REVIEW ARTICLE

Yoga as an Alternative Therapy for Weight Management in Child and Adolescent Obesity: A Systematic Review and Implications for Research

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ABSTRACT

Background • Obesity remains among one of the greatest health care threats facing today's children and adolescents. Yoga has gained increased popularity in the United States and appears as a promising way to assist with weight loss and management in adults. However, research examining yoga programs targeting weight loss for children or adolescents are relatively scarce.

Objective • The current study provided a systematic review of yoga-based interventions targeting weight loss among overweight or obese children and adolescents.

Methodology • The authors conducted a systematic review of articles obtained from Alt HealthWatch, CINAHL, SPORTDiscus, PubMed, and Web of Science databases. Inclusion criteria were studies employed yoga as a primary component, targeted overweight or obese children or adolescents, measured body weight or BMI as an outcome, utilized any type of study design, and published in peer-reviewed journals in English language.

Results • A total of nine studies met the inclusion criteria. Most studies were conducted in the United States (n = 5), and implemented in the school setting (n = 5). Among studies reviewed, three were randomized controlled trials, and two were with the attrition rates approaching 50%. A majority of the interventions were able to facilitate weight loss and relevant behaviors.

Conclusion • The impact of yoga interventions on child and adolescent obesity was small but meaningful. Some of the limitations include small sample sizes, lack of follow-up assessment after posttest, lack of control groups, lack of utilization of behavioral theories, and lack of intervention targeting disadvantaged populations. Future interventions utilizing randomized controlled trials with large sample sizes are needed to assess the impact of yoga on child and adolescent obesity. (*Altern Ther Health Med.* 2020;27(1):48-55).

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INTRODUCTION

The prevalence of obesity among U.S. children and adolescents has almost tripled since 1980, about one in five school-aged students are obese, making obesity the largest health care threat facing today's children and adolescents.[1] Children with obesity are at higher risk of having other chronic health conditions and diseases.[2] Early obesity is also associated with being obese as an adult.[3] Obesity is the most prevalent nutritional disorder among children and is an energy imbalance between calories consumed and calories expended.[4] Moderate daily physical activity and healthy eating are modifiable and particularly important for preventing childhood obesity.[5] Weight loss strategies that incorporate dietary modifications and exercise have proven effective in achieving weight loss, but most of the weight is regained over time.[6]

To improve long-term outcomes of weight loss, mind and body movement approaches, combined with other traditional weight-loss strategies, have the potential to offer a holistic approach to sustain wellness.[7] Yoga, a form of lifestyle-based exercise for health and fitness, includes low physical impact postures (*asana*), breath-work (*pranayama*), and meditation (*dhyana*); emphasizing regular body

stretching, mind-body awareness, and mindful concentration. Yoga has experienced enhanced popularity as a mind-body practice in the United States.[8] Lauche and colleagues' review study reported that yoga can reduce body mass index (BMI) in overweight/obese individuals.[9] Results of a study indicated that regular yoga practice was associated with weight-related health behaviors (e.g., healthy eating, and moderate-to-vigorous physical activity), which might facilitate healthy weight management.[10] A study that surveyed 1830 young adults found that participants who were overweight and practiced yoga regularly showed decreases in their BMI, whereas those not practicing regularly had significant increases in their BMI. Researchers concluded that regular yoga practices may facilitate weight gain prevention.[11]

Researchers implemented yoga interventions in the school setting suggested that yoga holds the significance of improving child and adolescent health. These studies indicated that yoga practice might benefit children by improving their motor skills, mental ability, social skills[12,13] as well as improved general health, attention, and relaxation skills.[14] As the awareness of health benefits of yoga practice rises, yoga programs have also been designed into the physical education curriculum in school.[15,16,17] According to the National Health Interview Survey, among children, the use of yoga practice during the past 12 months increased from 2012 to 2017.[18] Although use of complementary and alternative medicine (e.g., mind-body movement and relaxation techniques) among children and adolescents is becoming more prevalent, however, the extent of use of those approaches as treatment options for specific health conditions in children necessitates further investigation.[19]

Yoga appears as a promising way to assist with weight loss and management in adults. Yoga has also been implemented for school-aged students and incorporated into the physical education curriculum. However, research studies examining yoga-based approaches in preventing or treating obesity among children or adolescents are relatively scarce in the empirical literature. Thus, the purpose of this study was to review yoga programs published in peer-reviewed literature targeting weight loss among overweight or obese children or adolescents. Based on this review, recommendations for future interventions have been developed.

