ISSN: 0976-822X

Available online on www.ijcpr.com

International Journal of Current Pharmaceutical Review and Research 2022; 14(4); 50-59

Review Article

Randomized Controlled Trial on the Effect of Yoga and Meditation on Cognitive Function: A Systematic Review & Meta-analysis

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Received: 06-11-2022 / Revised: 28-11-2022 / Accepted: 18-12-2022
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Conflict of interest: Nil

Abstract

Background & Objective: Yoga is a potentially beneficial form of physical exercise, but limited research has been done into its effects on the brain and its function. The objective of this study was to investigate the impact of yoga and meditation on cognitive function using randomized controlled trials (RCT) studies.

Methods: A literature search was performed using Pub Med and Google Scholar databases over the past 10 years for RCT studies that contained articles on the effects of yoga and meditation on cognitive function. The risk of bias was assessed using modified jadad scale. For each outcome mean difference (MD) & standard mean difference (SMD) with a 95% confidence interval (CI) was assessed. Adjusted point estimates from each study was extracted and combined using the random effect model to determine the heterogeneity of studies.

Results: Twelve RCT studies with 1,089 participants were included. The mean jadad score was 5.3 with a 0.6 standard deviation. The studies reported significant positive effect of yoga on cognitive function (MD = 0.38, 95 per cent CI: 1.21 to 0.45, P=0.37) between the experimental and control groups. Meditation exhibited a statistically significant effect compared to standard care control in cognitive function (SMD =2.21, 95% CI [3.99, 0.43], p <.001), with significant heterogeneity (I2 = 97%, p = 0.01).

Conclusion: This systematic review and meta-analysis of RCTs suggested that yoga & meditation showed significant improvement in many cognitive domains of attention and executive functioning of verbal working memory, auditory attention & short-term retentive capacity. The research findings support the notion that yoga practices were more effective on cognitive function than mindfulness meditation.

Keywords: Cognition – cognitive function - meta-analysis – meditation - randomized controlled trial - systematic review - yoga.

INTRODUCTION

The process through which external or internal input is altered, condensed, elaborated, stored, recovered, and utilized is known as cognition. Recently, there has been a lot of interest in science regarding the effects of meditation and yoga on human health, and is used as a contemporary medicine [1]. Yoga is an old Indian science and way of life that involves doing certain poses, breathing in a certain way, and meditating. The physical, mental, emotional, and spiritual

aspects of a person are all intended to be in harmony and good health. Asana (physical postures), pranayama (breath control), pratyahara (control of the senses), dharana (concentration), dhyana (meditation), and samadhi are the eight components of yoga, which are frequently metaphorically represented as a tree [2]. For people with impairments or conditions that prevent them from engaging in traditional types of exercise, yoga may be an alternate type of exercise that can help them reach the prescribed levels of physical activity. In Sanskrit, the term "yoga" derives from the root "yuj" which signifies "attachment, connection, or balance. Human breathing, deep breathing, and pranayama are tools that yoga uses to help people experience happiness, sadness, success, and failure in equal measure [3].

Meditation can be a term that covers spontaneous changes in state, and thus large-scale changes in intellectual practices that accompany consciousness at its fullest. It is a component of major beliefs such as Hinduism and Buddhism, and variants can be found in other religions. A self-help and self-copying tool as well as a supplement to psychotherapy, meditation is still practised today [4]. It's a great way to rejuvenate your mind and body to help manage stress and anxiety. There are various meditation methods such as Mantra, and Mindfulness Meditation (MM). Popular meditation methods involve large Yoga Mantra, Transcendental Meditation, Mindfulness Meditation, Kundalini Kriya, Shank Riya, Kirtan Kriya, Sahazi Samadhi, Silence, Integrated Body, Spirit Training (IBMT), and Pranayama (P). The biological mechanisms that are exacerbated by stress and contribute to disease, such as the immunological system, neuroendocrine system, and nerve transmission, are all much improved by meditation [5].

