Association Between Objective Social Isolation and Unmet Medical Needs: A Nationwide Cross-sectional Study in Korea

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Objectives: The aim of this study was to analyze the relationship between objective social isolation (SI) and unmet medical needs (UMN) in adults aged 19 and older.

Methods: A cross-sectional analysis was conducted of 208 619 adults aged 19 and older, excluding missing data, using the 2019 Korea Community Health Survey. To analyze the association between objective SI and UMN, the chi-square test and logistic regression analysis were performed.

Results: The prevalence of UMN was 1.14 times higher (odds ratio [OR], 1.14; 95% confidence interval [CI], 1.06 to 1.23) among those with SI than among those without SI, and the OR for groups with 5 SI types was 2.77 (95% CI, 1.86 to 4.12) compared to those with no SI types. In addition, a stratified analysis by age group showed that the association between SI and UMN existed even in groups under 64 years old. However, among those aged 65 and older, SI was associated with an OR of 1.53 (95% CI, 1.37 to 1.71) for UMN compared to non-SI. As the number of SI types increased, the prevalence of UMN also increased, indicating a strong association between SI and UMN in older adults.

Conclusions: This study found that individuals with SI experienced UMN due to fear and anxiety about interpersonal relationships. Therefore, based on the results of this cross-sectional study, it is necessary to investigate the causal relationship between SI and UMN through future longitudinal data.

Key words: Aged, Health service accessibility, Social isolation, Social interaction

INTRODUCTION

Social isolation (SI) refers to a state in which individuals lack a sense of belonging, which is the most fundamental element of life [1,2]. In modern society, SI is considered an important indicator of whether individuals engage in appropriate interactions with others [3]. SI is also divided into subjective and objective aspects, with the latter defined by a lack of complex social connections, such as a lack of social relationships, network deficits, and insufficient social support, rather than simply by an individual's loneliness [4].

The proportion of people experiencing objective SI is steadily increasing worldwide. According to the "SI Index" report released by the Organization for Economic Cooperation and Development (OECD) in 2022 [5], Korea's SI rate is 20.6%, which was the second highest among OECD countries compared to

the average rate of 9.6%. The SI rates of different age groups (15-29, 30-49, and 50 years old and above) were also found to be higher than the average [5]. In particular, the SI rate among people aged 65 and above was 36.6%, significantly exceeding the average rates in Germany, Japan, and the United States (5-12%), indicating a very serious situation for SI among older Korean adults [3,6].

Previous studies analyzing the causes of SI among older Korean adults suggest that life changes such as children's independence, the death of a spouse, retirement, and other aging-related factors contribute significantly to SI. This issue is exacerbated by Korea's failure to create an environment conducive to enjoying culture, leisure, and social activities, which are often perceived as an economic burden [7]. Furthermore, among the younger generation in Korea, stress from the need to become independent from parents and solve life's problems on their own, as well as insecurity and fear of societal changes, have led to a serious sense of social exclusion and stress due to social and economic crises, consequently leading to more severe SI compared to other countries [7].

SI has a significant impact on the deterioration of physical and mental health, as well as the quality of life [8]. However, even though socially isolated individuals are aware of the need for treatment due to reluctance and reduced desire to participate in social activities, they tend not to visit medical institutions, indicating that medical care for this issue is unsatisfactory [9]. Unmet medical needs (UMN) are used as a measure of medical accessibility worldwide [10,11]. Reducing UMN is necessary, as individuals who have a desire for treatment may not receive it in a timely manner due to various reasons, resulting in increased disease severity and even death [12].

According to a previous study in Japan [9], the rate of UMN was higher in individuals with SI than in those without SI [9]. A previous study analyzing the relationship between social networks and outpatient clinic utilization among 3378 older adults in Korea found that those with fewer social connections were less likely to use outpatient clinics [13]. Additionally, a previous international meta-analysis found that SI not only worsens health but also reduces medical utilization, making it an important factor that can lead to death from loneliness [14].

