Review Article
Comparative Efficacy and Acceptability of Nonpharmacotherapy in the Treatment of Inattention for ADHD: A Network Meta-Analysis

Xusheng Che,1 Choi Jong-Hwan,2 and Xiuhai Shang3

1Sport and Science College, Nantong University, Nantong, Jiangsu 226019, China
2Chungbuk National University, Cheongju 28644, Republic of Korea
3Department of Physical Education, Sangmyung University, Seoul 03016, Republic of Korea

Correspondence should be addressed to Xusheng Che; xsche113@ntu.edu.cn

Received 22 April 2021; Revised 10 May 2021; Accepted 14 May 2021; Published 26 May 2021

Academic Editor: Zhihan Lv

Copyright © 2021 Xusheng Che et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

This article is aimed to compare the efficacy and acceptability of exercise intervention with other nonpharmacological therapies in improving attention in ADHD patients and then rank those therapies. Methods. Relevant RCT studies from the Cochrane Library, Web of Science, Psycinfo, and PubMed were systematically searched from January 2011 to January 2020. The literature was screened, and the researchers extracted and used Stata16 and WinBugs1.4 independently to analyze the data. Results. The improvement of “attention deficit” in ADHD patients was measured in 83 independent studies with 4,998 participants and 14 nonpharmacological therapies. Therapies were ranked as follows, according to the efficacy and acceptability of the cumulative probability area under the curve (SUCRA): (1) meditation and cognitive; (2) sport intervention therapy; (3) vitamin and mineral; (4) cognitive behavioral therapy; (5) computer training; (6) psychological education; (7) working memory training; (8) neurofeedback therapy; (9) polyunsaturated fatty acids; (10) mineral supplements; (11) mental relaxation; (12) vitamin; (13) biofeedback therapy; and (14) school-based training. However, because the effect size of meditation and cognitive therapy was at a marginally significant level (SMD = −1.07, (−2.15, 0.00)), the robustness of the results was far lower than that of sport intervention therapy. Therefore, careful interpretation is needed in practice. Conclusion. Considering the efficacy and acceptability of various nonpharmacological therapies, sport intervention has a more stable effect on the improvement of attention deficit. Secondly, meditation and cognitive therapy, cognitive behavioral therapy, and computer training can also be effective complementary tools.

1. Introduction

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder commonly seen in the early childhood, with a global incidence rate of about 1.4–3.0% among children, and most of them are males. Its main symptoms include attention deficit, hyperactivity, impulsivity, and a mixture of the three disorders [1]. Globally, it is estimated that 8–10% [2] of children and 5–6% [3] of adults are affected to varying degrees. Affected by genetic inheritance and prenatal environmental factors, inattention in patients is difficult to be effectively alleviated because the onset period spans from the early childhood to late adolescence (4–17 years old) and continues until adulthood [4]. Therefore, it has a serious negative impact on the early academic development of patients and the socialization process such as work and life in adulthood [5].

The traditional treatment of ADHD mostly uses pharmacological intervention to improve attention and alleviate hyperactive impulse and other explicit behavior by regulating the transmission of signal factors between synapses [6]. For example, central stimulants such as methylphenidate and amphetamine, one of the most commonly used dopamine and norepinephrine reuptake inhibitors, enhance the effects of monoamines and increase arousal levels in the brain’s limbic nervous system by gradually increasing the concentration of these two neurotransmitters in the synaptic cleft. In this way, the attention level and inhibition control...
ability of patients can be improved [7]. Noncentral stimulant drugs, such as atomoxetine, selectively inhibit the reuptake of noradrenaline, 5-HT2A, and dopamine by NETs, increase the concentration of noradrenaline in the prefrontal cortex (PFC), and thus, improve the hyperactivity symptoms [8,9]. Although pharmacological therapy has the advantages of short duration and quick effect, it has been criticized for the rapid rebound of symptoms after drug withdrawal, accompanied by adverse short-term negative effects such as nausea, drowsiness, insomnia, and low emotional tolerance [10], as well as the obstruction of its life-long growth and development process [11], leading to a high withdrawal rate [12, 13]. On the other hand, although psychobehavioral intervention therapy has no obvious physiological negative effects, it is difficult to be adopted by most patients because of the complicated treatment process and long cycle with slow effect [14]. In addition, hyperactivity symptoms usually recur with the end of the medication or psychobehavioral therapy cycle [15]. Therefore, there is an urgent need for a highly effective, cheap, and operable nonpharmacological therapy.

Based on the characteristics of hyperactive impulsion of patients, modern scholars have integrated sport intervention therapy into traditional treatment methods and achieved the expected effect. Studies demonstrate that [16], in addition to the general health benefits, exercise can also increase the level of blood flow and neurotransmitter in the brain, thus improving neuroplasticity, so as to better concentrate and process information. A recent meta-analysis also showed that [17], under the intervention of multiple combinations of moderate-intensity aerobic exercise, ADHD patients’ attention deficit can not only be alleviated in the short term but also obtain long-term enhancement effect. However, compared with sport intervention, other nonpharmacological therapies have different mechanisms of action, but their efficacy in practice is also worthy of affirming [18–23]. For a long time, there are still differences in the ranking of the advantages and disadvantages of various nonpharmacological therapies in improving ADHD symptoms [24–27]. In view of the fact that the traditional meta-analysis only compares the efficacy differences of pharmacotherapy such as stimulant (amphetamine and methylphenidate) and nonstimulant therapy (atomoxetine, clonidine sustained release, and guanfacine sustained release), so far, few studies have compared the effects of various nonpharmacotherapies in practice, and there is no study to directly compare the efficacy of exercise intervention with other nonpharmacotherapies. Therefore, it is not possible to confirm the overranking of sport interventions in terms of specific efficacy and acceptability compared with other nonpharmacological therapies. Consequently, this study intends to explore the ranking of sport intervention therapy in nonpharmacological therapy for ADHD through network meta-analysis on the basis of comprehensive comparison of efficacy and acceptability.

2. Materials and Methods

2.1. Retrieval Strategy and Selection Criteria. The published and unpublished randomized controlled trials (RCTs) from PubMed, Cochrane Library, Psycinfo, and Web of Science were systematically searched. The searching items included “Attention Deficit Hyperactivity Disorder,” “Non-Pharmacotherapy,” “Cognitive Behavior Therapy,” “Physical Activity,” “Cognitive Training,” and “Mindfulness,” “Working Memory Training,” “Neurofeedback,” “Biofeedback,” “Psychoeducation,” “School-based Treatment,” “Dietary,” “Multivitamin,” “Mineral,” and “Polyunsaturated Fatty Acid.” The searching content was limited to English literature, and the searching time span was from January 2011 to January 2021. For articles that are registered but not yet published, or where the relevant data is not fully presented in the results, the researchers contacted the author by e-mail or searched the journal’s website for unpublished data to supplement the incomplete report in the original paper or to provide data for unpublished research.

