



COMPLEMENTARY NURSING INTERVENTIONS TO IMPROVE CONSCIOUSNESS IN STROKE PATIENTS: A NARRATIVE REVIEW

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ABSTRACT

Stroke is a leading cause of mortality and long-term disability, with disorders of consciousness (DoC) being a critical complication affecting 10–40% of acute stroke patients. Early recovery of consciousness is strongly associated with improved prognosis, reduced ICU stay, and better functional outcomes. Complementary nursing interventions, particularly sensory-based strategies, have emerged as low-risk approaches to enhance arousal and awareness in stroke patients. This narrative review aimed to synthesize evidence on complementary nursing interventions—specifically acupressure and multimodal sensory stimulation—to enhance consciousness in stroke patients. A comprehensive search was conducted across PubMed, Scopus, CINAHL, ScienceDirect, and Google Scholar (August–November 2025). From 316 identified records using keywords such as ‘stroke’, ‘consciousness’, ‘sensory stimulation’, and ‘acupressure’, ten eligible studies involving adult stroke patients were selected and synthesized narratively. The synthesis demonstrated that sensory-based interventions significantly improved Glasgow Coma Scale (GCS) scores, often within three days, while remaining safe and feasible for nurse-led implementation. Beyond arousal, these interventions enhanced cognitive function and behavioral responsiveness through mechanisms involving stimulation of the reticular activating system. However, heterogeneity in protocols currently limits standardization. Complementary sensory interventions offer effective, low-risk strategies for holistic neurorehabilitation. This study contributes to science by establishing the clinical value of early, structured, and personalized sensory stimulation and advocating its integration into routine nursing protocols to optimize patient outcomes.

Keywords: acupressure; complementary therapies; glasgow coma scale; nursing care; stroke

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INTRODUCTION

Stroke remains one of the leading causes of mortality and long-term disability worldwide, with approximately 12.2 million new cases and around 6.6 million deaths each year (World Stroke Organization, 2023). Beyond physical impairments, one of the most critical and life-threatening consequences of stroke is the development of disorders of consciousness (DoC), including coma, stupor, and minimally conscious states. Approximately 10–40% of acute stroke patients experience altered consciousness during hospitalization, and this condition is strongly associated with increased mortality, prolonged mechanical ventilation, extended ICU stay, and poorer functional outcomes (Huang et al., 2022). Early improvement in consciousness is a major determinant of prognosis; therefore, interventions that can enhance arousal and awareness are clinically significant.

Consciousness recovery is influenced by multiple neurological and physiological mechanisms, including cerebral perfusion, reticular activating system activity, sensory network activation, and autonomic modulation. While pharmacological strategies such as neurostimulants have been explored, their use is limited by side effects and inconsistent outcomes. Consequently, non-pharmacological, low-risk, and easily deliverable interventions, especially those that can be

implemented by nurses at the bedside, are increasingly viewed as essential components of comprehensive stroke care.

Among these strategies, complementary nursing interventions have gained considerable attention. Multimodal sensory stimulation (MMSS), which includes structured auditory, tactile, visual, olfactory, and gustatory stimuli, has been widely used to enhance arousal in patients with acquired brain injury. Evidence suggests that sensory stimulation may prevent sensory deprivation, modulate autonomic responses, increase reticular system activation, and thereby facilitate improvements in consciousness level. Studies involving stroke and non-stroke DoC populations indicate that MMSS can significantly increase GCS scores compared to standard care (Faozi et al., 2021; Moattari et al., 2016). A recent meta-analysis on coma arousal therapy also reported meaningful improvements in CRS-R and GCS across several sensory modalities, supporting its clinical relevance (Kumar et al., 2024).

In addition to multimodal stimulation, complementary therapies such as acupressure have emerged as promising nursing interventions. Acupressure is a non-invasive technique that involves applying manual pressure to specific acupoints based on meridian theory. Although direct evidence on acupressure for consciousness recovery after stroke remains limited, strong supportive findings come from acupuncture research, where stimulation of similar points has been shown to facilitate neurological recovery, improve cerebral blood flow, enhance autonomic stability, and increase GCS scores in post-stroke coma (Huang et al., 2022). However, acupuncture requires invasive procedures and specialized certification. In contrast, acupressure utilizes the same meridian points but applies manual pressure, offering a non-invasive, safer alternative that is more feasible for bedside nurses. These biological mechanisms provide a robust rationale for exploring acupressure as an intervention more feasible for nurses, as a complementary strategy in stroke care.

