

Exploring Cognitive Stimulation as a Therapy for the Prevention of Delirium in a Hospital Setting: A Narrative Review

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Abstract

Delirium is the most common complication after major surgeries, with incidence rates ranging from 50% to 87%. Fortunately, postoperative delirium is preventable in up to 50% of patients, with the best preventive strategy being non-pharmacological interventions. However, these therapeutic approaches often face scalability challenges due to the complexity and high variability of their delivery, low patient engagement, and the existing clinical workforce constraints in the hospital setting. Cognitive stimulation is a non-pharmacological intervention with the potential to overcome the scalability and sustainability challenges of other non-pharmacological approaches, but evidence supporting its use is limited, especially in older adults at high risk for delirium. This narrative literature review examines evidence-based cognitive stimulation techniques being used as a non-pharmacological approach to prevent delirium in hospital settings.

Keywords: Delirium, Cognitive Stimulation, Cognitive Training, Cognitive Rehabilitation, Cognitive Prehabilitation, Geriatric, Prevention

Introduction

Delirium is an acute brain dysfunction affecting more than 11 million hospitalized older adults with an estimated annual cost of \$150 billion [1]. These older adults have a higher risk of all-cause mortality (odds ratio ~ 4), stay an additional 2-4 days in the hospital, and are two times more likely to develop or experience worsening Alzheimer's Disease and Related Dementias (ADRDs) [2-7]. Delirium is the most common complication after major surgeries, with incidence rates ranging from 50% to 87% [8]. Delirium emerges from a complex interaction among predisposing vulnerability risk factors, such as prior cognitive impairment, and acute insults, such as undergoing major surgery [9-11]. Fortunately, postoperative delirium is preventable in up to 50% of patients, with the best preventive strategy being non-pharmacological interventions [12-15]. However, these therapeutic approaches often face scalability challenges due to the complexity and high variability of their delivery, low patient engagement, and the existing clinical workforce constraints in the hospital setting [16, 17].

Cognitive stimulation is a non-pharmacological intervention with the potential to overcome the scalability and sustainability challenges of other non-pharmacological approaches, but evidence supporting its use is limited, especially in older adults at high risk for delirium. Cognitive stimulation encompasses a variety of activities aimed at enhancing cognitive functions, including attention, memory, and executive function [18]. The rationale for utilizing cognitive stimulation as a preventive measure for delirium is based on several mechanisms. Cognitive stimulation helps build cognitive reserve, promotes neuroplasticity, enhances sensory engagement, and fosters social interaction [19-21]. Strategies for delivering cognitive stimulation includes traditional reality orientation and workbooks to brain-training applications and online games [22-26]. However, implementing cognitive stimulation in acute hospital settings faces several challenges, including limited resources, staffing issues, and a lack of training among nursing staff [27]. Additionally, conventional delivery of cognitive stimulation can often become repetitive, leading to decreased motivation and partic-

ipant disengagement [28]. Incorporating games into cognitive stimulation therapy and using virtual reality (VR) to deliver such cognitive games has been shown to enhance cognitive functions and increase participant engagement [29-34]. Thus, VR delivery of cognitive stimulation games is emerging as a potential solution to enhance patient engagement and overcome the scalability issues of the current delirium prevention approaches.

This narrative literature review examines evidence-based cognitive stimulation techniques being used as a non-pharmacological approach to prevent delirium in hospital settings. Of note is that the present review focuses on research published in the last 10 years. This review builds on prior important literature by concentrating specifically on cognitive stimulation as a non-pharmacological intervention for preventing delirium [35, 36].

Methods

We undertook a narrative literature review of peer-reviewed articles from January 2014 to September 2024 to identify and critically analyze research on cognitive stimulation (CS) as a non-pharmacological therapy for preventing or managing delirium. The methodology for this review conformed to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Figure 1) [37]. The population of interest included adults > 18 years old who were admitted to the hospital and had cognitive stimulation as a part of CS exercise, cognitive pre- rehabilitation, or rehabilitation. We defined cognitive stimulation as any therapies or strategies directed at improving patient cognition or the domains of cognition. Examples of interventions included repeated tasks, games, skills, or questions, such as orientation exercises in both writing and/or verbal exercises delivered by health care professionals, family, computer software, or virtual reality. We sought to find studies comparing patients who received the intervention and those who did not and reported on our primary outcome of interest—delirium. The present narrative review included original research articles such as randomized-controlled trials (RCT), quasi-experimental trials (i.e., non-RCT), observational trials, and pre/post-intervention trials describing the application of cognitive stimulation in the hospital setting and reporting of delirium according to validated tools such as the CAM-ICU [38]. English-language publications were chosen to study adults in hospital settings.

