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Effectiveness of Mental Imagery in Physical Recovery among Stroke Survivors: A Systematic Review

Nurul Syuhaida Azazian, Shazli Ezzat Ghazali, Ponnusamy Subramaniam

Centre for Rehabilitation & Special Needs (iCaReHab), Centre for Healthy Aging & Wellness (H-CARE), Universiti Kebangsaan Malaysia, 50300 UKM Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur

Corresponding Authors Email: shazli_ezzat@ukm.edu.my

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Abstract

Mental imagery is a cognitive approach that enhances motor performance by engaging visual and kinesthetic imagery techniques which activate motor-related brain areas and promote body awareness. This systematic review aimed to evaluate the efficacy of mental imagery interventions in improving physical function among stroke survivors while also exploring psychological factors influencing treatment outcomes. *Methodology* A comprehensive bibliographic search was conducted from 2014 to 2024 across PubMed, Wiley-Blackwell, and ScienceDirect. Eight studies meeting predefined inclusion criteria including randomized controlled trials and observational studies were reviewed. *Results* The studies examined various types of mental imagery interventions including motor imagery-based practices and Motor Imagery Training (MIT) consistently demonstrating their effectiveness in enhancing motor function and physical recovery. Furthermore, psychological factors such as motivation and attentional focus were found to significantly enhance engagement and the effectiveness of these interventions. *Conclusion* This review provides substantial evidence supporting the use of mental imagery interventions as a valuable therapeutic tool in stroke rehabilitation. Future research should focus on optimizing these interventions and further exploring their impact on psychological factors to fully realize their potential in clinical practice.

Keywords: Mental Imagery, Stroke Rehabilitation, Motor Recovery, Motor Imagery Training, Stroke Survivors, Neuroplasticity, Psychological Factors

Introductions

Stroke or cerebrovascular accident (CVA) is a leading cause of death and long-term disability worldwide. In Malaysia, stroke ranks as the third leading cause of death, with 21,952 fatalities reported by the World Health Organization in 2020. Survivors often experience lasting physical and cognitive impairments with hemiplegia (paralysis) or hemiparesis (weakness) on

one side of the body, being among the most common consequences. These impairments can severely limit mobility, independence, and overall quality of life, making stroke rehabilitation a significant challenge for both patients and healthcare providers. Additionally, the financial burden associated with stroke is substantial which encompasses medical expenses, rehabilitation costs and long-term care for dependent individuals. Therefore, research that explores innovative and effective rehabilitation strategies is crucial in helping survivors regain functional abilities and improve their quality of life (World Health Organization, 2020; Langhorne et al., 2011).

Over the years, a variety of rehabilitation strategies have been developed to enhance functional recovery and promote independence among stroke survivors. Traditional approaches such as physiotherapy and occupational therapy, have been supplemented by newer interventions like constraint-induced movement therapy (CIMT), virtual reality and robotic-assisted therapies (Nilsen et al., 2015; Laver et al., 2017). These strategies are valuable but often limited by factors such as cost, availability and physical demand on the patient. Recent advancements in neuroimaging techniques and the discovery of mirror neurons have deepened our understanding of brain plasticity and its role in stroke recovery. These developments have paved the way for innovative therapies including mental imagery which leverages the brain's capacity to rewire itself through the mental simulation of movements (Decety & Grèzes, 2006; Rizzolatti & Craighero, 2004).

Mental imagery or motor imagery training is a cognitive technique where individuals mentally rehearse movements without physically performing them. It has gained prominence in stroke rehabilitation due to its potential to stimulate motor networks in the brain that are like those activated during actual movement execution. Originally used in sports psychology to enhance athletic performance, motor imagery is now being explored as a therapeutic tool for individuals with neurological impairments such as stroke survivors. Research indicates that mental imagery can strengthen motor pathways, improve movement coordination and enhance motor learning (Page et al., 2001; Braun et al., 2006). This technique is particularly relevant for stroke patients who may face physical limitations that restrict traditional exercise as mental imagery can offer a means of engagement without exerting physical strain (Jackson et al., 2001; Sharma et al., 2006).

