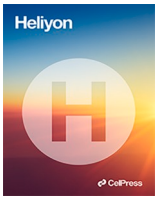
Heliyon 11 (2025) e40935

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

Impact of medical resources in residential area on unmet healthcare needs: Findings from a multi-level analysis of Korean nationwide data

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ARTICLE INFO

Keywords:
Unmet healthcare needs
Medical resource
Regional health disparity
Multi-level model

ABSTRACT

Purpose: This study aimed to examine whether sufficient medical resources in residential areas influence individuals' unmet healthcare needs in South Korea, where overpopulation is of concern.
Methods: Two publicly available datasets were utilized: The Korean Community Health Survey at the individual-level and the Korean medical utilization statistics at the regional-level. It included 176,378 individuals. To address the clustered nature of the regional-level data, a multi-level framework was applied, containing individual-level data, incorporating demographic details and health information.
Results: Individuals living in small cities and rural areas with sufficient medical resources were 1.26 times more likely to experience unmet healthcare needs than those living in well-resourced metropolitan cities. Additionally, the adjusted odds ratio for unmet healthcare needs was the highest at 1.32 for those living in small cities and rural areas lacking sufficient medical resources. Stratified analyses revealed the largest disparity in unmet healthcare needs between income levels in regions with sufficient resources. In these areas, those with the lowest income were 1.77 times more likely to experience unmet healthcare than those with the highest income. Similarly, in metropolitan cities, the income-based gap in unmet healthcare needs was most pronounced, with the adjusted odds ratio for the lowest-income group being 1.66.
Conclusions: Our findings demonstrate that living in small cities or rural areas with insufficient medical resources, as well as having a low income level even in an area with sufficient medical services, significantly increases individuals' unmet healthcare needs. This suggests then need for equitable distribution medical resources across regions and public health support policies that do not limit access to medical care for people with poor socioeconomic status.

1. Introduction

Unmet healthcare needs refer to the need to receive necessary medical services but not receiving it due to various factors. While

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https://doi.org/10.1016/j.heliyon.2024.e40935
Received 18 June 2024; Received in revised form 8 November 2024; Accepted 3 December 2024
Available online 4 December 2024

unmet healthcare needs are not always directly linked to adverse health outcomes, they highlight barriers to optimal health and well-being, with correlational associations to reduced quality of life, increased preventable diseases, and avoidable deaths [1].

Unmet healthcare needs may arise from supply-side limitations, such as inadequate healthcare facilities, and demand-side factors like financial constraints, low health literacy or limited service awareness [2]. Barriers often include accessibility (e.g., high costs), availability (e.g., lack of nearby healthcare providers or transportation), and acceptability issues (e.g., long waiting times or preference for certain types of providers). Each factor shows varying impacts on healthcare utilization [3,4].

Additionally, there are two primary perspectives on approaching unmet healthcare needs: a clinical approach, assessing needs based on clinical standards and a subjective approach, relying on individuals' self-assessment of their needs and healthcare experiences.

Subjective approach is often considered more feasible for research purposes as it reflects individuals' unique positions to evaluate their health status and identify unmet needs. While clinical assessments provide specific standards, subjective assessments allow individuals to express their perceived healthcare needs and gaps which can be more comprehensive in highlighting service deficiencies and individual well-being. Therefore, this study employed the subjective approach [5,6].

In 1989, the healthcare insurance system in South Korea was expanded to cover all residents, enhancing access to medical care. The development of the health insurance system, including enhanced health insurance coverage and improved health insurance copayment ceiling system, has significantly contributed to the improvement of access to medical care [7]. Despite these positive evaluations, some vulnerable groups continue to experience unmet healthcare needs, receiving less than adequate medical assistance [8,9]. It remains a challenge to balance the continuous increase in medical costs with the fulfillment of medical needs.

Unmet healthcare needs are not limited to South Korea. In Taiwan, despite the implementation of the National Health Insurance (NHI) program in 1995, which aimed to provide basic medical care and reduce the financial burden for citizens, unmet healthcare needs persist [10]. Similar issues are evident in South Korea, which has 13.2 hospital beds per 10,000 people-considerably more than Taiwan's 5.7 beds per 10,000 people-yet still faces unmet healthcare needs [11]. This suggests that countries like Taiwan, with even fewer hospital beds, likely face significant unmet healthcare needs as well. These findings underscore the necessity of improving the allocation of medical resources and ensuring appropriate access to healthcare services to address this critical international public health concern. In addition to the problem of hospital beds, many factors can be the cause of this problem, including geographic differences, shortage of hospital beds, doctors, nurses, and specialists relative to population [12,13].

