healthcare needs	0.902	0.457	0.019	<.001
Health literacy	→ Co-occurring healthcare needs	0.087	0.054	0.015	<.001
Health status	→ Co-occurring healthcare needs	-0.787	-0.213	0.034	<.001

[a]The results of unstandardized coefficients, [b]The results of standardized coefficients.

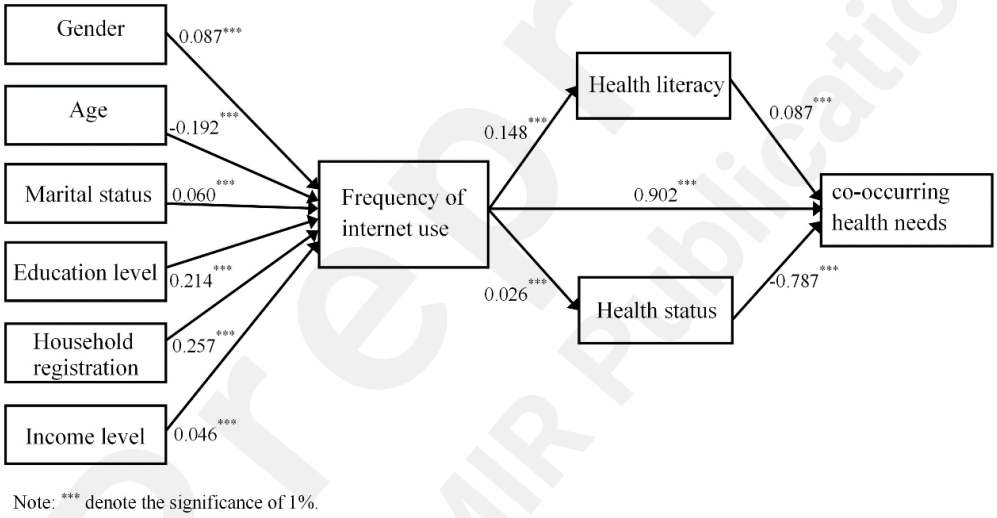


Fig. 3. Path diagram of effect of Internet use frequency on CHE

Discussion

Principal findings

Our study presents a novel perspective by examining the prevalence of multiple CHNs in Chinese residents, thereby expanding the literature, which is primarily limited to singular healthcare needs. We attempted to explore the current status of CHNs among Chinese residents and examine the relationship and pathways between residents' Internet use frequency and CHNs by using data from the 'Survey on Chinese Residents' Health Service Needs in the New Era' from four districts. In our study, we found that CHNs were common among Chinese residents, with 68.74% of the participants

having more than two concurrent needs. The CHNs of the key populations, that is, the individuals with chronic diseases, the pregnant women and the children, were more diverse than those of the general population. In terms of the specific healthcare services, the main healthcare service required by the respondents was preventive care. The combination of three types of services was the most common among the residents, namely, physical exercise guidance, network health information and traditional Chinese medicine.

The findings can inspire and remind policymakers that in their system planning, resource allocation and service management, they should keep pace with the characteristics and dynamic changes in residents' healthcare needs to create reasonable service environments and guide service development. The findings can also help service providers by informing them of the adjustments that should be made to service content and modes in this information age to strike a balance between supply and demand in the healthcare system.

Furthermore, we found a notable distinction between the CHNs of the urban and the rural residents, with the rural residents having significantly fewer CHNs compared with their urban counterparts. This finding is consistent with that of previous research [42]. In China, the persistent urban–rural gap has led to better access to healthcare services and higher health literacy for urban residents compared with rural residents [43]. The urban residents in our study exhibited a considerable need for preventive care, such as network health information, mental health support and physical exercise guidance. The provision of such services is crucial for promoting the general well-being of and preventing diseases among the urban population. However, the rural residents required more disease diagnosis and curative services than the urban residents, including, but not limited to, chronic disease management, outpatient services and inpatient services. Rural residents may perceive the provision of their healthcare needs to be lagging behind that of the healthcare needs of urban residents. Thus, the development process of full-lifecycle services may not match the CHNs of rural and urban residents. Therefore, the government and society should be attentive to residents' changing healthcare needs and the discrepancies in such needs. The government should also dynamically adjust the content of healthcare services and focus on providing network information guidance, exercise guidance, health guidance and other essential healthcare services. Moreover, the government should prioritise the CHNs of rural residents and extend varied healthcare services based on the identified discrepancies between the CHNs of the urban and rural residents to ensure the accessibility of and equity in healthcare services.