Auditory-based interventions, including familiar voice stimulation (FAST) and structured music therapy, have likewise demonstrated positive effects on arousal by influencing emotional memory networks, activating the limbic system, and enhancing cortical responsiveness. Several quasi-experimental studies in stroke patients and ICU populations found that family-delivered or nurse-delivered auditory stimulation improved attention, responsiveness, and consciousness level (Purbianto & Agustanti, 2018; Zaky et al., 2024). Similarly, tactile stimulation, therapeutic touch, reflexology, and aromatherapy have shown potential benefits in consciousness and physiological stability, particularly among critically ill patients (Purbianto & Agustanti, 2018; Sargolzaei et al., 2017).

Nurses play a central role in monitoring, assessing, and facilitating consciousness recovery. As frontline providers in stroke and critical care units, nurses are uniquely positioned to deliver continuous, structured, and individualized sensory-based or complementary interventions. These interventions are low risk, cost-effective, and can be initiated early, which is an essential aspect given that early-phase stimulation is associated with better neurological outcomes. However, despite the growing number of studies, the evidence remains heterogeneous in intervention protocols, outcome measures, and target populations. Many studies vary in frequency, duration, and choice of sensory modality, making it challenging to standardize practice. Moreover, the existing literature is scattered across stroke, traumatic brain injury, ICU, and neuroscience nursing fields, limiting the ability of clinicians to synthesize optimal strategies for stroke-specific consciousness recovery.

Given these gaps, a comprehensive narrative review is needed to consolidate current evidence on complementary nursing interventions that have been applied to enhance consciousness among stroke patients. This review aims to synthesize existing findings, explore the theoretical and physiological frameworks supporting these interventions, evaluate their clinical effectiveness, and

provide practical recommendations that may guide nursing practice and future research in stroke care.

METHOD

This study adopted a narrative review design to synthesize and interpret the current evidence on the effects of sensory-based interventions, including tactile stimulation, auditory stimulation, olfactory stimulation, multimodal sensory therapy, and acupressure, on consciousness recovery among stroke patients. A narrative review was selected because the available literature is heterogeneous in terms of study design, intervention modality, and outcome measurement, allowing a flexible yet comprehensive integration across nursing, neurorehabilitation, and neurophysiology domains (Green et al., 2006). To identify relevant studies, a comprehensive literature search was conducted between August and November 2025 using major electronic databases, including PubMed, Scopus, CINAHL, ScienceDirect, Wiley Online Library, and Google Scholar. The search strategy employed Boolean operators to combine keywords related to the population and intervention. The specific search string used was: “stroke,” “ischemic stroke,” “hemorrhagic stroke,” “consciousness,” “level of consciousness,” “GCS,” “coma recovery,” “sensory stimulation,” “acupressure,” “tactile stimulation,” “auditory stimulation,” and “multimodal stimulation,” with Boolean operators adjusted for each database. (“stroke”) AND (“GCS”) AND (“sensory stimulation” OR “acupressure” OR “tactile stimulation” OR “multimodal stimulation” OR “acupuncture”). Keywords were adjusted according to the specific indexing terms (MeSH or subject headings) of each database.

Studies were included if they met the following predefined criteria: (1) adult patients diagnosed with ischemic or hemorrhagic stroke; (2) utilization of sensory-based interventions as the primary treatment; (3) measurement of outcomes related to consciousness, such as the Glasgow Coma Scale (GCS), FOUR score, or clinical descriptors of arousal; and (4) study designs ranging from randomized controlled trials (RCTs) and quasi-experimental studies to observational studies published within the last 10 years (2015–2025). Only articles published in English or Indonesian with full-text availability were considered. Exclusion criteria included pediatric populations, interventions that were purely pharmacological or non-sensory, non-stroke neurological conditions, review articles (systematic, scoping, or narrative reviews), and publications without original data, such as editorials, commentaries, or conference abstracts.

