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Changes in the Emergency Department Visits Among the Older Adults With Dementia Before, and After the Nationwide Social Distancing Measures: An Interrupted Time Series Analysis

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ABSTRACT

Objectives: Social isolation is a well-known risk factor for dementia, particularly among the older adults. The recent global health crisis, coupled with prolonged social distancing, leading to unprecedented disruptions in social interactions and raising concerns about unforeseen impacts on vulnerable populations, particularly older individuals with dementia. This study examines the impact of extended social isolation on dementia patients receiving emergency care.

Methods: We conducted a nationwide study of emergency department (ED) visits among dementia patients aged 65+ during various phases of pandemic-related social distancing. Segmented quasi-Poisson regression models were used to determine changes in ED visits during and after social distancing compared to pre-social distancing.

Results: From 2017 to 2022, there were 203,772 ED visits by patients with dementia among older patients. The proportion of ED visits by patients with dementia decreased from 17% pre-pandemic to 15% during social isolation. Interrupted time series analysis revealed a decline in ED visits during social distancing (step change: 0.849, 95% confidence interval [CI] 0.804–0.897; slope change: 1.000, 95% CI 0.996–1.003) followed by a rebound after restrictions were lifted (step change: 1.076, 95% CI 1.024–1.131; slope change: 1.009, 95% CI 0.994–1.025). However, monthly admission and mortality rates increased during social distancing.

Conclusion: This study observed a decline in ED visits by patients with dementia among older patients during social distancing, followed by a rebound after restrictions were lifted. However, the social distancing period was associated with increased hospitalization and mortality. These findings underscore the importance of maintaining healthcare accessibility for vulnerable older adults.

1 | Introduction

Social isolation refers to the perceived or objective absence of support or connection from social networks [1]. This lack of social connections has been shown to have detrimental health outcomes, including mental health disorders and cognitive decline [2]. The Lancet Commission identified social isolation, along with depression and physical inactivity, as modifiable risk factors for dementia [3]. A review study reported that social isolation and loneliness are associated with poorer executive

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Summary

- Social distancing measures during the COVID-19 pandemic significantly reduced emergency department (ED) visits among elderly dementia patients in South Korea, with a stepwise recovery following the lifting of restrictions.
- Prolonged social isolation has been shown to lead to higher rates of adverse health outcomes, including hospitalization and mortality, among dementia patients.
- The decline in ED visits during the pandemic may have been influenced not only by reduced healthcare accessibility but also by delayed medical attention due to fear of COVID-19 exposure, potentially exacerbating unmet healthcare needs among dementia patients.

functioning, accelerated cognitive decline, and reduced overall cognitive performance [4]. In recent years, there has been growing interest in understanding the relationship between social isolation and the onset or progression of dementia [2, 5].

Social isolation has long been recognized as a major health concern for the older adults, contributing to numerous adverse outcomes. Several studies had already highlighted its negative effects on cognitive health, including an increased risk of dementia, all-cause mortality, and rehospitalization [5]. Dementia —a neurodegenerative condition characterized by progressive cognitive decline—poses a significant public health challenge, affecting individuals, families, and healthcare systems worldwide [6, 7]. These findings underscore the critical role of social connections in maintaining cognitive health and preventing dementia.

Moreover, social isolation has been linked to emergency department (ED) visits among older patients with dementia. Individuals with dementia often require additional support from caregivers to communicate with healthcare providers and assist with ongoing care and assessment in the ED [8]. ED visits are often triggered by the worsening of dementia-related symptoms, including behavioral issues, confusion, agitation, falls, and delirium, which are likely exacerbated by prolonged isolation [9, 10]. Research indicates that socially isolated older adults are more likely to seek emergency medical care due to the absence of a support network to help manage their symptoms, thereby increasing the demand for urgent medical assistance [11]. A Canadian study found that one in four dementia patients visit the ED at least once a year, tend to have longer stays, and face a higher likelihood of hospitalization compared to older adults without dementia [12]. It has been emphasized that thorough assessment in primary care and effective use of community resources can help reduce ED visits for dementia patients [8].

