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Super Brain Yoga in Physical Education and Sports Science: A Review with Bibliometric Analysis of Mental Health, Cognitive Function, and Physical Performance

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ABSTRACT

This study maps the development of Super Brain Yoga research within physical education and sports science. A bibliometric review of 284 peer-reviewed publications published between 2012 and 2025 examined publication growth, geographical distribution, study designs, participant groups, intervention protocols, cognitive outcomes, mental health effects, and physical-performance applications. The reviewed studies involved 9,847 participants and showed strong growth after 2019. Randomized controlled trials and quasi-experimental studies dominated the evidence base. Frequently examined outcomes included memory, concentration, anxiety, depression, sleep quality, balance, endurance, and neurobiological markers. Super Brain Yoga was typically performed for 5-10 minutes with minimal equipment and high adherence. The findings support its potential as an accessible mind-body exercise for physical education, sports training, rehabilitation, and community health programs globally.

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1. INTRODUCTION

Physical education and sports science increasingly recognize that exercise influences not only physical fitness but also cognitive performance, emotional regulation, and psychological well-being. Contemporary physical education programs therefore extend beyond strength, endurance, flexibility, and motor competence to include concentration, stress management, learning readiness, and healthy behavioural development. This broader perspective is especially important because academic pressure, sedentary behaviour, occupational stress, and mental health problems can reduce both physical participation and cognitive performance.

Mind-body exercise has attracted attention as an accessible approach for integrating movement, controlled breathing, concentration, and psychological regulation. Yoga-based activities may influence stress-related physiological processes, autonomic balance, attention, and emotional well-being [1-3]. These characteristics make yoga relevant to physical education, sport training, rehabilitation, and community exercise because it can combine low-to-moderate physical activity with cognitive engagement.

Super Brain Yoga (SBY), traditionally known as *Thoppukaranam*, is a structured mind-body activity involving repeated squatting movements while the participant holds the opposite earlobes. The activity combines lower-body movement, balance, coordination, rhythmic repetition, controlled breathing, and focused attention. Unlike many exercise interventions, SBY does not require specialized equipment, extensive facilities, or long training sessions. It can therefore be incorporated into school physical education, warm-up activities, recreational exercise, rehabilitation, and community fitness programs.

From a physical education perspective, the squatting component engages the lower limbs and requires postural control, movement coordination, and repeated muscular activity. From a sports science perspective, the practice may also influence balance, endurance, attentional control, stress regulation, and recovery. These combined characteristics distinguish SBY from seated meditation because it integrates cognitive concentration with active body movement.

Previous studies have examined yoga-related effects on cognitive ability, stress, anxiety, mood, autonomic regulation, and neuroplasticity [2-6]. Yoga-based activities may support concentration and academic performance [7]. Other investigations have examined SBY among university students, nursing students, older adults, haemodialysis patients, and individuals requiring cognitive or balance support [8-12]. Despite the growing number of studies, the evidence remains distributed across psychology, education, neuroscience, clinical medicine, rehabilitation, yoga studies, and sports science. This disciplinary fragmentation makes it difficult to determine how SBY research has developed, which populations have been studied, which outcomes have received the greatest attention, and how the intervention can be applied in physical education and sport-related settings. Bibliometric analysis provides a systematic method for examining publication growth, geographic contributions, research designs, thematic patterns, and disciplinary development [13, 14]. This approach is useful for identifying whether SBY has developed into a coherent research field and whether current evidence supports its broader use as a movement-based intervention.

This study aims to map the global development of SBY research published between 2012 and 2025. Specifically, it examines publication trends, geographical distribution, journal and disciplinary patterns, methodological designs, participant groups, intervention protocols, cognitive and mental health outcomes, physical-performance applications, and proposed

neurobiological mechanisms. It also evaluates the relevance of SBY to physical education, sports science, rehabilitation, and community exercise. The novelty of this study lies in repositioning SBY as a movement-based mind-body intervention within physical education and sports science. Previous studies have commonly emphasized mental health, cognition, or traditional yoga practice. The present analysis integrates these outcomes with physical-performance dimensions such as balance, endurance, movement coordination, adherence, exercise feasibility, and rehabilitation. It therefore provides a multidisciplinary framework for understanding how SBY may support cognitive, psychological, and physical development across educational, athletic, clinical, and community populations.

2. LITERATURE REVIEW

The present study addresses these gaps by mapping publication patterns and integrating cognitive, psychological, physical, and implementation outcomes. Previous studies provide important evidence regarding cognition, mental health, physiology, and rehabilitation. However, the field still lacks an integrated interpretation that positions Super Brain Yoga within physical education and sports science. **Table 1** summarizes the major research streams, their contributions, and the remaining research gaps.

Table 1. Synthesis of previous research and relevance to physical education and sports science.

RESEARCH STREAM	MAIN FOCUS	REPORTED CONTRIBUTION	REMAINING GAP
General yoga and mental health	Stress, anxiety, depression, and mood	Supports the psychological relevance of mind-body exercise	Evidence is not always specific to SBY
Cognitive and educational studies	Memory, concentration, and academic performance	Indicates potential value for school physical education and active learning	Limited long-term and multi-site evidence
Neuroscience and physiology	Prefrontal activation, autonomic balance, cortisol, and BDNF	Provides possible mechanisms for cognitive and emotional effects	Direct SBY-specific mechanistic evidence remains limited
Balance and rehabilitation	Postural control, cognitive rehabilitation, and functional support	Suggests relevance to adapted exercise and older adults	Exercise safety and protocol modification require further study
Athletic and sports studies	Performance, endurance, recovery, and attention	Indicates emerging sports-science applications	Few sport-specific trials and limited athlete samples
Intervention implementation	Duration, adherence, equipment, and setting	Shows that SBY is brief, low-cost, and adaptable	Optimal frequency, intensity, and progression remain unclear
Present study	Bibliometric mapping of SBY research	Integrates mental, cognitive, physical, and sports-related evidence	Provides a physical education and sports-science interpretation of the field

2.1. SBY as a Mind-Body Exercise

SBY combines physical movement with focused attention and controlled breathing. Its central movement pattern consists of repeated squatting while the participant holds the opposite earlobes. This structure requires bilateral coordination, lower-limb movement, postural stability, and sustained concentration. In physical education, activities that combine

movement and cognition may support learning readiness and motor control. SBY is relevant to this approach because participants must coordinate hand position, breathing, movement timing, and attention. The exercise can therefore be interpreted as a simple form of cognitively engaged physical activity. Unlike equipment-dependent exercise, SBY can be performed in classrooms, gymnasiums, homes, clinics, and community centres. Its short duration and simple movement structure make it potentially useful for warm-up sessions, active breaks, wellness activities, and low-cost exercise programs.