Exclusion Criteria

The exclusion criteria were as follows: editorial, commentaries, abstracts, review articles, case reports, and letters with duplicate, incomplete, and unavailable data; participants with severe cognitive impairment and a history of severe sensory or motor

impairment. For patients with terminal illnesses or a life expectancy of less than 6 months, where postoperative outcomes may be heavily influenced by factors other than the intervention being studied, pharmacological interventions for the prevention or treatment of delirium were excluded. Non-English articles were excluded. Articles focusing only on cognitive stimulations following hospital discharge (i.e., outpatients) were excluded as we sought to assess interventions applied in hospital settings.

Search Strategy

H.F. developed search strategies and reviewed them with a health sciences librarian. The search was conducted using PubMed (n=42), Scopus (n=40), and Web of Science (n=42) databases. Medical subject heading (MeSH) terms and keywords were used, including three key concepts: “Postoperative Delirium,” “Cognitive Stimulation,” and “Delirium in Older Adults.” Limitations included English-language articles. The initial search was conducted by the senior investigator (H.F.). Search results were managed using Covidence and EndNote X9 software [39].

Screening Methods and Data Extraction

Three reviewers (E.F. and N.D.) manually screened duplicate titles and abstracts for predetermined inclusion and exclusion criteria. Titles and abstracts lacking sufficient information for inclusion were reviewed in full-text form. A librarian (A.T.) resolved disagreements. Articles were chosen for full-text review after assessment of inclusion criteria for the study population, study comparison, and study outcomes. Subsequently, two investigators (H.F. and I.H.) independently reviewed full-text articles for final data extraction and analysis.

Data Synthesis

The findings were presented in a narrative format. We performed a narrative literature review due to the heterogeneity of interventions, outcomes, and study designs.

Results

Figure 1 depicts the PRISMA flow diagram. The search identified 124 articles. After an initial review of the titles and research origin, 70 duplicate articles were eliminated, leaving 54 articles for further consideration. After the title and abstract review, nine articles were removed for failure to meet inclusion criteria, leaving 43 publications for full-text review. After the full-text screening, 28 articles met the inclusion criteria. All 28 articles were reviewed using the standard extraction form, including the study sample, research methodology, research outcomes, and clinical implications, if available. Our literature search yielded twelve articles for in-depth analysis (Table 1).

Table 1: Study Summary.

Study	Purpose/Intervention	Design, Age, Sample Size	Outcomes and Outcome Measures	Results	Conclusion
Chen et al. (2024)	Investigate effects of RAM-based cognitive stimulation therapy (CST) in elderly NSCLC patients undergoing resection.	Single-center RCT; Age > 65; n=280	Delirium prevalence/incidence using Nursing Delirium Screening Scale.	Delirium: 20.71% (control) vs 10.71% (CST group); P = 0.032.	RAM-based CST reduced postoperative delirium incidence.