METHODS

Literature Search

The current study was designed to provide a systematic review of evidence-based yoga interventions' impact on child and adolescent obesity. A professional librarian developed customized search strategies for each key database: Alt HealthWatch (EBSCOHost), CINAHL (EBSCOHost), SPORTDiscus (EBSCOHost), PubMed, and Web of Science. The authors performed the search during July 2019 using combinations of the following keywords: Yoga AND (weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") AND (child* OR teen* OR adolescen* OR pediatric). Customized searches are detailed in Appendix 1.

Considering other terms such as meditation, meditative movement, mind-body practice, and "mindful movement" that might share similar components as yoga practice, the authors conducted the search by replacing yoga with each of those terms in each key database. One additional article was found that matched the inclusion criteria.[29]

To identify other potential articles that might not be indexed in the aforementioned databases, the same keywords were used for a secondary search on Google Scholar. One additional article was identified and included.[28] The authors also searched the reference lists of each of the selected articles. One additional article matched inclusion criteria was included.[27]

Additionally, the authors hand-searched for the keywords on selected peer-reviewed journals publishing yoga related articles in order to increase the sensitivity of the search (i.e., *International Journal of Yoga Therapy, Journal of Alternative and Complementary Medicine, Journal of Evidence-Based Integrative Medicine, and Journal of Integrative Medicine*). No additional articles were found that matched the inclusion criteria.

In the first stage of the literature search, titles and abstracts of identified studies were checked for inclusion. In the second stage, full-text articles were retrieved and checked for inclusion. Two authors independently assessed the eligibility of the studies; a third author checked those articles based on the selection criteria for inclusion. Authors and titles of studies were used to identify identical articles to avoid double counting of the same study.

Study Selection

Inclusion criteria were intervention studies that: (a) used yoga as a primary component of treatment, (b) targeted overweight or obese (BMI values at or above the 85th percentile for children and teens of the same age and sex) 20 children or adolescents (World Health Organization's definition of a child-a person 19 years or younger was utilized for this inclusion criteria), (c) measured body weight or BMI as an outcome, (d) utilized any type of study design, and (e) published in peer-reviewed journals in English language with full-text available between January 1968 and July 2019. Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA)[21,22] were applied to illustrate the selection of these articles for inclusion in this systematic review (Figure 1).

Studies that were non-intervention studies (e.g., cross-sectional, review, and commentary studies; n = 95), targeting adults (n = 33), repeated studies (n = 39), accepted conference poster proposals (n = 4), targeting non overweight or obese participants (e.g., participants with eating disorders, cerebral palsy, Duchenne muscular dystrophy; n = 10), lack of body weight or BMI assessment (n = 3), and non-yoga or lower dosage of yoga intervention studies (n = 4) were excluded.