2.2. Physical Education and Cognitive Development

Physical education contributes not only to physical fitness but also to concentration, behavioural regulation, and academic engagement. Movement-based activities may influence attention by increasing physiological arousal, supporting cerebral circulation, and requiring participants to coordinate sensory and motor information. Yoga-based interventions among schoolchildren have been associated with improvements in cognitive ability and academic-related outcomes [7]. SBY may offer similar benefits because it combines repeated movement with sustained attentional focus. Studies involving adolescents have reported improvements in sustained attention following regular SBY practice [10]. These findings are relevant to physical education because concentration is important for learning movement skills, following instructions, maintaining safety, and participating effectively in sport. An activity that improves attention while also involving physical movement may therefore have value within school-based exercise programs.

2.3. Sports Science and Physical-Performance Applications

Sports science examines the physiological, psychological, biomechanical, and behavioural factors that influence performance. Within this field, SBY may be relevant to balance, coordination, endurance, recovery, and attentional control. Balance is particularly important in sport, aging, rehabilitation, and injury prevention. Research involving inactive older adults has reported improvements in balance and balance confidence after SBY practice [11]. Although older adults are not athletic populations, the movement may influence postural control and neuromuscular coordination. The repeated squatting component may also provide low-intensity muscular activity involving the lower limbs. However, the available studies do not establish SBY as a substitute for strength or endurance training. Its potential value lies more plausibly in its integration with warm-up routines, coordination activities, active recovery, and cognitive preparation. For athletes, concentration and emotional regulation are closely connected to performance. Mind-body practices may help athletes manage anxiety, maintain attention, and recover psychologically from training demands. Nevertheless, evidence specifically involving athletes remains limited compared with studies involving students and clinical populations.

2.4. Mental Health and Exercise Participation

Mental health can influence motivation, exercise adherence, academic performance, and athletic participation. Anxiety, depression, and stress may reduce concentration and willingness to participate in physical activity. Therefore, psychological well-being is an important concern in physical education and sports science. Yoga-based interventions have demonstrated benefits for stress-related physiological measures, mood, anxiety, and depression [1-3]. Proposed mechanisms include parasympathetic activation, reduced cortisol, improved emotional regulation, and changes in neurotransmitter systems. Studies involving university students and nursing students have reported reductions in stress, anxiety, and

depressive symptoms following yoga or SBY-related interventions [8,9]. SBY may be useful as a complementary activity within student wellness and physical education programs. However, the reviewed evidence should not be interpreted as proof that SBY can replace clinical treatment. Its most defensible role is as a complementary, low-cost movement practice that may support stress management and psychological well-being.

2.5. Cognitive Function and Academic Performance

Memory, concentration, and attention are among the most frequently examined outcomes in SBY research. These functions are relevant to both education and sport because successful performance depends on information processing, decision-making, task focus, and movement learning. Research involving adolescents has shown improvements in sustained attention after SBY practice [10]. Studies involving nursing students have also reported improvements in concentration, memory, and academic progress [12]. These outcomes suggest that SBY may support cognitive readiness when incorporated into educational routines. From a sports-science perspective, improved attention may benefit tactical decision-making, response selection, and technical-skill execution. Nevertheless, direct evidence linking SBY to competitive sports performance remains comparatively limited and requires further investigation.

2.6. Neurobiological and Physiological Mechanisms

The proposed mechanisms of SBY draw largely from the broader yoga and mind-body literature. Yoga practices have been associated with changes in prefrontal activation, hippocampal structure, autonomic balance, cortisol regulation, and brain-derived neurotrophic factor [2-6]. The prefrontal cortex supports attention, decision-making, and emotional control, while the hippocampus contributes to memory formation. Improvements in these systems may help explain reported cognitive benefits. Increased parasympathetic activity may also reduce stress responses and support physiological recovery. Brain-derived neurotrophic factor contributes to neural growth, synaptic plasticity, and cognitive adaptation. Yoga interventions have been associated with increased BDNF concentrations, although much of this evidence concerns broader yoga practices rather than SBY alone [6]. Therefore, the neurobiological explanation of SBY remains plausible but not fully confirmed. Future studies should distinguish direct SBY evidence from evidence transferred from meditation, general yoga, or other mind-body interventions.

2.7. Balance, Rehabilitation, and Special Populations

SBY has also been studied in populations requiring rehabilitation or functional support. A study involving haemodialysis patients reported improvements in cognitive function after SBY practice [8]. Research involving older adults reported improvements in balance and balance confidence [11]. These findings suggest potential applications in adapted physical education, geriatric exercise, and rehabilitation. Because the intervention is brief and requires minimal equipment, it may be suitable for settings with limited resources. However, movement modifications may be necessary for participants with joint limitations, severe balance impairment, or mobility restrictions. Claims that SBY is universally safe should therefore be made cautiously. Exercise supervision and individual screening remain important in physical education and rehabilitation settings.

2.8. Intervention Feasibility and Exercise Adherence

Feasibility is an important component of physical education and sports-program implementation. Exercise interventions are more likely to be sustained when they are brief, affordable, accessible, and easy to understand. SBY sessions generally lasted 5-10 minutes and required no specialized equipment. Reported implementation settings included schools, workplaces, homes, clinics, and community centres. Such flexibility supports the potential integration of SBY into regular physical activity routines. Supervised programs generally showed stronger adherence than home-based practice. Teacher guidance, peer participation, monitoring, and structured scheduling may improve engagement. In physical education, SBY may therefore be more effective when it is included in planned sessions rather than assigned only as independent practice.

2.9. Bibliometric Research in Physical Education and Sports Science

Bibliometric analysis enables researchers to quantify publication output, collaboration patterns, methodological development, thematic clusters, and research gaps [13, 14]. It is particularly useful for emerging interdisciplinary topics because relevant studies may be distributed across different journals and academic fields. In SBY research, bibliometric mapping can identify the extent to which physical education and sports-science journals contribute to the field. It can also determine whether the literature remains dominated by clinical and psychological perspectives or is expanding toward performance, rehabilitation, and exercise science. Physical education and sports journals represent an identifiable part of the publication landscape. It also identifies athletes and sports performers as one of the studied population groups. However, these areas remain smaller than the educational, clinical, and cognitive domains. This imbalance provides an important direction for future sports-science research.