Faustino et al. (2022)	Evaluate combined non-pharmacological interventions (reorientation, cognitive stimulation, sensory correction) for delirium prevention.	Single-center RCT; Age > 18; n=144	Delirium incidence density using Confusion Assessment Method (CAM-ICU).	Incidence density: 2.3×10^{-2} (control) vs 1.3×10^{-2} (intervention); P = 0.04.	Combined non-pharmacological interventions reduced delirium in critically ill patients.
Martinez et al. (2017)	Assess effectiveness of multicomponent intervention (early mobilization, shared leadership, team participation) for delirium prevention.	Before-and-after study; Age > 18; n=227	Delirium incidence using CAM-ICU.	Incidence: 38% → 24% (relative risk = 0.62; P = 0.02).	Multicomponent strategies successfully reduced delirium through team engagement and concrete tasks.
Mudge et al. (2008)	Evaluate structured, early rehabilitation program (exercise, cognitive stimulation) on delirium in older patients.	Controlled trial; Age ≥ 65; n=124	Delirium incidence identified via chart review using validated methodology.	Incidence: 35.5% (control) vs 19.4% (intervention); P = 0.19.	Early rehabilitation reduced delirium incidence.
Alvarez et al. (2017)	Assess impact of OT-led cognitive intervention protocol on delirium incidence, duration, and severity in older ICU patients.	Pilot RCT; Age > 60; n=140	Delirium incidence/duration using CAM-ICU.	Incidence: 20% (control) vs 3% (treatment); P = 0.01. Duration significantly lower in treatment group (P < 0.001).	OT and cognitive strategies reduced incidence, duration, and severity of delirium.
Rivosecchi et al. (2016)	Assess non-pharmacologic protocol impact on delirium duration and incidence in ICU patients with sedation/mobility protocols already in place.	Pre-post intervention; n=483	Incidence/duration using Intensive Care Delirium Screening Checklist (ICDSC).	Incidence: 15.7% (Phase I) vs 9.4% (Phase II); P = 0.04. Duration reduced by 50.6% (P < 0.001).	Nonpharmacologic strategies further reduced delirium despite existing sedation/mobility protocols.
Colombo et al. (2012)	Assess cognitive stimulation protocol impact (orientation, sensory interventions) on delirium in ICU patients.	Observational study; Age > 18; n=314	Delirium occurrence using CAM-ICU.	Occurrence: 36% (Phase I) vs 22% (Phase II); P = 0.02.	Reorientation strategies reduced delirium incidence.
Şanlıtürk et al. (2023)	Evaluate two-stage intervention (sensory stimulation, sleep hygiene) impact on delirium in COVID-19 ICU patients.	Pre/post-test; Age > 18; n=92	Delirium incidence using CAM-ICU.	Incidence: 80% (control) vs 56% (intervention); P < 0.05.	Sensory stimulation and sleep hygiene effectively reduced delirium in critically ill COVID-19 patients.
Mitchell et al. (2017)	Assess feasibility and acceptability of family-led interventions (orientation, sensory checks, cognitive stimulation) for reducing delirium.	Feasibility RCT; Age ≥ 16; n=61	Feasibility, retention, and acceptability.	Low recruitment rate (28%); no withdrawals from intervention group.	Family-led cognitive stimulation is feasible and acceptable but requires further studies.

Munro et al. (2017)	Assess impact of family voice recordings (automated messages) on reducing delirium in critically ill adults.	Prospective RCT; Age > 18; n=30	Delirium-free days using CAM-ICU.	Mean delirium-free days: 1.9 (voice group) vs 1.6 (control); P = 0.04.	Family-delivered voice messages increased delirium-free days.
E. Alvarez et al. (2020)	Assess feasibility of software-based cognitive stimulation modules on delirium prevention.	Feasibility study; Age > 75; n=30	Delirium incidence using CAM-ICU.	Incidence: 15.6% (baseline) vs 6.6% (post-implementation).	Software-based cognitive stimulation reduced delirium incidence.
Faisal et al. (2024)	Evaluate VR-based cognitive games for delirium prevention in older surgical patients.	Pilot trial; Age ≥ 60; n=30	Safety, feasibility, acceptability using CAM-ICU.	No differences observed due to small sample size; usability score = 92.	VR games are safe, feasible, and acceptable, but efficacy on delirium prevention requires further studies.