However, despite the need for managing health deterioration and UMN caused by SI, current policies aimed at improving SI in Korea are mostly pursued at the local government level. Policies directly providing medical support to SI individuals are currently non-existent, as most policies being implemented are still in the stage of identifying the status of SI within local communities [15,16]. Furthermore, despite the fact that the level of SI among young and middle-aged adults in Korea is higher than the OECD average [5], the majority of research on SI has been limited to those over 65 years of age [9,13]. The Korea Institute of Child Care and Education has reported that as of 2020, around 370 000 young adults aged 18 to 34 in Korea are living a life of isolation from society, yet policies and research targeting this demographic are not active.

Therefore, this study aimed to calculate the SI index based on a social relationship model for Korean adults aged 19 or older, and to investigate the objective relationship between SI and UMN [17,18]. Specifically, based on the fact that the SI rate in each age group in Korea is higher than the OECD average [3,6], this study conducted a stratified analysis of the impact of SI on UMN among those aged 65 and older. Based on this, we hope to provide a foundation for policy and institutional measures to improve medical accessibility for vulnerable populations who need medical services but are unable to receive them due to SI.

METHODS

Data Source and Study Participants

This study used the 2019 Korea Community Health Survey (KCHS) [19], which was conducted by the Korea Disease Control and Prevention Agency (KDCA). This secondary analysis used raw data from the KCHS to investigate the association between SI and UMN in older adults living in Korea.

The KCHS was conducted to support the development and evaluation of health policies by providing local health statistics, which became increasingly important with the implementation of the local government system. In addition, the study findings will be used as basic data for calculating health statistics at the city, county, and district levels in order to establish local healthcare plans, expand infrastructure, and evaluate the performance of local health projects. The KCHS is an annual sample survey of 251 public health centers in 16 cities and provinces that has been conducted since 2008. Sampling was conducted using a systematic extraction method in consideration of the number of households based on the number of households by type of house in urban and rural villages and hamlets (*tong*, *ban*, and *ri*, respectively). The survey was designed to ensure that representative samples of adults aged 19 and older could be drawn from the households included in
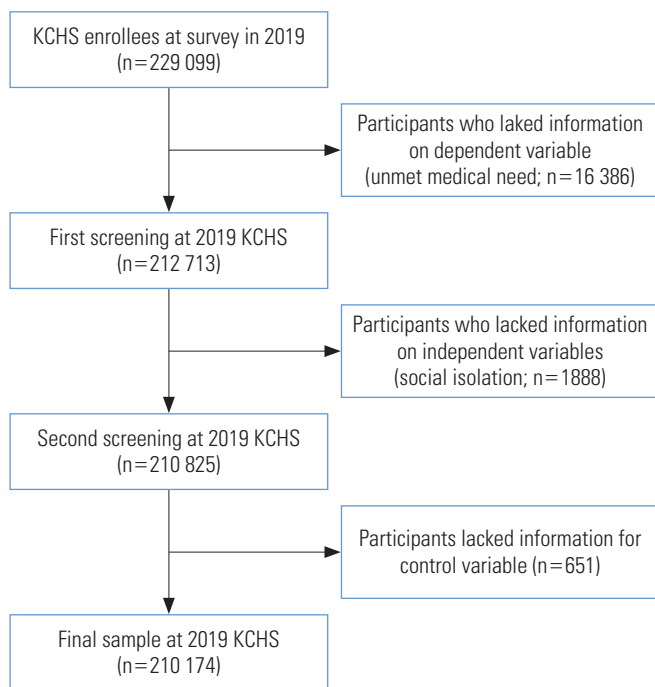
Figure 1. Flow chart for sample selection. KCHS, Korea Community Health Survey.

the study. In 2019, a total of 229 099 individuals participated in the KCHS.