Despite its promise, mental imagery remains underutilized in stroke rehabilitation in Malaysia. Existing studies on mental imagery predominantly originate from other countries with limited research on its implementation and efficacy within the Malaysian healthcare context. Furthermore, while many studies focus on physical recovery, the psychological factors influencing the effectiveness of mental imagery such as motivation, mental well-being, and coping strategies are often overlooked. These factors are crucial as they contribute significantly to patient engagement and long-term adherence to rehabilitation programs (Mulder, 2007; Schuster et al., 2011). Given that stroke recovery is a complex process involving both physical and mental adaptation, understanding these psychological dimensions is essential for developing effective and holistic rehabilitation programs that address the needs of the whole patient.

The aim of this systematic review is to assess the efficacy of mental imagery interventions in improving physical function among stroke patients while also exploring the psychological factors that may influence treatment outcomes. Specifically, this study seeks to identify and synthesize relevant studies on mental imagery interventions in stroke rehabilitation. It will examine the impact of mental imagery on recovery in both upper of hemiparetic patients. Additionally, the research will investigate the psychological elements that may contribute to the effectiveness of these interventions and assess the feasibility of developing a mental imagery protocol tailored for stroke patients in Malaysia. By reviewing the current body of evidence, this study aims to provide valuable insights that could guide clinical practice and inform future research on the use of mental imagery in stroke rehabilitation, particularly in Malaysia. The findings will focus on behavioral measures of physical function, neuroimaging studies on mental imagery and physical ability, comparisons with traditional rehabilitation approaches and the psychological factors influencing mental imagery effectiveness.

Materials and Methods

Study Design

This systematic review adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, with the PRISMA flowchart outlining the search strategy (Page et al. 2021). According to Page et al. (2021), PRISMA provides several benefits such as it helps formulate clear research questions, establishes inclusion and exclusion criteria, and facilitates a thorough examination of databases in a timely manner. In this review, PRISMA was utilized to identify previous research on the effectiveness of mental imagery interventions in improving physical function among stroke survivors. The three databases used for searching were PubMed, Wiley-Blackwell, and ScienceDirect Journal. The systematic review process consists of three phases: identification, screening, and inclusion (Figure 1.1).

