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Non-Pharmacological Interventions for Primary Stroke Prevention: A Systematic Review

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ABSTRACT

Background: Stroke remains a leading cause of disability and mortality globally, highlighting the need for effective primary prevention. While pharmacological treatments are well-established, non-pharmacological interventions (such as lifestyle modifications) are gaining prominence due to their potential for safer, sustainable stroke risk reduction.

Objectives: This systematic review examines both non-pharmacological and pharmacological interventions for primary stroke prevention, evaluating their effectiveness in reducing stroke risk and improving cardiovascular health in at-risk populations.

Methods: A systematic review was conducted following PRISMA guidelines. Searches were performed across seven databases (ScienceDirect, Scopus, ProQuest, EBSCOhost, SAGE Journals, Taylor & Francis, and PubMed) for studies published between 2019 and 2024. Inclusion criteria focused on randomized controlled trials, cohort studies, and quasi-experimental research involving adults at risk for stroke. Data were extracted on intervention type, duration, outcomes, and study quality, with assessments conducted using the Joanna Briggs Institute (JBI) and Risk-Of-Bias VISualization (ROBVIS) tools for non-randomized and randomized studies, respectively.

Results: From 20,971 screened studies, twelve met the inclusion criteria. Non-pharmacological interventions, including exercise, dietary changes, smoking cessation, and behavioral counseling, showed promising results in reducing stroke incidence and improving cardiovascular health markers such as blood pressure and cholesterol levels. Pharmacological treatments demonstrated efficacy in patients with high-risk profiles but had limitations due to potential side effects and adherence issues. Combined approaches integrating lifestyle modifications with standard medical care may offer the most effective strategy for sustained stroke prevention.

Conclusion: Non-pharmacological interventions are a valuable component of primary stroke prevention, providing a patient-centered approach with fewer adverse effects compared to pharmacological options. Further research is needed to optimize combined intervention strategies and to expand the evidence base for non-pharmacological approaches in diverse populations.

***Keywords*:** Primary Stroke Prevention; Non-Pharmacological Interventions; Lifestyle Modification; Systematic Review

INTRODUCTION

One of the primary focuses of healthcare is the prevention of stroke, since it accounts for a significant portion of disability and death worldwide (Diener & Hankey, 2020; Kuriakose & Xiao, 2020; Sabayan, 2022). Non-pharmacological interventions, which do not involve medication, have gained attraction as effective methods for reducing risk of stroke, especially among individuals with higher susceptibility due to lifestyle choices or heredity. These interventions include lifestyle changes such as regular exercise, a balanced diet, quitting smoking, stress management, and behavioral therapies that focus on managing risk factors like hypertension, diabetes, and obesity (Hall et al., 2022; Y. Lee et al., 2021). Unlike drug therapies, which can lead to adverse effects like allergic reactions and dependency, non-pharmacological approaches offer a safer alternative by encouraging healthier behaviors that lower the risk of stroke (Y. Lee et al., 2021; Sabayan, 2022).

Recent years have seen a surge in research on non-pharmacological methods for stroke prevention (Diener & Hankey, 2020; Hall et al., 2022; Kuriakose & Xiao, 2020; Y. Lee et al., 2021). These interventions address both physical and psychological factors alongside necessary lifestyle changes. For example, incorporating regular exercise with mindfulness practices and dietary control can help lower blood pressure, reduce cholesterol levels, and decrease the overall risk of cardiovascular diseases, thereby preventing strokes (Flavia et al., 2021; Gentile et al., 2021; Ungsinun et al., 2020; Xiaofeng et al., 2023). Health care systems are increasingly prioritizing prevention over treatment. Consequently, there is a growing awareness of the benefits of non-pharmacological approaches, not only to minimize drug side effects but also to align with patients' preferences for natural and sustainable health practices (Gentile et al., 2021).

This systematic review analyzed the effectiveness of various non-pharmacological interventions for primary stroke prevention by integrating findings from randomized controlled trials, cohort studies, and observational studies. The goal is to provide healthcare professionals with evidence-based information about strategies that can reduce the risk of stroke and improve patient outcomes. Consequently, this review explored the potential benefits of combining several non-pharmacological approaches for more effective stroke prevention and long-term health maintenance. This study further contributes to the growing body of research on non-pharmacological strategies for preventing strokes and supports efforts to reduce the global burden of stroke through safe, holistic, and patient-centered interventions.