The cognitive function involves a lifelong learning process from observational thinking to memory formation, both short term & long term. Initially, it was believed that the central nervous system (CNS) was the only part of the brain that controlled cognition, and that long-term potentiating and neurogenesis had a role in the formation and maintenance of memories [6]. Cognitive function, which includes attention, memory, language, spatial orientation, and execution, is a mental activity or process that utilizes thoughts, experiences, and emotions to gain knowledge and understanding. It has a significant impact on how well young adults' function throughout this crucial stage of development [7]. This study aims to explore the potential relationship between mindfulness and cognitive function in the context of yoga practice through systematic reviews and meta-analysis.

Material & Methods

Research question

The research question was synthesized using the PICO elements, and the PICOS for this study are:

Criteria	Inclusion
Population (s)	Persons ≤ 85 years of both gender
Intervention	Yoga & Mediation
Comparison	Standard care and physical exercise
Outcomes	Cognitive function enhancement, memory enhancement
Study design	RCTs published between 2006-2021

Sources of information and search tactics: Following PRISMA, a methodical search approach was created (Preferred Recommended Reporting Item for Systematic Review & Meta-Analysis). A variety of search phrases were used. A systematic literature search was conducted over the past 10 years using the Pub Med, Google Scholar, and Cochrane Library databases. Cognition, cognitive function, meditation, meta-analysis, systematic review, and yoga were the search terms

independently to conduct the systematic literature review. A hand search for additional potentially significant findings was also conducted, using citations of the included studies as well as certain chosen research studies.

Selection criteria: Only RCT studies that collected information on each participant's level of cognitive function were used to recruit participants, along with yoga and meditation practices. The results for this connection included MD and SMD with 95% CI or adequate raw data. There were no size limitations on inclusion. The discussion helped in understanding any differences. For quality evaluation of included studies, the modified Jadad scale was applied as previously mentioned.

Data abstraction: The defined data abstraction form was used to fetch the study title, first author's name, publication year, when and where the study was performed, the number of members, time period of intervention, the method used to evaluate cognitive function, and the adjusted effect estimates with 95% CI.

Statistical analysis: The Revman 5.3 program was used for data analysis (Cochrane, London, UK). Using the general inverse variance method previously described, adjusted point estimates for the associations between yoga, physical activity, meditation, and standard care were retrieved from each trial and aggregated to inversely weight each study's contribution to pooled analysis. When data was measured using the same scales across studies MD and SMD. Their respective 95% CI were used to determine overall differences between the test and placebo groups. SMD in contrast was employed when the outcomes were scaled differently. To determine study heterogeneity within each meta-analysis, the statistic of the I2 test was applied. The fixed-effect model performed best when heterogeneity was minimal (I2≤50%).

The MD and SMD together with their respective 95% confidence intervals were used to determine the overall differences between treatment and control groups across studies when the data were obtained on the same scales. When outcomes were measured using various scales, SMD was applied in contrast. To pinpoint study heterogeneity within each meta-analysis, using I2 test statistics were used. Fixed-effect meta-analysis was used when heterogeneity was minimal (I2≤50%). Meta-analysis with random effects was used where heterogeneity was moderate to high (I2≥50%).

Result

Study selection: A total of 3,242 articles were found initially out of which 1100 articles were removed due to duplication. 2142 articles remained for abstract and title screening after that 1848 articles were excluded due to no yoga & meditation group, other diseases or language other than English. 294 articles were left for full text screening after duplicates were removed and titles and abstracts were reviewed. About 282 items were discarded due to non-RCT. Finally, the 12 included RCTs' characteristic was compiled.

Participants & intervention characteristics: The total participants included in each trial ranged from 30-200 and the total participants included in this study were 745. These RCTs used waiting lists, walking, stretching, and exercise groups as comparator groups. Classes remained between 45-120 minutes, and the length of the intervention ranged greatly from 5 weeks-20 weeks. The most popular measures employed in these studies were In the beginning, it was thought that the central nervous system (CNS) was the sole area of the brain that managed cognition and that neurogenesis and long-term potentiation played a part in the creation and upkeep of memories and RAVLT (Rey Auditory Verbal Learning Test) was also utilised these investigations.