Figure 1. Data extraction process

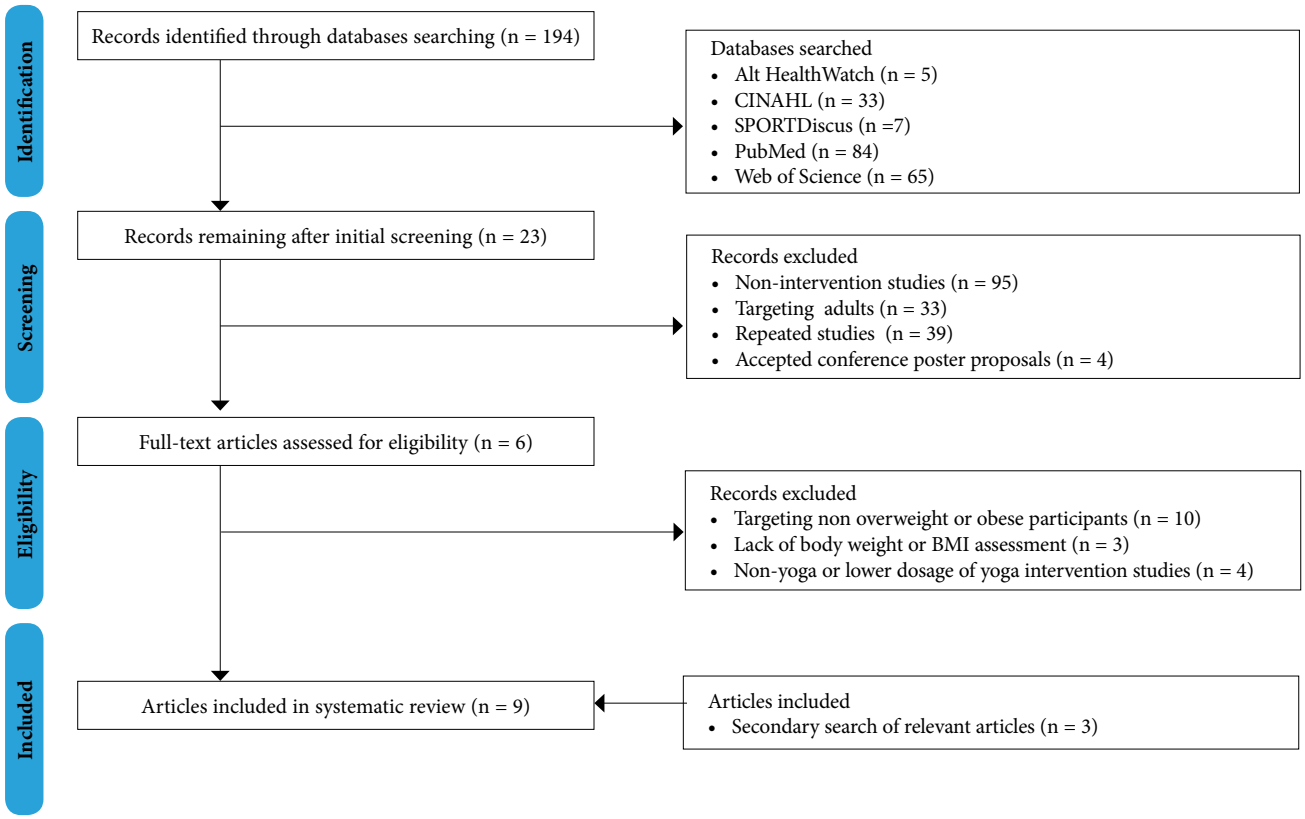

Table 1. Summary of Yoga Programs for Improving Child and Adolescent Obesity (n = 9).

Author(s), country, year	Sampling frame, demographics	Design, intervention, setting	Measures	Time of assessment	Intervention effects
Slawta et al.,[23] U.S., 2008	91 children aged 6-12 (nearly one half participants exceeded optimal range of BMI)	Single group pretest-posttest PRECEDE-PROCEED Model Triweekly 2-hour physical activity (including yoga postures) and nutrition for 12 weeks School	Body Composition (BMI, body weight, skinfold thickness, body fat); Fitness; Nutrition Knowledge and Diet Composition; Lipids and Lipoproteins	Baseline; 12-week	BMI decreased significantly at posttest
Benavides & Caballero,[24] U.S., 2009	14 predominantly Hispanic adolescents aged 8-15 (mean BMI = 26.4 kg/m^2; BMI ≥ 95th percentile for related age and gender) at risk for developing type 2 diabetes	Single group pretest-posttest Triweekly 75-min Ashtanga yoga with breath control and meditation for 12 weeks Clinic	Body weight, BMI; Lab parameters (Glucose, total cholesterol, low density lipoprotein; high density lipoprotein; triglycerides; C-reactive protein); Psychological measures (Beck Self-Concept Inventory-Youth; Beck Anxiety Inventory-Youth; Beck Depression Inventory-Youth)	Baseline; 12-week	Of the 14 participants, 11 experienced weight loss (average weight loss was 2 kg). The mean baseline weight was 61.2 ± 20.2 kg and decreased to 59.2 ± 19.2 kg (p = 0.01), which correlated with changes in BMI from 26.4 ± 6.6 to 25.6 ± 6.2 kg/m^2
Sarvestani et al.,[25] Iran, 2009	60 obese female adolescents aged 11-15 (mean BMI = 29.3 kg/m^2; BMI ≥ 95th percentile for related age and gender)	Quasi-experimental Experiment (n = 30): Weekly 4-hour session (2-hour yoga therapy and 2-hour behavior modification or dietary instruction) for 16 weeks (lasted for 6 months) Control (n = 30): Attended three sessions of the same intervention School	Body weight, BMI, arm circumferences; Dutch Eating Behavior Questionnaire	Baseline; 6-month	There were statistically significant differences in changes in body weight (-2.75 kg vs. 0.62 kg), BMI (-1.07 kg/m^2 vs. 0.24 kg/m^2) in the experimental group in contrast to control group

Table 1. (continued)