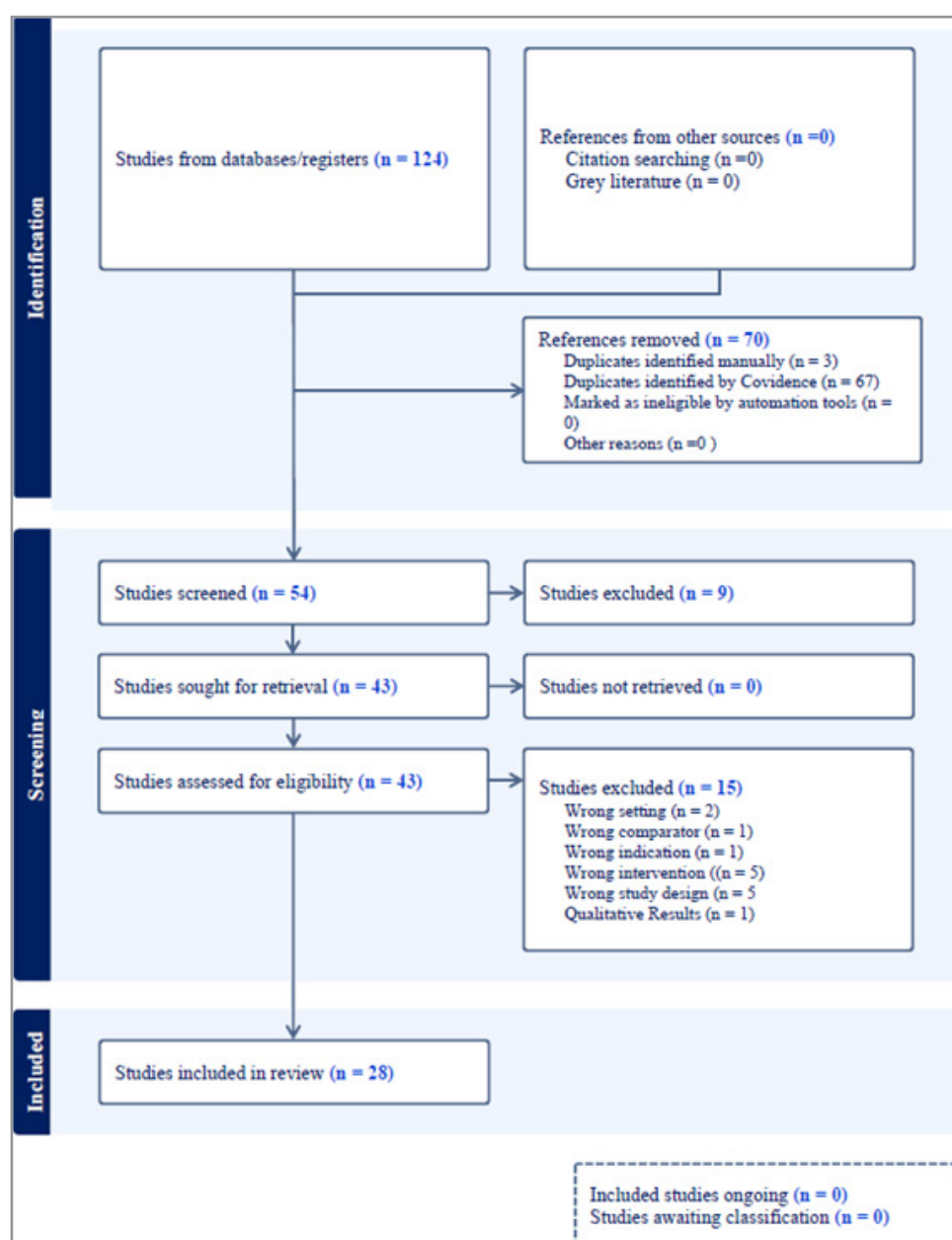


Figure 1: PRISMA flowchart of study selection.