Non-RCT studies, systematic reviews, animal studies, and studies with a sample size of less than 10 people were excluded. Eventually, 14 kinds of nonpharmacological therapy were included: cognitive behavioral therapy (CBT), working memory training (WMT), computer training (CT), meditation (MAP), meditation and cognitive training (MC), vitamin and mineral (VM) supplements, vitamin (VI), mineral (MI), polyunsaturated fatty acids (PUFAs), neural feedback training (NF), school-based training (SB), biofeedback training (BF), psychological education (PE), and sport intervention (SPT).

2.2. Data Extraction and Quality Assessment. Four researchers (WLY, XSY, WC, and CJH) independently screened the qualified literature and collected the main outcomes and supplementary materials which support the original reports and could be used for this analysis, and four researchers (CZY, SJ, YD, and XHS) extracted relevant information using predetermined data extraction tables and assessed the risk of bias. Any differences shall be resolved by consensus and arbitration by the corresponding author (XSC).

2.3. Extraction of Results. In this study, the score changes of inattention of the subjects before and after the experiment were extracted as the efficacy evaluation index. The scores were derived from results measured by a variety of standardized psychological scales, such as The Barkley ADHD Current Symptoms Scale, ADHD Rating Scale, “Conners Adult ADHD Rating Scale Self-Report,” and “Swanson, Nolan, and Pelham (SNAP-IV) DSM-IV ADHD Rating Scale.” For the results of different surveys in the same scale, priority is given to the results reported by observers, followed by those reported by teachers and finally by parents.
where $a$ is the number of people who quit the experimental group; $a + b$ is the total number of people in the experimental group; $c$ is the number of dropouts in the control group; and $c + d$ is the total number in the control group.

$$
\text{SMD} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{1}{n_1} s_1^2 + \frac{1}{n_2} s_2^2\right) / \left((n_1 - 1) + (n_2 - 1)\right)}}
$$

where $\bar{X}_1$ is the mean of group 1, $n_1$ is the sample size of group 1, $s_1^2$ is the standard deviation of group 1, $\bar{X}_2$ is the mean of group 2, $n_2$ is the sample size of group 2, and $s_2^2$ is the standard deviation of group 2.

Homogeneity test:

$$
Q = \sum_{i=1}^{m} w_i MH_{1i} \left( \frac{\text{Ln}(\text{OR}_{i}) - \text{Ln}(\text{OR}_{\text{MH}}))}{2} \right)^2,
$$

$$
\text{OR}_{\text{MH}} = \frac{\sum_{i=1}^{m} w_i \text{MH}_{1i}^{\text{OR}_{i}}}{\sum_{i=1}^{m} W_i},
$$

$$
W_{\text{MH}_{1i}} = \frac{1}{\text{Variance}_{i}},
$$

$$
\text{Variance}_{i} = \left( \frac{\text{Ln}(\text{OR}_{i}) - \text{Ln}(\text{OR}_{\text{MH}}))}{1.96} \right)^2.
$$

where $Q$ is standardized sum of squares of effect size, $w$ is the weight of the $N$th study in all the included studies, $K$ is the number of studies included in meta-analysis, OR is the odds ratio, MH: Mantel–Haenszel method, and $m$ is the number of target events in the experimental group.

First, Stata16 was used to map the network evidence for each therapy and to test for homogeneity. Secondly, based on the Bayesian framework, WinBugs1.4.3 was used for network analysis, and all relative treatment effects were compared and evaluated by combining direct and indirect comparative evidence. The average effect estimate (SMD or RR) and its 95% confidence interval (CI) for each comparison were calculated using the Markov chain Monte Carlo (MCMC) method, with both Markov chains running simultaneously [30]. Under the assumption that the convergence degree of the MCMC model is stable (the value of R approaches 1, indicating that MCMC simulation has good convergence and is relatively stable), the posterior probability is inferred according to the prior probability.

$$
R = \sqrt{\frac{(m - 1/m)W + (1/m)B}{W}},
$$

where $B$ is the interchain variance, $W$ is the mean of the in-chain variances, and $m$ is the total amount of Markov chains.

Because fixed-effect models are based on the assumption that all studies come from the same population, they deviate from reality. In order to better fit the model, the random-effects model was used for analysis in this study. The model is iterated 100,000 times, and the first 5000 times are used for annealing to eliminate the influence of the initial value. The degree of convergence is judged according to the model iteration diagram. The iterative steps of the algorithm are as follows:

$$
P(X): \text{random sample; } f_{mn}: \text{sample mean of the function } m: \text{number of convergent steps; } n: \text{number of iteration steps}
$$

1. A candidate state $X_i$ is randomly selected according to the suggested distribution $q(X, X')$.

2. The acceptance probability is calculated.

3. A number $u$ is randomly selected from the interval $(0, 1)$ according to uniform distribution. If $u \leq a(X, X_i)$ then $X_i = X'$; otherwise, $X_i = X$.

4. The three steps mentioned above are repeated $n$ times; then, the posterior sample set $X^1, X^2, \ldots, X^n$ can be obtained.

5. Each moment of the posterior distribution is calculated according to the posterior samples, and the corresponding statistical inference is made.

$$
a(X, X') = \min \left\{ \frac{P(X')q(X, X')}{P(X)q(X, X')} \right\},
$$

$$
f_{mn} = \frac{1}{n-m} \sum_{i=m+1}^{n} f(x_i).
$$

After dividing the evidence of a specific comparison into direct evidence and indirect evidence by the nodesplitting method, the inconsistency of the model was calculated [31], and local and global inconsistency tests were used to check the consistency of the network. The local inconsistency test is used to evaluate the inconsistency of any closed loop in the network evidence graph. The overall inconsistency test is to test the goodness of fit of the model through the interaction design of each therapy [32]. If any relevant sources of deviation are
found, sensitivity analysis or metaregression analysis will be performed [31, 33, 34]. By drawing a cumulative probability chart of the efficacy and acceptability of each nonpharmacological therapy, the area under the cumulative probability curve (SUCRA) was used to rank the efficacy and acceptability of each therapy [32, 35, 36]. If more than 10 studies were included, publication bias and small-sample study effect were verified by Egger [37]. The Modified JADAD scale was used to evaluate the risk of bias. Additionally, we assessed the certainty of evidence contributing to this network analysis of the main outcomes with the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework.