However, introduction of social distancing measures during the COVID-19 pandemic caused unprecedented disruptions in social interactions, raising concerns about unintended consequences for vulnerable populations, particularly older individuals with dementia [13]. These disruptions present an opportunity to investigate how reduced social connectivity during this period may have influenced dementia-related emergency care needs. However, most studies on social isolation transitions related to COVID-19 have primarily focused on psychological distress or mental health conditions [14–16]. And, long-term time-series analyses exploring the effects of pandemic-related social distancing on this population remain exceedingly rare [17, 18]. Therefore, this study aims to examine the impact of long-term interventions related to social isolation on cognitive health among older adults in the ED. Specifically, it focuses on the potential effects of reduced social connectivity and limited healthcare access during the pandemic, using the interrupted time series (ITS) method.

2 | Methods

2.1 | Data Source and Study Population

We conducted a population-based cross-sectional study including patients aged 65 years and older who visited the ED from January 1, 2017, to December 31, 2022, using the National Emergency Department Information System (NEDIS) database. This study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies.

This database includes demographic information (age, gender, region, and insurance status), ED visit details (date and time of arrival and departure, mode of arrival, transport method, chief complaint, and triage results according to the Korean Triage Acuity Scale [KTAS]), as well as disposition and diagnosis codes based on the International Classification of Diseases, 10th Edition (ICD-10) [19]. Detailed descriptions of the NEDIS database design and variables were provided in previous studies [20, 21].

This study was approved by the Institutional Review Boards of the National Medical Center (NMC-2023-03-037), which waived the requirement for informed consent due to the retrospective nature of the study.

2.2 | Study Outcomes and Variables

The primary outcome was the number of dementia-related ED visits during the historical, implementation, and lifting phases of social distancing. ED visits with dementia were classified into three categories: Alzheimer's disease (F00, G30), vascular dementia (F01), and other dementia (F02-F03) [22].

The variables included patient demographics (age, sex, and insurance status) and ED factors (type and region of the ED, ambulance use, admission, mortality, triage results according to the KTAS, and final clinical outcomes). Patient age was categorized into three groups: 65–74, 75–84, and 85+ years. ED regions were categorized based on population density and administrative divisions (urban, sub-urban, and rural areas). The health outcomes assessed all-cause mortality, hospitalization, and emergency rates. The emergency rate among patients with dementia was included in KTAS levels 1-2.