Previous studies in South Korea have predominantly focused on identifying the annual status and trends in unmet healthcare needs [14,15]. However, our research transcends merely delineating the current state of unmet healthcare needs by analyzing the differences between regions. Moreover, our study aims to propose policy implications based on these regional disparities. This approach not only enriches the existing body of literature, but also provides a nuanced understanding of the complexities surrounding unmet healthcare needs across different geographic locations. By highlighting these regional differences, this study aimed to inform and guide the development of targeted policies that effectively address the specific challenges inherent to each region, thereby contributing to the reduction of unmet healthcare needs nationwide.

2. Methods

2.1. Data and study population

This study utilized two publicly available datasets. First, it utilized individual-level data from the 2022 Korean Community Health Survey (CHS) conducted by the Korea Centers for Disease Control and Prevention. The CHS has been conducted annually since 2008 on

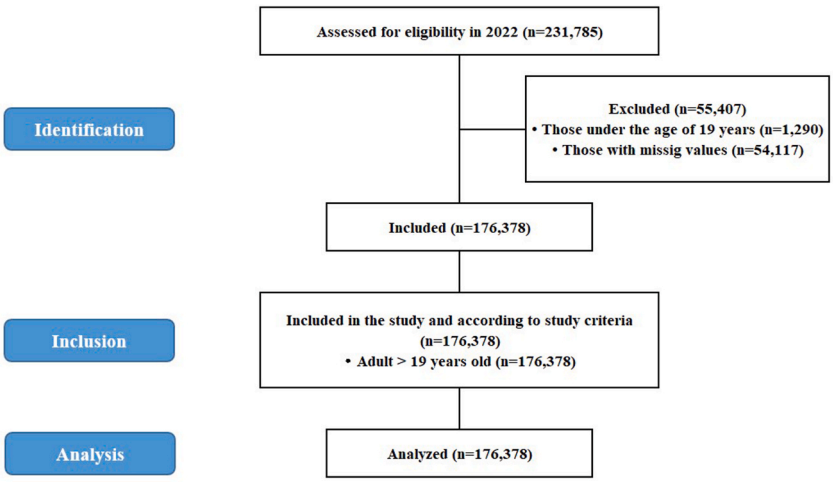

Fig. 1. STROBE flow chart.

all adults aged 19 or older residing within the territory of Korea in order to generate regional health statistics and implement evidence-based health projects in each region. Using statistical methods that take into account regional characteristics, the sample size was set at an average of 900 people (relative standard error ± 3 %) from 258 public health centers across the country. Then, professional investigators visited the selected sample households and conducted one-on-one interviews on 17 areas, including health behavior and chronic diseases [16]. Second, it utilized regional-level data from the medical utilization statistics, which are aggregate data released by Statistics Korea. It contains information about the population covered by health insurance, utilization of medical services, and medical resources availability across all cities, counties, and districts.

Among the respondents to the 2022 CHS (n = 231,785), after excluding those under the age of 19 years (n = 1290) and those with missing values (n = 54,117), we analyzed 176,378 individuals. The study's reporting adheres to the guidelines outlined in the Strengthening the Reporting of Observational Studies in Epidemiology statement, as illustrated in the flow chart in Fig. 1.

The study protocol was reviewed and approved by the Institutional Review Board of the Gachon University Gil Medical Center (IRB number: GFIRB2024-133). Informed consent was waived since the data did not contain any identifiable information.

2.2. Measures

The dependent variable was unmet healthcare needs, which was defined by the CHS as the absence of receiving necessary medical attention at a hospital or clinic within the past year. At this time, necessary medical attention includes all types of medical care, including checkups, treatments, and medications. Specifically, CHS participants self-reported "yes" or "no" to the question, "Have you ever experienced not receiving necessary medical services in the past year?" [17].