Healthcare Professional-Led Cognitive Stimulation

We identified 8 studies ranging from feasibility studies to pre- and post-intervention studies to randomized clinical trials in which healthcare professionals delivered cognitive stimulation, including nurses, occupational therapists, and physical therapists. There were wide variations in the type of outcome reported about delirium (e.g., incidence, duration, density, delirium-free days). A randomized clinical trial (RCT) by Chen et al [40]. evaluated RAM-based cognitive stimulation therapy (CST) in 280 older postoperative patients with non-small cell lung cancer. Delirium screening was performed using the Nursing Delirium Screening Scale [41]. The study found that the incidence of postoperative delirium was significantly lower in the CST group (10.71%) compared to the control group (20.71%). Faustino et al [42]. conducted an RCT with 144 critically ill patients to assess non-pharmacological interventions, including reorientation, cognitive stimulation, sensory correction, environmental management, and sleep promotion. Delirium incidence density was measured using the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) tool, the experimental group had a significantly lower incidence of delirium (1.3×10^{-2} person-days) compared to the control group (2.3×10^{-2} person-days), with a hazard ratio of 0.40 (95% CI: 0.17–0.95; $P = 0.04$). Felipe Martinez et al [43]. studied the impact of tailored interventions, including early mobilization, physical therapy, cognitive stimulation, and family involvement, on 227 adult ICU patients. Delirium was measured using the CAM-ICU tool. The study found a significant reduction in delirium incidence, decreasing from 38% to 24%, with a relative risk of 0.62 ($P = 0.02$). Mudge et al [44]. examined the impact of a structured early rehabilitation program, including early physiotherapy, an individualized exercise program, nursing support for functional independence, and cognitive stimulation activities on 124 patients aged 65 and older. Delirium was identified according to chart review using validated methodology [45]. The author reported that the intervention group experienced a lower incidence of delirium than the control group (19.4% vs. 35.5%, $P = 0.04$). Álvarez et al [46]. conducted an RCT of 140 elderly ICU patients. Delirium screening was performed using the CAM-ICU the study results showed a reduced incidence of delirium (20% in the control group vs. 3% in the experimental group) after implementing an occupational therapy-led cognitive intervention protocol that included stimulation, rehabilitation, and training exercises ($P = 0.001$). Rivosecchi et al [47]. evaluated cognitive stimulation as part of a non-pharmacological delirium prevention bundle that included nursing education, music, reorientation, and sensory care per Pain, agitation, and delirium management guidelines [48]. Intensive Care Delirium Screening Checklist (ICDSC)[49] was utilized to screen delirium. The author and colleagues studied 230 patients in the pre-implementation phase and 253 in the post-implementation phase, reporting a decrease in delirium incidence from 15.7% in Phase I to 9.4% in Phase II ($P = 0.04$). Colombo et al [50]. reported a significant reduction in delirium occurrence, measured using CAM. [38] The study results showed delirium occurrence decreased from 36% in Phase I to 22% in Phase II following the introduction of a cognitive stimulation protocol that included orientation, environmental, acoustic, and visual interventions ($P = 0.020$). This was controlled for dementia, APACHE II score, and mechanical ventilation. Şanlıtürk et al [51]. evaluated a two-stage intervention involving sensory stimulation and sleep hygiene in

a pretest-posttest control trial with 92 COVID-19 ICU patients. Screening of delirium was performed using the CAM ICU tool. They found a significant reduction in delirium, with 56% of the experimental group affected compared to 80% in the control group ($P < 0.05$).

Family Led Cognitive Stimulations

We found two studies in which a family member delivered cognitive stimulation. Mitchell et al [52]. conducted a single-center randomized controlled trial with 90 patients, examining a family-delivered intervention that included daily orientation, sensory checks, and cognitive stimulation through discussions about family life and reminiscing. They reported the intervention as feasible and acceptable despite a low recruitment rate of 28%. Munro et al [53]. conducted a three-arm RCT of 30 patients testing a family-led intervention via voice recordings and found an increase in mean delirium-free days (evaluated by CAM-ICU) in the family voice recording group (1.9 days) vs the control group (1.6 days; $P = 0.04$).

Software-Based Cognitive Stimulation

E.A. Alvarez et al [54]. feasibility study evaluated software, including modules for time-spatial re-orientation, cognitive stimulation, early mobilization, sensorial support use promotion, sleep hygiene, and pain management optimization. The clinical feasibility assessment showed that 83.3% of the 30 enrolled hospitalized patients (76 ± 8 years) completed the 5-day protocol of software usage during hospitalization. Delirium was measured using the CAM-ICU tool. Software use was associated with a decrease in delirium incidence of 5 of 32 (15.6%) at baseline to 2 of 30 (6.6%) after its implementation.

Virtual Reality-Based Cognitive Stimulation

Faisal et al [55]. developed a prototype VR platform, "ReCognitionVR," designed for immersive cognitive stimulation games. Initial testing included a 20-minute VR session with healthy older volunteers followed by a pilot trial with low-risk older surgical patients [56]. Preliminary findings showed that the VR games were feasible, safe, and well-accepted, with all patients completing the sessions and achieving a mean System Usability Scale (SUS) score of 92 ($SD = 8$) without safety concerns. Game performance was assessed through metrics like the percentage of balloons popped and completion time, but no significant differences were found between groups. Due to the small sample size, the study did not observe any differences in delirium occurrence.