3. The Results

3.1. Literature Retrieval Results. A total of 2952 studies were retrieved, including 2118 from the Cochrane Library, 465 from Web of Science, 174 from Psycinfo, and 195 from PubMed. 2,715 either repeated studies or inconsistent research topics were excluded from systematic reviews. After reading the full text, 153 studies with inconsistent outcome indicators and nonrandomized controlled trials were excluded, and 86 studies were included, six of which were CBT vs. NF; one study was CBT vs. PE; seven studies were CBT vs. control; nine studies were WMT vs. control; one study was CT vs. NF; six studies were CT vs. control; eight studies were MAP vs. control; two studies were MAP vs. control; two studies were MC vs. control; three studies were VM vs. control; five studies were MI vs. control; nine studies were PUFA vs. control; three studies were NF vs. BF; two studies were NF vs. SPT; eleven studies were NF vs. control; two studies were SB vs. control; four studies were PE vs. control; and two studies were SPT vs. control. See Figure 1 for the literature screening process.

General characteristics of the literature: 86 RCTs were included, involving 14 kinds of nonpharmacological treatments, and they are cognitive behavioral therapy (CBT), working memory training (WMT), computer training (CT), meditation (MAP), meditation and cognitive (MC), vitamin and mineral (VM), vitamin (VI), mineral (MI), polyunsaturated fatty acid (PUFA), neural feedback (NF), biofeedback (BF), school-based training (SB), psychological education (PE), and sport intervention therapy (SPT). A total of 4998 participants were included, with 2538 in the experimental group and 2460 in the control group. Forty-three studies reported CAARS scores; three studies reported BCS scores; ten studies reported SNAP scores; three studies reported IPDDAI scores; two studies reported DBDRS-P scores; sixteen studies reported ASRS scores; two studies reported DISYPs scores; CBCL scores were reported in four studies; SWAN score was reported in three studies; three studies reported FBB-HKS scores; one study reported DSM-IV scores; and two studies reported a CSI-4 score. The Jadad score is above average, which means the quality of included studies in this analysis is above average (Jadad score ≥ 4), and only six studies were below average in quality (Jadad score < 4) (See Table 1). Our results also consider the GRADE quality ratings.

3.2. Network Meta-Analysis

3.2.1. Homogeneity Test. Homogeneity test results indicate that cognitive behavioral therapy SMD = −0.77 (−1.00, −0.54), working memory training SMD = −0.49 (−0.71, −0.27), computer training SMD = −0.94 (−1.87, −0.01), meditation SMD = −0.66 (−0.85, −0.47), meditation and cognitive training SMD = −0.99 (−1.33, −0.66), vitamin and mineral SMD = −1.78 (−2.13, −1.44), vitamin SMD = −0.86 (−1.17, −0.55), mineral SMD = −0.52 (−0.88, −0.16), polyunsaturated fatty acid SMD = −0.42 (−0.58, −0.26), neural feedback SMD = −0.26 (−0.46, −0.05), school-based practice SMD = −0.60 (−1.11, −0.08), the psychological education SMD = −0.39 (−0.60, −0.19), the sport intervention SMD = −1.04 (−1.68, −0.39), the efficacy was significantly better than that of the control group, and the computer training is superior to the neural feedback therapy SMD = −0.94 (−1.87, −0.01). The efficacy of other comparative studies was not statistically significant. The homogeneity test results showed that 11 groups of comparative studies had high homogeneity, while the degree of heterogeneity among the other comparative studies was medium to high (Table 2).

3.2.2. Network Evidence Diagram. As can be seen from Figure 2, there were a total of 14 nonpharmacological therapies and 15 comparative studies included. There were direct comparisons between 6 closed loops and 7 nonpharmacologic therapies. The size of the node represents the sample size of the study, and the width of the line represents the number of comparative studies between the two therapies. The most compared treatments included neurofeedback therapy (NF), polyunsaturated fatty acids (PUFAs), meditation (MAP), mineral (MI), cognitive behavioral therapy (CBT), and working memory training (WMT). Vitamin (VI), school-based training (SB), vitamin and mineral (VM), and meditation and cognitive therapy (MC) had a weak overall relationship with the network structure. In all studies, there was at least one control trial. Due to the presence of closed loops in the network evidence map, a closed loop inconsistency test was required.

3.2.3. Consistency Test. The loop inconsistency test was used to explore the level of inconsistency among the internal comparison studies of each closed loop. As shown in Figure 3, among the 6 closed loops, the inconsistency factor IF of the other closed loops was close to 0 and all the 95% confidence intervals contained 0, $P > 0.05$, except for the neurofeedback-motor intervention-control group (NF-SPT-c). Therefore, there was no statistical inconsistency among the internal studies of each closed loop, so the consistency model was adopted for analysis in subsequent studies.

As can be seen from Figure 2, there is a closed loop composed of four studies in the network evidence graph. Therefore, the closed loop was split into two independently closed triangular loops using the node-splitting model. By calculating the absolute value of the difference between
2952 records identified through database searching (Cochrane 2118, PubMed 195, Web of Science 465, PsycInfo 174)

1163 duplicates excluded
886 systematic review or meta-analysis excluded
557 titles and abstracts excluded
263 non-RCT studies excluded

83 RCTs included in the network meta-analysis
6 assessed CBT vs NF; 7 assessed CBT vs control
1 assessed CBT vs PE; 9 assessed WMT vs control
1 assessed CT vs NF; 9 assessed PUFA vs control
8 assessed MAP vs PE; 2 assessed CT vs control
2 assessed NF vs SPT; 3 assessed VM vs control
5 assessed MI vs control; 6 assessed CT vs control
3 assessed NF vs BF; 2 assessed MC vs control
11 assessed NF vs control; 2 assessed SB vs control

Figure 1: Flowchart of study selection.

Table 1: Characteristics of included studies.