In our study, we observed a significant positive association between Internet use frequency and CHN. The results remained robust after we controlled for the household- and individual-level

characteristics of the respondents. The positive effect of Internet use frequency on CHN was consistent with the findings of Li and Zhang [44]. However, the aforementioned authors focused on a single healthcare need, rather than multiple healthcare needs. Internet platforms can integrate and disseminate information quickly and thus enable individuals to access vast health-related information during their daily browsing routines. In addition, access to medical websites, health apps and WeChat public numbers can enable residents to acquire previously unknown or inaccessible health information, which may directly stimulate and catalyse the emergence of multiple CHNs [45]. Moreover, individuals who are suffering from a chronic disease can use the Internet to self-diagnose, obtain treatment and plan their prognosis to gain a deep understanding of their health concerns and needs. Meanwhile, the Internet can increase patients' need for disease diagnosis and treatment services [46] and facilitate the formation of social connections among residents in different regions to communicate by providing various information-sharing mechanisms to promote health information dissemination and sharing whilst raising residents' awareness of their needs [34]. Therefore, the Chinese government should promote Internet technology and expand its usage to provide accurate health information through big data platforms and ultimately improve residents' access to healthcare services and overall well-being.

In our empirical study, we found that health literacy was one of the pathways through which Internet use frequency could affect CHE. The pathway suggested that high Internet use frequency can increase CHE by enhancing residents' health literacy. We revealed that Internet use frequency can enhance individuals' health literacy, as shown by the significant increase in the respondents' weekly physical activity participation. This finding aligns with that of Zhang and Minto [47, 48] and can be attributed to the self-selection characteristics of Internet use [36], in which individuals can selectively use the Internet based on their needs and conditions. This self-selection can empower individuals to access professional information related to their health, manage their well-being, improve their health literacy and spread the benefits of online health information. Improved health literacy will likely drive the need for exercise and dietary, work and relaxation guidance among residents and foster the emergence of CHNs. However, some studies argued that excessive Internet use may engender overreliance on the technology and compromise healthy lifestyles and behaviours, such as reduce physical activity and increase smoking and drinking [35]. Although we did not observe the inhibitory effect of Internet use frequency on health literacy, the potential negative effects of irrational Internet use cannot be ignored. In this regard, the government should increase educational programmes about and public awareness of rational Internet usage, strengthen its supervision and standardisation of online health information, screen high-quality sources to prevent

potential hazards and promote healthy lifestyles among the residents. Such measures may improve residents' health literacy and enable them to address their CHNs effectively.

We also revealed that health status mediated the relationship between Internet use frequency and CHE. The pathway involved the inhibitory effect of frequent Internet use on CHE by improving the residents' health status. The positive impact of Internet use frequency on health status is consistent with the findings of Zhang [49], which indicated that frequent Internet use can significantly promote physical and mental well-being, because health information has long been monopolised by professionals, which has prevented individuals from assessing their health status promptly or making dynamic adjustments for improvement [50]. The primary advantage of Internet technology is its ability to address the imbalance in health information, which will allow individuals to make informed decisions about their health and well-being by accessing vast online resources [51]. Frequent Internet use can facilitate access to beneficial health information, which can help residents optimise personal healthcare services and improve their health outcomes [33].

Furthermore, high Internet use frequency may expand residents' social networks and increase their social participation and interaction, which can result in improved health and reduced health-related concerns and thus less need for traditional healthcare services [52].