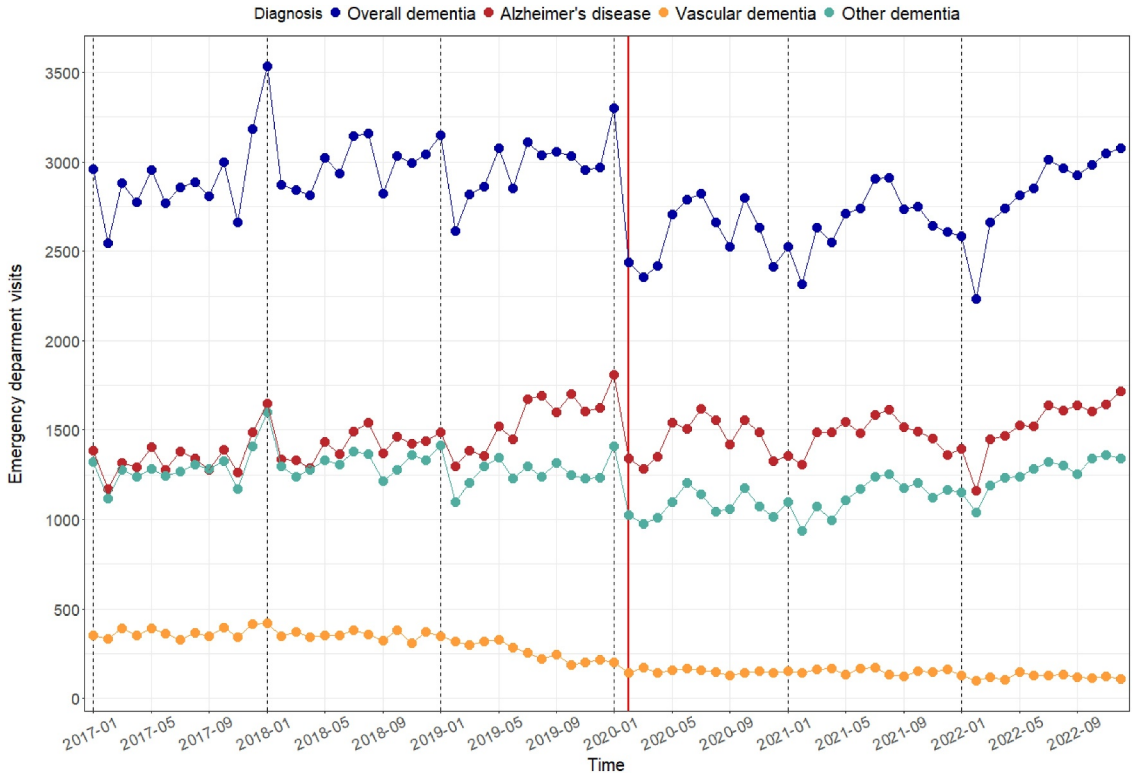

FIGURE 1 | Monthly trends of patients with dementia visiting emergency department. The red line represents the beginning of the first onset of COVID-19 pandemic in South Korea.

2.3 | Statistical Analysis

Descriptive analysis using a chi-square test was conducted to compare the characteristics of dementia patients. Rates of mortality, hospitalization, and triage outcomes were calculated for each month during the study period. The ITS analysis was performed on monthly ED visit data from 2017 to 2022 [23]. Among quasi-experimental research designs, ITS analysis is considered one of the most robust, especially when conducting a randomized trial is not feasible or unethical [24, 25]. And another advantage of interrupted time series analysis is its resilience to common time-dependent confounders that stay relatively stable over time [26]. ITS allows for the identification of immediate shifts in trends (step changes) and gradual changes over time (slope changes) resulting from the social isolation caused by the COVID-19 pandemic. To assess whether ED visits during the implementation of social distancing (February 2020 to March 2022) and after the lifting of restrictions (April 2022 to December 2022) differed from the pre-social distancing period (January 2017 to January 2020), a segmented quasi-Poisson regression model was used to analyze monthly trends. The ITS model includes the intervention, an interaction term to account for step and slope changes, and a covariate adjusted for seasonality. The model is as follows:

$$Y_t = \beta_0 + \beta_1 T + \sum_{j=1}^{2} \beta_{j2} X_{tj} + \sum_{j=1}^{2} \beta_{j3} X_{tj}(T - T_0)$$

Where Y_t represents the number of ED visits at time t, β_0 is the baseline level, β_1 represents the time since the start of the study (in months), T represents the time elapsed since the beginning of the study, β_2 is the step change after the intervention j (pre-intervention is coded 0, else 1), X_{tj} is a dummy variable indicating the intervention j, and β_3 indicates the slope change after the intervention j.

For sensitivity analysis, we estimate rate ratios (RRs) and 95% confidence intervals (CIs) by comparing the rates of emergency department visits during the month with the lowest rate and the most recent month within the closest comparator period that includes the same months. Specifically, we compare: (1) the period during the implementation of social distancing (April 2020 to December 2020) with the pre-social distancing period (April 2019 to December 2019); and (2) the period after the lifting of restrictions (April 2022 to December 2022) with the period before the lifting of restrictions (April 2021 to December 2021). We also performed additional analyses, matching the periods before and after the implementation of social distancing (in months) and the period before and after the lifting of restrictions (in weeks). Subgroup analyses were conducted each dementia subcategory and examined the periods before (January 2017 to January 2020) and after (February 2020 to December 2022) the implementation of social distancing using a single breakpoint. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) and R statistical software version 4.3.3 (R Foundation for Statistical Computing). The threshold for statistical significance was set at $p < 0.05$ using a two-sided test.

3 | RESULTS

From January 1, 2017, to December 31, 2022, the total number of ED visits by older patients was 11,639,534. Among this

TABLE 1 | Demographic characteristics of the older population with dementia who visited emergency department.