The principal variable of interest was on determining the presence of sufficient medical resources in residential areas, which were categorized into the following four groups: 1) metropolitan cities with sufficient medical resources, 2) small cities and rural areas with sufficient medical resources, 3) metropolitan cities with insufficient medical resources, and 4) small cities and rural areas with insufficient medical resources. Specifically, the sufficiency of medical resources in the residential areas was identified by analyzing the number of medical facilities, beds, and personnel per 10,000 residents across the 244 districts included in the analysis. If two or more of these three indicators exceeded the national median, the district was operationally defined as having sufficient medical resources. Accordingly, out of 244 districts across the country, 115 were determined to have sufficient medical resources, while 129 were identified to have insufficient medical resources. Additionally, residential areas were divided into metropolitan cities and small cities/rural areas based on the population size. Among the 244 districts, 74 were metropolitan cities, while 170 were small cities and rural areas.

We incorporated socioeconomic variables, patterns of health behavior, and factors related to health conditions as covariates. Socioeconomic variables included information about gender (men and women), age (ranging from 20 to 29, 30–39, 40–49, 50–59, 60–69, to 70+), marital status (married and unmarried/other), education level (low, middle, and high), current economic activity (yes or no), and household income level (divided into quartiles from Q1 to Q4). Health behavior patterns included information about smoking (yes or no) and drinking (yes or no). Lastly, factors related to health conditions included information related to the presence of chronic diseases (yes or no) such as high blood pressure or diabetes, subjective health status (good or bad), and the presence of depressive symptoms (yes or no) as assessed by the Korean version of the Patients Health Questionnaire-9 (PHQ-9) index. Those with a PHQ-9 total score of less than 5 points and more than 5 points were categorized into normal and depressive groups, respectively [18].

2.3. Statistical analysis

A chi-square test was conducted to examine and compare the general characteristics of the study population, with descriptive statistics presented in terms of frequencies (N) and percentages (%). Following this, we applied a multi-level model (MLM) framework to address the clustered structure of the regional-level data, where individual-level data containing demographic characteristics and health information were nested. Restricted Maximum Likelihood was employed to estimate the parameters of MLM, which provides less biased estimates of the fixed effects and more precise estimates of the variance components of the random effects [19,20]. Subsequently, a multi-level logistic regression analysis was conducted to investigate the impact of medical resources availability in residential areas on an individual's unmet healthcare needs.

To assess the suitability of the research model for a multi-level analysis, the Intraclass Correlation Coefficient (ICC) was computed and reported [21]. The ICC indicates the proportion of variance explained by regional differences in the total variance of the outcome variable. In addition, the results of the MLM incorporate two concepts: Between-area variance, indicating the variation or difference between the higher-level units (such as regions) in a hierarchical dataset, and percentage change in variation, indicating the proportion of the total variance explained in higher-level units. All statistical analyses were conducted using the SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA). The results are presented as adjusted odds ratios (aOR), 95 % confidence intervals (CIs), and p-values, with statistical significance determined by a p-value of less than 0.05.

3. Results

Table 1 presents the general characteristics of the study population. In total, 9224 (5.2 %) of the 176,378 individuals included in the analysis experienced unmet healthcare within the previous year. Differences in unmet healthcare needs were confirmed based on individual characteristics, except for current economic activity and chronic diseases. The percentage of individuals experiencing unmet healthcare needs was notably high among those who were unmarried, had low levels of education or income, smoked, perceived

their subjective health to be poor, and had depressive symptoms. Furthermore, individuals living in small cities and rural areas with insufficient medical resources experienced higher rates of unmet healthcare.

Table 2 shows the results of the multi-level analysis exploring factors associated with unmet healthcare needs. In this MLM framework, the ICC value of the null model was 90.3 %, indicating a strong clustering effect [22]. Model 3, which accounts for all covariates, found that individuals living in small cities and rural areas with sufficient medical resources were 1.26 times more likely to experience unmet healthcare needs compared to those living in metropolitan cities with sufficient resources (95 % CI: 1.06–1.49). Moreover, for those living in small cities and rural areas lacking sufficient medical resources, the aOR for unmet healthcare needs was the highest at 1.32 (95 % CI: 1.13–1.53).