The study selection process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021), as illustrated in Figure 1. The screening process consisted of two stages: initial screening of titles and abstracts, followed by full-text review to ensure relevance and adherence to inclusion criteria. Screening was conducted independently by two reviewers, and disagreements were resolved through discussion until consensus was achieved. Although a formal meta-analysis risk-of-bias assessment was not performed, all included studies were critically appraised for methodological clarity and relevance to the research objective. For each eligible study, relevant information was extracted, including author, year, study design, sample characteristics, type and frequency of sensory intervention, outcome measures related to consciousness, and key findings. The extracted data were then organized and narratively synthesized.

Because of substantial heterogeneity across studies in methodological design, intervention dosage, sensory modality, and outcome indicators, a narrative synthesis rather than a meta-analysis was used. The synthesis grouped the findings into the following thematic categories: acupressure interventions, tactile stimulation, auditory stimulation, olfactory stimulation, multimodal sensory therapy, and neuro-nursing sensory stimulation frameworks. Through qualitative comparison, the narrative synthesis identified recurring patterns, clinical effects, and nursing implications across the included studies.

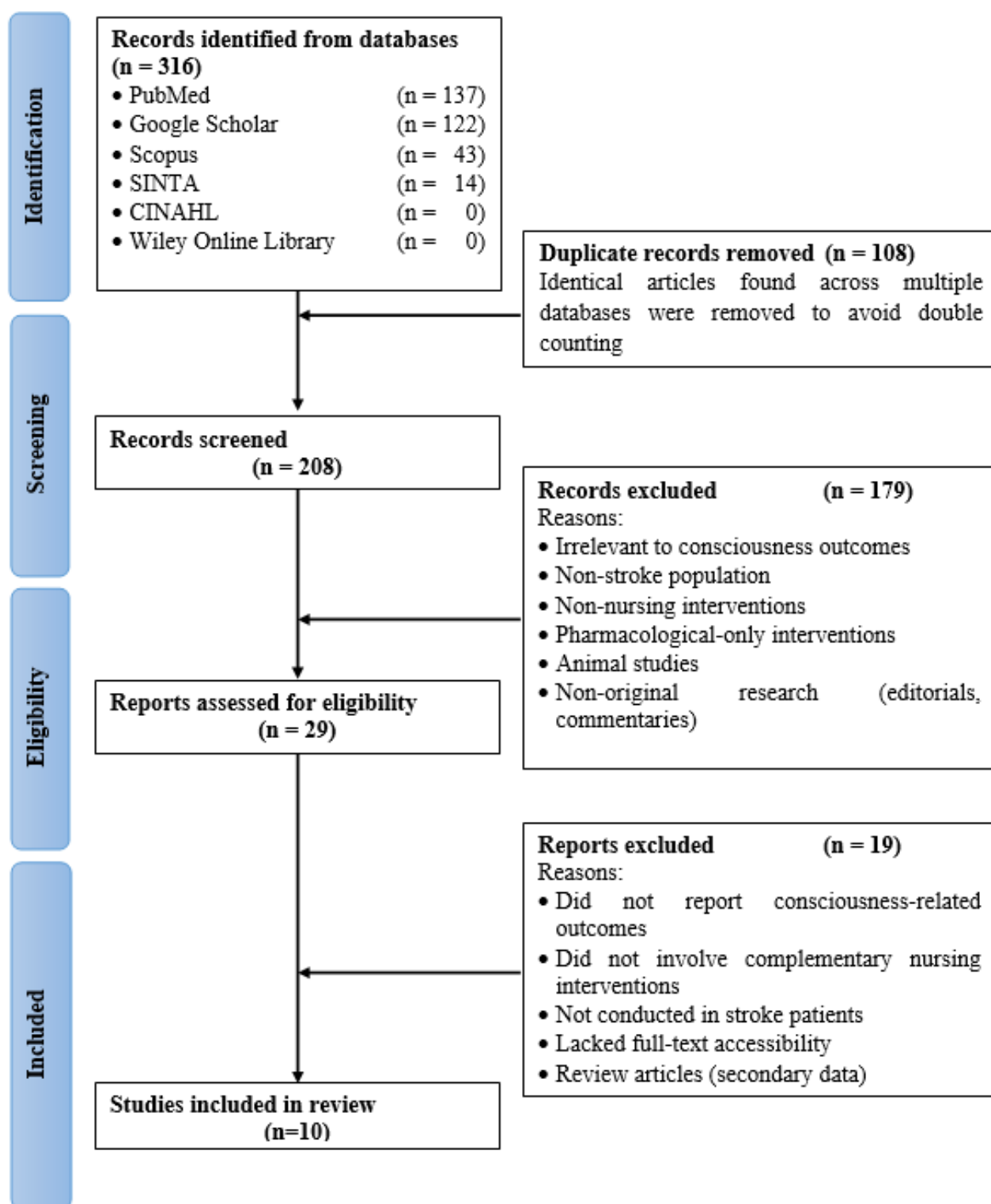


Figure 1. PRISMA flow diagram of the literature search and study selection process.

RESULT

A comprehensive literature search was conducted using four electronic databases: PubMed, Google Scholar, Scopus, and SINTA. The search strategy combined keywords related to stroke, consciousness, and complementary nursing interventions, including “stroke,” “cerebrovascular accident,” “consciousness,” “coma,” “Glasgow Coma Scale,” “sensory stimulation,” “acupressure,” and “nursing complementary therapy.”

The initial search identified 316 records, consisting of 137 from PubMed, 122 from Google Scholar, 43 from Scopus, and 14 from SINTA. After removing 108 duplicate articles, 208 records remained for title and abstract screening. During screening, 179 articles were excluded for irrelevance to consciousness outcomes, non-stroke populations, non-nursing interventions, pharmacological-only interventions, animal studies, or non-original research designs. A total of 29 full-text articles were assessed for eligibility. Of these, 19 articles were excluded because they did not report consciousness-related outcomes, did not involve complementary nursing interventions, were not conducted in stroke patients, lacked full-text accessibility, or were review/commentary papers. Ultimately, 10 studies met the inclusion criteria and were included in this narrative review. The characteristics and key findings of these studies are summarized in table 1.