2.10. Research Gap and Conceptual Position

Existing research has reported possible benefits of yoga and SBY for cognition, mental health, balance, and academic performance [1-12]. However, several gaps remain. First, much of the neurobiological explanation is derived from general yoga and meditation research rather than direct SBY experiments. Second, relatively few studies have focused specifically on athletes, physical performance, exercise physiology, or sport-specific outcomes. Third, intervention protocols vary in frequency, duration, repetition, and supervision. Fourth, the global structure and disciplinary development of SBY research have not been systematically interpreted from a physical education and sports-science perspective.

3. METHODS

This study employed a bibliometric review to examine the development of SBY research within physical education, sports science, cognitive science, rehabilitation, and health-related disciplines. Bibliometric analysis was selected because it provides a systematic approach for mapping publication growth, geographical contribution, research design, thematic development, and disciplinary structure within an emerging field [13, 14].

Scientific publications published between 2012 and 2025 were retrieved from Scopus, Web of Science Core Collection, PubMed, and Google Scholar. The search was conducted using combinations of the terms *SBY*, *Thoppukaranam*, *brain yoga*, *yogic squats*, *mental health*, *concentration*, *attention*, *cognitive function*, *memory*, *psychological well-being*, *stress*

reduction, *anxiety*, and *depression*. The search syntax was adjusted according to the requirements of each database.

The review included peer-reviewed original research articles published in English between 2012 and 2025. Systematic reviews, meta-analyses, narrative reviews, opinion pieces, editorials, conference abstracts, books, book chapters, duplicate publications, and studies with insufficient methodological information were excluded.

After screening and eligibility assessment, 284 publications were included in the analysis. Extracted information included publication year, country of origin, journal, study design, participant characteristics, sample size, intervention duration, session frequency, outcome measures, and major findings. Outcomes were organized into cognitive function, mental health, neurobiological mechanisms, academic performance, physical performance, rehabilitation, and intervention methodology.

Descriptive bibliometric analysis was used to summarize annual publication trends, geographical distribution, journal patterns, study designs, population characteristics, intervention protocols, and outcome frequencies. Thematic analysis was also used to identify recurring research domains through keyword grouping and categorical organization of study focus. Reporting completeness for observational studies was examined with reference to the STROBE guidelines, while randomized controlled trials were evaluated using the JADAD scale [15,16]. In addition, because this study analyzed previously published literature and did not directly involve human participants, ethical approval and informed consent were not required.

4. RESULTS AND DISCUSSION

4.1. Publication Trends

Figure 1 presents the annual growth of SBY publications between 2012 and 2025. As shown in **Figure 1**, research output remained limited during the initial period from 2012 to 2015, when only 15 publications were identified. Publication growth became more visible during 2016-2019 and accelerated substantially after 2019. The 2020-2025 period accounted for 217 publications, representing 76.1% of the total literature. The highest annual output occurred in 2024, with 58 publications.

The growth pattern indicates increasing scientific recognition of SBY as a mind-body exercise with possible applications in cognitive training, mental health, physical education, rehabilitation, and sports science. This development also reflects broader interest in accessible non-pharmacological interventions and exercise-based strategies for improving psychological and cognitive outcomes [2, 3].

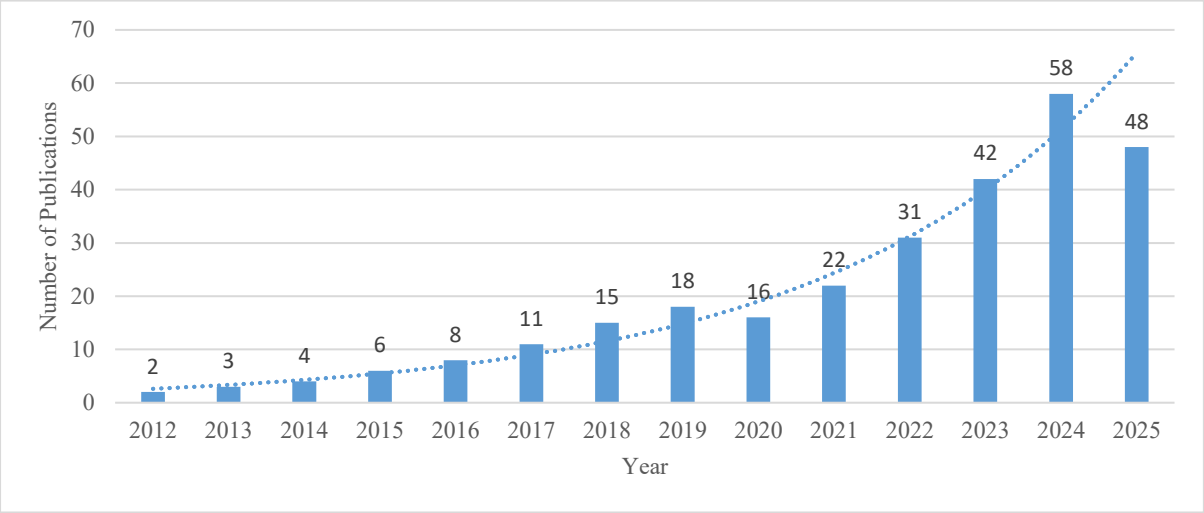

Figure 1. Annual growth of publications on SBY from 2012 to 2025.

4.2. Geographical Distribution

Figure 2 presents the geographical distribution of SBY research. India was the largest contributor, with 75 publications, followed by China with 43 publications and the United States with 36 publications. Iran, the United Kingdom, Turkey, Thailand, Japan, Ethiopia, and Spain were also represented among the leading contributors. Together, the ten leading countries accounted for all 284 publications included in the dataset. India's leading position is consistent with the cultural origin of SBY and the broader integration of yoga into health, education, and wellness programs. The participation of countries from Asia, Europe, North America, and Africa indicates that SBY research has developed beyond its traditional context and entered international scientific discussion.

International collaboration was identified when a publication included authors affiliated with institutions in more than one country. International collaboration was also evident, with 67.3% of publications involving multi-institutional or multinational authorship. This pattern suggests increasing interdisciplinary and cross-country interest in SBY, particularly in psychology, education, rehabilitation, public health, and sports science.