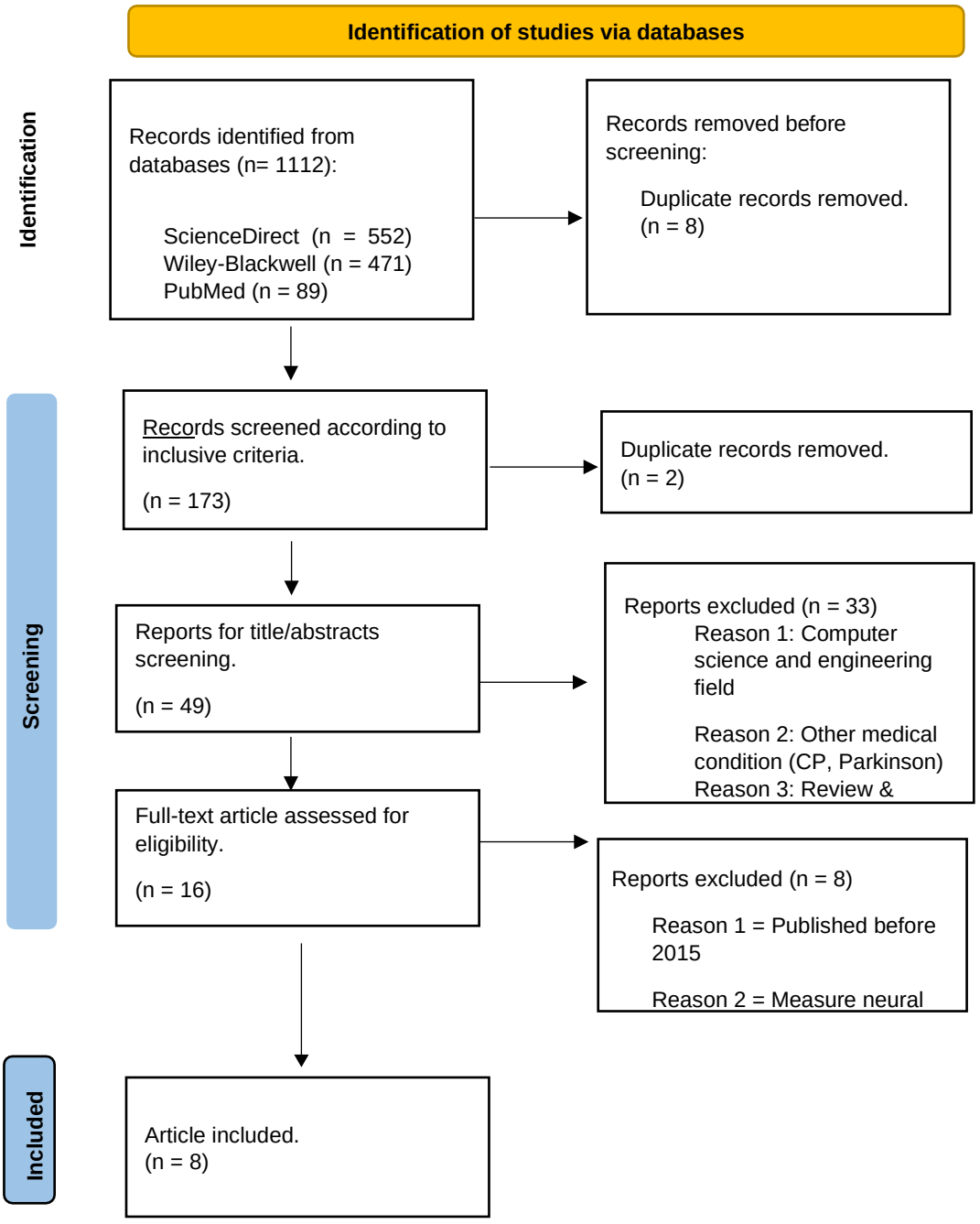

Figure 1.1 PRISMA flowchart

Search Strategy

The first part is to identify the keywords that will be used in the search strategy procedure. Based on previous research, similar terms and keywords connected to underlying mental images and physical abilities were used. The keyword list was examined and corrected, including the addition of several spelling variations. Table 2.1 shows the final form of the keyword search list. The major goal of this systematic review is to find empirical quantitative studies that have investigated the usefulness of mental imagery in improving physical function in stroke survivors. The author searched for articles in the main bibliographic databases which are PubMed, Wiley-Blackwell and ScienceDirect. The search terms or keywords used to gather the data and select the information were the following: “stroke”, “physical ability’ and “mental imagery” (Table 2.1).

Table 2.2
Keyword Search List

Term	**Keyword That Was Used for Searching Process**
Mental Imagery	("mental imagery" OR "motor imagery" OR ‘Autogenic Relaxation) AND
Physical Ability	("physical ability" OR "motor function") AND
Stroke Survivors	("stroke patients" OR "stroke survivors" OR "cerebrovascular accident" OR “CVA”)

Inclusion and Exclusion Criteria

To establish the selection criteria for this study, several factors were evaluated as outlined in Table 2.2 The following inclusion filters were applied during the article search which only research articles were considered, specifically those with cross-sectional, longitudinal or experimental designs. The content must pertain to the medical, neurological, and psychological fields by focusing on stroke rehabilitation, mental imagery interventions, cognitive rehabilitation and psychological factors affecting recovery. Articles published between 2015 and 2024 were included to ensure the review is based on the most recent literature. Manuscripts must be written in either English or Malay. Exclusion criteria consisted of articles published before 2015, non-research articles (such as reviews, conference proceedings, or books), qualitative and mixed-method studies and content unrelated to stroke such as engineering or computer science or conditions like Parkinson's and Cerebral Palsy.