From the 229 099 individuals registered in the 2019 KCHS, we excluded 16 386 participants due to incomplete information on dependent variables, 1888 individuals for lacking data on independent variables, and 651 individuals for missing control variable values. This was done to investigate the association between SI and UMN (Figure 1).

Independent Variables

In this study, the independent variable was SI. The SI index was calculated using the presence of a spouse, single-person household, participation in social activities, social network, and job status with reference to prior studies [17,18]. Scores ranged from 0 to 5, with higher scores indicating greater SI [17,18]. The variables are defined below.

First, the presence of a spouse was categorized as either "no spouse" (due to divorce, bereavement, separation, or being unmarried) or "with spouse." Second, whether an individual lived in a single-person household was defined in contrast with households containing 2 or more people. Third, participation in social activities was classified as either "yes" or "no." The social activities considered were limited to religious activities, clubs, leisure activities, and charity work. Fourth, the social

network was categorized as "no," for those who reported contact with family, neighbors, or friends less than once a month, and "yes," for those who reported such contact more than once a month. Fifth, job status was split into an unemployed group, consisting of those who identified as unemployed, and an employed group, which included individuals working as managers, specialists, office workers, service workers, sales workers, agricultural/forestry workers, skilled workers, machine operators, unskilled laborers, soldiers, or students.

SI was defined as a score of 3-5 according to previous studies by Steptoe et al. [17] and Menes et al. [18]. Furthermore, in this study, the Hosmer-Lemeshow test was conducted with the SI cut-off set to 2-5 and 3-5, and it was found that defining SI as a score of 3-5 yielded a more suitable model. Supplemental Material 1 shows the adequacy of categorizing SI through the Hosmer-Lemeshow test (where a higher p-value and a lower chi-square value indicate better goodness-of-fit). However, considering the uncertainty in categorizing SI, it was also treated as a continuous independent variable.

Dependent Variables

The dependent variable in this study was UMN, defined as an affirmative response to the question, "Have you ever needed medical treatment but not received it in the past 12 months?"

Control Variables

In this study, predefined variables such as age, sex, education level, residency region, and family income in the KCHS were selected as variables. The age groups were classified as 19-29 years, 30-49 years, 50-64 years, and 65 years or older, and sex was classified as male and female. Participants were classified according to their education level as elementary school graduates or lower, middle school graduates, high school graduates, and college graduates or higher, and the residency regions were classified as the capital area, metropolitan cities, and rural areas. Considering that family income is non-standardized due to variations in household size among participants in the 2019 KCHS, we calculated the household-equivalized income values. Subsequently, we categorized them into quartiles: first quartile (low), second quartile (middle-low), third quartile (middle-high), and fourth quartile (high).

As variables for health behavior factors, predefined data such as current smoking status, current alcohol drinking status, moderate or vigorous physical exercise (MVPE), depression, subjective stress level, hypertension diagnosis, and dia-

betes diagnosis were selected as variables. Participants were classified according to their current smoking status as smokers, former smokers, and non-smokers, and their current alcohol drinking status was classified as "ever" and "never." MVPE was categorized as "yes" and "no." Depression was defined using the Patient Health Questionnaire-9 score, with scores under 9 classified as "no" and those of 10 or higher classified as "yes." Subjective stress levels were classified as "high," "moderate," or "none." The diagnoses of hypertension and diabetes were classified as "yes" and "no."

Statistical Analysis

In this study, the general characteristics were compared among categories of SI and UMN using the chi-square test with the complex sampling Rao-Scott correction, to represent the entire population, as this study was designed to use weighted values. Logistic regression analysis was performed, with adjustment for age, sex, education level, residency region, family income, smoking and alcohol drinking status, MVPE, depression experience, subjective stress level, hypertension diagnosis, and diabetes diagnosis.

The weights recommended by the KCHS were applied, and thus all results are presented as weighted values. For all analyses, the criterion for statistical significance was p-value ≤ 0.05 (2-tailed). All analyses were carried out using the SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Ethics Statement

The data were obtained from an open-access dataset and did not contain any personal information on patients; therefore, no ethical approval was required.