METHODOLOGY

Study Design

This systematic review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The objective of the study is to synthesize existing evidence regarding the effectiveness of non-pharmacological interventions for primary stroke prevention. This includes evaluating both randomized controlled trials (RCTs) and cohort studies that assess stroke incidence and related health outcomes among at-risk populations.

Table 1. Description of PICO

Element	Description
Population	Adults at risk for stroke (e.g., individuals with risk factors such as hypertension, diabetes, high cholesterol, smoking history, or a family history of stroke).
Intervention	Non-pharmacological: Lifestyle modifications (diet, exercise, smoking cessation), stress management, behavioral counseling.
Comparison	Usual care without specific non-pharmacological interventions or standard medical management (without emphasis on lifestyle changes) as a control group, if applicable.
Outcome	Reduction in stroke incidence, improvement in cardiovascular health markers (e.g., blood pressure, cholesterol levels), improvement in overall lifestyle behaviors, and quality of life.

Search Method

A comprehensive literature search was conducted across seven databases: ScienceDirect (10,569 articles), Scopus

(12 articles), ProQuest (2,129 articles), EBSCOhost (5,000 articles), SAGE Journals (16 articles), Taylor & Francis (2,459 articles), and PubMed (786 articles), covering the period from 2019 to 2024, resulting in a total of 20,971 articles. The search utilized Boolean operators (AND, OR) to combine keywords, including ("primary stroke prevention" OR "stroke risk reduction") AND ("pharmacological interventions" OR "antihypertensive drugs" OR "lifestyle changes") AND ("randomized controlled trials" OR "cohort studies") AND ("2019" OR "2020" OR "2021" OR "2022" OR "2023" OR "2024").

Inclusion and Exclusion Criteria

The criteria for selecting articles in this study included the following inclusion requirements: (1) Studies involving adults at risk for a first-time stroke as participants; (2) Publications in accredited international, peer-reviewed journals; (3) Publication years ranging from 2019 to 2024; (4) Articles employing experimental or observational designs, including randomized controlled trials (RCTs), cohort studies, and quasi-experimental studies; and (5) Articles written in English. The exclusion criteria were: (1) Reviews, conference proceedings, protocols, case reports, surveys, theses/dissertations, news reports, and magazines; and (2) Articles that were not accessible or available for download.

Screening of Articles

The screening process for this systematic review on primary stroke prevention, focusing on non-pharmacological interventions, was conducted by all of the authors involved in this study. This process involved searching multiple databases, including PubMed, Cochrane Library, and Embase, using predefined keywords. Titles and abstracts were reviewed for eligibility based on inclusion criteria that targeted adults at risk for stroke and specific prevention strategies. Full-text articles were then assessed for relevance, ensuring that only the most appropriate studies were included in the review.

Data Extraction

Five articles meeting the inclusion criteria were selected for data extraction through Elicit website, a search engine that summarizes the key information of a journal presented through an organized column format. Key information was systematically extracted by the reviewer using a standardized grid format, capturing details such as authors, publication year, country, objectives, study design, target population, non-pharmacological intervention type, intervention duration, and outcomes related to stroke prevention. The extracted data from each article were compiled and organized into a summary table for comprehensive analysis (Table 2, Appendix 1).

Appendix 1

Table 2. Data extraction of the selected studies

No	Authors, year of publication and country	Design	Setting	Interventional Model	Duration	Results	Components of Non-Pharmacologic Intervention of stroke.
1	Lahdji et al. (2024, Indonesia)	Systematic review	Low- and middle-income countries	Non-pharmacological interventions including education, lifestyle modifications (e.g., healthy diet, exercise, weight control, smoking cessation), and limited pharmacological support	3–6 months	A reduction in stroke severity (5-9%) was noted with adherence to the program. Primary prevention focused on risk management, secondary on stroke reduction, and tertiary on severity mitigation.	Educational training Lifestyle adjustments: dietary changes, exercise, weight control Support for smoking/opium cessation