The findings of this study can provide directions for research on the relationship between Internet use frequency and healthcare needs. Furthermore, attention should be paid to the mediating effect of health status and the function of Internet technology as an information channel that can positively improve people's health by providing reliable health information. The impact of health status on healthcare needs should also be evaluated to effectively address the issue of CHNs and help identify areas where the prevalence of CHNs may vary with the residents' health status. The provision of unnecessary services that will not contribute to health status improvement should be avoided; instead, the delivery of essential healthcare services that cater to residents' specific requirements in this new era should be prioritised.

Limitations

Our study has several limitations. Firstly, though we incorporated the respondents' household- and individual-level variables, other factors may affect CHE and the robustness of the study results. Therefore, future studies should consider additional covariates to control for the confounding effects. Secondly, from the perspective of health literacy and health status, we explored how residents' CHNs can be affected by their Internet use frequency. However, residents' social interaction and social participation and other activities may influence their CHNs through frequent Internet use, which requires further investigation. Thirdly, we used cross-sectional data in our study, which could not

establish a causality relationship between Internet use frequency and CHE and address reverse causality. Lastly, we used survey data from 2018 to test the relationship between Internet use frequency and CHE. Given the popularity and application of Internet technology, future research should use recent Internet data to further examine the relationship.

Conclusions

Our study reveals the association between Internet use frequency and CHE among Chinese residents and clarifies the pathways through which the relationship is formed. The results show that high Internet use frequency can increase residents' access to health-related information and awareness of and demand for healthcare services. Moreover, the relationship between Internet use frequency and CHE is mediated by health literacy and health status, which can be explained through two pathways: Internet use frequency → health literacy → CHE and Internet use frequency → health status → CHE. The findings provide evidence for the beneficial spillover effect of online health information on individuals' overall health. Given the evolving healthcare needs of the general population, the utilisation of Internet-based technologies can guide the effective adaptation of healthcare service content and patterns to public demands.

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Data Availability

The data sets generated and analyzed during this study are not publicly available due to limited availability of data supporting the findings, but are available from the corresponding author on reasonable request.

Authors' Contributions

Y.X devised the analysis plan, conducted data and result analyses, and composed the final manuscript version. R.H formulated the primary study framework. X.L contributed to the data analysis process and interpretation of results. L.Z and R.H reviewed and refined the final manuscript version, while Y.X and X.L collected relevant references. All authors have read and approved the published version of this manuscript.

Conflicts of Interest

None declared

Abbreviations

CNNIC: China Internet Network Information Center
CHNs: Co-occurring Healthcare Needs
EQ-5D: EuroQol Five Dimensions