RESULTS

Table 1 presents the general characteristics of the participants to examine the association between SI and UMN. Out of the 210 174 participants, the prevalence of UMN diseases was 6.0% (n=12 787). The group with SI comprised 8.1% (n=20 929) of the total participants, and within this group, the prevalence of UMN was also 8.1% (n=1869). Additionally, participants with an SI score of 0 represented 43.0% of the total (91 643 individuals), with a UMN prevalence of 5.3% (n=4745). Those with the highest SI score of 5 made up 0.1% (n=280) of the participants, among whom the prevalence of UMN was significantly higher at 20.7% (n=63).

Table 1. General characteristics of the study population

Characteristics	Total	Unmet medical needs		p-value
		No	Yes	
Total	210 174 (100)	197 387 (94.0)	12 787 (6.0)	
Social isolation				<0.001
No	189 245 (91.9)	178 327 (94.2)	10 918 (5.8)	
Yes	20 929 (8.1)	19 060 (91.9)	1869 (8.1)	
No. of social isolation types				<0.001
0	91 643 (43.0)	86 898 (94.7)	4745 (5.3)	
1	60 653 (31.1)	57 055 (93.9)	3598 (6.1)	
2	36 949 (17.8)	34 374 (93.3)	2575 (6.7)	
3	16 469 (6.6)	15 146 (92.6)	1323 (7.4)	
4	4180 (1.4)	3697 (89.4)	483 (10.6)	
5	280 (0.1)	217 (79.3)	63 (20.7)	
Age (y)				<0.001
19-29	19 589 (16.0)	18 350 (93.7)	1239 (6.3)	
30-49	56 153 (35.5)	52 303 (93.3)	3850 (6.7)	
50-64	63 447 (28.5)	59 654 (94.1)	3793 (5.9)	
≥65	70 985 (20.1)	67 080 (95.2)	3905 (4.8)	
Sex				<0.001
Male	92 539 (48.8)	87 808 (94.7)	4731 (5.3)	
Female	117 635 (51.2)	109 579 (93.3)	8056 (6.7)	
Education				<0.001
≤Elementary school	51 955 (12.3)	48 209 (93.1)	3746 (6.9)	
Middle school	24 807 (8.6)	23 424 (93.8)	1383 (6.2)	
High school	59 936 (29.7)	56 538 (94.0)	3398 (6.0)	
≥College	73 476 (49.5)	69 216 (94.2)	4260 (5.8)	
Family income				<0.001
Low	58 821 (19.6)	54 403 (92.5)	4418 (7.5)	
Middle-low	48 920 (21.8)	46 002 (93.8)	2918 (6.2)	
Middle-high	50 807 (27.6)	48 121 (94.6)	2686 (5.4)	
High	51 626 (30.9)	48 861 (94.6)	2765 (5.4)	
Residency region				<0.001
Capital area	59 086 (44.2)	55 730 (94.5)	3356 (5.5)	
Metropolitan city	41 541 (25.6)	39 153 (94.1)	2388 (5.9)	
Rural area	109 547 (30.3)	102 504 (93.2)	7043 (6.8)	
Current smoking status				0.206
Smoker	33 808 (18.5)	31 483 (92.9)	2325 (7.1)	
Former smoker	42 678 (20.0)	40 537 (94.8)	2141 (5.2)	
Non-smoker	133 688 (61.5)	125 367 (94.1)	8321 (5.9)	
Current alcohol drinking status				0.002
Ever	132 419 (71.9)	124 352 (93.9)	8067 (6.1)	
Never	77 755 (28.1)	73 035 (94.3)	4720 (5.7)	
Regular walking				<0.001
No	125 659 (54.2)	117 205 (93.6)	8454 (6.4)	
Yes	84 515 (45.8)	80 182 (94.5)	4333 (5.5)	