| Author, year | Design | Sample size | Age | Jadad score | Tool |
|--------------|--------|-------------|-----|-------------|------|
| Naomi, 2014  | CBT    | 34          | 8.9 ± 1  | 4           | CAARS |
| Young, 2016  | PUFA   | 11          | 14      | 7           | SNAP  |
| Safren, 2010 | CBT    | 43          | 42.3 ± 10| 6           | CAARS-S |
| Young, 2016  | PUFA   | 11          | 11      | 7           | SNAP  |
| Arthur, 2015 | CBT    | 43          | 20.3    | 6           | CAARS-S |
| Toshiko, 2015| PUFA   | 38          | 13.7 ± 1.1| 3         | CAARS |
| LaCount, 2015| CBT    | 17          | 17      | 4           | BCS   |
| Crippa, 2017 | PUFA  | 25          | 11.1 ± 1.9| 6         | ASRS  |
| Leanne, 2015 | CBT   | 10          | 4.9 ± 1.1| 4           | SNAP-IV |
| Tzang, 2016  | PUFA   | 58          | 9.3 ± 2.7| 6           | SNAP  |
| Fleming, 2015| CBT   | 19          | 21.2 ± 1.7| 6         | BCS   |
| Cornu, 2017  | PUFA   | 80          | 7 ± 3   | 6           | ASRS  |
| Wang, 2016   | CBT    | 10          | 26 ± 4.5| 7           | CAARS-S |
| Muller, 2014 | PUFA   | 55          | 55      | 6           | DISYPs |
| Zahra, 2014  | WMT    | 12          | 12      | 5           | SNAP  |
| Dienke, 2015 | PUFA  | 19          | 18      | 6           | CBCL  |
| Anna, 2015   | WMT    | 13          | 13      | 7           | IPDDAI |
| Crippa, 2019 | PUFA  | 25          | 25      | 6           | ASRS  |
| Wei, 2017    | WMT    | 11          | 9       | 5           | SNAP-IV |
| Celestino, 2019| PUFA | 46          | 49      | 6           | CAARS  |
| Martine, 2014| WMT   | 27          | 24      | 6           | CAARS-S |
| Pelsser, 2011| PUFA  | 50          | 50      | 6           | ASRS  |
| Jens, 2013   | WMT    | 38          | 37      | 2           | CAARS-S |
| Moreno, 2019 | NF     | 21          | 19      | 7           | ASRS  |
| Agnese, 2018 | WMT    | 40          | 40      | 6           | IPDDAI |
| Minder, 2018A| NF     | 29          | 23      | 6           | CAARS  |
| Beck, 2013   | WMT    | 26          | 26      | 6           | CAARS-S |
| Minder, 2018B| NF     | 25          | 25      | 6           | CAARS-S |
| Sandie, 2018 | WMT    | 22          | 13      | 6           | CAARS-S |
| Michael, 2017A| NF    | 38          | 41      | 4           | CAARS |
| Naomi, 2011  | CT     | 13          | 15      | 6           | CAARS-S |
| Michael, 2017B| NF    | 39          | 41      | 4           | CAARS |
| Aida, 2018   | CT     | 35          | 35      | 6           | CAARS-S |
| Maurizio, 2014| NF    | 13          | 12      | 7           | CAARS |
Table 1: Continued.

| Author, year | Design | Sample size | Age | Jadad score | Tool |
|--------------|--------|-------------|-----|-------------|------|
| Leon, 2013   | CT     | 45          | 51  | 6.0         |      |
| Ali, 2011    | NF     | 22          | 17  | 6.0         |      |
| Oord, 2012   | CT     | 22          | 17  | 6.0         |      |
| Streel, 2017 | NF     | 10          | 9.2 | 1.1         |      |
| Cho, 2019    | CT     | 85          | 87  | 6.0         |      |
| Gelade, 2018 | NF     | 39          | 37  | 6.0         |      |
| Bachmann, 2018 | MAP  | PE  | 21  | 19          | 6.0         |      |
| Gelade, 2018 | NF     | 39          | 37  | 6.0         |      |
| Dois, 2015   | MAP    | PE  | 41  | 40          | 6.0         |      |
| Chien, 2016  | SPT    | Ctr | 16  | 16          | 6.0         |      |
| John, 2017   | MAP    | Ctr | 11  | 11          | 6.0         |      |
| Claudia, 2012 | SPT | Ctr | 10  | 11          | 6.0         |      |
| Huguet, 2017 | MAP    | Ctr | 5   | 5           | 6.0         |      |
| Naomi, 2014  | NF     | 34          | 36  | 6.0         |      |
| Poppy, 2013  | MAP    | Ctr | 32  | 29          | 6.0         |      |
| Naomi, 2011  | NF     | 13          | 15  | 6.0         |      |
| Jillian, 2013 | MAP  | Ctr | 20  | 20          | 6.0         |      |
| Holger, 2010 | NF     | 59          | 35  | 6.0         |      |
| Herman, 2017 | MAP    | Ctr | 50  | 50          | 6.0         |      |
| M.M, 2010    | NF     | 8           | 6   | 6.0         |      |
| Lotte, 2018  | MAP    | Ctr | 60  | 60          | 6.0         |      |
| Meise I, 2013 | MAP  | Ctr | 14  | 14          | 6.0         |      |
| Edel, 2014   | MAP    | Ctr | 39  | 52          | 6.0         |      |
| Bink, 2016   | NF     | 59          | 31  | 6.0         |      |
| Gu, 2016     | MC     | Ctr | 30  | 26          | 6.0         |      |
| Shereena, 2018 | NF   | Ctr | 24  | 19          | 6.0         |      |
| Hepark, 2019 | MC     | Ctr | 55  | 48          | 6.0         |      |
| Albrecht, 2017 | NF   | Ctr | 24  | 24          | 6.0         |      |
| Kathryyn, 2019 | VM   | Ctr | 47  | 46          | 6.0         |      |
| ManiHee, 2015 | NF   | Ctr | 8   | 8           | 6.0         |      |
| Julia, 2018  | VM     | Ctr | 47  | 46          | 6.0         |      |
| Alegria, 2017 | NF   | Ctr | 18  | 13          | 6.0         |      |
| Julia, 2017  | YM     | Ctr | 42  | 38          | 6.0         |      |
| Harris, 2019 | NF     | 11          | 11  | 6.0         |      |
| Hatem, 2018  | VI     | Ctr | 20  | 20          | 6.0         |      |
| Joshua, 2012 | SB     | Ctr | 23  | 24          | 6.0         |      |
| Nadia, 2019  | VI     | Ctr | 51  | 51          | 6.0         |      |
| Looyeh, 2012 | SB     | Ctr | 7   | 7           | 6.0         |      |
| Eugene, 2011 | MI     | Ctr | 8   | 24          | 6.0         |      |
| Young, 2016  | PE     | Ctr | 14  | 11          | 6.0         |      |
| Fereshteh, 2015 | MI   | Ctr | 33  | 33          | 6.0         |      |
| Alexandra, 2015 | PE   | Ctr | 107 | 109         | 6.0         |      |
| Vidal, 2013  | PE     | CBT | 17  | 15          | 6.0         |      |
| Bai, 2015    | PE     | Ctr | 44  | 45          | 6.0         |      |
| Maite, 2013  | PE     | Ctr | 44  | 43          | 6.0         |      |
| Naomi, 2014  | CBT    | NF  | 34  | 34          | 6.0         |      |
| Naomi, 2011  | CT     | NF  | 13  | 13          | 6.0         |      |

Note: CBT =cognitive behavioral therapy; WMT = working memory training; CT = computer training; MAP = meditation; MC = meditation and cognition; VM = vitamin and mineral; VI = vitamin; Mi = mineral; PUFA = polyunsaturated fatty acid; NF = neurofeedback; BF = biofeedback; SB = school-based training; PE = psychological education; SPT = sport intervention therapy; ctrol = control group; CAARS-S = Conners’ Adult ADHD Rating Scale Self-Report; BCS = Barkley ADHD Current Symptoms Scale; SNAP = Swanson, Nolan, Pelham; IPDDAI = rating scale “identificazione precoce del disturbo da deficit di attenzione iperattivita; DBDRS-P = Disruptive Behavior Disorders Rating Scale; ASRS = adult ADHD Self-Report Scale; DISYPs = FBB ADHS parent-rated and teacher-rated programmes; CBCL = Child Behavior Checklist; SWAN = Strengths and Weaknesses in ADHD and Normal Behaviors; FBB-HKS = Fremdbeurteilungsbogen fur Hyperkinetische Storungen; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders; CSI-4 = Children Symptom Inventory.