Table 1.
Summary of Included Studies on Complementary Nursing Interventions for Consciousness Recovery in Stroke Patients

No	Author & Year (Country)	Title	Objective	Design	Key Findings
1.	Andri et al., 2024, Indonesia	Effect of Acupressure on Changes in GCS Scores	To assess the effect of acupressure on improving GCS in stroke patients with decreased consciousness	Quasi-experimental	Routine acupressure significantly increased GCS scores; it is safe, simple, and feasible for nurses to apply.
2.	Lewis & Lobo, 2025, India	Effectiveness of Multimodal Sensory Stimulation on the Level of Consciousness among Unconscious Patients	To examine the effect of multimodal sensory stimulation (MMSS) on consciousness in unconscious patients, including those with stroke	Randomized clinical trial	MMSS (two sessions per day for 7 days) significantly improved GCS scores and consciousness compared to the control.
3.	Faozi et al., 2021, Indonesia	Effects of a Multimodal Sensory Stimulation Intervention on Glasgow Coma Scale Scores in Stroke Patients with Unconsciousness	To evaluate the effect of MMSS on GCS in stroke patients with decreased consciousness	Quasi-experimental (pretest-posttest with control)	Significant GCS improvement in the intervention group (mean ~9.6 → ~13.2), while control group showed no significant change.
4.	Mohammed Diab et al., 2025, Egypt	Effect of Multimodal Sensory Stimulation on Consciousness and Cognitive Function for Patients with Acute Stroke	To measure the effectiveness of nurse-administered MMSS on consciousness and cognitive function in acute stroke patients	Quasi-experimental	MMSS significantly improved GCS and cognitive function compared to control.
5.	Purbianto & Agustanti, 2018, Indonesia	Effect of Sensory and Tactile Stimulation to Increase GCS Score in Stroke Patients with Consciousness Disorders at Abdul Moeloek Hospital, Lampung	To evaluate whether sensory + tactile stimulation increases GCS in stroke patients with impaired consciousness	Quasi-experimental	Stimulation significantly improved GCS ($p = 0.006$) in the intervention group compared to baseline.
6.	Sargolzaei et al., 2017, Iran	Effect of a Structured Sensory Stimulation Program on Sensory Function of Patients with Stroke-Induced Disorder of	To evaluate improvement in sensory function and consciousness in stroke patients with impaired consciousness	Quasi-experimental	Structured sensory stimulation program improved sensory function scores across modalities; supported as a complementary