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Table 1. Continued from the previous page

| Characteristics | Total | Unmet medical needs | | p-value |
		No	Yes	
Moderate or vigorous exercise				0.169
No	176 814 (82.2)	166 016 (93.9)	10 798 (6.1)	
Yes	33 360 (17.8)	31 371 (94.2)	1989 (5.8)	
Depression				<0.001
Yes	13 137 (6.4)	11 160 (84.6)	1977 (15.4)	
No	197 037 (93.6)	186 227 (94.6)	10 810 (5.4)	
Perceived stress				<0.001
High	46 788 (25.0)	41 421 (89.1)	5367 (10.9)	
Moderate	111 918 (55.6)	106 328 (95.3)	5590 (4.7)	
Low	51 468 (19.4)	49 638 (96.7)	1830 (3.3)	
Diabetes diagnosis				0.034
No	184 711 (90.9)	173 351 (94.0)	11 360 (6.0)	
Yes	25 463 (9.1)	24 036 (94.4)	1427 (5.6)	
Hypertension diagnosis				<0.001
No	147 636 (78.2)	138 420 (93.8)	9216 (6.2)	
Yes	62 538 (21.8)	58 967 (94.6)	3571 (5.4)	

Values are presented as number (weighted %).

Table 2 presents the results of analyses that adjusted for control variables to assess the relationship between SI and UMN. In model 1, individuals with SI had a 1.23-fold higher prevalence of UMN than those without SI (95% confidence interval [CI], 1.14 to 1.33). In model 2, when compared to individuals with an SI score of 0, the prevalence of UMN was 1.13 times higher in individuals with a score of 3 (95% CI, 1.06 to 1.20), 1.71 times higher in those with a score of 4 (95% CI, 1.48 to 1.98), and 3.09 times higher in those with a score of 5 (95% CI, 2.09 to 4.56).

Table 3 presents the results of a stratified analysis examining the association between SI and UMN across different age groups. In individuals aged 50 and younger, no association was observed between SI and UMN. However, in the 50-64 age group, those with SI had a 1.28-fold higher risk of UMN than those without SI (95% CI, 1.10 to 1.49). Furthermore, individuals with an SI score of 5 had a 2.31-fold higher risk of UMN than the reference group (95% CI, 1.18 to 4.52). In older adults (aged 65 and older), the presence of SI was associated with a 1.70-fold higher rate of UMN than in those without SI (95% CI, 1.53 to 1.89). Additionally, those with an SI score of 5 had a 5.41-fold higher rate of UMN than those with an SI score of 0 (95% CI, 3.40 to 8.61).

Supplemental Material 2 presents additional analyses conducted to explore the relationship between five indicators

Table 2. Factors associated with unmet medical needs in the group of social isolation (SI)