Discussion

Delirium emerges from a complex interaction among predisposing vulnerability risk factors, such as prior cognitive impairment, and acute insults, such as undergoing major surgery. Fortunately, delirium is preventable in up to 50% of patients, with the best preventive strategy being non-pharmacological interventions. However, these therapeutic approaches often face scalability challenges due to the complexity and high variability of their delivery, low patient engagement, and the existing clinical workforce constraints in the hospital setting. Cognitive stimulation is a non-pharmacological intervention with the potential to overcome the scalability and sustainability challenges of other non-pharmacological approaches, but evidence supporting its use is limited, especially in older patients at high risk for delirium. This paper reviewed cognitive stimulation therapy

for the prevention and treatment of delirium. Considering the number of studies included in this paper, there is a clear need for additional research on applying cognitive stimulation therapy in the hospital setting.

We identified only ten studies that evaluated cognitive stimulation for delirium prevention but exhibited significant bias, warranting caution in their clinical application (Table 2). Healthcare professional-led cognitive stimulation demonstrated a variable reduction in delirium, as evidenced by three RCTs, three pre- and post-intervention studies, and one study using a chart-based identification method of delirium. One study focused solely on the feasibility of implementing a prevention program and did not report on delirium-related outcomes.

Family-led cognitive stimulation for hospitalized patients is under-utilized and under-reported, warranting further investigation. It presents an alternative to healthcare professional-led cognitive stimulation, which faces challenges such as limited resources, staffing issues, and insufficient training among nursing staff. Feasibility studies on family-led cognitive stimulation included in this review, while not sufficiently powered to assess delirium outcomes, can aid in developing protocols for future randomized controlled trials. For instance, Mitchell et al. provided a sample size estimate of 596 for achieving 80% power at a significance level of ($P = 0.05$).

Conventional strategies used for cognitive stimulation in the ambulatory setting range from traditional reality orientation and workbooks to brain-training applications and online games. Healthcare professionals and family-led conventional cognitive stimulation can often become repetitive, decreasing motivation and participant disengagement. Incorporating games into cognitive stimulation therapy and using virtual reality (VR) to deliver such cognitive games has been shown to enhance cognitive functions and increase participant engagement. Thus, VR delivery of cognitive stimulation games is emerging as a potential solution to enhance patient engagement and overcome the scalability issues of the current delirium prevention approaches. This review identified one study on software-based cognitive stimulation and two studies on VR-based cognitive stimulation, all exhibiting small sample sizes and a high risk of bias. Consequently, the efficacy of these interventions for delirium prevention and management remains inconclusive. In a feasibility study by Alvarez et al. software-based re-orientation and cognitive stimulation

correlated with a reduction in delirium incidence from 15.6% (5 of 32) at baseline to 6.6% (2 of 30) post-implementation. Faisal et al. assessed VR-based cognitive stimulation games for older surgical patients, finding them safe, feasible, and acceptable, though delirium outcomes were not reported.

Limitations

This narrative review has several limitations. Firstly, it focused exclusively on peer-reviewed literature published in English, potentially omitting relevant studies in other languages and unpublished work. Secondly, it excluded other reviews, case reports, and commentaries. Thirdly, the included studies were assessed to have a critical, serious, or high risk of bias, which restricts the ability to draw definitive conclusions regarding the effects of cognitive stimulation. Fourthly, most of the studies were pilot or

feasibility studies, making it premature to determine their impact on delirium outcomes. Lastly, the review may be constrained by the specific databases searched, with potentially relevant studies not indexed in these sources.

Conclusion

Cognitive stimulation for delirium prevention in a hospital setting is a relatively new area of research and warrants further exploration. In addition, implementing cognitive stimulation in hospital settings faces several challenges. VR delivery of cognitive stimulation games is emerging as a potential solution to enhance patient engagement and overcome the scalability issues of the current delirium prevention approaches. However, insufficient evidence is available supporting its use. In turn, the authors are conducting a study to evaluate VR-based cognitive stimulation games to prevent delirium in older adults in the hospital setting. Larger, multi-center trials to evaluate VR-based cognitive intervention protocols are needed to examine the effects on delirium outcomes in a hospital setting.

Author Contributions

Emman Fatima (E.F.), Ian Hill (I.H.), Noah Dover (N.D.), and Hina Faisal (H.F.) contributed to all aspects of the manuscript, including study conception, design, acquisition, analysis, and interpretation of data, drafting the article. In addition, H.F. contributed to editing, revising, and writing an article's final draft.

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