Table 2.3
Article-Finding Criteria

Criteria	Inclusion	Exclusion
Year Duration	2015 - 2024	Before 2015
Language	English/Malay article	Not English/Malay article
Type of article	Research article	Article other than research article (review, conference, proceedings and books)
Research design	Cross-sectional, experimental and longitudinal studies	Qualitative and mixed method
Content	Stroke rehabilitation, mental imagery interventions, cognitive rehabilitation and psychological factor on recovery	Engineering, computer science field, and non- stroke condition such as Parkinson and Cerebral Palsy

Extraction Process

The PUBMED, Wiley Blackwell, and ScienceDirect Journal databases were searched for studies from 3 November 2023 to 8 December 2023. Figure 1 shows the total number of articles that were discovered, the number of remaining articles after removing duplicates, the number of articles that did not meet the inclusion requirements, as well as the articles that were chosen for further study. Initially, there were 1112 papers. However, 947 papers were excluded due to duplication and screening using the automation tools referring to the exclusion criteria. During the screening process, the title and abstract of each paper were assessed for relevance. A total of 774 titles were excluded due to the prevalence of "imagery" in the computer science and engineering field. The complete text of the studies that were judged acceptable was next assessed for eligibility according to their methodology and findings. Several manuscripts were eliminated for various reasons after reading the entire article (e.g. other conditions (Cerebral Palsy and Parkinson) and only measure the neural affected following stroke). There were 8 manuscripts that were included and fulfilled the research objective of identifying mental imagery effectiveness in improving physical functions among stroke survivors. The PRISMA flow diagram is shown in Figure 1.1.

Results and Discussions

This section begins by analyzing the characteristics of the 8 selected studies included in this systematic review (Table 3.1). To systematically explore these studies, they have been identified as essential sources to address the research theme of the effectiveness of mental imagery on physical recovery among stroke survivors. Table 3.2 lists the journal articles analyzed in this systematic review.

Characteristics of the Study

Table 3.1

Characteristics of the Study

Reference	Country	Settings	Sampel Study	Types of Strokes
Bajaj et al. (2015)	USA	Hospital	10	4 left hemiparesis and 6 right hemiparesis.
Irimia et al. (2018)	Romania	Hospital	10	Ischemic stroke
Mubeen et al. (2021)	Pakistan	Welfare society	50	Ischemic stroke
m & Lee (2015)	public of Korea	Hospital	24	First-time stroke survivors (specific type of stroke not mentioned)
Polli et al. (2016)	Itali	Hospital	28	Ischemic or hemorrhagic stroke
ajaj et al. (2015)	USA	abilitation center	30	Left thalamic hemorrhage, left basal ganglia infarct, right cingulate gyrus infarct, right caudate infarct, right motor cortex infarct, right basal ganglia and thalamic hemorrhage
iote et al. (2016)	Itali	Hospital	31	Specific type of stroke not mentioned
Wang et al. (2023)	China	Hospital	39	Ischemic and hemorrhagic strokes

This systematic review includes eight studies conducted in different countries, examining mental imagery interventions in stroke rehabilitation. The studies were primarily conducted in hospital environments with some conducted in rehabilitation centers and welfare societies. Bajaj et al. (2015) conducted two separate studies in the USA. The first study was conducted in a hospital which involved 10 participants, 4 of whom had left hemiparesis while 6 had right hemiparesis. The second study, carried out in a rehabilitation center had a larger sample of 30 participants with diverse stroke types including left thalamic hemorrhage, left basal ganglia infarct, right cingulate gyrus infarct, right caudate infarct, right motor cortex infarct and right basal ganglia and thalamic hemorrhage. Irimia et al. (2018) conducted a study in Romania with 10 participants in a hospital setting, focusing on individuals who had experienced ischemic strokes. Mubeen et al. (2021) conducted their research in Pakistan within a welfare society, examining 50 participants which all of whom had suffered ischemic strokes. In the Republic of Korea, Kim and Lee (2015) studied 24 first-time stroke survivors, though the specific stroke types were not mentioned. Polli et al. (2016) conducted research in Italy involving 28 participants in a hospital setting with stroke types including both ischemic and hemorrhagic strokes. Another study in Italy by Saiote et al. (2016) involved 31

participants in a hospital setting, though the specific stroke types were not disclosed. Lastly, Wang et al. (2013) conducted their study in China with 39 participants in a hospital setting, focusing on both ischemic and hemorrhagic strokes.