| Variables | Unmet medical needs | |
	Model 1	Model 2
SI		
No	1.00 (reference)	-
Yes	1.23 (1.14, 1.33)	-
No. of SI type		
0	-	1.00 (reference)
1	-	1.13 (1.06, 1.20)
2	-	1.24 (1.16, 1.34)
3	-	1.27 (1.16, 1.39)
4	-	1.71 (1.48, 1.98)
5	-	3.09 (2.09, 4.56)
Age (y)		
19-29	1.00 (reference)	1.00 (reference)
30-49	1.03 (0.96, 1.12)	1.11 (1.02, 1.21)
50-64	0.89 (0.81, 0.97)	0.97 (0.88, 1.06)
≥65	0.58 (0.52, 0.65)	0.61 (0.55, 0.69)
Sex		
Male	1.00 (reference)	1.00 (reference)
Female	1.40 (1.31, 1.50)	1.41 (1.32, 1.52)
Education		
≤Elementry school	1.64 (1.49, 1.81)	1.59 (1.44, 1.75)
Middle school	1.34 (1.22, 1.47)	1.32 (1.20, 1.45)
High school	1.08 (1.02, 1.15)	1.07 (1.01, 1.14)
≥College	1.00 (reference)	1.00 (reference)
Family income		
Low	1.36 (1.27, 1.47)	1.35 (1.25, 1.45)
Middle-low	1.14 (1.06, 1.23)	1.15 (1.07, 1.23)
Middle-high	1.00 (0.93, 1.08)	1.01 (0.94, 1.09)
High	1.00 (reference)	1.00 (reference)
Residency region		
Capital area	1.00 (reference)	1.00 (reference)
Metropolitan city	1.09 (1.01, 1.16)	1.09 (1.02, 1.17)
Rural area	1.24 (1.16, 1.33)	1.25 (1.17, 1.34)
Current smoking status		
Smoker	1.00 (reference)	1.00 (reference)
Former Smoker	1.35 (1.25, 1.46)	1.33 (1.23, 1.44)
Non-Smoker	1.18 (1.09, 1.29)	1.18 (1.09, 1.28)
Current alcoholic drinking status		
Ever	1.09 (1.03, 1.16)	1.10 (1.04, 1.17)
Never	1.00 (reference)	1.00 (reference)
Regular walking		
No	1.08 (1.03, 1.14)	1.08 (1.03, 1.14)
Yes	1.00 (reference)	1.00 (reference)

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Table 2. Continued from the previous page

Variables	Unmet medical needs	
	Model 1	Model 2
Moderate or vigorous exercise		
No	0.97 (0.91, 1.04)	0.96 (0.90, 1.03)
Yes	1.00 (reference)	1.00 (reference)
Depression		
No	1.00 (reference)	1.00 (reference)
Yes	2.09 (1.95, 2.25)	2.05 (1.91, 2.21)
Perceived stress		
High	2.89 (2.67, 3.13)	2.90 (2.68, 3.14)
Moderate	1.37 (1.27, 1.48)	1.38 (1.28, 1.49)
Low	1.00 (reference)	1.00 (reference)
Diabetes diagnosis		
No	1.00 (reference)	1.00 (reference)
Yes	0.95 (0.88, 1.04)	0.95 (0.87, 1.03)
Hypertension diagnosis		
No	1.00 (reference)	1.00 (reference)
Yes	0.92 (0.86, 0.98)	0.92 (0.86, 0.98)

Values are presented as adjusted odds ratio (95% confidence interval).

used to measure SI and UMN disease by age group. In all age groups, significant associations were observed between the 5 SI indicators and UMN. However, for the "presence of job" index, the prevalence of UMN was lower among the unemployed than among the employed.

In the 19-29 year age group, living in a single-person household was associated with UMN; in the 30-49 year age group, associations were found with participation in social activities, having a social network, and employment status; in the 50-64 years age group, being married, participating in social activities, and having a social network were associated factors; and in the over 65 years age group, all indicators except for employment status showed associations.

DISCUSSION

This study aimed to investigate the correlation between objective SI and UMN using the KCHS, which was conducted among Korean adults aged 19 and over. In the global context of increasing SI [5], Korea's SI level is higher than the OECD average across all age groups, and particularly, the SI of people aged 65 and over has steadily increased from 28.2% in 2011 to 31.1% in 2021 [20]. However, the measurement indicator used to compare SI internationally is a single question [21]— "Is there someone you can ask for help when you need it?"—

Table 3. Factors associated with unmet medical needs in participants with social isolation (SI) by age