Seo et al.,[26] Korea, 2012	20 obese male adolescents aged 13-15 (mean BMI = 28.8 kg/m^2; BMI ≥ 95th percentile for related age and gender)	Randomized Experiment (n = 10): Triweekly 50-min Asana yoga including warm-up (10 min), yoga postures (40 min), and relaxation (10 min) for eight weeks Control (n = 10): General health education regarding type 2 diabetes prevention, balanced diet consumption, and physical activity engagement School	Body weight, BMI, fat-free mass, fat mass, body fat, basal metabolic rate	Baseline; 8-week	Body weight, and BMI significantly decreased among experiment group after intervention, but not in the control group
Hainsworth et al.,[27] U.S., 2014	16 obese adolescents aged 11-17 (BMI ≥ 95th percentile for related age and gender), and with at least one medical comorbidity	Single group pretest-posttest Semiweekly 60-min Hatha yoga including warm-up (5 min), yoga postures (45-50 min), restoration and meditation (5-10 min) for eight weeks (15 sessions in total) Clinic	Body weight, BMI; Physical Activity; Physical Functioning; Feasibility and acceptability (Holistic Health Questionnaire; Pediatric Quality of Life Inventory); Spielberger State Anxiety Inventory-Child	Baseline; 8-week	Weight did not change significantly from pretest to posttest
Nanthakumar ,[28] Malaysia, 2016	One obese female adolescent aged 19 (BMI = 29.1 kg/m^2; BMI ≥ 95th percentile for related age and gender)	Qualitative single case study pretest-posttest 70-min Classical yoga including awareness practice (5 min), yoga postures (55 min), breath control and meditation (10 min) for ten weeks (14 sessions in total) School	Body weight, BMI, waist and hip circumferences; Physical Strength	Baseline; 10-week	The participant revealed a weight reduction (i.e., 2 kg) and decrease in BMI from 29.14 to 28. 30 kg/m^2
Shomaker et al.,[29] U.S., 2017	33 obese female adlescents aged 12-17 (mean BMI = 29.8 kg/m^2; BMI ≥ 95th percentile for related age and gender) with family history of diabetes, and elevated depressive symptoms	Randomized Experiment (n = 17): Weekly 60-min meditation, yoga "mindful" movement, mindfulness awareness practices for six weeks Control (n = 16): Cognitive restructuring and behavioral activation School	Body weight, BMI; Mindful Attention Awareness Scale; Schedule for Affective Disorders and Schizophrenia for School-Age Children; Insulin Resistance; Acceptability	Baseline; 6-week; 6-month follow-up	At posttest and six months follow-up, BMI of participants in both experiment and control groups remain high
Hainsworth et al.,[30] U.S., 2018	10 obese adolescents aged 11-17 (BMI ≥ 95th percentile for related age and gender), and with at least one medical comorbidity	Single group pretest-posttest Semiweekly 60-min Iyengar yoga including yoga postures and breath control for eight weeks (16 total classes) Clinic	BMI; Gait; Feasibility and acceptability (Holistic Health Questionnaire; Pediatric Quality of Life Inventory); Pain Intensity; Physical Activity	Baseline; 8-week	At posttest, participants' BMI percentile was exactly the same
Xiang et al.,[31] China, 2019	44 obese adolescents aged 10-14 (BMI ≥ 95th percentile for related age and gender)	Randomized Experiment (n = 22): 5 hs/day, 6 days/week exercise (including triweekly 60-90 min yoga with intensity of 50-75% HRmax) and dietary intervention for six weeks Control (n = 22): Waitlist Community (Bootcamp)	BMI; Self-Control (Stroop Task; Handgrip Task); Maximal Grip Strength; Physical Activity; Trait Self-Control	Baseline; 6-week	BMI was significantly lower posttest compared with pretest for the experiment group; no significant decrease in BMI was found in the control group

Table 2. Risk of Bias Assessment of Included Studies

Study	Sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessors	Incomplete outcome data	Selective outcome reporting	Other sources of bias
Slawta et al.,[23] 2008	Unclear	Unclear	Unclear	Unclear	Unclear	Yes	Unclear
Benavides & Caballero,[24] 2009	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Sarvestani et al.,[25] 2009	Unclear	Unclear	Unclear	Unclear	Unclear	Yes	Unclear
Seo et al.,[26] 2012	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Hainsworth et al.,[27] 2014	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Nanthakumar,[28] 2016	Unclear	Unclear	Unclear	Unclear	Unclear	Yes	Unclear
Shomaker et al.,[29] 2017	Yes	Yes	Yes	No	Yes	Yes	Unclear
Hainsworth et al.,[30] 2018	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Xiang et al.,[31] 2019	Yes	Unclear	Unclear	Unclear	Unclear	Yes	Unclear