Quality of Data

The reporting of this study adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The STROBE checklist was used to assess the completeness of reporting in the study. Each item on the checklist was scored based on whether it was adequately reported (Yes) or not reported (No). The overall STROBE score for this study was 25.75 out of 32, indicating a high level of reporting completeness. Following is a summary of the STROBE score across all articles that indicate the number of items that were adequately reported and those that were not reported. Among the checklist items, 25 were adequately reported while 7 items were not reported across all articles. Overall, the study demonstrated strong adherence to the STROBE guidelines with most items adequately reported. However, areas for improvement include addressing potential sources of bias and discussing the generalizability of the study results. Despite these limitations, the study exceeded the recommended cutoff point of 15 with an average score of 25.75

Behavioral Measures of Physical Function

Several studies have consistently demonstrated the effectiveness of mental imagery interventions in improving physical function among stroke patients. Polli et al. (2017) and Lee et al. (2015) reported significant improvements in upper limb function following mental imagery interventions. Mubeen et al. (2021) found that stroke patients who received mental imagery interventions alongside conventional physical therapy showed greater improvements in hand function compared to those who received only physical therapy. Irimia et al. (2018) highlighted the high classification accuracy of a motor imagery-based Brain-Computer Interface (BCI) for stroke rehabilitation training. Bajaj et al. (2015) reported significant improvements in sensation and motor movements following mental practice and physical therapy interventions. Saiote et al. (2019) demonstrated positive effects of mental imagery on motor performance. Lastly, Wang et al. (2022) showed that Motor Imagery Training (MIT) led to higher improvements in upper limb function compared to the control group. These findings collectively underscore the efficacy of mental imagery interventions in enhancing physical function among stroke survivors. As evidenced by the findings, mental imagery emerges as an effective strategy for improving physical function among stroke survivors. However, the combination of mental imagery with physical therapy appears to enhance the effectiveness and speed of recovery even further. This suggests that mental imagery holds promise as a complementary treatment that is evidence-based and beneficial for stroke survivors seeking to improve their physical function and overall rehabilitation outcomes.

Neuroimaging Studies on Mental Imagery and Physical Ability

Neuroimaging studies have provided valuable insights into the neural mechanisms underlying mental imagery interventions and their impact on physical ability in stroke survivors. Bajaj et al. (2015) demonstrated significant changes in brain network activity and causal information flow between key motor regions following mental imagery practice paired with physical therapy. These findings suggest that mental imagery interventions can modulate brain networks associated with motor function and recovery. Similarly, Bajaj et al. (2015) highlighted the reorganization of motor networks during motor-imagery and motor-execution

tasks after the intervention which emphasize the roles of the premotor cortex (PMC) and primary motor cortex (M1) in motor recovery. Additionally, Saiote et al. (2019) found higher resting-state functional connectivity (RSFC) within the motor imagery network to be associated with increased activation in various brain regions involved in motor imagery. This provides insights into the neural mechanisms underlying mental imagery and its impact on motor function and recovery. Furthermore, Wang et al. (2022) utilized task-based functional magnetic resonance imaging (fMRI) to investigate the neural mechanisms of Motor Imagery Training (MIT) in stroke rehabilitation and revealed significant changes in brain activation patterns and functional connectivity associated with motor improvement. Overall, these neuroimaging findings support the effectiveness of mental imagery interventions in reshaping brain activation and connectivity to promote motor recovery in stroke patients.