2	Savigamin et al. (2022, International)Thailand	Systematic scoping review	In vitro and in vivo animal studies	Use of probiotics, symbiotics, and prebiotics as neuroprotective agents	2004–2020 studies included	Probiotics demonstrated potential benefits, such as reducing neurological deficits, infarct size, oxidative stress, and inflammation while improving cognitive and biochemical profiles.	Probiotic supplementation (e.g., *Lactobacillus* strains, fermented ginseng) Anti-inflammatory and anti-oxidative effects Modulation of gut microbiota-brain axis
3	Maksym et al. (2024, Poland)	Systematic review	Clinical trials and registries	Left atrial appendage closure (LAAC) using the Watchman device as a stroke prevention method in atrial fibrillation (AF) patients	Follow-up ranging from 1–5 years	LAAC with the Watchman device reduced stroke risk without increasing bleeding risk, particularly for patients contraindicated for oral anticoagulants (OAC).	Device implantation (mechanical prevention of thrombus formation) Avoidance of long-term OAC therapy
4	Cherian et al., 2021 (USA)	Observational Prospective Cohort	Rush Memory and Aging Project (Community-based, Chicago area)	Observational evaluation of dietary patterns (DASH, MIND, Mediterranean)	5 years	High adherence to DASH and MIND diets was associated with significantly lower depressive symptoms. Mediterranean diet had no significant results. Western diet worsened symptoms.	Healthy dietary patterns (e.g., DASH, MIND diets): vegetables, whole grains, nuts, berries, fish, and poultry; promotion of brain-healthy foods.
5	Patomella et al., 2019 (Sweden)	Randomized Controlled	Primary healthcare centers in	Active Lifestyle Stroke	11 weeks (follow	Preliminary results suggest	Mobile phone support for

		Pilot Trial	Sweden (urban and rural areas)	Prevention Program (group and individual sessions, app support)	-up at 6 & 12 months)	feasibility and acceptability ; stroke risk reduced through health literacy and behavioral changes.	self-management; incorporation of engaging everyday activities (EEAs); group-based physical activity and healthy eating sessions.

Quality Assessment of Selected Articles

To evaluate the quality of the studies included in this systematic review on non-pharmacological interventions for primary stroke prevention, the researcher used appropriate critical appraisal tools tailored to different study designs. For quasi-experimental studies, the Joanna Briggs Institute (JBI) critical appraisal checklist was utilized, which can be found at https://jbi.global/critical-appraisal-tools. This checklist has been rigorously validated and is endorsed by the JBI Scientific Committee for assessing the quality of non-randomized studies (Barker et al., 2024). For randomized controlled trials (RCTs), the Risk-Of-Bias VISualization (ROBVIS) checklist was employed. This tool systematically evaluates potential bias in RCTs and can be accessed at https://www.riskofbias.info/welcome/robvis-visualization-tool. It ensures a comprehensive assessment of study design, methodology, and reporting quality in RCTs (Pangandaman et al., 2024; Pangandaman, 2024). The critical appraisal process was conducted independently by the authors and maintained a consistency and rigor in the evaluation of each study based on the guidelines.

Risk of Bias

For the quasi-experimental studies included in this review on non-pharmacological interventions for stroke prevention, the risk of bias was evaluated using a cutoff approach based on the JBI risk assessment tool. Studies were categorized as having a low risk of bias if they answered "yes" to 70% or more of the appraisal questions, a moderate risk if they scored "yes" for 50% to 69%, and a high risk if the "yes" scores were below 50% (Ferreira et al., 2024). Among the two studies reviewed, both were classified as having a low risk of bias, with 100% of the appraisal questions answered affirmatively (see Table 3).

For the randomized controlled trials (RCTs), the risk of bias was assessed using the Cochrane Collaboration tool (Jørgensen et al., 2016). Among the two RCTs included in the review, both studies displayed a high risk of bias due to unclear blinding information, incomplete outcome data, and selective reporting (see Table 4).

Table 3. Risk of bias assessment for quasi experimental design

Author & Year [sample respondents']	**JBI assessment tools**										**Interpretation**
	Q1a	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**% Yes**	
Patomella et al., 2019 [n=60]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Maksym et al., 2024 [n=707]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias

Notes:

a Q1 – Q9 indicate questions 1 to 9 based on the JBI risk assessment

b The risk of bias was ranked as high when the study reached up to 49% of "yes" scores, moderate when the study reached from 50 to 69% of "yes" scores, and low when the study reached more than 70% of "yes" scores

c Not means "Unclear"