RESULTS

The authors searched and received a total of 194 articles including Alt HealthWatch (EBSCOHost) (n = 5), CINAHL (EBSCOHost) (n = 33), SPORTDiscus (EBSCOHost) (n = 7), PubMed (n = 84), and Web of Science (n = 65). After screening, six studies meeting the inclusion criteria were identified. Additionally, one article was identified by replacing yoga with other terms (i.e., meditation, meditative movement, mind-body practice, and "mindful movement") in each key database;[29] one article was identified via secondary search on Google Scholar;[28] one article was identified by searching the reference lists of each of the selected article.[27] A total of nine studies met the inclusion criteria (see Figure for data extraction process).

The following data were extracted: publishing data (i.e., author, publication year, country where the study was conducted), characteristics of participants (i.e., number of participants, gender, age, and mean BMI), study design (i.e., intervention assignment, duration, intervention components, and setting), time of assessment, and highlighted outcomes as presented in Table 1.

The included studies involved 289 participants. Sample sizes were small, ranging in size from one to 91 adolescents. Most interventions were conducted in the United States,[23,24,27,29,30] with one in Iran,[25] one in Korea,[26] one in Malaysia,[28] and one in China.[31] Regarding study design conducted in those interventions, four were single group pre-and posttest design,[23,24,27,30] three were randomized controlled trials,[26,29,31] one was quasi-experimental design,[25] and one was qualitative case study design.[28] Only one intervention addressed the use of the PRECEDE-PROCEED Model as a framework in program development.[23] The interventions implemented were Ashtanga (Classical) yoga, Hatha yoga, Iyengar yoga, and yoga "mindful" movement. Five interventions were implemented in school,[23,25,26,28,29] the other four were delivered in community settings (e.g., clinic). The duration of the intervention ranged from six to 16 weeks. Only one intervention conducted the follow-up assessment (i.e., 6-month follow-up) after posttest.[29]

Body weight and BMI changes from pretest to posttest were the only one body composition outcome assessed across all included interventions. Additional outcomes assessed including fitness assessment, psychological measures, physical activity, and eating behaviors. The majority of the interventions were able to facilitate weight loss and improve additional outcome behaviors relevant to obesity prevention in the participants under study. Three interventions evaluated the program feasibility and acceptability.[27,29,30] Table 1 provides descriptive results of the included studies.

Risk of bias of included studies was assessed utilizing the Cochrane guidelines for systematic reviews.[32] Risk of selection bias was generally high as only two interventions reported adequate random sequence generation.[29,31] Risk of performance bias was also high as only one intervention reported blinding of participants and personnel.[29] Incomplete outcome data were adequately addressed in five interventions.[24,26,27,29,30] Risk of selective outcome reporting had a low risk of bias as all interventions had adequate reporting. Six interventions were non randomized studies which may cause selection bias.[23,24,25,27,28,30]

DISCUSSION

The purpose of the study was to evaluate yoga-based intervention targeting weight loss among overweight or obese children and adolescents. Obesity is an emerging health concern globally. Yoga, a form of mind-body practice, is growing in Western society and has been found to be associated with physical fitness and mental well-being. Though the purpose of yoga is self-realization, it has beneficial effects on physical and psychological health. However, only nine interventions meeting inclusion criteria were identified during a 50-year time span. Overall, it was found that yoga-based interventions might be promising in assisting weight loss[23-28,31] in participants studied in school[23,25,26,28,29] and community settings.[24,27,30,31] Future interventions and robust evaluations utilizing randomized controlled trials are needed to assess the impact of yoga on child and adolescent obesity.

Five out of nine interventions were implemented in the school setting. School-based physical activity programs have been effective in promoting healthy behaviors such as physical activity and healthy eating that contribute to obesity prevention.[33] Additionally, as obesity disproportionately

burdens children residing in low-income areas and ethnic minority populations, only one intervention reviewed was delivered to Hispanic children with 14 participants completed the program.[24] This finding is consistent with results from the 2017 National Health Interview Survey,[18] which presented that the use of yoga among Hispanic and non-Hispanic black children was lower than among non-Hispanic white children. Future school-based interventions should be designed and implemented for culturally minority populations as those who are at risk of being obese.