TTO: time trade-off

References

1. Gustavsson E. From Needs to Health Care Needs. Health Care Anal. Mar 22, 2014;22(1): 22–35. [dol:10.1007/s10728-013-0241-8]
2. Bao L, Li WT, Zhong BL. Feelings of loneliness and mental health needs and services utilization among Chinese residents during the COVID-19 epidemic. Global Health. Apr 26, 2021;17(1):51. [doi:10.1186/s12992-021-00704-5]
3. Hou SM. Changes in China's health needs and health industry in 70 years of new China. Population and Health. Oct 2019;11:31-34.
4. He RB, Liu XJ, Xing YQ, Zhang L. Theoretical construction and practical dimensions of residents′ health care service needs in China – from a structural perspective. Chin J Public Health. Jul 23, 2024;40(7):892-898.
5. Tormohlen KN, Mojtabai R, Seiwell A, McGinty EE, Stuart EA, Tobin KE, et al. Co-occurring opioid use and depressive disorders: patient characteristics and co-occurring health conditions. J Dual Diagn. Sep 28, 2021;17(4):296-303. [doi.org/10.1080/15504263.2021.1979349]
6. Liu W, Liu Y, Twum P, Li S. National equity of health resource allocation in China: data from 2009 to 2013. Int J Equity Health. Apr 19, 2016;15:68. [doi:10.1186/s12939-016-0357-1]
7. Zheng L, Hu R, Dong Z, Hao Y. Comparing the needs and utilization of health services between urban residents and rural-to-urban migrants in China from 2012 to 2016. BMC Health Serv Res. Sep 17, 2018;18(1):717. [doi:10.1186/s12913-018-3522-y]
8. Statistical Information Center of the National Health and Wellness Commission of the People’s Republic of China. The 2017 China’s Health and Family Planning Statistical Yearbook. 2018.
9. URL:http://www.nhc.gov.cn/mohwsbwstjxxzx/tjtjnj/202106/bb81a4c32259405189689e6f7cfe5b8f.shtml. [accessed 2023-05-09]
10. Deetjen U, Powell JA. Internet use and health: connecting secondary data through spatial microsimulation. Digit Health. Sep 2, 2016; 2:2055207616666588. [doi:10.1177/2055207616666588].
11. Rado N, Girasek E, Bekasi S, Gyorffy Z. Digital technology access and health-related internet use among people experiencing homelessness in hungary: quantitative survey. J Med Internet Res. Oct 19, 2022;24(10):e38729. [doi:10.2196/38729]
12. China Internet Network Information Center. The 51th Statistical Report on China’s Internet Development. 2023.
13. URL:http://www.cnnic.cn/n4/2023/0302/c199-10755.html. [accessed 2023-05-09]
14. China Internet Network Information Center. The 49th Statistical Report on China’s Internet Development. 2021.
15. URL:http://www3.cnnic.cn/n4/2022/0401/c88-1131.html. [accessed 2023-05-09]
16. Benetoli A, Chen TF, Aslani P. Consumer Health-Related Activities on social media: Exploratory Study. J Med Internet Res. Oct 13, 2017;19(10): e352. [doi:10.2196/jmir.7656]
17. Oshima SM, Tait SD, Thomas SM, Fayanju OM, Ingraham K, Barrett NJ, et al. Association of smartphone ownership and internet use with markers of health literacy and access: cross-sectional survey study of perspectives from project PLACE (Population Level Approaches to Cancer Elimination). J Med Internet Res. Jun 9, 2021;23(6): e24947. [doi:10.2196/24947]
18. Lee HY, Wang K, Johnson K, Kubanga K, Han A, Choi E. Does the Use of Social Media Affect Online Health Information-Seeking Behaviors among Underserved African Americans in Rural Alabama? J Health Care Poor Underserved. Nov 2022;33(4): 1949-1964. [doi:10.1353/hpu.2022.0147]
19. Sun X, Yan W, Zhou H, Wang Z, Zhang X, Huang S, et al. Internet use and need for digital health technology among the elderly: a cross-sectional survey in China. Bmc Public Health. Sep 11, 2020;20(1):1386. [doi:10.1186/s12889-020-09448-0].