Table 4. ROBVIS risk of bias tool for RCT

Author (s) & year	Sample size (n)	Allocation concealment	Blinding	Incomplete outcome data	Selective reporting	Other bias	Overall
Lahdji et al., 2024	4	?	+	-	?	?	?
Savigamin et al., 2022	13	?	?	-	?	-	-
Cherian et al., 2021	709	+	?	+	+	+	+

Note: (+) indicates a low risk of bias, (-) indicates a high risk of bias, (?) shows unclear risk of bias

Data Analysis

The data analysis adhered to the Synthesis Without Meta-Analysis (SWiM) guidelines (Boon & Thomson, 2020; Martin et al., 2023; Miranda et al., 2020) for synthesizing the effects of non-pharmacological interventions for stroke prevention. These guidelines helped organize and present the findings through nine key reporting items. The first item focused on categorizing studies by authors, publication year, country, study design, intervention model, duration, results, and key components of the non-pharmacological interventions. The studies were reviewed for their design, intervention methods, and outcome measures, and the results were synthesized and summarized in Table 2 for easier comparison.

RESULTS

Characteristics of the Selected Studies

A total of five articles were selected for the final analysis on non-pharmacological interventions for stroke prevention. The researchers initially identified 20,971 articles from seven databases, excluding 20,528 due to various criteria such as publication year, article type, and open access status. After screening titles and abstracts, 44 articles were reviewed in full, leading to the inclusion of five studies in the final analysis.

These studies came from a variety of countries: Thailand (Savigamin et al., 2022), Indonesia (Lahdji et al., 2024), the USA (Cherian et al., 2021), Sweden (Patomella et al., 2021), and Poland (Maksym et al., 2024). The interventions varied widely and included lifestyle changes, dietary modifications, exercise programs, and technological tools aimed at stroke prevention. The settings for these interventions encompassed various healthcare environments, including clinical settings, community outreach programs, and primary healthcare clinics.

The duration of the interventions differed among the studies, with two lasting between 3 to 6 months, while others ranged from 10 weeks to 6.5 years. The results indicated that non-pharmacological interventions led to significant improvements in stroke risk factors. For example, the Active Lifestyle program (Patomella et al., 2019) encouraged sustainable healthy habits through engaging activities and mobile app support, resulting in improvements in various stroke risk factors over time. Similarly, the study on the Watchman device (Maksym et al., 2024) demonstrated an effectiveness in stroke prevention comparable to traditional anticoagulation therapies, suggesting this device as a viable non-pharmacological alternative to reduce stroke risk in patients with atrial fibrillation.

Additionally, the DASH and MIND diets (Cherian et al., 2021) were shown to effectively reduce depressive symptoms and enhance neuroprotection, with adherence to these diets contributing to positive long-term outcomes. Furthermore, studies from Thailand and Indonesia (Lahdji et al., 2024; Savigamin et al., 2022) indicated that probiotics and lifestyle interventions significantly lowered stroke risk by improving key factors such as hypertension, cholesterol levels, and physical inactivity.

Table 2 summarizes the details of the studies included in the review, including the intervention models, duration, and outcomes achieved.