		Overall dementia		Alzheimer's disease		Vascular dementia		Other dementia	
Variables		**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Total		203,772	100.00	105,387	100.00	17,082	100.00	88,243	100.00
Year	2017	34,279	16.82	15,991	15.17	4389	25.69	15,247	17.28
	2018	36,208	17.77	17,137	16.26	4316	25.27	15,994	18.12
	2019	35,524	17.43	18,388	17.45	3228	18.90	15,158	17.18
	2020	31,856	15.63	17,792	16.88	1868	10.94	13,232	14.99
	2021	32,021	15.71	17,697	16.79	1821	10.66	13,549	15.35
	2022	33,884	16.63	18,382	17.44	1460	8.55	15,063	17.07
Age	65–74	27,095	13.30	13,703	13.00	3941	23.07	10,600	12.01
	75–84	101,509	49.81	52,812	50.11	8835	51.72	43,399	49.18
	85+	75,168	36.89	38,872	36.89	4306	25.21	34,244	38.81
Sex	Male	72,162	35.41	36,797	34.92	7351	43.03	30,686	34.77
	Female	131,610	64.59	68,590	65.08	9731	56.97	57,557	65.23
Region	Urban	82,085	40.28	37,293	35.39	6625	38.78	40,624	46.04
	Sub-urban	105,892	51.97	56,982	54.07	9328	54.61	43,395	49.18
	Rural	15,795	7.75	11,112	10.54	1129	6.61	4224	4.79
Insurance	Medicare	3061	1.50	1708	1.62	333	1.95	1127	1.28
	Medicaid	171,781	84.30	88,674	84.14	14,578	85.34	74,376	84.29
	Others	28,930	14.20	15,005	14.24	2171	12.71	12,740	14.44
Type of ED	Level 1	53,964	26.48	20,364	19.32	3861	22.60	31,030	35.16
	Level 2	84,867	41.65	42,913	40.72	8033	47.03	36,792	41.69
	Level 3	64,941	31.87	42,110	39.96	5188	30.37	20,421	23.14
Ambulance use	Yes	130,027	63.81	64,238	60.95	10,542	61.71	59,482	67.41
Admission	ICU	31,029	15.23	12,879	12.22	3054	17.88	16,039	18.18
	Hospital ward	93,814	46.04	43,905	41.66	7865	46.04	45,183	51.20
In-hospital mortality	ED	672	0.33	349	0.33	42	0.25	298	0.34
	Hospital ward	13,980	6.86	6086	5.77	884	5.18	7376	8.36

Abbreviations: ED, emergency department; ICU, intensive care unit.

population, 203,772 patients (1.75%) were diagnosed with dementia. The average proportion of older patients visiting the ED due to dementia was 17% before the implementation of social isolation measures during the COVID-19 pandemic, but it slightly decreased to 15% after the measures were implemented. Monthly trends in ED visits by dementia patients showed varying patterns over time (Figure 1). The number of overall dementia-related visits exhibited an increasing monthly trend during the pre-social distancing period. However, after the implementation of social distancing, the number of ED visits declined immediately. Following the lifting of social distancing restrictions, the ED visits steadily increased.

Among dementia patients, those aged 75–84 years comprised the largest proportion (49.81%), followed by patients aged 85 years and older (36.89%), and those aged 65–74 years (13.30%; Table 1). Females comprised 65% of the study population, while males accounted for 35%. More than 9% of ED visits by patients with dementia were due to unintentional accidents, with slip-downs and falls contributing to approximately 6% of these cases (Supporting Information S1: Appendix 1). By chief complaints, the most common symptoms across all dementia diagnoses were dyspnea (26,109 cases, 11.74%), fever (23,767 cases, 10.69%), and asthenia (20,701 cases, 9.31%; Table 2). The main symptoms showed a similar pattern regardless of social distancing policy (Supporting Information S1: Appendix 2). For patients with Alzheimer's disease, asthenia was the most common symptom (10.13%), followed by dyspnea (9.94%) and fever (9.56%). Similarly, for vascular dementia and other types of dementia, asthenia, dyspnea, and fever were the most prevalent symptoms.

In terms of healthcare outcomes, there were substantial increases in mortality and hospitalization rates among dementia patients following the onset of the COVID-19 pandemic (Figure 2, Supporting Information S1: Appendix 3). Although mortality and emergency rates fluctuated over time, a sharp decrease was observed after the end of social distancing measures. The admission rate demonstrated a sustained increase compared to the pre-pandemic period. Emergency cases

TABLE 2 | Top 10 chief complaints of the older population with dementia who visited emergency department.