Comparison with Traditional Rehabilitation Approaches

In comparing mental imagery interventions with traditional rehabilitation approaches, several studies have highlighted the potential benefits of integrating mental imagery techniques into existing rehabilitation programs. Polli et al. (2017) demonstrated the advantages of Graded Motor Imagery (GMI) over traditional rehabilitation approaches, especially for patients with severe arm paresis, suggesting the potential for enhancing physical function outcomes in stroke patients. Similarly, Mubeen et al. (2021) found that incorporating mental imagery alongside conventional physical therapy led to greater improvements in hand function compared to traditional therapy alone. These findings underscore the added benefit of integrating mental imagery into rehabilitation programs for stroke survivors.

Moreover, studies by Wang et al. (2022), and Bajaj et al. (2015) compared the outcomes of mental imagery interventions combined with conventional rehabilitation to conventional rehabilitation alone. Both studies demonstrated that integrating mental imagery techniques into rehabilitation programs resulted in greater improvements in upper limb function, highlighting the potential advantages of mental imagery-based interventions in enhancing motor recovery compared to traditional approaches. Overall, these findings suggest that integrating mental imagery techniques into existing rehabilitation programs may offer synergistic benefits and optimize motor recovery outcomes for stroke survivors. Further research could explore the long- term implications of incorporating mental imagery into rehabilitation programs and its potential to enhance stroke rehabilitation outcomes.

Psychological Factors Influencing Mental Imagery Effectiveness

The study by Irimia et al. (2018) highlighted the significant impact of psychological factors on the effectiveness of mental imagery in stroke rehabilitation. Participants reported feeling motivated during motor imagery practice using the BCI system, driven by their desire to improve motor functions and actively contribute to their recovery process. This motivation likely enhanced their engagement and focus on the mental imagery tasks and lead to better outcomes in terms of motor function recovery. Additionally, participants experienced early motor improvements during the training sessions which served as positive reinforcement and encouraged them to continue with the intervention. The study also emphasized the importance of providing real-time feedback and incorporating real hand movement into the rehabilitation process. These feedback mechanisms, combined with multisensory engagement through the BCI system, enhanced participants' sense of agency and control over

their motor functions which further supporting the effectiveness of mental imagery interventions in stroke rehabilitation.

Although Polli et al. (2017) did not specifically investigate psychological factors influencing the effectiveness of Graded Motor Imagery (GMI), the study's inclusion of implicit and explicit motor imagery components implies consideration of psychological variables such as attentional focus and cognitive abilities. The findings demonstrated the advantages of GMI over traditional rehabilitation approaches like mirror therapy and explicit motor imagery especially for patients with severe arm paresis. This suggests that GMI techniques may capitalize on psychological factors such as motivation and engagement to enhance motor function recovery in stroke patients. Further research could explore the interplay between psychological factors and GMI effectiveness, shedding light on the underlying mechanisms of motor imagery interventions in stroke rehabilitation. It is worth noting that psychological variables are often underlooked in studies assessing the effectiveness of mental imagery interventions as evidenced by the limited number of articles considering psychological influence towards mental imagery effectiveness. Understanding the role of psychological factors in shaping the outcomes of mental imagery interventions could provide valuable insights for optimizing stroke rehabilitation strategies.

Summary of main Findings

The objective of this systematic review is to assess the efficacy of mental imagery interventions in improving physical ability among stroke patients, while also exploring the potential psychological factors that may influence treatment outcomes. The systematic review revealed promising findings regarding the effectiveness of mental imagery interventions in improving physical function among stroke patients. Behavioral measures demonstrated significant improvements in upper limb function which supported by studies utilizing assessments such as the Wolf Motor Function Test (WMFT) and Fugl-Meyer Assessment. Neuroimaging studies provided insights into the neural mechanisms underlying mental imagery and highlight changes in brain activation patterns and functional connectivity associated with motor recovery. Comparisons with traditional rehabilitation approaches suggested the added benefits of integrating mental imagery techniques and showcase superior outcomes in terms of motor function improvement. Additionally, psychological factors including motivation, early motor improvements and multisensory engagement played crucial roles in enhancing the efficacy of mental imagery interventions underscoring the importance of considering psychological variables in stroke rehabilitation strategies.