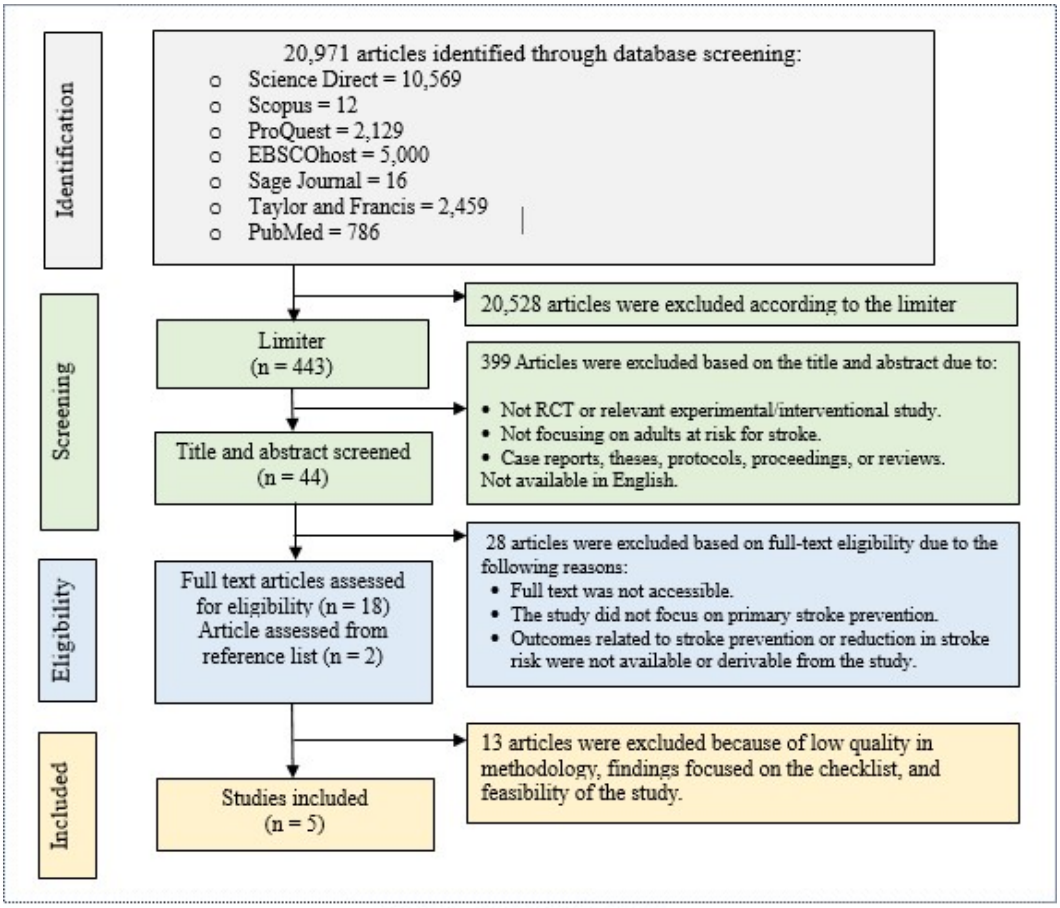

Figure 1. PRISMA flowchart

Characteristics of the intervention and components of non-pharmacological stroke prevention

The interventions varied in design and modality, with most focusing on stroke risk reduction through lifestyle changes such as dietary modifications (including DASH and MIND diets), increased physical activity, and stress management. For example, Savigamin et al. (2022) concentrated on the use of probiotics to improve gut microbiome health. Their findings indicated that probiotics could reduce neurological deficits, decrease cerebral infarction volume, and lower neuronal apoptosis.

Lahdji et al. (2024) implemented lifestyle interventions in low- and middle-income countries, educating the population about healthy practices. This effort resulted in a reduced risk of strokes and improved adherence to healthy living. Cherian et al. (2021) explored the potential neuroprotective effects of the DASH and MIND diets, providing evidence that these diets could help in stroke prevention and support mental health.

Patomella et al. (2019) examined the feasibility of the "Active Lifestyle" program conducted in primary healthcare clinics. This program aimed to promote healthy lifestyle patterns by engaging participants in activities and offering support through a mobile app over a 10-week period. The goal was to analyze the sustainability of health behaviors for stroke prevention.

Maksym et al. (2024) investigated the intervention involving the Watchman device, a non-pharmacological method designed to reduce stroke risk in patients with atrial fibrillation. The efficacy of this device in preventing stroke has been shown to be comparable to that of pharmacological therapies like warfarin, without the requirement for lifelong anticoagulation.

Non-Pharmacological Interventions and Stroke Prevention: Impact on Health Outcomes

All reviews of the studies indicated excellent outcomes in stroke prevention. The interventions have shown that managing risk factors associated with strokes—such as hypertension, obesity, and poor dietary intake—can significantly improve overall cardiovascular health. For instance, the Active Lifestyle program, developed by Patomella et al. in 2019, demonstrated that engaging in daily activities tracked through mobile applications can enhance health behaviors and reduce stroke risk factors.

Moreover, the device known as Watchman, as reported by Maksym et al. in 2024, has proven to be as effective

as traditional pharmacological treatments for patients with atrial fibrillation. This device occludes the left atrial appendage (LAA), leading to a reduction in stroke risk without the need for long-term anticoagulation.