No	Author & Year (Country)	Title	Objective	Design	Key Findings
Consciousness					nursing intervention.
7.	Kristiani & Kristiyawati, 2025, Indonesia	Application of Bimodal Sensory Stimulation (Auditory + Gustatory) in Stroke Patients with Decreased Consciousness	To analyze the effect of two-mode sensory stimulation on GCS in hemorrhagic stroke patients	Quasi-experimental (pre-post)	GCS significantly increased within 3 days of intervention (e.g., 9.5 → 13.5), indicating stimulation may support recovery of consciousness.
8.	Varghese et al., 2021, India	Effectiveness of Voice Stimulus on Level of Consciousness in Comatose Patients	To evaluate the effect of voice stimulation on consciousness in comatose patients	Experimental (voice intervention)	Positive response to familiar voices; improved consciousness (eye opening, verbal, motor) compared to baseline.
9.	Zaky et al., 2024, Egypt	Impact of Auditory Stimulation Nursing Protocol on Auditory Response in Cerebrovascular Stroke Patients	To evaluate how auditory protocol intervention affects auditory response and consciousness in stroke patients	Experimental / nursing intervention	Implementation of the auditory protocol by nurses improved auditory response and potentially supported the recovery of consciousness.
10.	Cheng et al., 2018, China	Do Sensory Stimulation Programs Impact Behavioral Responsiveness in Patients with Disorders of Consciousness?	To assess the effect of sensory stimulation programs on consciousness and behavioral responses in patients with disorders of consciousness (vegetative/minimally conscious)	Time-series observational	Stimulation improved behavioral responses (arousal, oromotor), though full consciousness recovery was not always achieved.

Effectiveness of Sensory Interventions on Consciousness

Almost all experimental and quasi-experimental studies indicate that sensory stimulation can significantly improve Glasgow Coma Scale (GCS) scores in stroke patients or patients with consciousness disorders. Interventions such as acupressure, multimodal sensory stimulation (MMSS), or bimodal stimulation have been shown to enhance patient consciousness levels rapidly. For example, Andri et al. (2024) reported improved GCS scores through routine acupressure, while Kristiani & Kristiyawati (2025) demonstrated an increase in GCS from 9.5 to 13.5 within three days using bimodal stimulation. These findings suggest that sensory stimulation is an effective and efficient method for aiding the recovery of patient consciousness.

Types of Sensory Interventions

Various modalities of sensory stimulation were used in the studies, including single-modality and multi-modality approaches. The interventions involved acupressure or tactile stimulation, multimodal sensory stimulation, bimodal (auditory + gustatory) stimulation, voice or auditory stimulation, and multisensory approaches such as music, visual, and tactile stimulation. The findings indicate that sensory interventions can be tailored to patient conditions and the availability of clinical resources. Both single and multi-modality approaches were practical, providing flexibility for nurses in their application.

Effects on Functions Beyond Consciousness

In addition to improving consciousness, several studies reported additional benefits on cognitive function, motor function, and behavioral responses. For instance, MMSS not only improved GCS but also enhanced cognitive function in patients (Mohammed Diab et al., 2025). Structured sensory stimulation programs improved sensory function across different modalities (Sargolzaei et al., 2017). Other studies reported improvements in behavioral responses such as arousal and oromotor ability (Cheng et al., 2018). This emphasizes that sensory stimulation provides holistic benefits, not limited to consciousness alone.

Safety and Feasibility

Several studies have highlighted that sensory stimulation interventions are safe and easy for nurses to implement in clinical practice. Acupressure and multimodal sensory stimulation can be conducted without significant risk, and the procedures are simple enough to integrate into routine nursing care in ICUs or stroke units (Andri et al., 2024). These findings indicate that sensory stimulation is not only effective but also practical and feasible for regular clinical application.