Study quality: The modified Jadad was used to assess the 12 papers under consideration. 12 studies (45.2%) were given scores of 4, 5, 6, or 7 based on this evaluation. The mean modified jaded score was 5.3 and the standard deviation was 0.6 Table 1.the modified jadad of the included study.

ID	Included study	Was the research described as randomized?#	Was the approach of randomization appropriate?*	Was the research described as blinding?#	Was the approach of blinding appropriate?*	Was there a presentation withdrawals of dropouts? #	Was there a presentation of the inclusion /exclusion criteria ? #	Was the approach used to asses adverse effect described?#	Was the approach of statistical analysis described?#	Total
1	Oken (2006)	1	1	0	1	1	1	0	1	6
2	Sharma (2006)	1	1	0	0	1	1	0	1	5
3	Travis (2009)	1	1	0	0	1	1	0	1	5
4	Chaya (2012)	1	1	0	0	1	1	0	1	5
5	Bowden (2012)	1	1	0	0	1	0	0	1	5
6	Bilderbeck (2013)	1	1	0	0	1	1	0	1	5
7	Telles (2013)	1	1	0	0	1	1	0	1	5
8	Hariprasad (2013)	1	1	1	1	1	1	0	1	7
9	Innes (2017)	1	1	0	0	1	1	0	1	5
10	Eyre (2016)	1	1	0	1	1	1	0	1	6
11	Yobas (2019)	1	1	0	0	1	1	0	1	5
12	Kumbhar (2020)	1	1	0	0	1	1	0	1	5

#: "1" means Yes", "0" means "No";

*: "1" means "Yes", "0" means "Not described"

Overall effect size: The pooled analysis found a significant effect of yoga on the cognitive function of 780 participants MD (-0.38, 95%CI-1.21, 0.45) as shown in fig.2(a). Heterogeneity was high, with an I2 of 82%. SMD of (-0.11, 95% CI: -0.46, -0.25) as shown in fig.2(b). Heterogeneity was high, with an I2 of 79%. The pooled analysis found a significant effect of meditation on the cognitive function of 246 participants MD of (-15.94, 95% CI: -31.66, -0.21) as shown in fig.3(a). Heterogeneity was high, with an I2 of 100%. SMD of (-2.21, 95%CI: -3.99, 0.43) as shown in fig.3(b). Heterogeneity was high, with an I2 of 97%.