Additionally, we conducted a stratified analysis according to the sufficiency of medical resources in the residential area (Table 3). Notably, the disparity in unmet healthcare needs between income levels was confirmed to be largest in areas having sufficient medical resources. Among residents in areas with sufficient medical resources, the probability of experiencing unmet healthcare was 1.77 times higher in the lowest income group than in the highest income group (95 % CI: 1.58–1.99). Table 4 presents the results of the stratified

Table 1
General characteristics of the study population.

Variables	Unmet healthcare needs						
	Total		Yes		No		*P-value*
	N	%	N	%	N	%	
	176,378	100.0	9224	5.2	167,154	94.8	
Individual-level							
Sex							<0.0001
Men	79,051	44.8	3447	4.4	75,604	95.6	
Women	97,327	55.2	5777	5.9	91,550	94.1	
Age							<0.0001
20~29	16,601	9.4	777	4.7	15,824	95.3	
30~39	18,289	10.4	961	5.3	17,328	94.7	
40~49	25,264	14.3	1362	5.4	23,902	94.6	
50~59	32,042	18.2	1834	5.7	30,208	94.3	
60~69	38,660	21.9	1808	4.7	36,852	95.3	
70 +	45,522	25.8	2482	5.5	43,040	94.5	
Marital status							<0.0001
Married	114,080	64.7	5347	4.7	108,733	95.3	
Unmarried and Other	62,298	35.3	3877	6.2	58,421	93.8	
Education level							<0.0001
Low	37,580	21.3	2573	6.8	35,007	93.2	
Middle	72,374	41.0	3638	5.0	68,736	95.0	
High	66,424	37.7	3013	4.5	63,411	95.5	
Economic activity							0.3436
Yes	106,004	60.1	5587	5.3	100,417	94.7	
No	70,374	39.9	3637	5.2	66,737	94.8	
Household Income level							<0.0001
Q1 (lowest)	50,047	28.4	3487	7.0	46,560	93.0	
Q2	46,958	26.6	2286	4.9	44,672	95.1	
Q3	43,280	24.5	1944	4.5	41,336	95.5	
Q4 (highest)	36,093	20.5	1507	4.2	34,586	95.8	
Chronic diseases							0.1734
Yes	64,041	36.3	3288	5.1	60,753	94.9	
No	112,337	63.7	5936	5.3	106,401	94.7	
Smoking							<0.0001
Yes	28,601	16.2	1796	6.3	26,805	93.7	
No	147,777	83.8	7428	5.0	140,349	95.0	
Drinking							0.0021
Yes	140,109	79.4	7210	5.1	132,899	94.9	
No	36,269	20.6	2014	5.6	34,255	94.4	
Subjective health status							<0.0001
Good	69,428	39.4	2238	3.2	67,190	96.8	
Bad	106,950	60.6	6986	6.5	99,964	93.5	
Depressive symptoms							<0.0001
Yes	30,604	17.4	3756	12.3	26,848	87.7	
No	145,774	82.6	5468	3.8	140,306	96.2	
Regional-level							
Medical resources in residential area							<0.0001
Sufficient Metropolitan cities	49,156	27.9	2158	4.4	46,998	95.6	
Sufficient Small cities and Rural areas	39,370	22.3	2144	5.4	37,226	94.6	
Insufficient Metropolitan cities	10,051	5.7	425	4.2	9626	95.8	
Insufficient Small cities and Rural areas	77,801	44.1	4497	5.8	73,304	94.2	

Table 2
Adjusted odds ratios of unmet healthcare needs by characteristics of individual- and regional-level (multi-level model).