20. Wang X, Xie Y, Yang X, Gu D. Internet-based healthcare knowledge service for improvement of Chinese medicine healthcare service quality. Healthcare (Basel). Jul 31, 2023;11(15):2170. [doi:10.3390/healthcare11152170].
21. Choi N. Relationship between health service use and health information technology use among older adults: analysis of the US National Health Interview Survey. J Med Internet Res. Apr 20, 2011;13(2): e33. [doi:10.2196/jmir.1753]
22. Flynn KE, Smith MA, Freese J. When do older adults turn to the internet for health information? findings from the Wisconsin longitudinal study. J Gen Intern Med. Dec 2006;21(12):1295-1301. [doi: 10.1111/j.1525-1497.2006.00622.x]
23. Arcia A, Stonbraker S, Warner ERA. Continuing Education Module-Information Needs and Information-Seeking Processes of Low-Income Pregnant Women in Relation to Digital Maternity Education Resources. J Perinat Educ. Jul 1, 2019;28(3):151-162. [doi:10.1891/1058-1243.28.3.151]
24. Li Y, Ye S, Zhou Y, Mao F, Guo H, Lin Y, et al. Web-Based Medical Information Searching by Chinese Patients with Breast Cancer and its Influence on Survival: Observational Study. J Med Internet Res. Apr 17, 2020;22(4):e16768. [doi:10.2196/16768]
25. Shim H, Ailshire J, Zelinski E, Crimmins E. The health and retirement study: analysis of associations between use of the internet for health information and use of health services at multiple time points. J Med Internet Res. May 25, 2018; 20(5): e200. [doi:10.2196/jmir.8203]
26. Haileamlak A. What factors affect health seeking behavior? Ethiop J Health Sci. Mar 2018; 28(2):110. [doi:10.4314/ejhs.v28i2.1]
27. Widayanti AW, Green JA, Heydon S, Norris P. Health-seeking behavior of people in indonesia: a narrative review. J Epidemiol Glob Health. Mar 10, 2020;10(1):6-15. [doi:10.2991/jegh.k.200102.001]
28. Limaye VS, Grabow ML, Stull VJ, Patz JA. Developing a definition of climate and health literacy. Health Aff (Millwood). Dec 2020;39(12):2182-2188. [doi:10.1377/hlthaff.2020.01116].
29. Wei P, Zhang Y, Wu S, Wang Q, Shui G, Su C, et al. Current situation and influencing factors of traditional Chinese medicine nursing clinic in Henan province. J Healthc Eng. Mar 21, 2022:8941922. [doi:10.1155/2022/8941922]
30. Xu WJ, Wang LT, Zhao ZP, Zhu LM, Zu LH, Zhang Q, et al. Prospects of a comprehensive evaluation system for traditional Chinese medicine services. J Integr Med. Nov 15, 2017;15(6):426-432. [doi:10.1016/S2095-4964(17)60364-9].
31. Zhu Z, Xu J, Lin Y, Chai K, Zhou Y, Jia R, et al. Correlation between nutritional status and oral health quality of life, self-efficacy of older inpatients and the influencing factors. BMC Geriatr. Apr 5, 2022;22(1):280. [doi:10.1186/s12877-022-02830-0].
32. Jia J, Nie XF, Ke L, Liu B, Wang WR. Mental health and its influencing factors among immigrants with chronic diseases in China. J Immigr Minor Health. Oct 24, 2022; 24(5):1269-1280. [doi:10.1007/s10903-021-01311-7].
33. Wang J, Wang Y, Cai H, Zhang J, Pan B, Bao G, et al. Analysis of the status quo of the elderly's demands of medical and elderly care combination in the underdeveloped regions of western China and its influencing factors: a case study of lanzhou. BMC Geriatr. Sep 9,2020;20(1):338. [doi:10.1186/s12877-020-01616-6].
34. Beck F, Richard JB, Nguyen-Thanh V, Montagni I, Parizot I, Renahy E. Use of the internet as a health information resource among French young adults: results from a nationally representative survey. J Med Internet Res. May 13, 2014;16(5): e2934. [doi: 10.2196/jmir.2934]
35. Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. J Health Econ. Jan 2010;29(1):1-28. [doi: 10.1016/j.jhealeco.2009.10.003]
36. Mano RS. Social media and online health services: A health empowerment perspective to online health information. Computers in Human Behavior. Oct 2014; 39:404-412. [doi: 10.1016/j.chb.2014.07.032]