	Overall dementia			Alzheimer's disease			Vascular dementia			Other dementia		
Rank	Chief complaints	N	%	Chief complaints	N	%	Chief complaints	N	%	Chief complaints	N	%
1	Dyspnea	26,109	11.74	Asthenia	11,315	10.13	Dyspnea	1646	9.15	Dyspnea	14,037	14.03
2	Fever	23,767	10.69	Dyspnea	11,093	9.94	Fever	1630	9.06	Fever	12,230	12.22
3	Asthenia	20,701	9.31	Fever	10,670	9.56	Asthenia	1524	8.47	Asthenia	8688	8.68
4	Abdominal pain	7155	3.22	Dizziness	4197	3.76	Dysarthria	757	4.21	Abdominal pain	3637	3.63
5	Dizziness	6354	2.86	Abdominal pain	3316	2.97	Dizziness	619	3.44	Disorientation	2814	2.82
6	Disorientation	5662	2.55	Coxalgia	3191	2.86	Disorientation	491	2.73	Coxalgia	2130	2.13
7	Coxalgia	5438	2.45	Disorientation	2573	2.30	Headache	488	2.71	Mental status changes	1966	1.96
8	Mental status changes	4171	1.88	Dysarthria	2178	1.95	Left hemiparesis	430	2.39	Dizziness	1746	1.74
9	Dysarthria	4090	1.84	Back pain	2004	1.79	Mental status changes	399	2.22	Sputum	1694	1.69
10	Vomiting	3443	1.55	Mental status changes	1951	1.75	Right hemiparesis	364	2.02	Vomiting	1511	1.51

accounted for a higher proportion of ED visits during the social distancing period than in the pre-social distancing period.

The temporal trends were analyzed using ITS analysis (Figure 3). During the implementation of social distancing, ED visits for overall dementia decreased (step change: 0.849, 95% confidence interval [CI] 0.804–0.897; slope change: 1.000, 95% CI 0.996–1.003). However, ED visits recovered after the lifting of social distancing measures (step change: 1.076, 95% CI 1.024–1.131; slope change: 1.009, 95% CI 0.994–1.025). Similar patterns were observed in patients included in the sensitivity analyses, as well as in patients with Alzheimer's disease and other types of dementia (Supporting Information S1: Appendix 4-6). When comparing the periods before and after the onset of social distancing, ED visits among all dementia patients decreased sharply during the pandemic (step change: 0.832, 95% CI 0.787–0.880), but the slope exhibited an upward trend (slope change: 1.003, 95% CI 1.000–1.005; Supporting Information S1: Appendix 7).

4 | Discussion

We conducted a retrospective study to evaluate the long-term effects of social isolation measures implemented during the COVID-19 pandemic, focusing on policy impacts and their influence on ED visits for dementia in South Korea. After the introduction of social distancing measures in February 2020, monthly ED visits with dementia among patients aged 65 and older declined significantly (step change: 0.849, 95% CI 0.804–0.897). However, following the lifting of social distancing measures in April 2022, a notable rebound in ED visits was observed (step change: 1.076, 95% CI 1.024–1.131).

Our findings are consistent with previous studies. Maclagan et al. reported a decline in ED visits by patients with dementia (rate ratio [RR] 0.50, 95% CI 0.47–0.53) during social isolation compared to pre-pandemic levels [17]. Similarly, during the first wave of the COVID-19 pandemic, significant declines were observed across all healthcare services in Canada, with the largest decreases in nursing home admissions (older adults RR: 0.11, 95% CI, 0.06–0.18; dementia RR: 0.10, 95% CI, 0.07–0.15) and ED visits (older adults RR: 0.45, 95% CI, 0.44–0.47; dementia RR: 0.45, 95% CI, 0.41–0.48) [18].