Intervention Duration and Timing

The effects of sensory stimulation can appear within a short time. Studies demonstrated that MMSS conducted twice daily for seven days, significantly improved patient consciousness (Lewis & Lobo, 2025), while bimodal stimulation improved GCS within three days (Kristiani & Kristiyawati, 2025). This suggests that sensory interventions can be used to rapidly improve patient consciousness, providing flexibility in setting the duration and intensity of the intervention based on clinical needs.

Patterns of Consciousness vs Behavioral Responses

In addition to GCS scores, several studies assessed behavioral responses to provide a more comprehensive evaluation of consciousness quality. Behavioral responses, such as arousal and oromotor ability, improved following sensory stimulation, although full recovery of consciousness was not always achieved (Cheng et al., 2018). Measuring both GCS and behavioral responses offers a more complete picture of the effects of sensory stimulation on patients, making it a valuable assessment tool in nursing practice.

DISCUSSION

Sensory stimulation interventions likely facilitate recovery of consciousness by activating the reticular activating system (RAS), a neural network central to arousal and wakefulness. By delivering structured sensory input, these interventions may “wake up” or maintain activation in residual pathways that support consciousness. For instance, in the Egyptian quasi-experimental study, Mohammed Diab et al. (2025), the authors explicitly reference the “environmental effect hypothesis” — the idea that enriched sensory input can drive RAS activation and thereby improve consciousness levels in acute stroke patients.

Beyond immediate arousal, neuroplasticity is a critical mechanism. Multimodal (or multisensory) stimulation can engage multiple sensory pathways simultaneously, promoting neural circuit reorganization and strengthening. While earlier reviews noted benefits on sensory deficits, a recent systematic review by Norwood et al. (2023) concluded that multimodal sensory therapy can facilitate recovery in disorders of consciousness by promoting sustained activation and circuit reorganization. These neurobiological foundations support the plausibility and therapeutic rationale for sensory-based nursing interventions to restore consciousness in stroke.

A quasi-experimental study by Faozi et al. (2021) demonstrated that multimodal sensory stimulation significantly increased GCS scores in stroke patients with impaired consciousness (pretest to posttest), where patients received auditory, visual, olfactory, gustatory, and tactile stimulation five times daily for five days, resulting in a mean GCS increase from 9.63 to 13.18 ($p =$

.001) in the intervention group, whereas the control group did not show a significant change. Moreover, the Egyptian study by Mohammed Diab et al. (2025) with 100 acute stroke patients found that multimodal sensory stimulation (MMSS) not only significantly raised consciousness levels (GCS) but also enhanced cognitive function (assessed with the Rancho Los Amigos scale) compared to control ($p < 0.001$). These findings suggest that sensory stimulation interventions can yield clinically meaningful improvements in consciousness even within a relatively short timeframe.

A notable strength of the current evidence is the heterogeneity of modalities across studies, from acupuncture to bimodal (auditory + gustatory) to fully multimodal stimulation, yet all report positive effects. This indicates that the therapeutic “active ingredient” may not be limited to a single sense, but rather to structured, meaningful, and repeated sensory input tailored to the patient’s capacities and context.

Additionally, several studies show that effects can occur quite rapidly. In one of the bimodal stimulation studies (auditory + gustatory), GCS increased within 3 days (e.g., from 9.5 to 13.5), suggesting that even short, concentrated interventions can provide tangible benefits. This rapid effect is clinically valuable: early restoration of consciousness may improve prognosis, reduce ICU length of stay, and enable earlier initiation of rehabilitation. While the primary endpoint in many studies was consciousness (GCS), several reported secondary benefits on cognitive function and behavioral responsiveness. As noted, Mohammed Diab et al. (2025) found significant cognitive improvements in addition to GCS gains, suggesting that MMSS enhances not only awareness but also cognitive processing.