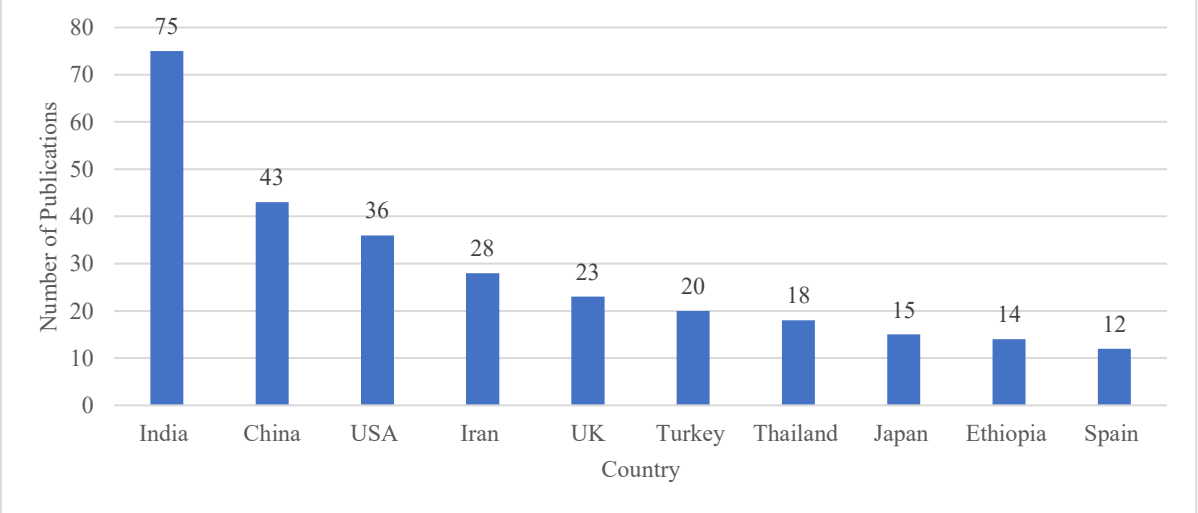

Figure 2. Geographical distribution of SBY research by country.

4.3. Journal and Disciplinary Distribution

Table 2 presents the eight journals with the highest number of publications on SBY. As shown in **Table 2**, *Frontiers in Psychology* was the leading publication outlet, with 28 articles, followed by the *Journal of Physical Education and Sport*, with 24 articles. Other contributing journals represented yoga, integrative medicine, complementary medicine, psychiatry, and neuroendocrinology. The presence of the *Journal of Physical Education and Sport* as the second-largest publication outlet indicates a clear connection between SBY research and the fields of physical education and sports science. However, the overall journal distribution remained interdisciplinary, with strong representation from psychology, neuroscience, clinical medicine, and integrative health.

Table 2. Top eight journals publishing research on SBY.

RANK	JOURNAL NAME	ARTICLES	PERCENTAGE OF TOTAL (%)	DISCIPLINE	IMPACT-FACTOR CATEGORY
1	*Frontiers in Psychology*	28	9.9	Psychology and neuroscience	High (IF > 3)
2	*Journal of Physical Education and Sport*	24	8.5	Physical education and sports	Medium (IF 1.5-3)
3	*International Journal of Yoga*	6	2.1	Yoga and wellness	Medium (IF 1.5-3)
4	*Advances in Integrative Medicine*	5	1.8	Integrative medicine	Medium (IF 1.5-3)
5	*Evidence-Based Complementary and Alternative Medicine*	4	1.4	Complementary medicine	Medium (IF 1.5-3)
6	*Journal of Alternative and Complementary Medicine*	4	1.4	Mind-body medicine	Medium (IF 1.5-3)
7	*Psychiatry Research*	3	1.1	Clinical psychiatry	High (IF > 3)
8	*Neuroendocrinology Letters*	3	1.1	Neuroendocrinology	Medium (IF 1.5-3)
	Total	**77**	**27.3**	Multidisciplinary	Mixed

Table 3 summarizes the remaining journals according to disciplinary cluster. The remaining journals were distributed across clinical medicine and psychiatry, neuroscience, education, sports science, integrative medicine, gerontology, rehabilitation, public health, traditional medicine, and interdisciplinary research.

Sports science journals accounted for 8.5% of the remaining publication distribution, indicating that physical-performance and exercise-related applications form an identifiable but still developing part of the evidence base. SBY research has not developed within a single academic field. Instead, it connects physical movement, cognitive performance, psychological well-being, rehabilitation, and community health. This multidisciplinary pattern supports the relevance of SBY to physical education and sports science, particularly where movement, cognition, health promotion, and rehabilitation intersect.

Table 3. Distribution of remaining journals by disciplinary cluster.

DISCIPLINARY CLUSTER	NUMBER OF JOURNALS	PERCENTAGE OF TOTAL PUBLICATIONS (%)	MAIN RESEARCH FOCUS	PRIMARY TARGET AUDIENCE
Clinical medicine and psychiatry	4	12.3	Clinical efficacy, symptom reduction, and treatment outcomes	Psychiatrists and clinical psychologists
Neuroscience and brain research	5	11.3	Neurobiological mechanisms, brain imaging, and neurochemistry	Neuroscientists and cognitive scientists
Education and academic performance	5	9.9	Academic achievement, cognitive enhancement, and concentration	Educators and school administrators
Sports science and athletics	4	8.5	Athletic performance, sports injury prevention, and endurance	Sports scientists and athletic trainers
Integrative and holistic medicine	6	10.6	Wellness integration, traditional systems, and holistic approaches	Integrative practitioners and wellness specialists
Gerontology and rehabilitation	3	6.3	Fall prevention, balance, cognitive aging, and elderly care	Geriatricians and occupational therapists
Public health and community medicine	3	5.6	Community programs, accessibility, health equity, and policy	Public-health officials and policymakers
Yoga and traditional medicine	2	5.3	Traditional knowledge, practice protocols, and cultural integration	Yoga practitioners and traditional-medicine specialists
Interdisciplinary and emerging research	2	3.1	Novel mechanisms, interdisciplinary insights, and emerging trends	Cross-disciplinary researchers
Total	**34**	**72.9**	Comprehensive integration	Diverse professionals

4.4. Study Design and Methodological Characteristics

Table 4 presents the methodological distribution of the 284 publications. Randomized controlled trials represented the largest study category, with 93 studies or 32.7% of the total. Cross-sectional studies accounted for 28.9%, while quasi-experimental studies represented 25.4%. Qualitative studies, case reports, and mixed-methods studies formed smaller proportions. The combined proportion of randomized controlled trials and quasi-experimental studies reached 58.1%, indicating that intervention-based research dominated the evidence base. This pattern is important for physical education and sports science because intervention studies provide stronger evidence for evaluating changes in concentration, balance, endurance, stress, and exercise-related performance. The mean JADAD score for randomized trials was 3.8 ± 0.8, indicating adequate-to-good methodological quality. Nevertheless, variation in intervention frequency, session duration, number of repetitions, supervision, and participant characteristics limits direct comparison among studies.