The sharp and immediate decline in ED visits could be attributed to a combination of physical access barriers, changes in patient health-seeking behavior, and healthcare system adaptations [19]. During the pandemic, many healthcare facilities reallocated resources to fever screening and isolation wards. Some local hospital emergency rooms were repurposed as triage and diagnostic units for COVID-19, while private services canceled or postponed appointments, particularly following the implementation of social isolation measures [22]. This strained healthcare system likely made it difficult for patients to access care. Additionally, fear of exposure to the virus discouraged patients and caregivers from seeking emergency care, leading to a potential delay in necessary treatment [27, 28]. We observed an increase in median ED length of stay (Pre-social distancing: 3.18 h, implementation of social distancing: 4.02 h, lifting social distancing restrictions: 4.30 h), which persisted even after social distancing restrictions were lifted. Conversely, the rebound in ED visits post-pandemic may suggest delayed medical needs, worsened health conditions due to prolonged isolation, and accumulated unmet care demands among dementia patients, rather than indicating a complete return to pre-pandemic patterns [18].

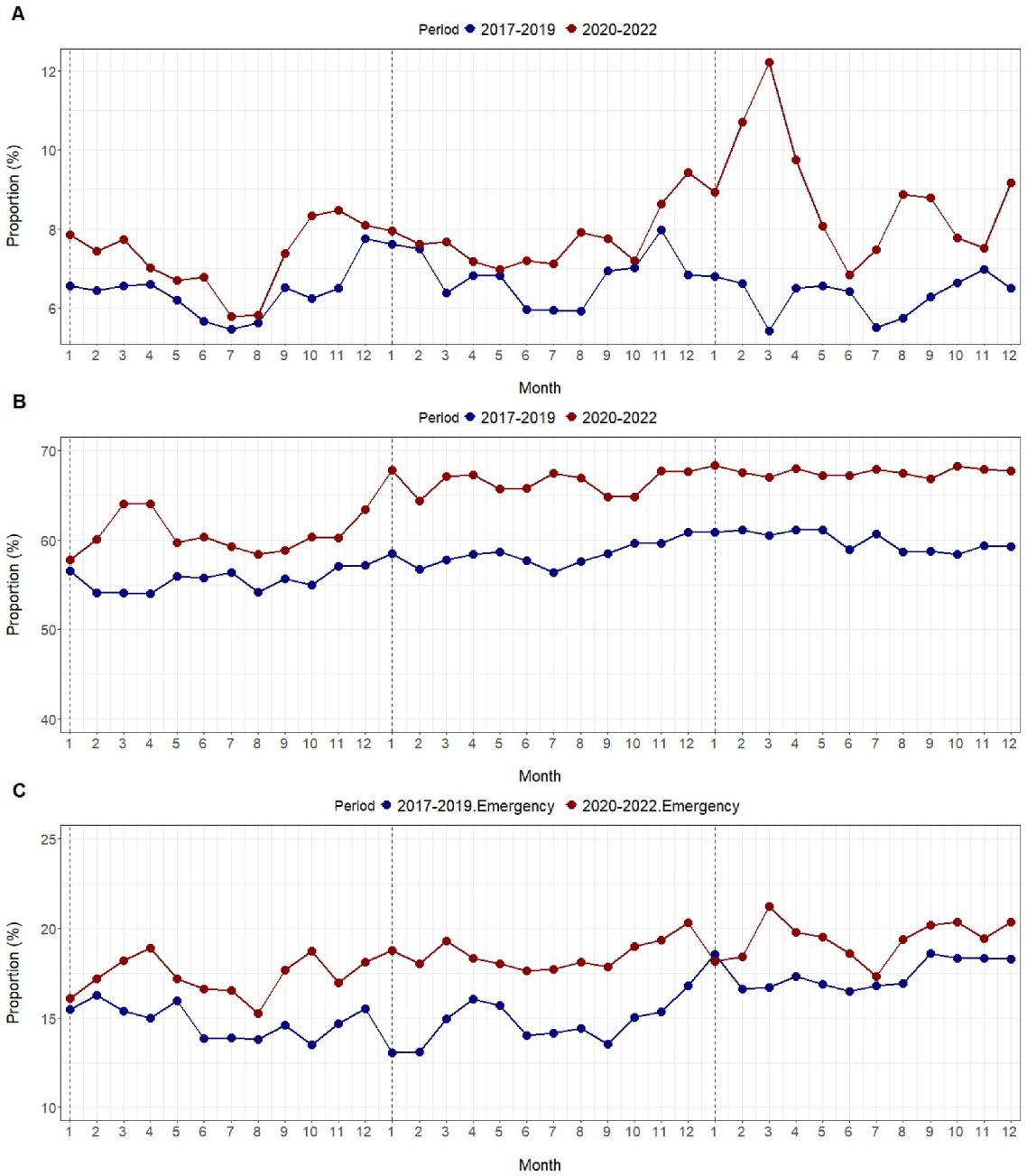

FIGURE 2 | Monthly proportion of (A) mortality, (B) hospital admission, and (C) emergency of patients with dementia.