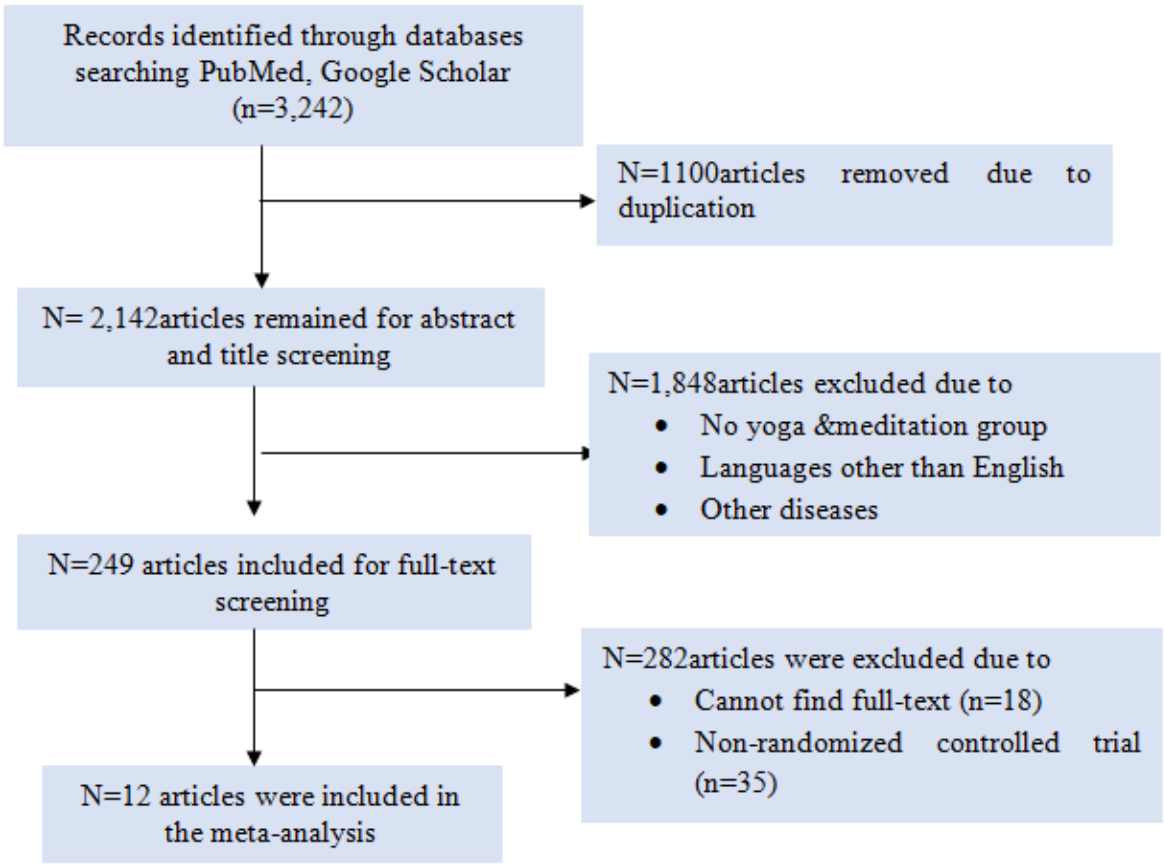

Figure 1: Search Strategy and Selection Process

DISCUSSION & CONCLUSION

In this study, our goal was to evaluate the impact of meditation and yoga on cognitive function. We discovered a modestly favourable of yoga and meditation on cognitive function. Only 12 articles are included in our meta-analysis. The cognitive processes have a beneficial impact on all the variables under investigation, while only (Sharma.,2006) examined the data is available about the effectiveness of the cognitive function. These studies, despite meeting the criteria for inclusion, varied in terms of intervention& characteristics, the number of participants, the number of sessions, the reported results, and the statistical presentation of the data.

Yoga appeared to have a likely advantage over physical exercise when it came to controlling cognitive function (Stroop test). In this study, the mean difference in cognitive abilities was less than the MD of 0.5. This study discovered no change in cognitive function symptoms between the yoga group and the control group. The 12 studies examined were evaluated using the modified Jadad scale. The standard mean difference for yoga shown in this research was slightly higher than the SMD of 0.5. For cognitive function symptoms, we found no difference between the yoga and physical exercise group. Funnel plot of yoga on experimental group and physical exercise control group course pass rates (random effects model) SMD. This study found a probable effect favouring meditation over standard care control in cognitive function assessed by the Stroop test. The mean difference in cognitive function shown in this research was higher than the MD of 0.5. Funnel plot of meditation on experimental group and standard care control group course pass rates (random-effects model) MD. The standard mean difference for meditation

showed in this research was slightly higher than the SMD of 0.5. For cognitive function symptoms, This study found no difference between the meditation and standard care groups. Funnel plot of meditation on experimental group and standard care control group course pass rates (random effects model) SMD.