Table 4. Study design and methodological distribution of SBY research.

STUDY DESIGN	NUMBER OF STUDIES	PERCENTAGE (%)	METHODOLOGICAL QUALITY	MAIN RESEARCH PERIOD	APPLICABILITY
Randomized controlled trials	93	32.7	Gold standard; JADAD = 3.8 ± 0.8	2016-2025; 60.4% conducted during 2020-2025	High; supports evidence-based practice
Quasi-experimental studies	72	25.4	Good; moderate risk of bias	2016-2025	Moderate to high; supports practical applications
Cross-sectional studies	82	28.9	Acceptable observational quality	2012-2025	Moderate; identifies observational associations
Qualitative studies	28	9.9	Exploratory qualitative evidence	2019-2025	Moderate; provides contextual understanding
Case reports or case series	7	2.5	Limited preliminary evidence	2012-2018	Low; provides preliminary findings
Mixed-methods studies	2	0.7	Comprehensive and triangulated	2020-2025	High; integrates multiple evidence sources
Total	**284**	**100.0**	**Mean quality score: 3.2/5**	Increasing rigor over time	Strong overall evidence base

4.5. Population Characteristics

Table 5 presents the populations examined across the reviewed studies. School-aged children represented the largest research group, with 79 studies and 3,188 participants. University and college students formed the second-largest category, followed by older adults, clinical populations, athletes, and healthy community adults.

The large representation of students demonstrates the educational relevance of SBY, particularly for concentration, academic performance, stress management, and learning readiness. These outcomes are directly relevant to physical education because cognitive engagement and emotional regulation influence participation, skill acquisition, and classroom behaviour. Athletes and sports performers were included in 20 studies involving 607 participants. Although this category was smaller than the educational and clinical groups, it provides an emerging basis for examining performance, endurance, recovery, attentional control, and sport-related psychological preparation.

Table 5. Target population characteristics and sampling across reviewed studies.

POPULATION GROUP	NUMBER OF STUDIES	TOTAL PARTICIPANTS	STUDIES (%)	SAMPLE-SIZE RANGE	MEDIAN SAMPLE SIZE	MAIN OUTCOME FOCUS	MAIN REPORTED BENEFIT
School-aged children, 7-15 years	79	3,188	27.8	15-195	48	Academic performance, concentration, and behaviour	Improved concentration and academic grades
University and college students	71	2,415	25.0	18-251	52	Stress, anxiety, and cognitive enhancement	Reduced anxiety and stress
Older adults, ≥60 years	54	2,097	19.0	20-142	45	Balance, fall prevention, and cognitive aging	Improved balance and cognition; reduced falls
Clinical populations	44	1,104	15.5	25-180	50	Depression, anxiety, post-traumatic stress, and trauma	Reduced depression and anxiety
Athletes and sports performers	20	607	7.0	22-98	42	Performance, endurance, and recovery	Improved performance and endurance
Healthy community adults	16	436	5.6	18-65	38	Wellness, prevention, and general health	Improved well-being and adaptability
Total	**284**	**9,847**	**100.0**	**15-251**	**48**	Multi-domain effectiveness	Broad applicability

4.6. Outcome Measures and Assessment Instruments

Table 6 presents the outcome measures and assessment instruments reported across the reviewed studies. Memory was the most frequently assessed outcome, appearing in 55% of the studies, followed by concentration and attention in 50.4%. Anxiety was evaluated in 44.7% of studies, depressive symptoms in 37.3%, sleep quality in 25.4%, and neurobiological markers in 18.3%. Standardized instruments included the Wechsler Memory Scale, Montreal Cognitive Assessment, Digit Span Test, Continuous Performance Test, Digit Cancellation Test, Generalized Anxiety Disorder-7, State-Trait Anxiety Inventory, Hospital Anxiety and Depression Scale, Patient Health Questionnaire-9, Pittsburgh Sleep Quality Index, electroencephalography, cortisol, brain-derived neurotrophic factor, and heart-rate variability. SBY research has primarily emphasized cognitive and psychological outcomes. However, several of the assessment tools also have relevance to physical education and sports science. Attention, reaction control, emotional regulation, sleep quality, and autonomic balance may influence motor learning, exercise participation, recovery, and sport performance.

Nevertheless, direct measurement of physical-performance variables was less frequent. Measures such as muscular endurance, movement quality, agility, coordination, reaction time, sport-specific performance, and exercise intensity were not reported as dominant outcomes. The physical dimension of SBY remains less developed than its cognitive and mental health dimensions.

Table 6. Outcome measures and assessment instruments used in SBY research.

OUTCOME MEASURE	PERCENTAGE OF STUDIES (%)	NUMBER OF STUDIES	COMMON ASSESSMENT INSTRUMENTS OR MARKERS
Memory	55.0	156	Wechsler Memory Scale, Montreal Cognitive Assessment, and Digit Span Test
Concentration and attention	50.4	143	Continuous Performance Test and Digit Cancellation Test
Anxiety	44.7	127	Generalized Anxiety Disorder-7, State-Trait Anxiety Inventory, and Hospital Anxiety and Depression Scale
Depression	37.3	106	Patient Health Questionnaire-9 and Beck Depression Inventory
Sleep quality	25.4	72	Pittsburgh Sleep Quality Index
Neurobiological outcomes	18.3	52	Cortisol, brain-derived neurotrophic factor, heart-rate variability, and electroencephalography

4.7. Intervention Protocols and Implementation Characteristics

Table 7 summarizes the intervention protocols, adherence patterns, setting flexibility, cost, and reported safety of SBY. Most interventions lasted 5-10 minutes per session and were performed approximately three times per week. A commonly reported protocol involved three sets of 18 repetitions, producing 54 squatting movements per session. Intervention periods generally ranged from 4 to 16 weeks, although the broader literature included programs lasting from 2 to 52 weeks.