Study Designs and Quality Characteristics

The systematic review included studies employing various research designs to investigate the effectiveness of mental imagery interventions in stroke rehabilitation. Experimental designs such as RCTs and experimental studies were particularly well-suited for assessing intervention efficacy under controlled conditions and offer valuable insights into the effectiveness of mental imagery techniques. These designs provided rigorous evaluations that minimized bias and confounding factors, enhancing the reliability of the findings. Additionally, longitudinal intervention study designs offered the advantage of examining long-term treatment effects and providing insights into the sustainability of intervention outcomes over time. Quasi-experimental designs and cross- sectional research designs contributed to understanding real-world effectiveness and preliminary evidence on associations between variables of

interest. While experimental designs offered robust evaluations, they were often resource-intensive and may not fully capture real-world clinical settings. Quasi-experimental designs provided more practical insights but were susceptible to bias and lacked the randomization of RCTs. Cross-sectional designs offered preliminary evidence but were limited in establishing causal relationships. Overall, the combination of diverse research designs enriched the systematic review by providing a comprehensive evaluation of mental imagery's role in stroke rehabilitation outcomes.

Type of Mental Imagery Interventions

Upon reviewing the various intervention types employed in assessing the effectiveness of mental imagery in stroke rehabilitation, several patterns emerge that offer valuable insights particularly in the context of developing systematic administration of mental imagery in Malaysia. Firstly, studies utilizing innovative approaches such as Motor imagery-based Brain-Computer Interface (BCI) training and Graded Motor Imagery (GMI) techniques demonstrate the potential of cutting-edge technologies and structured protocols in enhancing motor function recovery which suggest opportunities for integrating these approaches into Malaysian rehabilitation programs. Additionally, interventions combining conventional physical therapy with mental imagery techniques highlight the synergistic effects of integrating motor imagery into traditional rehabilitation programs and provide valuable insights into potential strategies for optimizing stroke rehabilitation in Malaysia. Moreover, the effectiveness of mental practice (MP) alone or in combination with physical therapy (MP+PT) underscores the versatility and accessibility of mental imagery interventions across different settings and offer practical implications for integrating these approaches into Malaysian healthcare settings. Furthermore, the structured approach offered by Motor Imagery Training (MIT) in conjunction with conventional rehabilitation provides valuable insights into the development of standardized protocols for administering mental imagery interventions in clinical practice in Malaysia.

However, the lack of access to advanced technology may influence the choice of intervention types applicable in the Malaysian context. While studies employing Motor imagery- based Brain-Computer Interface (BCI) training showcase promising outcomes, the widespread adoption of such technology may be limited by factors such as cost, infrastructure and specialized training requirements. In contrast, interventions utilizing more accessible techniques such as Graded Motor Imagery (GMI) and mental practice (MP) offer practical alternatives that can be implemented with minimal technological requirements and making them potentially more feasible
for integration into Malaysian rehabilitation programs. Additionally, interventions combining conventional physical therapy with mental imagery techniques provide a balanced approach that leverages existing infrastructure while capitalizing on the benefits of mental imagery. Therefore, considerations of technological accessibility and feasibility are crucial in selecting intervention types that are applicable and sustainable within the Malaysian healthcare context.

Strength and Limitations

The systematic review boasts several strengths that contribute to its robustness and reliability. Firstly, the author conducted a thorough search across multiple databases to identify relevant studies. This approach ensured a wide range of literature, enhancing the

comprehensiveness and validity of our findings. Secondly, the review synthesized evidence from diverse study designs, including randomized controlled trials, observational studies and neuroimaging research. By integrating evidence from various sources, the study provides a comprehensive overview of the effectiveness of mental imagery interventions in stroke rehabilitation and offers insights into different facets of the topic. Lastly, the review is notable for its inclusion of psychological factors, often overlooked in similar research. By examining variables such as motivation, early motor improvements and engagement, the study expanded the scope of our investigation and provided valuable insights into the holistic effects of mental imagery interventions on physical function among stroke patients.