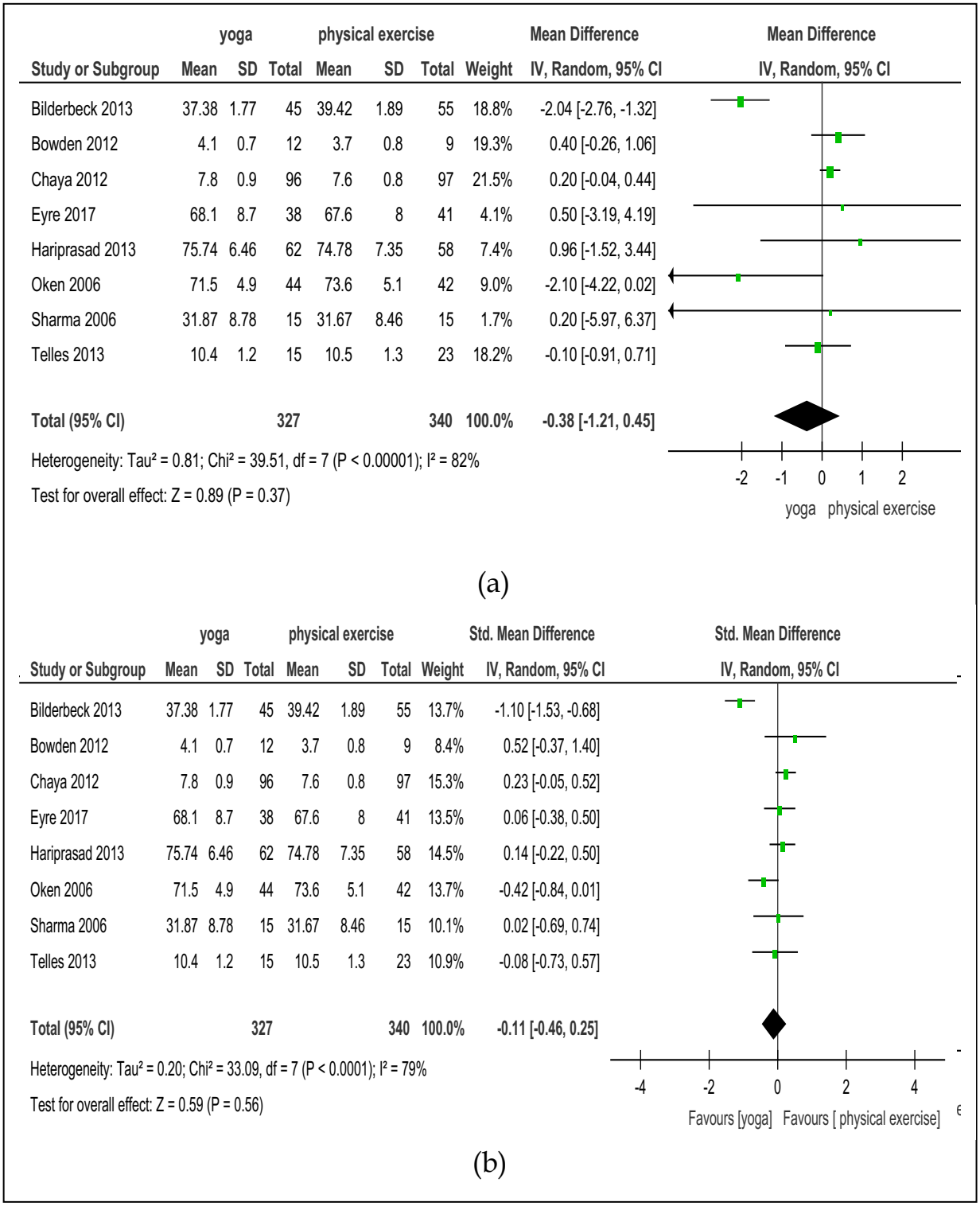

Figure 2: Forest plot of yoga and physical exercise
(a) Mean difference (MD) (b) Standard mean difference (SMD).