The short duration of SBY is particularly relevant to physical education. A 5-10-minute session can be incorporated into warm-up activities, active classroom breaks, school wellness programs, rehabilitation sessions, or pre-performance routines without substantially reducing the time available for other physical activities.

The reviewed studies also reported that SBY required no specialized equipment and could be performed in schools, homes, workplaces, clinics, and community settings. This flexibility supports its potential use in resource-limited environments. Supervised adherence ranged from 73 to 95%, while home-based adherence ranged from 63 to 80%. Structured supervision may strengthen participation and consistency.

The reviewed studies reported no serious adverse events. Minor transient discomfort, particularly joint soreness, was reported in a small proportion of participants and generally resolved within several days. However, the claim that SBY is safe for all populations should be interpreted cautiously. Participants with knee pain, mobility limitations, balance disorders, or musculoskeletal conditions may require screening, movement modification, or supervision.

Table 7. Intervention protocols and implementation characteristics of SBY.

PROTOCOL COMPONENT	COMMON PROTOCOL	REPORTED RANGE	EVIDENCE OR INTERPRETATION	PHYSICAL EDUCATION AND SPORTS-SCIENCE APPLICABILITY
Session duration	5-10 minutes	3-20 minutes	Supported across the reviewed studies	Can be integrated into lessons, warm-ups, and active breaks
Frequency	Three sessions per week	One to seven sessions per week	Three sessions per week were commonly reported	Can be incorporated into regular exercise schedules
Repetitions	Three sets of 18 repetitions, or 54 total	18-100 repetitions	Frequently used traditional protocol	Short and achievable for different age groups
Total intervention duration	4-16 weeks	2-52 weeks	Outcomes varied according to intervention dose	Short programs may produce measurable outcomes
Equipment	No equipment	None or a minimal exercise mat	Major feasibility advantage	Suitable for schools and low-resource settings
Special training	Minimal instruction	Self-directed practice to professional instruction	Widely accessible	Teachers or coaches can provide basic guidance
Setting	Home, school, office, clinic, or community	Highly flexible	Strong practical advantage	Scalable across education, sports, and rehabilitation
Cost per participant	No cost for self-directed practice	Free to approximately USD 200 per intervention	Accessible and potentially cost-effective	Suitable for resource-limited programs
Supervised adherence	73-95%	60-98%	Higher adherence under supervision	Supports teacher-, trainer-, or coach-led implementation
Home-based adherence	63-80%	50-90%	Demonstrates real-world feasibility	Independent practice remains possible
Supervised dropout	5-27%	2-40%	Generally acceptable for behavioural interventions	Structured monitoring may reduce withdrawal
Home-based dropout	20-37%	10-50%	Higher than supervised implementation	Follow-up and motivation may be required
Reported adverse effects	Minor transient discomfort	Joint soreness in approximately 1-2%	Symptoms reportedly resolved within two to three days	Screening and movement modification remain necessary
Serious adverse events	None reported	None documented	No serious events were reported in the reviewed dataset	Safety claims should still consider individual physical conditions

4.8. Neurobiological Mechanisms Relevant to Exercise and Performance

The reviewed literature identified several possible neurobiological mechanisms underlying SBY outcomes. These mechanisms included prefrontal cortical activation, hippocampal involvement, increased brain-derived neurotrophic factor, reduced cortisol, improved autonomic regulation, and changes in electroencephalographic activity. The prefrontal cortex supports executive control, sustained attention, decision-making, and emotional regulation.

Yoga and meditation studies have reported changes in prefrontal activity and self-regulatory brain networks [4, 17]. These mechanisms may help explain improvements in concentration and behavioural control observed in SBY-related studies. The hippocampus is involved in memory encoding and consolidation. Structural and functional changes in hippocampal regions have been reported after sustained mindfulness and yoga practice [17]. However, much of this evidence comes from general yoga and meditation studies rather than direct SBY experiments. Therefore, these findings should be interpreted as transferable mechanistic evidence rather than definitive proof of SBY-specific brain modification. Brain-derived neurotrophic factor supports neuronal survival, synaptic plasticity, and cognitive adaptation. Yoga interventions have been associated with increased BDNF concentrations [6]. From a sports-science perspective, BDNF is relevant because physical activity, learning, and neural adaptation are closely connected. Nevertheless, the extent to which the squatting, breathing, or attentional components of SBY independently contribute to BDNF changes remains unclear. Autonomic regulation may also explain some reported psychological and physiological outcomes. Yoga-related practices can increase parasympathetic activity and improve heart-rate variability while reducing stress-related physiological activation [2, 5, 18]. Improved autonomic balance may support emotional regulation, recovery, sleep, and exercise readiness.

4.9. Cognitive Function and Academic Performance

Concentration and memory were among the most consistently studied outcomes. 82% of concentration-focused studies found significant improvement, while memory-related outcomes were assessed in 55% of the total literature. Schoolchildren demonstrated improvements in sustained attention after regular SBY practice [10, 19]. Nursing students also showed improvements in concentration, memory, and academic progress [12]. These findings support the use of SBY as a brief cognitively engaging movement activity in educational settings. From a physical education perspective, concentration is essential for following instructions, learning motor skills, maintaining safety, and responding to changing movement tasks. Improved attentional control may also help students remain engaged during lessons and sport activities. However, academic improvement should not automatically be attributed to SBY alone. Changes in attention, teacher involvement, repeated testing, participant expectations, and additional learning support may also influence outcomes. Future research should employ active control groups and standardized academic measures.

4.10. Mental Health and Psychological Readiness

The reviewed studies reported positive outcomes for anxiety, depression, stress, and sleep. Anxiety was assessed in 44.7% of publications, while depression was examined in 37.3%. University students participating in a 12-week SBY intervention showed reductions in perceived stress and anxiety [9]. Yoga-based studies involving nursing students also reported reduced depression, anxiety, and stress [20]. Meta-analytic evidence from broader yoga interventions supports reductions in anxiety and depressive symptoms [3]. These outcomes are relevant to physical education and sports science because psychological distress can reduce motivation, concentration, recovery, and exercise adherence. In sport contexts, anxiety may also interfere with decision-making, coordination, and performance execution. SBY may therefore be considered a complementary activity for stress regulation and psychological preparation. However, it should not be presented as a substitute for clinical

psychological or psychiatric treatment. The strongest practical interpretation is that SBY may support well-being as part of a broader physical activity or wellness program.