It is worth noting that three interventions reviewed were conducted for adolescent female,[25,28,29] two interventions found reduced body weight and BMI among participants under study.[25,28] Studies presented that several perceived barriers such as body-image, gender norms,[34] concern about safety,[35] teacher attitudes and support, and type of activities[36] might inhibit adolescent female from engaging in physical activity. Besides, findings of a national survey reported that adolescent girls were more likely to have practiced yoga compared with adolescent boys.[18] To facilitate adolescent female to involve in 60 minutes of moderate-to-vigorous physical activity daily and receive health benefits of regular exercise, future studies implementing yoga programs for adolescent girls are still needed.

Among interventions reviewed, in three of those, yoga was offered along with dietary intervention as primary components of treatment;[23,25,31] in which participants who completed the program showed significantly decreased anthropometric indices (i.e., body weight, BMI) and improved obesity prevention behaviors (e.g., self-control, emotional eating, diet composition and knowledge). These findings provided evidence that combining with other weight loss strategies (e.g., behavior modification, or dietary instruction), yoga practice might be a beneficial adjuvant to weight management programs for overweight or obese children and adolescents.

In some interventions reviewed participants' BMI remain high at posttest assessment.[29,30] Factors that may have influenced the lack of changes in BMI or body weight in these studies including: First, these programs focused on using yoga physical movement and breath control as a means, however, the evidence showed that nutrition plays an important role to create change in weight management;[6] second, these programs provided short duration of intervention, ranged from six to eight weeks. Weight loss takes time. Yoga is an integrative approach exercise to improve one's physical fitness (e.g., flexibility, strength), attention, and relaxation, and emphasize healthy lifestyle.[37] Therefore, utilizing yoga intervention for weight management, it is imperative that longer or more intensive interventions are offered to increase the opportunity to make behavioral or nutritional changes in weight management.

For two of the interventions, the attrition rates were approaching 50% (i.e., 47% and 44% each) with fourteen completed the study out of the thirty participants,[24] and with fourteen (twelve did not attend any session and four attended 1-4 sessions) out of thirty two who were enrolled in the intervention.[27] Attrition is a threat to the internal validity of the study and limits the confidence in the efficacy of the trial. Future studies should improve retention and further investigate participants' perceived barriers to completing the intervention. Additionally, only one intervention included behavior modification in the treatment.[25] Future intervention should utilize behavioral theories to assist with the sustainment of yoga practice for participants.

Although examining the psychosocial outcomes is not the purpose of the study, findings from five included interventions[24,27,28,29,30] reported improved mental health indicators (e.g., anxiety, depression, self-image, stress, etc.). These findings are consistent with a systematic review that concluded that yoga practice may be an efficacious approach for managing stress.[38] Yoga practice is associated with heightened mindfulness and improved mood which might help reduce food intake.[39]

Limitations of the Interventions

Some limitations of yoga interventions for child and adolescent obesity were discovered. Majority of the studies utilized a small sample size, which limited the power of statistical analysis. Some of the studies were randomized controlled trials; other research designs were used (e.g., single group pretest-posttest, quasi-experimental, case study). Only one intervention was implemented for ethnic minority groups, it limited the variety of literature documenting the effect of yoga on weight loss. Some of the included studies reported that participants' BMI remain the same after the intervention, hence longer or more intensive interventions may be needed to achieve substantial changes in body weight or BMI. Or other outcome measures should also be considered when examining the effectiveness of the interventions. Finally, only one intervention utilized behavior change theory to assist with the development and implementation of yoga program in the included studies.

Limitations of This Review

There were some limitations of this review. The search was limited to the following databases: Alt HealthWatch (EBSCOHost), CINAHL (EBSCOHost), SPORTDiscus (EBSCOHost), PubMed, and Web of Science so that some articles might not have been identified. This review aimed to examine the impact of yoga on child and adolescent obesity, only interventions targeting individuals age 19 or younger with BMI values at or above the 85th percentile for related age and gender were included; intervention targeting overweight or obese college students aged older than 19 were excluded. Intervention studies utilized yoga as merely part of the treatment with lower dosage (e.g., 1-hour practice in total) were excluded, in which confounding occurs as outcomes may be influenced by other primary physical activity components (e.g., walking, rock climbing, strength training) instead of yoga practice. The literature search was limited to articles published in the English language; articles

published in other languages were excluded. Conference abstracts with missing information on the intervention description or outcomes were also excluded. Finally, findings reported were limited on studies measured body weight or BMI as an outcome. BMI may not be the most accurate indicator to determine the effect of weight on health, however, this is the only body composition outcome assessed across all of those included interventions. There are limitations inherent to the systematic review methods utilized in the study, thus the interpretation of the findings need to be carefully considered.