Variables	Unmet healthcare needs											
	Null model			Model 1			Model 2			Model 3		
	aOR	95 % CI		aOR	95 % CI		aOR	95 % CI		aOR	95 % CI	
Individual-level												
Sex												
Men				1.00						1.00		
Women				1.30	(1.24	1.37)				1.30	(1.24	1.37)
Age												
20~29				1.00						1.00		
30~39				1.10	(0.99	1.21)				1.10	(0.99	1.22)
40~49				1.12	(1.01	1.23)				1.12	(1.01	1.23)
50~59				1.15	(1.04	1.27)				1.15	(1.04	1.27)
60~69				0.82	(0.73	0.91)				0.82	(0.73	0.91)
70 +				0.69	(0.61	0.77)				0.69	(0.61	0.77)
Marital status												
Married				1.00								
Unmarried and other				1.09	(1.04	1.15)				1.09	(1.04	1.15)
Education level												
Low				1.30	(1.19	1.41)				1.29	(1.18	1.40)
Middle				1.03	(0.97	1.09)				1.02	(0.96	1.09)
High				1.00						1.00		
Economic activity												
Yes				1.00						1.00		
No				0.78	(0.74	0.82)				0.78	(0.74	0.82)
Household Income level												
Q1 (lowest)				1.54	(1.42	1.67)				1.54	(1.42	1.67)
Q2				1.13	(1.06	1.22)				1.13	(1.05	1.22)
Q3				1.06	(0.99	1.14)				1.06	(0.99	1.14)
Q4 (highest)				1.00						1.00		
Chronic diseases												
Yes				0.83	(0.79	0.87)				0.83	(0.79	0.87)
No				1.00						1.00		
Smoking												
Yes				1.35	(1.27	1.44)				1.35	(1.27	1.44)
No				1.00						1.00		
Drinking												
Yes				1.01	(0.96	1.07)				1.01	(0.96	1.07)
No				1.00						1.00		
Subjective health status												
Good				1.00						1.00		
Bad				1.64	(1.56	1.73)				1.64	(1.56	1.73)
Depressive symptoms												
Yes				3.09	(2.95	3.24)				3.09	(2.95	3.24)
No				1.00						1.00		
Regional-level												
Medical resources in residential area												
Sufficient Metropolitan cities							1.00			1.00		
Sufficient Small cities and Rural areas							1.29	(1.11	1.54)	1.26	(1.06	1.49)
Insufficient Metropolitan cities							0.99	(0.73	1.35)	0.98	(0.73	1.31)
Insufficient Small cities and Rural areas							1.35	(1.16	1.58)	1.32	(1.13	1.53)
Between area variance (SE)	0.2491(0.02664)*			0.2239(0.02430)*			0.2296(0.02481)*			0.2076(0.02274)*		
Percentage change in variation	–			0.10			0.08			0.17		
Model Fitness												
−2 Log Likelihood		70111.11		66182.79			70113.84			66185.33		
Intraclass correlation coefficient (%)	90.3			90.2			90.2			90.1		

aOR, adjusted odds ratio, CI, confidence interval, SE, standard error.
*p < .05.

Table 3
Results of analysis of factors affecting unmet healthcare needs, stratified by the sufficiency of medical resources in the residential area.

Variables	Unmet healthcare needs							
	Medical resources							
	Sufficient areas				Insufficient areas			
	aOR	95 % CI			aOR	95 % CI		
Sex								
Men	1.00				1.00			
Women	1.32	(1.23	–	1.42)	1.28	(1.19	–	1.37)
Age								
20~29	1.00				1.00			
30~39	1.03	(0.90	–	1.17)	1.22	(1.03	–	1.44)
40~49	1.06	(0.93	–	1.20)	1.23	(1.05	–	1.44)
50~59	1.11	(0.97	–	1.26)	1.26	(1.08	–	1.48)
60~69	0.77	(0.67	–	0.89)	0.92	(0.78	–	1.09)
70 +	0.57	(0.48	–	0.67)	0.84	(0.71	–	1.00)
Marital status								
Married	1.00				1.00			
Unmarried and other	1.07	(0.99	–	1.15)	1.11	(1.04	–	1.19)
Education level								
Low	1.23	(1.08	–	1.41)	1.32	(1.18	–	1.49)
Middle	1.01	(0.93	–	1.10)	1.05	(0.96	–	1.14)
High	1.00				1.00			
Economic activity								
Yes	1.00				1.00			
No	0.71	(0.66	–	0.77)	0.85	(0.80	–	0.91)
Household Income level								
Q1 (lowest)	1.77	(1.58	–	1.99)	1.32	(1.18	–	1.49)
Q2	1.19	(1.08	–	1.32)	1.06	(0.95	–	1.18)
Q3	1.15	(1.05	–	1.26)	0.96	(0.86	–	1.07)
Q4 (highest)	1.00				1.00			
Chronic diseases								
Yes	0.81	(0.75	–	0.88)	0.84	(0.78	–	0.90)
No	1.00				1.00			
Smoking								
Yes	1.39	(1.27	–	1.52)	1.31	(1.19	–	1.43)
No	1.00				1.00			
Drinking								
Yes	0.95	(0.88	–	1.03)	1.05	(0.98	–	1.13)
No	1.00				1.00			
Subjective health status								
Good	1.00				1.00			
Bad	1.58	(1.47	–	1.70)	1.70	(1.57	–	1.83)
Depressive symptoms								
Yes	3.39	(3.16	–	3.63)	2.85	(2.67	–	3.04)
No	1.00				1.00			