Furthermore, other studies reported improvements in behavioral measures such as arousal, oromotor responses, and motor responses, even when full consciousness recovery was not achieved. Such improvements in behavioral responsiveness reflect enhanced neural engagement and may be critical for defining a patient’s recovery trajectory. These broader benefits align with the evidence base from acquired brain injury. Norwood et al. (2023) reported that multimodal sensory therapy not only supports arousal but also improves somatosensory sensation, motor control, and functional outcomes in brain-injured populations. Recent meta-analyses further reinforce that sensory stimulation serves as an effective coma arousal therapy, yielding statistically significant improvements in GCS scores compared to standard care (Kumar et al., 2024). Thus, the interventions reviewed appear to deliver holistic benefits, not solely awakening but also extending into cognition and responsiveness, which are vital in post-stroke rehabilitation.

One remarkable aspect of sensory stimulation interventions is their safety and feasibility. Many of the reviewed studies report that sensory stimulation protocols (e.g., tactile stimulation, acupuncture, auditory stimulation) are non-invasive, low risk, and deliverable by nursing staff in usual care settings. For example, Andri et al. (2024) demonstrated that routine acupuncture significantly increased GCS scores in patients with decreased consciousness, highlighting it as a safe and simple intervention feasible for nurse-led application in hospital settings. Similarly, Mohammed Diab et al., (2025) recommend integrating MMSS into routine nursing care in neurological intensive care units, given its potent effects and acceptable safety profile. These findings suggest that sensory stimulation is not only practical but also highly implementable in typical stroke care settings without requiring sophisticated equipment or intensive training.

However, implementation is not without challenges. Key issues include dose standardization, personalization, and timing. The reviewed studies used diverse protocols, with different daily session frequencies, durations, and numbers of days, making it challenging to derive a consensus “optimal dose.” Without standardization, nurse teams may struggle to translate research into practice. Moreover, while personalization (e.g., using patient-preferred music or familiar voices) is

likely beneficial, few studies systematically evaluate the effects of tailored versus generic stimuli. Family involvement in sensory interventions also remains under-explored in stroke: studies in traumatic brain injury contexts suggest that familiar voices and family-administered stimulation can yield better responses than nurse-administered generic protocols (Zuo et al., 2021). Finally, the timing of stimulation relative to stroke onset is unclear. Some interventions begin in the acute ICU phase, while others may be introduced later. Identifying the window of optimal neuroplastic potential (and thus maximal responsiveness) to sensory stimulation is a critical research gap.

Studies within the broader evidence base strengthen confidence in the benefits of sensory stimulation. The systematic review by Norwood et al. (2023) integrated 43 studies on adult populations with acquired brain injury (ABI). The authors found that multimodal sensory therapy is associated with positive changes in consciousness (mostly measured via GCS) and is generally low-risk. There is also broad support from the fundamental sensory rehabilitation literature. Moreover, Kumar et al. (2024) confirmed in a recent meta-analysis that coma arousal therapy significantly improves consciousness in patients with disorders of consciousness, providing strong statistical backing to the narrative findings of this review. In comatose and minimally conscious populations, older systematic reviews show mixed evidence. A Cochrane review found no strong evidence for sensory stimulation programs in brain-injured comatose patients, primarily due to methodological limitations in the available studies. Nevertheless, more recent meta-analyses suggest benefits, particularly when stimulation is initiated early, combined modalities are used, and family is involved (e.g., auditory + tactile stimulation in the early phase yields larger GCS gains) (Zuo et al., 2021). Overall, the consistency of findings across different patient populations, designs, and stimulation modalities supports the translational potential of sensory stimulation as a complementary nursing intervention in stroke.

Based on the review of evidence, several implications emerge for nursing practice in stroke care:

1. **Integration into Nursing Care Plans:** Given the demonstrated efficacy and safety, structured sensory stimulation protocols should be integrated into routine nursing care for stroke patients with impaired consciousness. Such protocols could be formalized as part of ICU or stroke-unit care bundles.
2. **Nurse Training and Family Involvement:** Nurses need training to deliver multimodal stimulation effectively, knowing how to choose modalities, offer sessions, and assess patient responses. In addition, involving family members (e.g., using familiar voices, preferred music, or meaningful touch) could enhance personalization and possibly improve outcomes, as indicated in brain-injury literature (Zuo et al., 2021).
3. **Personalization of Stimuli:** Where possible, stimuli should be tailored to patients' preferences and backgrounds, such as familiar music, loved ones' voices, preferred tactile sensations, etc. Personalized stimulation may elicit stronger engagement, emotional resonance, and neuroplastic responses.
4. **Monitoring and Dose Adjustment:** Because there is no consensus on optimal dose, nurses should carefully monitor patient responses (GCS, behavioral signs) and adapt the stimulation protocol over time. Feedback from patients/families (when possible) should also guide adjustments.
5. **Early Initiation:** Considering the potential for neuroplasticity in the early post-stroke phase, initiating sensory stimulation as soon as the patient is stable may optimize recovery. However, timing should be balanced with patient condition, safety, and resource availability.