CONCLUSIONS

The study aimed at evaluating the impact of yoga-based interventions targeting overweight or obese children and adolescents. Yoga-based interventions appear to be a promising approach for weight loss and management among overweight or obese children and adolescents. The effects were small but meaningful, further research is needed to investigate how yoga practice could treat and prevent the growing issue of child and adolescent obesity. More research should be conducted on studies of yoga on weight loss among groups such as various ethnicity, socioeconomic status, geographical location, and younger children. It is necessary that the researchers and practitioners continue to examine the impact of yoga intervention, a life-long mind-body approach, on children and adolescents who are overweight or obese. In school, yoga-based exercise could also be incorporated into curricula that may be beneficial to obesity prevention among children and adolescents.

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REFERENCES

1. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States, 2015–2016. *NCHS Data Brief*. 2017;288:1-8.
2. World Health Organization. Childhood overweight and obesity.http://www.who.int/dietphysicalactivity/childhood/en/index.html Accessed July 23, 2019.
3. Herman KM, Craig CL, Gauvin L, Katzmarzyk PT. Tracking of obesity and physical activity from childhood to adulthood: The physical activity longitudinal study. *Int J Pediatr Obes*. 2009;4(4):281-8.
4. Williams EP, Mesidor M, Winters K, Dubbert PM, Wyatt SB. Overweight and obesity: Prevalence, consequences, and causes of a growing public health problem. *Curr Obes Rep*. 2015;4(3):363-370.
5. Dai CL, Sharma M. Predicting childhood obesity prevention behaviors using Social Cognitive Theory for elementary school students in Taiwan. *Int J Health Educ*. 2014; 52(6):339-45.
6. Annesi JJ, Mareno N. Psychosocial changes as correlates of weight regain vs. continued loss within 2-year trials of a self-regulation-focused community-based intervention. *Clin Obes*. 2017;7(1):22-33.
7. Cramer H, Ward L, Steel A, Lauche R, Dobos G, Zhang Y. Prevalence, patterns, and predictors of yoga use: Results of a US nationally representative survey. *Am J Prev Med*. 2016;50(2):230-5.
8. Clarke TC, Barnes PM, Black LI, Stussman BJ, Nahin RL. Use of yoga, meditation, and chiropractors among U.S. adults aged 18 and over. *NCHS Data Brief*, no 325. Hyattsville, MD: National Center for Health Statistics. 2018.
9. Lauche R, Langhorst J, Lee MS, Dobos G, Cramer H. A systematic review and meta-analysis on the effects of yoga on weight-related outcomes. *Prev Med*. 2016;87:213-32.
10. Watts AW, Rydell SA, Eisenberg ME, Laska MN, Neumark-Sztainer D. Yoga's potential for promoting healthy eating and physical activity behaviors among young adults: a mixed-methods study. *Int J Behav Nutr Phys Act*. 2018;15(1):42.
11. Neumark-Sztainer D, MacLehose RF, Watts AW, Eisenberg ME, Laska MN, Larson N. How is the practice of yoga related to weight status? Population-based findings from Project EAT- IV. *J Phys Act Health*. 2017;14(12):905-12.
12. Khalsa S, Bethany B. Yoga in school settings: A research review. *Ann NY Acad Sci*. 2016;13731(1):45-55
13. Accardo AL. Yoga as a school-wide positive behavior support. *Child Educ*. 2017;93(2):109-113.
14. O'Neil ME. Ideishi RI, Benedetto M, Ideishi SK, Fragala-Pinkham M. A yoga program for preschool children in Head Start and early intervention: A feasibility study. *J Yoga Phys Ther*. 2016;6(2).
15. Otto V. Yoga for PE: Engaging high school students physically and mentally. JOPERD 2014;85(2):19-23.
16. Galan V, Iryna S, Zoriy Y, Briskin Y, Pityn M. Designing an effective approach to sport for the integration in higher education institutions (the effects of yoga practice). *J Phys Educ Sport*. 2017;17(1):509-518.
17. Noggle JJ, Steiner NS, Minami T, Khalsa S. Benefits of yoga for psychosocial well-being in a US high school curriculum: A preliminary randomized controlled trial. *J Dev Behav Pediatr*. 2012;33(3):93-201.