Variables	Unmet medical needs, SI[1]	
	Model 1	Model 2
19-29 y		
SI		
No	1.00 (reference)	-
Yes	0.86 (0.71, 1.02)	-
No. of SI types		
0	-	1.00 (reference)
1	-	0.98 (0.73, 1.32)
2	-	0.85 (0.63, 1.14)
3	-	0.77 (0.55, 1.08)
4	-	1.04 (0.59, 1.83)
5	-	1.05 (0.61, 1.94)
30-49 y		
SI		
No	1.00 (reference)	-
Yes	1.03 (0.87, 1.23)	-
No. of SI types		
0	-	1.00 (reference)
1	-	1.07 (0.98, 1.17)
2	-	1.17 (0.84, 1.19)
3	-	1.03 (0.84, 1.23)
4	-	1.33 (0.92, 1.91)
5	-	3.22 (1.47, 7.04)
50-64 y		
SI		
No	1.00 (reference)	-
Yes	1.28 (1.10, 1.49)	-
No. of SI types		
0	-	1.00 (reference)
1	-	1.11 (1.00, 1.24)
2	-	1.46 (1.29, 1.66)
3	-	1.32 (1.10, 1.59)
4	-	1.60 (1.18, 2.18)
5	-	2.31 (1.18, 4.52)
≥65 y		
SI		
No	1.00 (reference)	-
Yes	1.70 (1.53, 1.89)	-
No. of SI types		
0	-	1.00 (reference)
1	-	1.22 (1.06, 1.41)
2	-	1.68 (1.48, 1.92)
3	-	2.04 (1.76, 2.36)
4	-	2.47 (2.04, 2.98)
5	-	5.41 (3.40, 8.61)

Values are presented as adjusted odds ratio (95% confidence interval).
[1]Control variables: age, sex, education, family income, residency region, current smoking status, current alcoholic drinking status, regular walking, moderate or vigorous exercise, depression, perceived stress, diabetes diagnosis and hypertension diagnosis.

meaning that the validity and reliability of SI are quite low. Therefore, this study aimed to assess the current status of SI in Korea using measurement indicators that are currently being utilized to achieve a multifaceted understanding of SI. In addition, although there were not many studies using SI measurement similar to this study, it also sought to compare Korea's SI status with other countries. A comparative analysis with studies utilizing the same SI indicators as this study revealed a notably high rate of SI among the Korean population aged 65 and older. Furthermore, the study aimed to identify vulnerable groups experiencing unmet healthcare needs due to SI, providing foundational data for policy and institutional interventions.

To summarize the research findings, individuals with SI had a higher rate of UMN than the non-SI group, and as the number of SI types increased, the rate of UMN also increased. There was a strong association between SI and UMN in those aged 65 and above, compared to those under 65.

Humans are social animals, and a sense of belonging is crucial. To achieve this, continuous social and economic activities, such as socializing and engaging in community activities, are necessary [22]. However, when SI occurs due to an unfulfilled sense of belonging, it can cause neurological, physiological, physical, and social pain [23], leading to complex health problems such as increased stress, depression, and chronic illness [24-26]. SI may lead individuals to experience fear and anxiety about interpersonal relationships and travel outside the home, which can lead to agoraphobia and worsened health status; furthermore, they may experience UMN and not seek treatment at medical institutions [13,27,28]. A previous study found that the determinants of SI, such as the frequency of contact with family, friends, and the community, had a significant impact on health deterioration as the degree of SI increased [29]. This is because the lack of social support and communication exacerbates loneliness and isolation [29], which in turn increases fear and anxiety about interpersonal relationships and social contact, resulting in an increase in UMN [30]. Therefore, the results of this study show that SI and the degree of isolation are associated with UMN, which is consistent with previous studies [13,22-30].

Furthermore, this study found no association between SI and UMN in those aged 49 and under, which can be explained in light of the findings of several previous studies [31,32]. UMN refers to the lack of receiving necessary medical services. However, younger individuals may not accurately perceive the ne-

cessity of medical services [32]. In fact, according to prior research, younger individuals tend to interpret health in a narrow sense, not appropriately recognizing the need for health management and not considering the cumulative process of health issues [31]. Therefore, even if they have health problems, the group aged 49 and under who are SI may not perceive their health issues as a need for medical services. This interpretation explains the lack of an observed association between SI and UMN.