direct and indirect evidence in each closed loop, the consistency between direct and indirect evidence in the overall model was explored. From the results of local inconsistency of Table 3, it can be seen that there is no inconsistency between the direct and indirect comparisons of the efficacy of the two treatments in all the closed loops (P > 0.05), nor
In traditional meta-analysis, the publication bias test might suffer from ecological bias. See Figure 4 for the range on this network analysis, even though this analysis also showed that the baseline severity distributed in a similar high age. Additionally, the comparison of baseline severity of the participants had a similar mean age from 10 to 20, but there were a few comparisons which had relatively low or high age. Most comparisons such as age and nonpharmacotherapy. Most of the included studies had a similar mean age from 10 to 20, but there were a few comparisons which had relatively low or high age. Additionally, the comparison of baseline severity also showed that the baseline severity distributed in a similar range on this network analysis, even though this analyses might suffer from ecological bias. See Figure 4 for the assessment of transitivity.

### Table 2: Homogeneity test.

| Study       | SMD   | 95% CI | % weight | HI | P   | F (%) | Z    | P   |
|-------------|-------|--------|----------|----|-----|-------|------|-----|
| CBT-NF      | 0.12  | 0.34   | 0.10     | 7.46 | 24.65 | 0.00  | 0.80 | 1.08 | 0.28 |
| CBT-ctrl    | 0.77  | 1.00   | 0.54     | 6.76 | 7.88  | 0.25  | 0.24 | 6.57 | 0.00 |
| CBT-PE      | 0.16  | 0.62   | 0.94     | 0.59 | 0.00  | 0.00  | 0.00 | 0.40 | 0.69 |
| WMT-ctrl    | 0.49  | 0.71   | 0.27     | 7.61 | 110.31| 0.00  | 0.93 | 4.43 | 0.00 |
| CT-NF       | 0.94  | 1.87   | 0.01     | 0.41 | 0.00  | 0.00  | 0.00 | 1.98 | 0.05 |
| CT-ctrl     | 0.53  | 0.72   | 0.34     | 9.96 | 26.99 | 0.00  | 0.82 | 5.47 | 0.00 |
| MAP-PE      | 0.06  | 0.43   | 0.30     | 2.67 | 0.15  | 0.70  | 0.00 | 0.34 | 0.73 |
| MAP-ctrl    | 0.66  | 0.85   | 0.47     | 10.19| 16.39 | 0.02  | 0.57 | 6.91 | 0.00 |
| MC-ctrl     | 0.99  | 1.33   | 0.66     | 3.21 | 2.23  | 0.14  | 0.55 | 5.83 | 0.00 |
| VM-ctrl     | 1.78  | 2.13   | 1.44     | 3.03 | 11.44 | 0.00  | 0.83 | 10.16| 0.00 |
| VI-ctrl     | 0.86  | 1.17   | 0.55     | 3.82 | 10.15 | 0.00  | 0.90 | 5.51 | 0.00 |
| MI-ctrl     | 0.52  | 0.88   | 0.16     | 2.79 | 29.28 | 0.00  | 0.86 | 2.83 | 0.01 |
| PUFA-PE     | 0.37  | 1.15   | 0.41     | 0.59 | 0.00  | 0.00  | 0.00 | 0.92 | 0.36 |
| PUFA-ctrl   | 0.42  | 0.58   | 0.26     | 14.19| 61.88 | 0.00  | 0.87 | 5.14 | 0.00 |
| NF-BF       | 0.16  | 0.45   | 0.12     | 4.46 | 2.48  | 0.29  | 0.19 | 1.13 | 0.26 |
| NF-SPT      | 0.00  | 0.33   | 0.33     | 3.23 | 0.02  | 0.87  | 0.00 | 0.00 | 1.00 |
| NF-ctrl     | 0.26  | 0.46   | 0.05     | 8.20 | 18.62 | 0.05  | 0.46 | 2.39 | 0.02 |
| SB-ctrl     | 0.60  | 1.11   | 0.08     | 1.35 | 0.28  | 0.60  | 0.00 | 2.26 | 0.02 |
| PE-ctrl     | 0.39  | 0.60   | 0.19     | 8.62 | 49.72 | 0.00  | 0.94 | 3.76 | 0.00 |
| SPT-ctrl    | 1.04  | 1.68   | 0.39     | 0.86 | 13.23 | 0.00  | 0.92 | 3.16 | 0.00 |

CBT, cognitive behavioral therapy; WMT, working memory training; CT, computer training; MAP, meditation; MC, meditation and cognition; VM, vitamin and mineral; VI, vitamin; MI, mineral; PUFA, polyunsaturated fatty acid; NF, neurofeedback therapy; BF, biofeedback therapy; SB, school-based exercise; PE, psychological education; SPT, sport intervention; ctrl, control group.

3.2.4. Assessment of Transitivity. In order to adhere to the assumption of transitivity and reduce the risk of biased estimates, the distribution of methodological variables that may act as effect modifiers across treatment comparisons has been compared such as age and nonpharmacotherapy. Most of the participants had a similar mean age from 10 to 20, but there were a few comparisons which had relatively low or high age. Additionally, the comparison of baseline severity also showed that the baseline severity distributed in a similar range on this network analysis, even though this analyses might suffer from ecological bias. See Figure 4 for the assessment of transitivity.

3.2.5. Publication Bias Test. In traditional meta-analysis, because there is only one effect size, funnel plots are drawn using the standard error of effect value as the vertical axis and effect size as the horizontal axis [38]. However, in the network meta-analysis, multiple meta-analyses with direct comparisons of different controls exist simultaneously. Therefore, the publication bias of different control groups needs to be adjusted at the same time when making Egger detection. Accordingly, when the funnel chart is drawn and adjusted, the vertical axis is the effect size of each study, the horizontal axis is the total effect size of each control group, and the regression line after adjustment is in the middle. As can be seen from the comparison of funnel plots (Figure 5), all the included studies were centrally distributed above the funnel plots and showed a left-right symmetric trend around the zero position. Therefore, it was concluded that there was no publication bias in the included studies on the whole. However, some studies were distributed below the funnel plots, and it indicated that there was a small-sample study effect.