While the studies offer promising evidence, several limitations must be recognized:

1. **Protocol Variability:** There is significant heterogeneity in stimulation protocols (modalities, frequency, duration), which makes comparison difficult and complicates implementation.
2. **Study Designs:** Many studies are quasi-experimental with small sample sizes, limited control groups, and a lack of blinding, which raises the risk of bias.

3. **Outcomes:** While GCS is commonly used, it has limitations (e.g., ceiling/floor effects) and does not capture all dimensions of consciousness or cognitive recovery. Behavioral metrics and long-term functional outcomes are less consistently reported.
4. **Short Follow-Up:** Few studies include long-term follow-up to assess whether consciousness gains translate into lasting recovery (e.g., independence, cognitive function, quality of life).
5. **Generalizability:** Some studies may be context-specific (e.g., in particular hospitals or health systems), limiting external validity.

These limitations echo the concerns identified in recent high-quality systematic reviews. For instance, Zuo et al. (2021) and Norwood et al. (2023) emphasized that small sample sizes, lack of blinding, and protocol heterogeneity constrain many sensory stimulation studies. Consequently, there is a strong consensus in the current literature advocating for more rigorous Randomized Controlled Trials (RCTs) with standardized intervention dosages and validated outcome measures to establish high-level evidence.

To advance the field and strengthen clinical application, future research should address the following areas:

1. **Randomized Controlled Trials (RCTs):** Well-powered, methodologically rigorous RCTs are needed to establish the efficacy of sensory stimulation in stroke patients. These trials should standardize stimulation protocols (modalities, dosing, timing) and include control conditions.
2. **Long-Term Outcomes:** Studies need to extend follow-up beyond the acute phase to examine whether improvements in consciousness translate into functional recovery, cognitive gains, and quality of life.
3. **Dose Optimization:** Research should systematically compare different “doses” of stimulation (frequency, session length, total duration) to identify optimal regimens. Subgroup analyses (by stroke type, severity) may help tailor protocols.
4. **Personalized Interventions:** There is a need to evaluate whether personalized stimuli (familiar voice, music, smells) confer additional benefit over generic ones. Family-centered delivery and culturally relevant stimuli should be considered.
5. **Mechanistic Studies:** Incorporating neurophysiological measures (EEG, fMRI) will help elucidate how sensory stimulation modulates brain networks (e.g., the RAS and thalamocortical circuits). This could refine the understanding of responders vs non-responders.
6. **Implementation Science:** Research should examine how to integrate sensory stimulation into routine nursing care: barriers, facilitators, training needs, cost-effectiveness, and patient/family acceptability.

CONCLUSION

The reviewed complementary nursing interventions provide compelling preliminary evidence that sensory stimulation—across auditory, tactile, gustatory, and multimodal modalities—can significantly improve consciousness in stroke patients, as measured by the GCS. Beyond arousal, these interventions show promise for enhancing additional domains, such as cognitive function and behavioral responsiveness. Crucially, the evidence suggests that these strategies are safe, feasible, and cost-effective, making them highly suitable for integration into standard nursing care. However, the strength of current recommendations is tempered by methodological heterogeneity, the absence of standardized protocols, and limited long-term follow-up data. To fully realize the clinical potential of sensory stimulation, future research must prioritize rigorous randomized controlled trials, protocol standardization, and the exploration of personalized stimuli. From a nursing perspective, the implementation of structured sensory stimulation protocols, coupled with staff training and family involvement, represents a promising, holistic approach to accelerate consciousness recovery in stroke care.

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