While this review provides significant insights, it also highlights areas that warrant further exploration. The included studies exhibit heterogeneity in interventions, outcome measures, and participant characteristics. For example, Bajaj et al. (2015) utilized Mental Practice (MP) combined with physical therapy (PT), whereas Irimia et al. (2018) focused on Motor Imagery- based Brain-Computer Interface (BCI) training. This diversity complicates direct comparisons across studies and suggests the need for future research to establish more standardized intervention protocols. Additionally, variations in participant characteristics such as types of strokes (ischemic or hemorrhagic), stroke severity, and time since the stroke underscored the importance of context- specific findings.

Furthermore, the potential for bias such selection and measurement biases was noted, these considerations present opportunities for future research. All studies reviewed had small sample sizes, typically fewer than 50 participants which may limit the generalizability of the findings. Plus, Bajaj et al. (2015) utilized a convenience sampling method that may not represent the broader stroke survivor population. Addressing these limitations through larger, more diverse samples in future studies could enhance the representativeness of findings and their applicability to clinical settings. In conclusion, while the review provides valuable insights into the effectiveness of mental imagery interventions in stroke rehabilitation, recognizing these limitations opens avenues for future research. Enhancing the rigor of study designs and exploring objective measurement tools will contribute to a more comprehensive understanding of mental imagery's role in stroke recovery.

Implications

The findings of this review offer valuable insights for healthcare professionals seeking to integrate mental imagery interventions into stroke rehabilitation programs. By highlighting the potential benefits for patient outcomes such as improved motor function and enhanced recovery, practitioners can consider incorporating these interventions into existing rehabilitation protocols. Practical strategies for implementation may include integrating mental imagery exercises into therapy sessions, providing guidance on visualization techniques and utilizing feedback mechanisms to enhance engagement and effectiveness.

This review identifies several gaps in the literature regarding the effectiveness of mental imagery interventions in stroke rehabilitation, particularly regarding the influence of psychological factors. Future research should focus on addressing these gaps by employing specific methodologies and study designs to explore the underlying mechanisms and optimal delivery methods of mental imagery interventions. Furthermore, considering the psychological influence on mental imagery effectiveness such as motivation and engagement

is crucial for developing holistic rehabilitation approaches. The author is interested in constructing systematic administration of mental imagery interventions that should incorporate psychological factors into their research design to ensure comprehensive and effective stroke recovery strategies. Patient education and empowerment play essential roles in stroke rehabilitation and mental imagery techniques can serve as valuable tools for enhancing patient engagement and participation in theirrecovery journey. Healthcare professionals should emphasize the benefits of mental imagery in improving motor function and encourage patients to actively incorporate these techniques into their daily routines. Providing resources and recommendations for patients to practice mental imagery exercises independently can empower them to take control of their rehabilitation and promote long-term recovery. By integrating mental imagery as a complementary treatment option, patients can enhance their rehabilitation outcomes and optimize their recovery potential.

Conclusion

In conclusion, this systematic review provides valuable insights into the effectiveness of mental imagery interventions in improving physical function among stroke patients with implications for clinical practice, research directions and patient's empowerment. The comprehensive search strategy employed in this review facilitated the synthesis of diverse evidence from various study designs contribute to a comprehensive understanding of mental imagery effectiveness. By incorporating psychological factors into the analysis, this review sheds light on the multifaceted nature of mental imagery interventions and underscores their potential to enhance stroke rehabilitation outcomes. Moving forward, healthcare practitioners in Malaysia can leverage these findings to integrate mental imagery techniques into rehabilitation programs with a focus on patient education and empowerment. Furthermore, future research endeavors should explore innovative methodologies to optimize the delivery and efficacy of mental imagery interventions within the Malaysian healthcare system to ensure a holistic and personalized care for stroke survivors. Overall, this review provides a foundation for evidence-based practice and informs the development of tailored rehabilitation protocols to improve the quality of life for stroke patients in Malaysia and beyond.

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