3.2.6. Network Meta-Analyses. As there was no direct comparison between sport intervention therapy and many nonpharmacological therapies in the included studies, head-to-head comparison was used to provide indirect evidence for the studies that lacked direct comparison [28]. According to the head-to-head comparison of efficacy in Figure 6, it can be seen that vitamin and mineral (VM, SMD = −1.79 (−2.69, −0.88)), meditation and cognition (MC, SMD = −1.07 (−2.15, 0.00)), mineral (MI, SMD = −0.79 (−1.75, −0.19)), working memory training (WMT, SMD = −0.93 (−1.47, −0.38)), sport intervention therapy (SPT, SMD = −0.90 (1.76, 0.04)), meditation (MAP, SMD = −0.80 (1.32, 0.29)), the psychological education (PE, SMD = −0.67 (−1.27, −0.08)), cognitive behavior therapy (CBT, SMD = −0.65 (−1.12, −0.17)), computer training (CT, SMD = −0.63 (−1.25, −0.02)), polyunsaturated fatty acid (PUFA, SMD = −0.57 (−1.08, −0.07)), and neurofeedback therapy (NF, SMD = −0.45 (−0.87, −0.03)) were significantly better than the control group in improving attention deficit in ADHD patients. In addition, the efficacy of vitamin and mineral combined supplements was significantly better than that of polyunsaturated fatty acids (SMD = −1.21 (−2.25, −0.18)).
neurofeedback (SMD = −1.34 (−2.33, −0.34)), biofeedback (SMD = −1.65 (−2.99, −0.30)), and psychoeducation (SMD = −1.11 (−2.19, −0.03)), while there was no significant difference between other therapies. These results were basically consistent with the results of general meta-analysis.

The acceptability analysis demonstrated that there was no significant difference between the acceptability of exercise intervention therapy and the remaining non-pharmacological therapy. The acceptability of meditation was significantly better than that of vitamin supplements (RR = 0.10 (0.01, 0.73)), neurofeedback (RR = 0.39 (0.15, 1.00)), and biofeedback (RR = 0.22 (0.07, 0.70)). The acceptability of biofeedback therapy was significantly better than that of the control group (RR = 2.86 (1.14, 7.16)).

Figure 7 demonstrates a two-dimensional diagram of the efficacy and acceptability of all cross-comparison studies. According to the SUCRA ranking results, the cumulative probability of efficacy of sport intervention was 62%, slightly lower than vitamins and minerals (95%), meditation and cognition (68.8%), minerals (66.4%), and working memory training (65.1%). It was only secondary to vitamins (89.3%) and biofeedback (79.5%) for acceptability.

Taking into account the efficacy and acceptability of each nonpharmacological therapy, the following results were obtained by ranking the area under the cumulative probability curve: in 14 kinds of nonpharmacological intervention therapy, sport intervention therapy (SPT) effect on the improvement of the patients with ADHD attention deficit disorder is superior to the other 12 kinds of nonpharmacological treatments, only secondary to vitamin (VI) supplements and cognitive training (MC) based on meditation, and the overall ranking is third. However, the pairwise comparison of Figure 6 indicates that although vitamin (VI) supplements can improve attention deficit in ADHD patients to some extent, the effect is not significant. So, it was excluded. However, the effect size of meditation and cognitive therapy (SMD = −1.07, (−2.15, 0.00)) was at a marginal significant level, and the robustness of its results...
was worse than that of sport intervention therapy, so it needs careful interpretation in practice.

The overall ranking of all kinds of the non-pharmacological therapy is as follows: (1) medication and cognitive (MC); (2) sport intervention therapy (SPT); (3) vitamin and mineral (VM); (4) cognitive behavioral therapy (CBT); (5) computer training (CT); (6) psychological education (PE); (7) working memory training (WMT); (8) nerve feedback therapy (NF); (9) polyunsaturated fatty acids (PUFAs); (10) mineral (MI) supplements; (11) meditation (MAP); (12) vitamin (VI); (13) biofeedback therapy (BF); and (14) school-based training (SB).

4. Discussion

A total of 86 studies were included in this network meta-analysis, involving 68 double-blind studies and 1 single-blind study. A total of 4,998 study samples were collected. Of these, 2,538 patients were randomly assigned to 14 non-pharmacological treatments and 2,460 to a control group. Through a detailed search of published and unpublished research data, the efficacy and acceptability of each therapy were compared directly and indirectly, and the overall ranking provided the latest and comprehensive structured mathematical evidence for the clinical advantages of exercise intervention therapy.

The study indicates that all of the 11 nonpharmacological treatments were found to have superior curative effect on the control group (SMD = −1.79, −0.14)). Among them, the improvement effect of sport intervention therapy (SPT, SMD = −0.90(−1.76, −0.04)) on attention deficit was only secondary to working memory training (WMT, SMD = −0.93 (−1.47, −0.38)), which reached the high effect size level. The vitamin and mineral (VM) supplementation was significantly better than other treatments (VM, SMD = −1.79, −1.11)). A comparative analysis of the acceptability of nonpharmacological therapies found that there was no significant difference in acceptability between the sport intervention and other nonpharmacological therapies. The acceptability of meditation therapy alone was significantly better than vitamin (VI, RR = 0.1 (0.01, 0.73)), neuromyoblock (NF, RR = 0.39 (0.15, 1.00)), and biofeedback (BF, RR = 0.22 (0.07, 0.70)). The acceptability of biofeedback therapy was inferior to that of the control group (ctrol, RR = 2.86 (1.14, 7.16)). Thus, when efficacy was considered only, there was no significant difference in the effect of each therapy, and sport intervention therapy was not the best choice, only ranking the fourth (Figure 7). However, after taking into account the high dropout rate among other treatments, sport intervention was found to rank second, after meditation-based cognitive training (MC) (Figure 7).

In order to make the abovementioned results as robust as possible to provide reference information for clinical practice, this study focuses on the results of head-to-head interaction comparison under the condition that the retrieved information is completely reliable. Figure 7 shows that low efficacy of pharmacological therapy is usually accompanied by a high level of sample loss (BF (SMD = −0.14, RR = 2.86), SB (SMD = −0.63, RR = 1.02), and VI (SMD = −0.92, RR = 6.03)). This may be due to the slow and imperceptible improvement in attention levels from non-pharmacological therapies, and the lengthy intervention
cycle that leads to the withdrawal of patients with more severe symptoms undermines the stability of the randomization of the original study. As a result, most of the participants retained were those with mild symptoms and low improvement. Therefore, the real effects of non-pharmacological therapies were easily underestimated in the final evaluation of effect. According to the difference in analysis results between meditation and cognitive therapy (MC) and the control group, the effect size not only reached the high effect level but also had a large span of confidence interval, and the lower limit reached the point of no difference (SMD = −1.07 (−2.15, 0.00)) (P = 0.05), leading to the marginal significance of the difference between MC and the control group (Figure 5). So, careful interpretation and application should be carried out in the interpretation of results and practical guidance [39]. In this network meta-analysis, only two studies reported the results of the combination of meditation and cognitive therapy (MC), so the
interpretation of the results was not only limited by the intervention therapy from economy and applicability are selective reporting and potential risk of publication bias caused by the small sample effect [40]. In conclusion, although mediation and cognitive therapy (MC) ranks first in the overall ranking, the results of the improvement of hyperactivity impulsivity in ADHD patients and at the same time attention deficit disorder can be effectively alleviated. The long-term acute aerobic exercise can accumulate and enhance the short-term and psychological therapy and dietary supplements. Sport

Figure 5: Comparison-adjusted funnel plot and Egger test for each outcome.