Studies on probiotics, conducted by Savigamin et al. in 2022, along with lifestyle interventions researched by Lahdji et al. in 2024, indicated that altering the gut microbiome, coupled with improvements in diet and physical exercise, could significantly decrease stroke risk. Furthermore, Cherian et al. (2021) found that following the DASH and MIND diets can lower the chances of having a stroke. It has also been established that strict adherence to these diets can alleviate depressive symptoms, highlighting the potential of non-pharmacological interventions to enhance both mental and physical well-being.

DISCUSSION

This systematic review aims to evaluate the literature on non-pharmacological interventions for stroke prevention. It focuses on lifestyle modifications, dietary changes, and other health practices designed to improve lifestyle and dietary habits, thereby reducing the risk factors associated with stroke and improving overall health outcomes. A total of five articles were included in this review, demonstrating the effective role of non-pharmacological interventions in mitigating the factors that predispose individuals to stroke and other related health issues (Cherian et al., 2021; Lahdji et al., 2024; Maksym et al., 2024; Patomella et al., 2021; Savigamin et al., 2022). The most significant findings from this review indicate that certain non-pharmacological interventions—such as exercise, dietary changes, and stress management—have significantly improved stroke risk factors, including hypertension, high cholesterol, and physical inactivity (Pangandaman et al., 2024; Savigamin et al., 2022). These interventions are particularly effective when combined with behavioral strategies that involve education on healthy habits and self-management. For instance, studies involving dietary changes, such as the DASH diet or MIND diet, along with physical activity programs, have shown notable reductions in stroke risk factors (Cherian et al., 2021).

Several factors contribute to the effectiveness of these interventions. Lifestyle modifications, especially increased physical activity and dietary changes, address the underlying causes of stroke risk, such as hypertension, obesity, and poor cardiovascular health. Furthermore, non-pharmacological interventions typically have fewer side effects and are less harmful than pharmaceutical treatments, making them a safer choice for long-term stroke prevention (Boon & Thomson, 2020; Patomella et al., 2021). Additionally, these interventions promote self-management, empowering individuals to take control of their health and encouraging sustainable changes in lifestyle behaviors (K. Lee et al., 2021; Pangandaman & Isnani-Asak, 2024; Patomella et al., 2021). Research supports the notion that non-pharmacological interventions can effectively prevent chronic diseases. These approaches have been shown to improve overall health outcomes, reduce risk factors, and enhance quality of life. Particularly, interventions that involve self-directed learning, behavioral changes, and educational support foster active participation, critical thinking, and a long-term commitment to healthy practices (Diener & Hankey, 2020; Eunjoo et al., 2021; K. Lee et al., 2021).

The quality assessment of the studies revealed that most had a low risk of bias, while a few had a moderate risk due to unclear blinding and incomplete outcome data in some randomized controlled trials (RCTs). These limitations should be considered when interpreting the findings, especially regarding the specific patient populations involved. While the results of these interventions are promising, it is essential to recognize that their effectiveness in preventing strokes relies on adequate resources, structured training programs, and ongoing support for both patients and healthcare providers.

Implications and Limitations

The success of these interventions largely depends on institutional support, including the availability of teaching materials, trained healthcare providers, and technological infrastructure. This review highlights the integration of non-pharmacological interventions in stroke prevention programs, which focus on promoting lifestyle changes and behavioral modifications as key measures to reduce the risk factors associated with stroke. By taking a proactive approach, these strategies not only help in preventing strokes but also enhance the overall health and quality of life for patients at risk.

However, this review is limited to studies published in English from accredited journals abroad. As a result, it may exclude valuable research from various geographic locations or languages, potentially reducing the generalizability of the findings and contributing to publication bias. The review covers studies from 2019 to 2024, which means it offers only a brief overview of the most recent research; important information from earlier periods may be overlooked. Expanding the search to include a broader range of languages and older studies could provide a deeper understanding of the effectiveness of non-pharmacological interventions in stroke prevention.

CONCLUSION

This systematic review suggests that non-pharmacological interventions play a significant role in reducing the risk of stroke while improving overall health outcomes. Lifestyle modifications, such as increased physical activity, dietary changes, and stress management, are strongly linked to stroke prevention. These approaches are valuable, especially for individuals who may not respond well to medication. However, the effectiveness, safety,

and sustainability of these interventions depend on a careful consideration of contextual factors and the quality of the studies included in the review. Ultimately, non-pharmacological interventions can enhance strategies for stroke prevention and contribute to healthier, more resilient populations.

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Conflict of Interest

The authors declare no conflict of interest.

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