4.11. Balance, Rehabilitation, and Special Populations

The reviewed evidence included older adults, haemodialysis patients, children with special needs, and menopausal women. SBY has been applied beyond healthy school and university populations. A study involving haemodialysis patients reported improvements in cognitive function after one month of SBY practice [8]. Research involving inactive older adults reported improvements in balance and balance confidence [11]. These findings suggest potential applications in rehabilitation, adapted physical education, and geriatric exercise. Balance improvement is especially relevant to sports science because postural control contributes to movement efficiency, fall prevention, injury reduction, and functional independence. Nevertheless, the evidence remains limited, and comparisons with established balance-training programs are still needed. Studies involving children with autism and other special needs have also reported reductions in disruptive behaviour and improvements in receptiveness to instruction after yoga-based activities [21]. However, these findings concern broader yoga interventions and should not be interpreted as direct evidence for SBY unless the intervention specifically included the SBY protocol. Similarly, studies involving menopausal women reported improvements in anxiety and sleep following mind-body therapies [22]. These findings support the broader applicability of yoga-based exercise but do not establish that SBY is equally effective across all populations.

4.12. Applications to Athletes and Sports Performers

Athletes and sports performers were represented in 20 studies involving 607 participants. Reported research interests included performance, endurance, recovery, and attentional control. The inclusion of athletes confirms that SBY has entered sports-related research, but this area remains small compared with educational and clinical applications. The reviewed evidence indicated general improvements in performance and endurance, although the underlying sport-specific measures were insufficiently described. Potential applications include pre-performance concentration, active recovery, emotional regulation, balance preparation, and low-intensity movement breaks. Because SBY includes repeated squatting, it may also provide light lower-body activation. However, it should not be described as a replacement for resistance training, aerobic conditioning, skill practice, or sport-specific preparation. Future sports-science studies should examine reaction time, postural stability, neuromuscular activation, perceived exertion, heart-rate response, movement quality, recovery, and competitive performance. Research should also compare SBY with conventional warm-ups, breathing exercises, and other mind-body activities.

4.13. Methodological Quality and Strength of Evidence

The evidence base showed increasing methodological rigor over time. Randomized controlled trials and quasi-experimental studies together accounted for 58.1% of publications. The randomized trials had a reported mean JADAD score of 3.8 ± 0.8, indicating adequate-to-good reporting quality. This methodological progression strengthens confidence that SBY has moved beyond preliminary case reports. However, several limitations remain. Many studies had relatively small samples, short intervention periods, limited follow-up, and inconsistent protocols. The median sample size was 48 participants, and long-term outcomes were rarely examined. The use of STROBE and JADAD also requires careful interpretation. STROBE is primarily a reporting guideline for observational studies rather than a numerical

risk-of-bias instrument [15]. Similarly, the JADAD scale focuses on randomization, blinding, and participant withdrawal [16]. Blinding is difficult in exercise interventions, which may reduce scores even when other methodological aspects are strong. Therefore, the evidence should be described as promising rather than conclusive. Future reviews should apply design-specific risk-of-bias tools and distinguish direct SBY studies from studies involving general yoga, meditation, or other mind-body interventions.

4.14. Relevance to Physical Education

The reviewed evidence supports several possible applications in physical education. First, SBY may be used as a short movement break that combines squatting, breathing, and concentration. Second, it may support students who experience examination anxiety, poor concentration, or difficulty transitioning into learning activities. Third, its minimal equipment requirements make it accessible in schools with limited facilities. However, implementation should remain educational rather than therapeutic. Physical education teachers should provide correct movement instructions, monitor knee alignment and balance, and adapt the activity for students with mobility limitations. SBY should complement rather than replace comprehensive physical education involving aerobic fitness, strength, flexibility, coordination, games, and sport skills. The educational value of SBY may be strongest when it is integrated into a broader mind-body learning module. Students can learn about breathing, postural control, stress regulation, movement awareness, and safe exercise practice.

4.15. Relevance to Sports Science

For sports science, the strongest current evidence relates to attention, psychological regulation, balance, feasibility, and adherence. These dimensions may support performance indirectly by improving concentration, emotional readiness, and recovery. Direct evidence for improved competitive performance remains limited. The reported benefits for endurance and athletic performance require stronger validation using controlled sport-specific trials. Future studies should define exercise intensity and quantify physiological responses during SBY. The squatting component should also be examined biomechanically. Repeated squats may create different joint loads depending on depth, tempo, foot position, mobility, and participant age. Sports-science research could determine whether SBY produces meaningful muscular or cardiovascular stimulus or functions primarily as a cognitive and coordinative activity.

4.16. Conceptual Integration of the Evidence

SBY may operate through four interacting dimensions:

(i) Movement, through repeated squatting and postural control;
(ii) Attention, through coordinated hand placement, breathing, and concentration;
(iii) Psychological regulation, through reduced stress and increased calmness;
(iv) Accessibility, through short duration, minimal equipment, and flexible implementation.

Together, these dimensions provide a framework for understanding SBY as a movement-based mind-body exercise. Its relevance to physical education lies in the integration of cognitive engagement and physical activity, while its relevance to sports science lies in potential applications to balance, attention, recovery, and psychological preparation. Nevertheless, the evidence base combines direct SBY studies with broader yoga and meditation research. Future investigations should clearly separate these evidence categories to avoid overstating SBY-specific effects.

4.17. Research Gaps and Future Directions

Several research gaps remain. First, sport-specific evidence is limited. Second, physiological intensity has not been sufficiently quantified. Third, intervention protocols vary across studies. Fourth, long-term adherence and sustainability are unclear. Fifth, direct neurobiological evidence for SBY remains limited.

Future studies should:

(i) compare SBY with conventional warm-up, breathing, balance, and mindfulness interventions;
(ii) measure heart rate, oxygen consumption, muscle activation, perceived exertion, and joint loading;
(iii) examine reaction time, balance, agility, motor learning, and sport-specific performance;
(iv) use larger randomized samples and longer follow-up periods;
(v) report intervention frequency, repetition, tempo, squat depth, breathing pattern, and supervision clearly;
(vi) distinguish direct SBY findings from general yoga evidence;
(vii) investigate adapted protocols for older adults, children, and participants with mobility limitations.