aOR, adjusted odds ratio, CI, confidence interval

analysis according to the size of residential area. Similarly, the income-based gap in unmet healthcare needs was most noticeable in metropolitan cities, with the aOR for unmet healthcare needs for the lowest-income group being 1.66 (95 % CI: 1.43–1.93).

4. Discussion

This study identified significant disparities in unmet healthcare needs across South Korea, attributable to the unequal distribution of medical resources and the influence of residential area sizes and socio-economic status on access to healthcare. We examined the landscape of unmet healthcare needs within the Korean population using two nationally representative datasets, the Korean Community Health Survey (CHS) and the Korean medical utilization statistics. Our analysis, which stratified participants at both individual and regional levels, confirmed that living in small cities and rural areas, especially those lacking sufficient medical resources, significantly impacts individual's unmet healthcare needs.

The analysis revealed an imbalance in the distribution of healthcare resources across South Korea. There are significant differences in unmet healthcare needs, depending primarily on the sufficiency of medical resources in one's residential area. Specifically, the analysis highlighted that the likelihood of experiencing unmet healthcare needs was elevated in both small cities and rural areas, irrespective of the availability of sufficient medical resources. But it is also important to consider that regions with generally healthier populations may exhibit lower unmet healthcare needs, potentially influencing the observed disparities. For example, areas with overall healthier residents might report fewer unmet needs, which could lead to an underestimation of access barriers in those regions [23].

Table 4
Results of analysis of factors affecting unmet healthcare needs, stratified by the size of residential area.

Variables	Unmet healthcare needs							
	Size of residential area							
	Metropolitan cities				Small cities and rural areas			
	aOR	95 % CI			aOR	95 % CI		
Sex								
Men	1.00				1.00			
Women	1.29	(1.18	–	1.42)	1.30	(1.22	–	1.38)
Age								
20~29	1.00				1.00			
30~39	1.03	(0.88	–	1.22)	1.14	(1.00	–	1.29)
40~49	1.10	(0.93	–	1.29)	1.13	(1.00	–	1.28)
50~59	1.10	(0.93	–	1.30)	1.18	(1.05	–	1.34)
60~69	0.81	(0.67	–	0.97)	0.83	(0.73	–	0.95)
70 +	0.62	(0.50	–	0.76)	0.72	(0.63	–	0.83)
Marital status								
Married	1.00				1.00			
Unmarried and other	1.06	(0.97	–	1.17)	1.10	(1.04	–	1.17)
Education level								
Low	1.16	(0.98	–	1.37)	1.32	(1.20	–	1.47)
Middle	1.05	(0.95	–	1.17)	1.02	(0.94	–	1.09)
High	1.00				1.00			
Economic activity								
Yes	1.00				1.00			
No	0.68	(0.62	–	0.75)	0.82	(0.78	–	0.87)
Household Income level								
Q1 (lowest)	1.66	(1.43	–	1.93)	1.49	(1.35	–	1.64)
Q2	1.21	(1.06	–	1.37)	1.10	(1.01	–	1.20)
Q3	1.03	(0.91	–	1.17)	1.07	(0.99	–	1.17)
Q4 (highest)	1.00				1.00			
Chronic diseases								
Yes	0.82	(0.74	–	0.91)	0.83	(0.78	–	0.88)
No	1.00				1.00			
Smoking								
Yes	1.35	(1.20	–	1.51)	1.35	(1.25	–	1.45)
No	1.00				1.00			
Drinking								
Yes	0.92	(0.83	–	1.02)	1.05	(0.98	–	1.12)
No	1.00				1.00			
Subjective health status								
Good	1.00				1.00			
Bad	1.59	(1.44	–	1.75)	1.66	(1.56	–	1.77)
Depressive symptoms								
Yes	3.29	(3.01	–	3.60)	3.02	(2.85	–	3.19)
No	1.00				1.00			

aOR, adjusted odds ratio, CI, confidence interval.