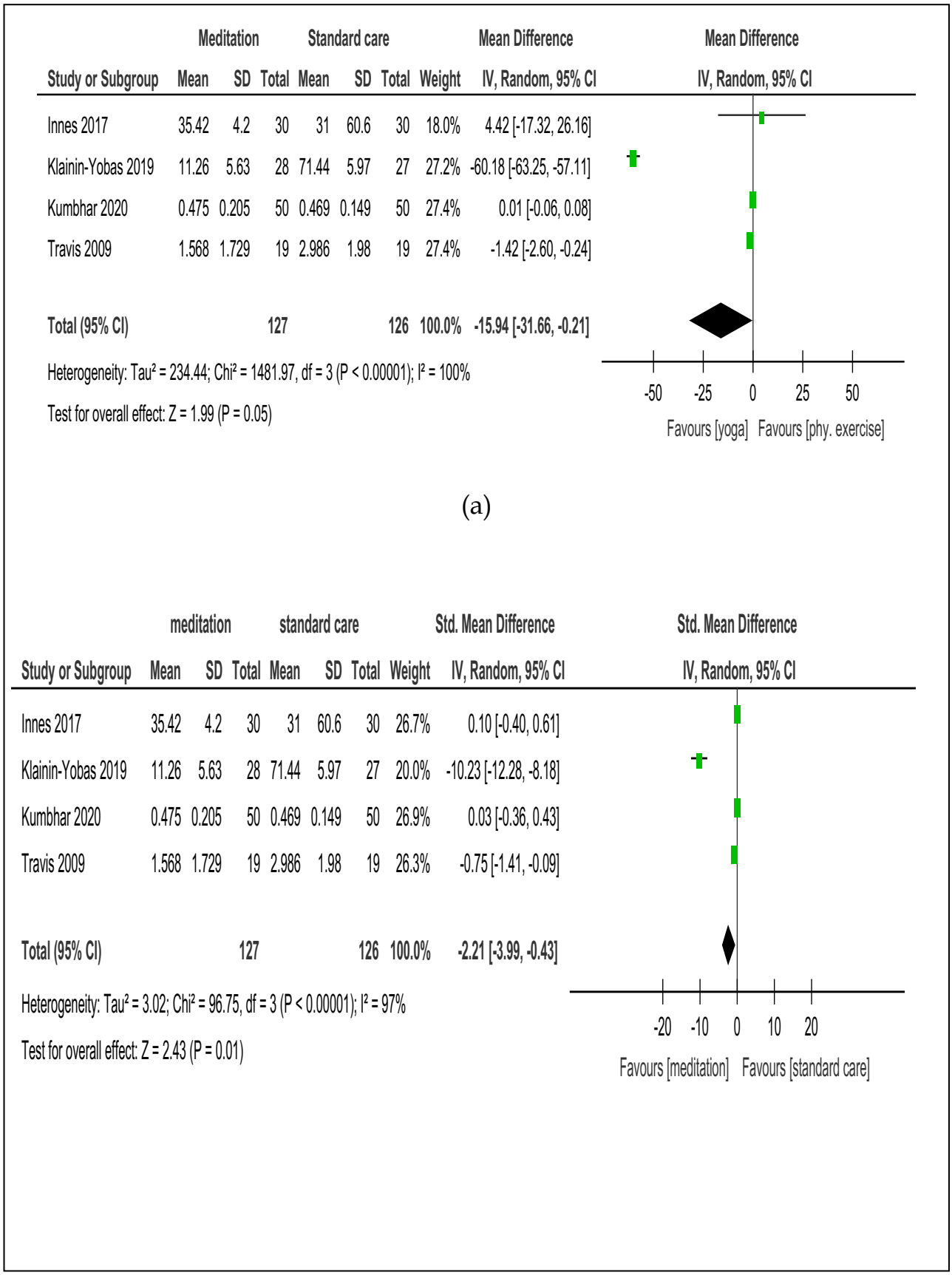

Figure 3: Forest plot of meditation and standard care
(a)Mean difference (MD) (b) Standard mean difference (SMD)