In contrast, in those aged 50-64 and 65 or older, there was a stronger association between SI and UMN than in the younger age group. A previous study in Korea found that older adults had a higher level of medical demands for chronic diseases and physical disabilities than younger age groups [33]. Furthermore, the number of medical treatments received by older adults is relatively high according to the utilization status of medical services reported by the National Health Insurance Service [34]. However, due to occupational status, income level, and difficulty in transportation, older adults also experience a high level of UMN [35]. In this situation, the occurrence of SI among older adults further deteriorates physical and mental health, leading to a decrease in quality of life, and consequently, an increased frequency of experiencing UMN compared to those without SI. Notably, as the severity of SI increases, the rate of UMN escalates more sharply due to social fears, despite the need for treatment [9,36].

Furthermore, a study analyzing the relationship between social networks and medical utilization in 3374 individuals aged 65 and older found that an increase in social connections led to heightened health management awareness among the elderly through social interactions. This awareness provided them with information or instrumental support for medical services, which indirectly helped reduce UMN by facilitating visits to medical institutions they had not previously accessed [13]. In addition, the Korean Ministry of Health and Welfare has recently prepared legislation to address SI and establish support for UMN groups. However, specific measures, such as the establishment of a "loneliness office" in Europe to address SI at the community level, are still lacking. Therefore, this study suggests that while promoting medical utilization is important for reducing UMN in SI, programs that build social networks and encourage regular participation are also necessary. Particularly for groups with high levels of SI, such programs could not only improve physical and mental health but also decrease UMN. Based on these results, it is anticipated that implementing

policies and programs tailored to the age-specific SI factors identified in this study could lower the rate of UMN, particularly among populations with limited access to healthcare due to SI. Such interventions are expected to contribute to overall health improvements.

One limitation of this study is that the use of cross-sectional KCHS data limited our ability to infer causal relationships between SI and UMN. Second, there is a potential for subjective bias due to the nature of the KCHS, which relies on respondents' self-reported opinions. It is therefore necessary to interpret the research findings while acknowledging the limitations of objectivity in self-reported data. Third, the SI measurement method of Steptoe et al. [17] and Menes et al. [18] was employed to assess objective SI, but it did not account for social networking services, which are a significant form of social connection for younger generations, as only direct contact is recognized as a social connection. Lastly, the SI measurement method of Steptoe et al. [17] and Menes et al. [18] primarily uses tool items developed for the elderly, which limits its ability to detect SI in non-elderly groups.

Despite these limitations, this study has several strengths. First, it extends beyond previous research that primarily focused on SI in the elderly by providing a comprehensive analysis of non-elderly populations. Second, it improves upon the subjective measures of SI, such as loneliness, by employing objective indicators for a more robust assessment. Third, the study is representative of the Korean population, as weights were applied to each sample based on data from the KCHS. Fourth, it advances our understanding by not uniformly classifying SI across all age groups; instead, it identifies age-specific SI indicators that are strongly associated with UMN. This nuanced approach offers valuable insights for improving access to healthcare services for those affected by SI.

This study analyzed the association between objectively measured SI and UMN based on the 2019 KCHS, in which adults aged 19 and older participated. The research findings showed that the rate of SI among older adults in Korea was considerably higher than in other countries, and SI was associated with a higher prevalence of UMN than was observed in the non-SI group. Additionally, there was a positive correlation between the severity of SI and the prevalence of UMN. Notably, the association between SI and UMN strengthened with increasing age.

Based on these results, it is anticipated that implementing policies and programs tailored to the age-specific SI factors identified in this study could lower the rate of UMN, particularly among populations with limited access to healthcare due to SI. Such interventions are expected to contribute to overall health improvements.

NOTES

Data Availability
The data that support the findings of this study are openly available from the Korea Community Health Survey at http://chs.kdca.go.kr/.

Supplemental Materials
Supplemental materials are available at https://doi.org/10.3961/jpmph.23.516.

Conflict of Interest
The authors have no conflicts of interest associated with the material presented in this paper.

Author Contributions
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