Prolonged lockdowns and social isolation have been associated with accelerated cognitive decline, worsened neuropsychiatric symptoms, and increased caregiver burden among dementia patients [27, 29]. Social deprivation has been shown to disrupt cognitive resilience, potentially accelerating dementia progression and increasing the likelihood of emergency healthcare utilization. This is particularly concerning given that dementia patients often rely on structured daily routines and caregiver support, both of which were severely disrupted during the pandemic. Previous studies reported significant reductions in memory function, increased depression and anxiety, and exacerbated behavioral symptoms during extended periods of isolation, both of which are known risk factors for dementia [30, 31]. Social isolation is often linked to increased ED visits [32]. However, during the pandemic, many hospitals dismantled geriatric care practices and implemented strict visitor restrictions, leaving the needs of dementia patients unmet. Resources were diverted to COVID-19 patient care [13], making it difficult to identify at-risk patients—especially among the older adults—after the pandemic's onset, potentially exacerbating their conditions. Given that dementia patients rely on structured routines and social interactions to maintain cognitive function, the disruption of care services and social engagement may have contributed to these adverse outcomes, leading to increased hospitalizations and mortality rates during the pandemic [17].

While the decline in ED visits may reflect positive trends, such as fewer preventable injuries or infections, it also raises concerns about unmet medical needs and delays in urgent care for conditions like stroke, acute myocardial infarction, and fall-related