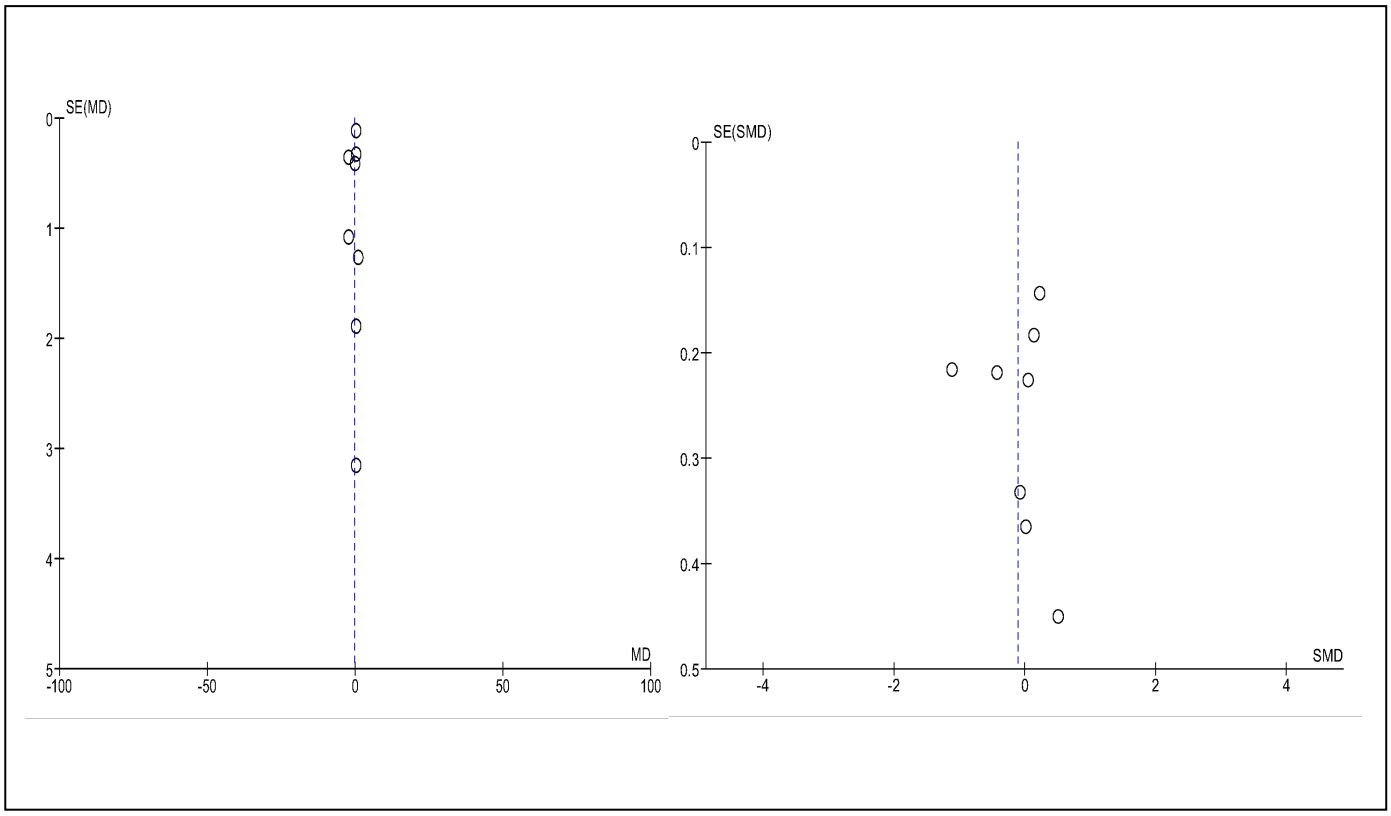

Figure 4: Funnel plot of yoga and physical exercise MD & SMD

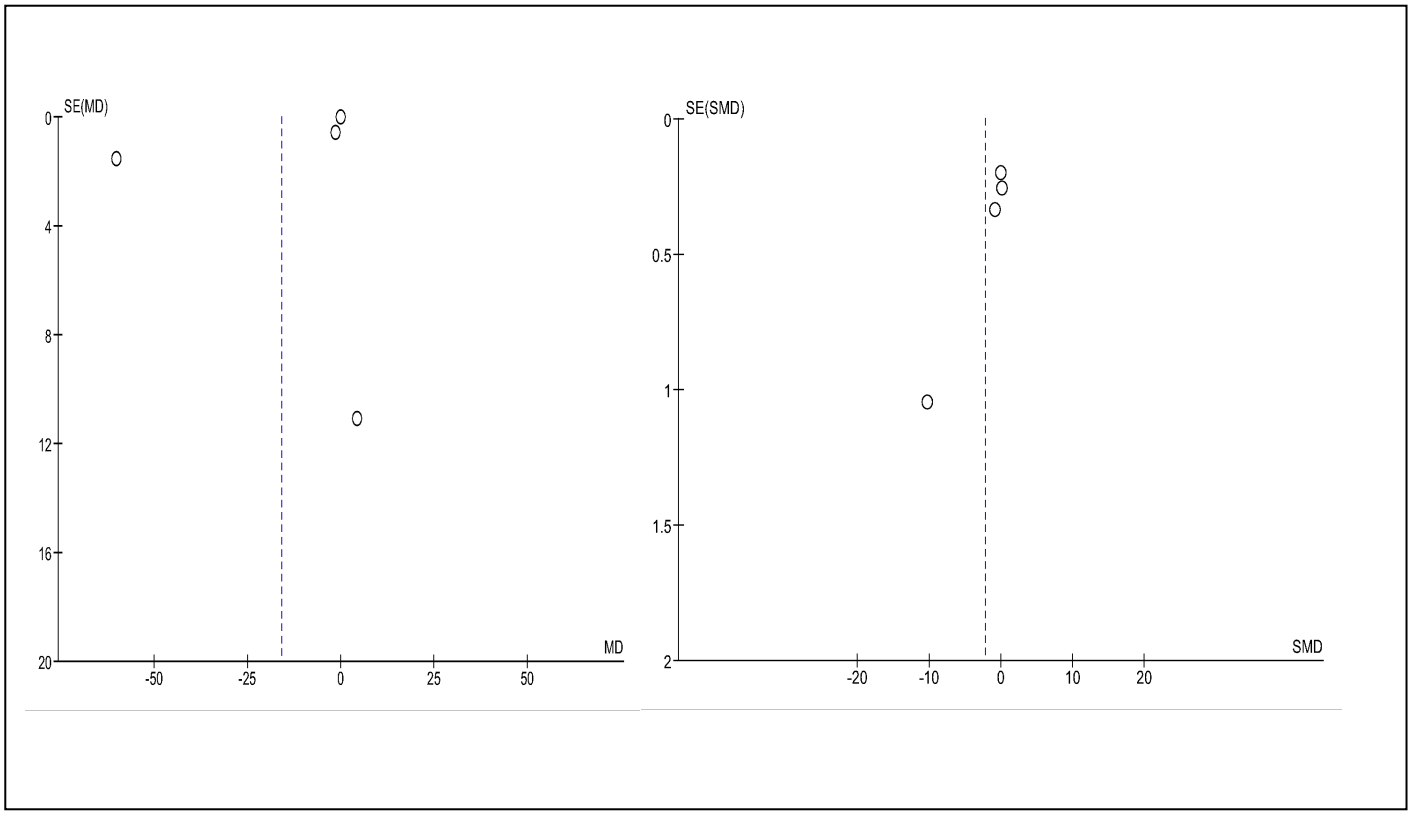

Figure 5: Funnel plot of meditation and standard care MD & SMD

Despite the broad spectrum of yoga & meditation, the findings of this research were based on the techniques that were used in the included studies, which were

some of the most commonly used techniques. Those studies included yoga (Tad asana, Surya namaskar), asana (Veer asana, Padahastana, Chakrasana, Sarvangasana, Halasana, Paschimotasana, Padmasana, Vajrasana, Ushtrasana), and meditation (Mindfulness Meditation) and showed more effect on 7-9-year-old school children. This study discovered that yoga and meditation may have some benefits for cognitive functions like memory and executive function. (Executive functions are carried out by prefrontal networks, which include the dorsolateral, medial, and orbitofrontal components and the substructures with which they are interconnected) (i.e., head of caudate and dorsomedial nucleus of the thalamus). Specifically crucial roles in coordinating working memory, attention, and attentional set-shifting techniques are played by working memory, attention, and attentional set-shifting methods.) by following cognitive tests such as go & no-go, Stroop test, RAVLT, MMSE, trail making test, and WAIS-III.

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