Figure 6: The results of network meta-analysis for efficacy and tolerability.
immediate effects of the patient’s apparent behavior and the intrinsic neurophysiology. Because of its low cost, ease of implementation, and additional psychological and physiological effects, the long-term acute aerobic exercise often serves as an auxiliary treatment method, as well as a kind of independent treatment, especially under special circumstances [41].

There are also limitations in this study. (1) The sample size of individual nodes in the network evidence map is too small, so the statistical efficacy is limited. (2) The overall inconsistency test is not significant, and the quality evaluation of some studies is still low. (3) Despite a detailed search of published and unpublished literature, complete collection of existing data cannot be ensured. (4) Due to the lack of comprehensive demographic data of patients, it is not possible to conduct subgroup regulation effect analysis.

5. Conclusions

This network meta-analysis showed that although meditation and cognitive therapy (MC) ranked first overall, the effect size of its efficacy was at a marginal significant level, so its results need to be carefully interpreted in clinical practice. Sport intervention therapy is not only very close to meditation and cognition (MC) in terms of efficacy but also has high acceptability and economic practicability. Therefore, sport intervention therapy is preliminarily judged to be the best nonpharmacological intervention means for the treatment of attention deficit in ADHD patients. In addition, meditation and cognitive therapy (MC), cognitive behavioral therapy (CBT), and computer training (MC) can also be effective complementary tools.

Although this analysis incorporates the most comprehensive literature currently available evidence about nonpharmacological treatment for ADHD, a small number of preregistered studies are still unavailable to us even though we have tried our best to collect reliable information about the most recent published studies. Still, we cannot rule out the possibility that some studies are absent in literature retrieval or recalculate the results of the same study in our analyses. Beside, considering the influence of the small-sample effect on the results, a large number of high-quality research designs are still needed to provide evidence to support the results of this study. We welcome any information that might help clarify any limitations in our manuscript.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no known conflicts of interest.

References

[1] M. Marty and D. Segal, *Diagnostic and Statistical Manual of Mental Disorders*, R. C. S. Lilienfeld, Ed., American Psychiatric Publishing, Arlington, TX, USA, DSM-5 edition, 2015.

[2] S. V. Faraone, J. Sergeant, C. Gillberg, and J. Biederman, “The worldwide prevalence of ADHD: is it an American condition?” *World Psychiatry Official Journal of the World Psychiatric Association*, vol. 2, no. 2, pp. 104–113, 2003.

[3] G. Polanczyk, M. Silva de Lima, B. Lessa Horta, J. Biederman, and L. Augusto Rohde, “The worldwide prevalence of ADHD: a systematic review and meta-regression analysis,” *The American Journal of Psychiatry*, vol. 164, no. 6, pp. 942–948, 2007.

[4] J. Biederman, C. R. Petty, M. Evans, J. Small, and S. V. Faraone, "How persistent is ADHD? A controlled 10-
year follow-up study of boys with ADHD,” *Psychiatry Research*, vol. 177, no. 3, pp. 299–304, 2010.

[5] S. N. Visser, “Increasing prevalence of parent-reported attention-deficit/hyperactivity disorder among children—United States, 2003 and 2007,” *MMWR. Morbidity and Mortality Weekly Report*, vol. 59, no. 44, pp. 1439–1443, 2010.

[6] Q. X. Ng, “A systematic review of the use of bupropion for attention-deficit/hyperactivity disorder in children and adolescents,” *Journal of Child and Adolescent Psychopharmacology*, vol. 27, no. 2, pp. 112–116, 2017.

[7] J. Chandler, J. Thomas, J. P. T. Higgins et al., *Cochrane Handbook for Systematic Reviews of Interventions (Version 5.1.0)*, Wiley, Hoboken, NJ, USA, 2011.

[8] S. Daniel et al., et al., et al., “Selective noradrenaline reuptake inhibitor atomoxetine directly blocks hERG currents,” *British Journal of Pharmacology*, vol. 156, no. 2, pp. 226–236, 2009.

[9] M. Séguin, A. Lahaie, C. Matte-Gagné, and M. H. Beauchamp, “Ready! Set? Let’s Train!: feasibility of an intensive attention training program and its beneficial effect after childhood traumatic brain injury,” *Annals of Physical and Rehabilitation Medicine*, vol. 61, no. 4, pp. 189–196, 2018.

[10] O. J. Storebø, N. Pedersan, E. Ramstad et al., “Methylphenidate for attention deficit hyperactivity disorder (ADHD) in children and adolescents: assessment of adverse events in non-randomised studies,” *Jama*, vol. 50, no. 2, p. 113, 2018.

[11] D. L. Hansen and E. H. Hansen, “Caught in a balancing act: parents’ dilemmas regarding their ADHD child’s treatment with stimulant medication,” *Qualitative Health Research*, vol. 16, no. 9, pp. 1267–1285, 2006.

[12] M. Brod, E. Schmitt, M. Goodwin, P. Hodgkins, and G. Nieder, “ADHD burden of illness in older adults: a life course perspective,” *Quality of Life Research*, vol. 21, no. 5, pp. 795–799, 2011.

[13] R. Cunill, X. Castells, A. Tobias, and D. Capellà, “Efficacy, safety and variability in pharmacotherapy for adults with attention deficit hyperactivity disorder: a meta-analysis and meta-regression in over 9000 patients,” *Psychopharmacology*, vol. 233, no. 2, pp. 187–197, 2016.

[14] S. Benner-Davis and P. C. Heaton, “Attention deficit and hyperactivity disorder: controversies of diagnosis and safety of pharmacological and nonpharmacological treatment,” *Current Drug Safety*, vol. 2, no. 1, pp. 33–42, 2017.

[15] P. S. Jensen and S. Jm, “3-year follow-up of the NIMH MTA study,” *Journal of the American Academy of Child & Adolescent Psychiatry*, vol. 46, no. 8, pp. 989–1002, 2017.

[16] A. M. José, L. B. N. Turibia, M. Mauro et al., “Exercise impact on sustained attention of ADHD children, methylphenidate effects,” *Attention Deficit and Hyperactivity Disorders*, vol. 2, no. 1, pp. 49–58, 2010.

[17] Q. X. Ng, C. Y. X. Ho, H. W. Chan, B. Z. J. Yong, and W.-S. Yee, “Managing childhood and adolescent attention-deficit/hyperactivity disorder (ADHD) with exercise: a systematic review,” *Complementary Therapies in Medicine*, vol. 34, no. 1, pp. 123–128, 2017.