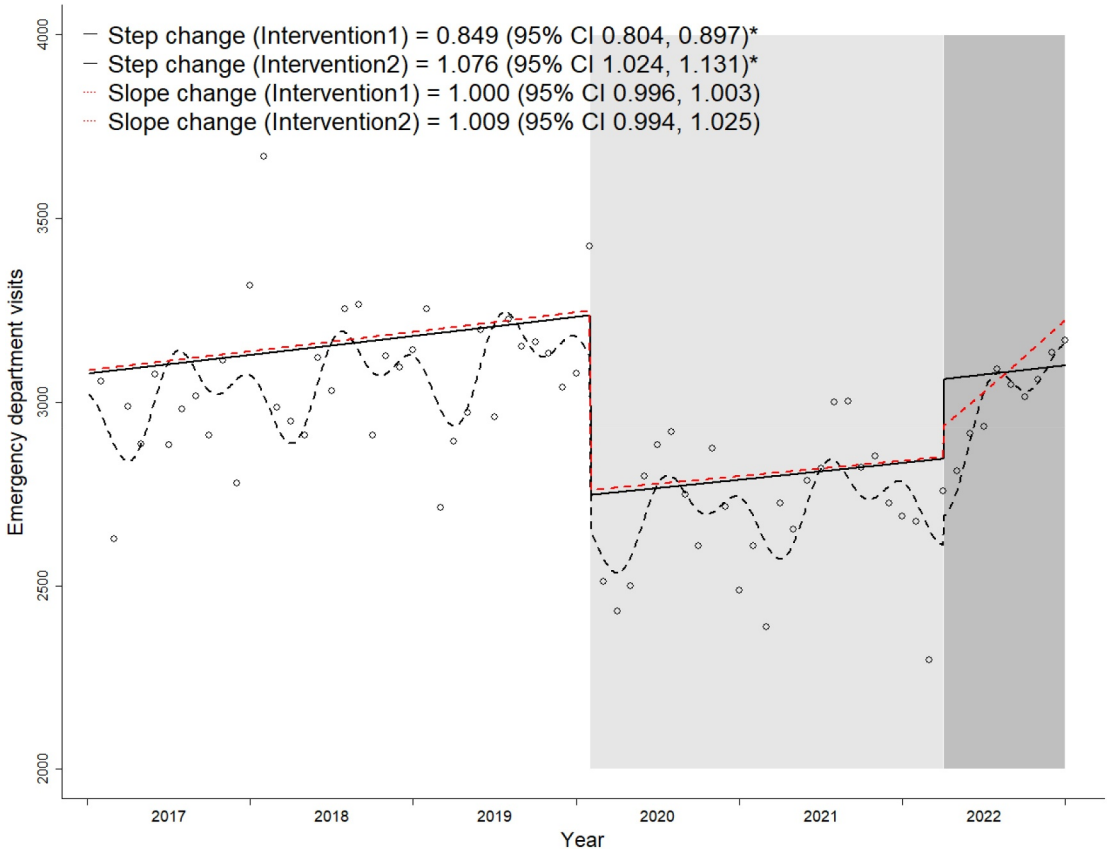

FIGURE 3 | Monthly estimated emergency department visits in the pre-social distancing, during social distancing, and the post-social distancing periods.

injuries [17]. The proportion of stroke, myocardial infarction, and fall-related injuries among ED visits slightly increased in this study. Furthermore, a Canadian study reported increased mortality rates among individuals with dementia during the pandemic, suggesting barriers to accessing community support and hospital services for this vulnerable population [18]. In this study, the proportions of ambulance use, hospitalization, and in-hospital mortality increased over the study period, and increases were observed even after social distancing restrictions were lifted. The concurrent increase in hospitalization and mortality rates further underscores the potential impact of reduced access to timely emergency care [18]. Further studies are needed to distinguish between deaths directly attributable to the COVID-19 pandemic and deaths due to other causes.

This study has several limitations. First, the definition of dementia relied on administrative data. In Korea, dementia diagnosis codes are based on clinical evaluations and tests such as the Mini-Mental State Examination [33]. However, as this study used administrative data, it may not accurately capture clinical diagnoses, introducing a potential for misclassification. Second, information on the appropriateness, quality of care, and reasons for ED visits by older patients with dementia during the social isolation period was lacking, a common limitation of administrative data [34]. This limitation restricts our ability to differentiate between necessary and potentially avoidable ED visits. Further studies will provide valuable insights to address these gaps. Third, we could not distinguish between community-dwelling and nursing home-dwelling older patients with dementia visiting the ED. Institutionalized patients may have faced different levels of exposure to social isolation measures and varying degrees of healthcare access. Finally, although ITS analysis is a robust quasi-experimental method for assessing policy effects, our study design cannot fully account for unmeasured factors, such as changes in caregiver support, or healthcare system adaptations during the pandemic.

5 | Conclusion

During the implementation of social distancing measures, ED visits among dementia patients aged 65 years and older decreased. Following the lifting of all social distancing measures in April 2022, ED visits rebounded. However, the social distancing period was associated with higher rates of adverse health outcomes, including increased hospitalization and mortality. The decline in ED visits does not necessarily indicate a reduced need for emergency care but rather underscores the challenges in accessing timely medical attention during a public health crisis. Our findings highlight the importance of maintaining healthcare accessibility for dementia patients, even during public health crises, to prevent delays in treatment and worsening health outcomes. Developing and implementing targeted interventions—such as enhanced community-based support and telemedicine services—will be critical in ensuring the continuity of dementia care during future public health crises and mitigating the adverse effects on this vulnerable

population. Further research is required to determine whether the increased social isolation observed during the pandemic is linked to a heightened risk of dementia onset or progression.

Author Contributions

K-S.L. and S.K. conceptualized this study. J.M. and S.K. developed the methods and conducted the literature search. J.M., K-S.L., and S.K. curated the data, which were analyzed by J.M. and interpreted by K-S.L. and S.K. J.M. and S.K. wrote the original draft of the manuscript, which was edited by K-S.L. and H.K.S. K-S.L. acquired funding and was responsible for project administration, while K-S.L. and H.K.S. contributed to data management resources. All authors had full access to the study data and take final responsibility for submitting it for publication.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data utilized in this study are third-party data managed by Korea's National Emergency Medical Center (NEMC). Researchers interested in accessing the data may contact the NEMC through their website (https://dw.nemc.or.kr/).

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.