37. Liu C, Zhou XH. Medical Information Spillovers and Health Care Choice of Chinese Residents in the Internet Era)—An Empirical Research Based on CHNS. Journal of Public Administration. Nov 2017; 14(4): 78-90.
38. Kitazawa M, Yoshimura M, Murata M, Sato-Fujimoto Y, Hitokoto H, Mimura M, et al. Associations between problematic Internet use and psychiatric symptoms among university students in Japan. Psychiatry Clin Neurosci. May 2018; 72(7): 531-539. [doi:10.1111/pcn.12662]
39. Shen C, Dumontheil I, Thomas M, Röösli M, Elliott P, Toledano M. Digital technology use and BMI: evidence from a cross-sectional analysis of an adolescent cohort study. J Med Internet Res. Jul 5, 2021; 23(7): e26485. [doi:10.2196/26485]
40. Ren W, Ma X, Tarimo CS, Xing Y, Lv X, Liang Z. A study on the current state and equity level of the health promotion service demands among older adults in China. Int J Equity Health. Apr 13, 2023;22(1):67. [doi:10.1186/s12939-023-01882-x]
41. Xu W, Li Z, Pan Z, He R, Zhang L. Prevalence and associated factors of self-treatment behaviour among different elder subgroups in rural China: a cross-sectional study. Int J Equity Health. Mar 12, 2020;19(1):32. [doi:10.1186/s12939-020-1148-2] [Medline: 32164667]
42. An analysis report of the National Health Services Survey in China, 2013. Center for Health Statistics and Information. 2015.
43. URL:http://www.nhc.gov.cn/ewebeditor/uploadfile/2016/10/20161026163512679.pdf [accessed 2021-04-22]
44. Xiong Z, Zhang L, Li Z, Xu W, Zhang Y, Ye T. Frequency of online health information seeking and types of information sought among the general Chinese population: cross-sectional study. J Med Internet Res. Dec 2, 2021;23(12):e30855. [doi:10.2196/30855]
45. Armstrong ME, Green J, Reeves GK, Beral V, Cairns BJ; Million Women Study Collaborators. Frequent physical activity may not reduce vascular disease risk as much as moderate activity: large prospective study of women in the United Kingdom. Circulation. Feb 24, 2015;131(8):721-729. [doi:10.1161/CIRCULATIONAHA.114.010296]
46. Xu J, Zheng J, Xu L, Wu H. Equity of health services utilisation and expenditure among urban and rural residents under universal health coverage. Int J Environ Res Public Health. Jan 12, 2021;18(2):593. [doi:10.3390/ijerph18020593].
47. Luo Y, Yao L, Hu L, Zhou L, Yuan F, Zhong X. Urban and rural disparities of personal health behaviors and the influencing factors during the covid-19 outbreak in China: based on an extended IMB model. Disaster Med Public Health Prep. Jun 2022;16(3):880-884. [doi:10.1017/dmp.2020.457].
48. Li F, Zhang Y. Analysis on the influence Mechanism of “Internet + healthcare” treatment on residents’ health service needs. Medicine and society. Mar 10, 2021; 34(3):23-28+44.
49. Savoli A, Barki H, Paré G. Examining how chronically ill patients’ reactions to and effective use of information technology can influence how well they self-manage their illness. MIS Quarterly. Jan 2020;44(1):351-389. [doi:10.25300/MISQ/2020/15103]
50. Han J, Zhang X, Meng Y. The impact of internet medical information overflow on residents’ medical expenditure based on China’s observations. Int J Environ Res Public Health. May 19, 2020;17(10): 3539. [dol: 10.3390/ijerph17103539]
51. Zhang S, Zhang Y. The relationship between internet use and mental health among older adults in China: the mediating role of physical exercise. isk Manag Healthc Policy. Nov 23, 2021; 14:4697-4708. [doi:10.2147/RMHP.S338183].
52. Minto C, Bauce B, Calore C, Rigato I, Folino F, Soriani N, et al. Is Internet use associated with anxiety in patients with and at risk for cardiomyopathy? Am Heart J. Jul 2015;170(1): 87-95. [doi: 10.1016/j.ahj.2015.02.024]
53. Zhang C, Wang Y, Wang J, Liu X. Does internet use promote mental health among middle-aged and older adults in China? Front Psychol. Nov 2022; 13:999498.

[doi:10.3389/fpsyg.2022.999498].
54. Richardson JR, Peacock SJ. Supplier-induced demand: reconsidering the theories and new Australian evidence. Appl Health Econ Health Policy. Aug 2006; 5(2):87-98. [doi:10.2165/00148365-200605020-00003]
55. He W, Cao L, Liu R, Wu Y, Zhang W. Factors associated with internet use and health information technology use among older people with multi-morbidity in the United States: findings from the national health interview survey 2018. BMC Geriatr. Sep 6, 2022;22(1):733. [doi:10.1186/s12877-022-03410-y].
56. Dheepthasri S, Taranath M, Garla BK, Karuppaiah M, Umesh, Sangeeta. Oral health status and treatment needs among intellectually disabled in Madurai. Journal of Advanced Oral Research. May 23, 2018;9(1-2):45-48. [doi:10.1177/2229411218762044]