[18] M.-R. Pan, F. Huang, M.-J. Zhao, Y.-F. Wang, Y.-F. Wang, and Q.-J. Qian, “A comparison of efficacy between cognitive behavioral therapy (CBT) and CBT combined with medication in adults with attention-deficit/hyperactivity disorder (ADHD),” *Psychiatry Research*, vol. 279, no. 1, pp. 23–33, 2019.

[19] K. Mawjee, S. Woltering, N. Lai, H. Gotlieb, R. Kronitz, and R. Tannock, “Working memory training in ADHD: controlling for engagement, motivation, and expectancy of improvement (pilot study),” *Journal of Attention Disorders*, vol. 21, no. 11, pp. 956–968, 2014.

[20] H. H. M. Lo, S. W. L. Wong, J. Y. H. Wong, J. W. K. Yeung, E. S. Ng, and S. Y. S. Wong, “The effects of family-based mindfulness intervention on adhd symptomology in young children and their parents: a randomized control trial,” *Journal of Attention Disorders*, vol. 24, no. 5, pp. 667–680, 2017.

[21] E. A. Sheereena, R. K. Gupta, C. N. Bennett, K. J. V. Sagar, and J. Rajeswaran, “EEG neurofeedback training in children with attention deficit/hyperactivity disorder: a cognitive and behavioral outcome study,” *Clinical EEG and Neuroscience*, vol. 50, no. 4, pp. 242–255, 2018.

[22] T. Hirvikoski, E. Waaler, T. Lindström, S. Bölte, and J. Jokinen, “Cognitive behavior therapy-based psychoeducational groups for adults with ADHD and their significant others (PEGASUS): an open clinical feasibility trial,” *ADHD Attention Deficit and Hyperactivity Disorders*, vol. 7, no. 1, pp. 89–99, 2015.

[23] A. Bikic, J. F. Leckman, T. Ø. Christensen, N. Bilenberg, and S. Dalsgaard, “Attention and executive functions computer training for attention-deficit/hyperactivity disorder (ADHD): results from a randomized, controlled trial,” *European Child & Adolescent Psychiatry*, vol. 27, no. 12, pp. 1563–1574, 2018.

[24] E. J. S. Sonuga-Barke, D. Brandeis, S. Cortese et al., “Non-pharmacological interventions for ADHD: systematic review and meta-analyses of randomized controlled trials of dietary and psychological treatments,” *American Journal of Psychiatry*, vol. 170, no. 3, pp. 275–289, 2013.

[25] F. Catala-Lopez, B. Hutton, A. Nunez-Beltran et al., “The pharmacological and non-pharmacological treatment of attention deficit hyperactivity disorder in children and adolescents: protocol for a systematic review and network meta-analysis of randomized controlled trials,” *Systematic Reviews*, vol. 4, no. 1, p. 19, 2015.

[26] K. Hodgson, A. D. Hutchinson, and L. Denson, “Non-pharmacological treatments for ADHD,” *Journal of Attention Disorders*, vol. 18, no. 4, pp. 275–282, 2012.

[27] P. Janice, S. Elizabeth, and B. Candice, “Complementary and alternative medical therapies for children with attention-deficit/hyperactivity disorder (ADHD): Alternative medicine review,” *A Journal of Clinical Therapeutics*, vol. 16, no. 4, pp. 323–337, 2011.

[28] D. Mavridis, M. Giannatsi, A. Cipriani, and G. Salanti, “A primer on network meta-analysis with emphasis on mental health,” *Evidence Based Mental Health*, vol. 18, no. 2, pp. 40–46, 2015.

[29] J. Chandler, J. Thomas, J. P. T. Higgins et al., *Cochrane Handbook for Systematic Reviews of Interventions (Version 6.0)*, Wiley, Hoboken, NJ, USA, 2019.

[30] D. Gardnerman, “Markov Chain Monte Carlo: stochastic simulation for Bayesian inference,” *Statistics in Medicine*, vol. 27, no. 16, pp. 3213–3214, 2008.

[31] S. Dias, N. J. Welton, D. M. Caldwell, and A. E. Ades, “Checking consistency in mixed treatment comparison meta-analysis,” *Statistics in Medicine*, vol. 29, no. 7–8, pp. 932–944, 2010.

[32] A. Chaimani, J. P. T. Higgins, D. Mavridis, P. Spyridonos, and G. Salanti, “Graphical tools for network meta-analysis in STATA,” *PLoS One*, vol. 8, no. 10, Article ID e76654, 2013.

[33] I. R. White, J. K. Barrett, D. Jackson, and J. P. T. Higgins, “Consistency and inconsistency in network meta-analysis: model estimation using multivariate meta-regression,” *Research Synthesis Methods*, vol. 3, no. 2, pp. 111–125, 2012.
[34] J. P. T. Higgins, D. Jackson, J. K. Barrett, G. Lu, A. E. Ades, and I. R. White, "Consistency and inconsistency in network meta-analysis: concepts and models for multi-arm studies," *Research Synthesis Methods*, vol. 3, no. 2, pp. 98–110, 2012.

[35] A. Chaimani, G. Salanti, S. Leucht, J. R. Geddes, and A. Cipriani, "Common pitfalls and mistakes in the set-up, analysis and interpretation of results in network meta-analysis: what clinicians should look for in a published article," *Evidence Based Mental Health*, vol. 20, no. 3, pp. 88–94, 2017.

[36] G. Salanti, A. E. Ades, and J. P. A. Ioannidis, "Graphical methods and numerical summaries for presenting results from multiple-treatment meta-analysis: an overview and tutorial," *Journal of Clinical Epidemiology*, vol. 64, no. 2, pp. 163–171, 2011.

[37] M. Egger, G. D. Smith, M. Schneider, and C. Minder, "Bias in meta-analysis detected by a simple, graphical test," *BMJ*, vol. 315, no. 7109, pp. 629–634, 1997.

[38] M. Dimitris and S. Georgia, "Exploring and accounting for publication bias in mental health: a brief overview of methods," *Evidence-based Mental Health*, vol. 17, no. 1, pp. 5–11, 2014.

[39] D. J. Biau, S. Kernéis, and R. Porcher, "Statistics in brief: the importance of sample size in the planning and interpretation of medical research," *Clinical Orthopaedics and Related Research*, vol. 466, no. 9, pp. 2282–2288, 2008.

[40] A. Cipriani, X. Zhou, C. Del Giovane et al., "Comparative efficacy and tolerability of antidepressants for major depressive disorder in children and adolescents: a network meta-analysis," *The Lancet*, vol. 388, no. 10047, pp. 881–890, 2016.

[41] A. Mehren, J. Özyurt, A. P. Lam et al., "Acute effects of aerobic exercise on executive function and attention in adult patients with ADHD," *Frontiers in Psychiatry*, vol. 10, no. 1, p. 132, 2019.