These directions would strengthen the position of SBY within physical education and sports science and clarify whether its primary benefits are cognitive, psychological, physical, or multidimensional.

5. CONCLUSION

This bibliometric analysis mapped Super Brain Yoga research published between 2012 and 2025 and highlighted its relevance to physical education and sports science. The evidence indicates growing interest in cognitive function, mental health, balance, rehabilitation, and physical-performance applications. Super Brain Yoga is a brief, low-cost, and equipment-free mind–body activity that may support concentration, memory, stress regulation, and movement-related outcomes. However, current evidence remains limited by inconsistent protocols, small samples, and few sport-specific studies. Future research should apply standardized interventions, larger randomized samples, longer follow-up periods, and direct physiological, biomechanical, and athletic-performance measurements to strengthen practical recommendations for education and sport.

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7. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

8. REFERENCES

[1] Pascoe, M. C., Bauer, I. E. (2015). A systematic review of randomised control trials on the effects of yoga on stress measures and mood. *Journal of Psychiatric Research, 68*, 270-282.

[2] Pascoe, M. C., Thompson, D. R., and Ski, C. F. (2017). Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis. *Psychoneuroendocrinology, 86*, 152-168.
[3] Martínez-Calderon, J., Casuso-Holgado, M. J., Muñoz-Fernandez, M. J., Garcia-Muñoz, C., and Heredia-Rizo, A. M. (2023). Yoga-based interventions may reduce anxiety symptoms in anxiety disorders and depression symptoms in depressive disorders: A systematic review with meta-analysis and meta-regression. *British Journal of Sports Medicine, 57*(22), 1442-1449.
[4] Gard, T., Noggle, J. J., Park, C. L., Vago, D. R., and Wilson, A. (2014). Potential self-regulatory mechanisms of yoga for psychological health. *Frontiers in Human Neuroscience, 8*, 770.
[5] Streeter, C. C., Gerbarg, P. L., Saper, R. B., Ciraulo, D. A., and Brown, R. P. (2012). Effects of yoga on the autonomic nervous system, gamma-aminobutyric acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. *Medical Hypotheses, 78*(5), 571-579.
[6] Sonawane, M. A., Lee, A. K., Gaikwad, S., Almeida, G. J., Darby, N. T., Calderon, T., Ramirez, A. G., Hughes, D. C., and Patel, D. I. (2025). Therapeutic yoga enhances neuroplasticity and metabolic regulation through elevated plasma brain-derived neurotrophic factor and ghrelin in a heterogeneous cancer survivor population. *Integrative Cancer Therapies, 24*, 15347354251385573.
[7] Chaya, M. S., Nagendra, H., Selvam, S., Kurpad, A., and Srinivasan, K. (2012). Effect of yoga on cognitive abilities in schoolchildren from a socioeconomically disadvantaged background: A randomized controlled study. *The Journal of Alternative and Complementary Medicine, 18*(12), 1161-1167.
[8] Babakhani, M., Rahzani, K., Hekmatpou, D., and Sheykh, V. (2024). The effect of Super Brain Yoga on the cognitive function of haemodialysis patients. *Heliyon, 10*(16), e36384.
[9] Sudhan, P., and Parveen, S. J. (2024). The effects of Thoppukaranam (Super Brain Yoga) on stress management and psychological health among university students: A 12-week intervention study. *Revista de Gestão Social e Ambiental, 18*(9), e07624.
[10] Panagar, T., and Kaur, D. (2024). Effect of Super Brain Yoga on sustained attention among adolescents. *Indian Journal of Yoga Exercise and Sport Science and Physical Education*, *9*(2), 1-7.
[11] Ziaei, S. H., Sohrabi, M., and Taheri, H. (2026). Comparison of the effects of transcranial direct current stimulation (tDCS) and super brain yoga on balance and balance confidence in inactive elderly individuals. *Zahedan Journal of Research in Medical Sciences*, *28*(28), e166115.
[12] Farahani, P. V., Ozturk, C., and Carew, A. (2024). The effect of super brain yoga on concentration, memory, and academic progress in nursing students: A quasi-experimental study. *International Journal of Community Based Nursing and Midwifery*, *12*(4), 218-227.
[13] Aria, M., and Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11*(4), 959-975.
[14] Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., and Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*, 285-296.
[15] Von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., and Vandenbroucke, J. P. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology

(STROBE) statement: Guidelines for reporting observational studies. *The Lancet*, *370*(9596), 1453-1457.

[16] Jadad, A. R., Moore, R. A., Carroll, D., Jenkinson, C., Reynolds, D. J. M., Gavaghan, D. J., and McQuay, H. J. (1996). Assessing the quality of reports of randomized clinical trials: Is blinding necessary? *Controlled Clinical Trials, 17*(1), 1-12.

[17] Hölzel, B. K., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S. M., Gard, T., and Lazar, S. W. (2011). Mindfulness practice leads to increases in regional brain gray matter density. *Psychiatry Research: Neuroimaging, 191*(1), 36-43.

[18] Thayer, J. F., Åhs, F., Fredrikson, M., Sollers, J. J., and Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: Implications for heart rate variability as a marker of stress and health. *Neuroscience and Biobehavioral Reviews, 36*(2), 747-756.

[19] Raut, S., and Barde, S. (2023). A study to assess the effectiveness of Super Brain Yoga on attention and concentration among teenage schoolchildren. *International Journal of Scientific Research*, *12*(12), 54-55.

[20] Martin, B., Peck, B., Ryan, L., Davies, A., and Terry, D. (2025). Supporting mental health and physical well-being among nursing students through yoga: A mixed-methods study. *Nursing Reports, 15*(8), 305.

[21] Killick, L., Hokanson, A., Lewis, Z. H., and Foster, E. (2023). The efficacy of yoga interventions for children with autism: A systematic review. *Journal of Yoga and Physiotherapy, 10*(3), 555786.

[22] Fan, Z., Zhang, Y., Shu, Y., Zhou, Y., and Zuo, Z. (2025). Mind-body therapies for sleep disturbances, depression, and anxiety in menopausal women: A systematic review and meta-analysis of randomized controlled trials. *Frontiers in Public Health, 13*, 1686981.