Accordingly, the size of residential areas in Korea significantly influences unmet healthcare needs, similar to the availability of adequate medical resources. This observation confirms the imbalance in the distribution of healthcare resources in Korea, with a notable concentration of medical resources in metropolitan cities. Conversely, individuals residing in smaller cities and rural areas are more likely to experience unmet healthcare needs compared to those in well-served metropolitan cities. Furthermore, the analysis revealed a pronounced income disparity in healthcare access, even in regions considered to have sufficient medical resources, indicating that the most significant disparity in unmet healthcare needs, based on income levels, was observed in metropolitan cities or areas with sufficient medical resources.

The main findings of our study were consistent with those of studies that investigated the factors affecting the unmet medical needs of elderly women in Korea [24]. The results of the above study revealed the same results as in our study, illustrating unmet medical rates according to residential areas and low income levels [25,26]. Additionally, many studies on unmet healthcare needs have identified factors influencing unmet medical care, including living alone, low family income, low educational level, basic activities of daily living, hyperactivity and diagnosis, and poor subjective health [27,28]. Therefore, this study contributes a novel dimension to the discussion on healthcare equity by elucidating the nuanced effects of residential area size on healthcare accessibility.

According to our analysis, healthcare policies in South Korea and comparable settings should adopt a more granular approach to address unmet healthcare needs. Currently, small cities and rural areas are experiencing unequal distribution of healthcare resources [29]. Efforts to enhance healthcare in rural areas have improved healthcare accessibility, making this a critical area for improvement [30]. Specifically, policies should prioritize the redistribution of healthcare resources to smaller cities and rural areas, which face unique healthcare access challenges [31,32]. Moreover, policy interventions must address the underlying socio-economic inequalities

contributing to healthcare disparities, ensuring that healthcare accessibility is equitable across all income groups [33].

This study had certain limitations. First, our findings were limited by its reliance on self-reported data and the use of single-year data for analysis. Self-reporting methods are based on respondents' subjective perceptions, which may not be comprehensively representative of the objective situation regarding unmet healthcare needs. Second, the analysis of data from a single year limited the ability to track changes in healthcare accessibility over time. Therefore, long-term follow-up research should be conducted to gain a deeper understanding of the dynamic changes in unmet healthcare needs and the distribution of medical resources. Third, despite considering various factors that may have influenced the results, it is crucial to acknowledge that this study could not have completely eliminated the possibility of remaining confounding effects arising from unmeasured variables. Lastly, these results may be attributed to the distinct characteristics of the Korean society and Korean healthcare system, suggesting limited applicability to other countries.

5. Conclusion

Our findings demonstrate that living in small cities and rural areas, especially areas with insufficient medical resources, significantly impacts individual's unmet healthcare needs. This highlights the seriousness of the medical resource imbalance between regions in South Korea, suggesting the urgent need for a public health policy aimed at allocating medical resources fairly. In addition, we found that people living in areas with sufficient medical services by with low income have higher unmet healthcare needs, which suggests that public health support policies should be established for people with limited access to medical care due to poor socioeconomic status. Such measures are crucial for guaranteeing universal healthcare access and enhancing health quality for everyone.

CRediT authorship contribution statement

Seo Yeong Choi: Writing – original draft, Investigation, Data curation, Conceptualization. **Il Yun:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jong Youn Moon:** Writing – review & editing, Supervision, Project administration, Funding acquisition.

Data availability statement

The datasets analyzed in this study are publicly accessible. First, the 2022 Korean Community Health Survey (CHS) is available online https://chs.kdca.go.kr/. Second, the medical utilization statistics by city, county, and district in Korea are available online at https://kosis.kr/.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jong Youn Moon reports financial support was provided by Gachon University Gil Medical Center. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This study was supported and funded by the Gachon University of Gil Medical Center (Grant Number: FRD2021-19).

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