18. Black LI, Barnes PM, Clarke TC, Stussman BJ, Nahin RL. Use of yoga, meditation, and chiropractors among U.S. children aged 4-17 years. *NCHS Data Brief*, no 324. Hyattsville, MD: National Center for Health Statistics. 2018.
19. Ndetan H, Evans MW, Williams RD, Woolsey C, Swartz JH. Use of movement therapies and relaxation techniques and management of health conditions among children. *Altern Ther Health Med*. 2014;20(4):44-50.
20. Centers for Disease Control and Prevention. Defining childhood obesity. Retrieved from https://www.cdc.gov/obesity/childhood/defining.html. Updated July 3, 2018. Accessed July 22, 2019.
21. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Int J Surg*. 2010;8(5):336-341.
22. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *J Clin Epidemiol*. 2009;62(10):e1-e34.
23. Slawta J, Bentley J, Smith J, Kelly J, Syman-Degler L. Promoting healthy lifestyles in children: A pilot program of Be a Fit Kid. *Health Promot Pract*. 2008;9(3):305-312.
24. Benavides S, Caballero J. Ashtanga yoga for children and adolescents for weight management and psychological well being: An uncontrolled open pilot study. *Complement Ther Clin Pract*. 2009;15(2):110-4.
25. Sarvestani RS, Jamalfard MH, Kargar M, Kaveh MH, Tabatabaee HR. Effect of dietary behaviour modification on anthropometric indices and eating behaviour in obese adolescent girls. *J Adv Nurs*. 2009;65(8):1670-5.
26. Seo DY, Lee S, Figueroa A, et al. Yoga training improves metabolic parameters in obese boys. *Korean J Physiol Pharmacol*. 2012;16(3):175-80.
27. Hainsworth KR, Salamon KS, Stolzman SC, et al. Hatha Yoga for pediatric obesity: a pilot study. *J Yoga Phys Ther*. 2014;4(4):172-9.
28. Nanthakumar C. Intervention of classical yoga in pediatric obesity: A case study. *J Nurs Health Sci*. 2016;5(1):34-43.
29. Shomaker LB, Bruggink S, Pivarunas B, et al. Pilot randomized controlled trial of a mindfulness-based group intervention in adolescent girls at risk for type 2 diabetes with depressive symptoms. *Complement Ther Med*. 2017;32:66-74.
30. Hainsworth KR, Liu XC, Simpson PM, et al. A pilot study of Iyengar yoga for pediatric obesity: Effects on gait and emotional functioning. *Children* (Basel). 2018;5(7):92.
31. Xiang MQ, Liao JW, Huang JH, et al. Effect of a combined exercise and dietary intervention on self-control in obese adolescents. *Front. Psychol*. 2019;10:1385.
32. Higgins JPT, Green S. Cochrane handbook for systematic reviews of interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.handbook.cochrane.org.
33. Kriemler S, Meyer U, Martin E, van Sluijs EM, Andersen LB, Martin BW. Effect of school-based interventions on physical activity and fitness in children and adolescents: A review of reviews and systematic update. *Br J Sports Med*. 2011;45(11):923-30.
34. Satija A, Khandpur N, Satija S. Physical activity among adolescents in India: A qualitative study of barriers and enablers. *Health Educ Behav*. 2018;45(6):926-934
35. Dwyer JJ, Allison KR, Goldenberg ER, Fein AJ, Yoshida KK, Boutilier MA. Adolescent girls' perceived barriers to participation in physical activity. *Adolescence*. 2006;41(161):75-89.
36. Dudley DA, Okely AD, Pearson P, Peat J. Engaging adolescent girls from linguistically diverse and low income backgrounds in school sport: A pilot randomised controlled trial. *J Sci Med Sport*. 2010;13(2):217-24.
37. Woodard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. *Int J Yoga*. 2011;4(2):49-54.
38. Sharma M. Yoga as an alternative and complementary approach for stress management: A systematic review. *J Evid Based Complementary Altern Med*. 2014;19(1):59-67.
39. Bernstein AM, Bar J, Ehrman JP, Golubic M, Roizen MF. Yoga in the management of overweight and obesity. *Am J Lifestyle Med*. 2014;8(1):33-41.

APPENDIX

Alt HealthWatch
Date Range for Database: 1990-present
Search Conducted: 7/19/19
yoga AND (TI(weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") OR AB(weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") OR DE("weight loss" or "body weight" or "obesity")) AND ((TI(child* OR adolescen* OR teen* OR youth OR pediatric) OR AB(child* OR adolescen* OR teen* OR youth OR pediatric) OR DE ("children" or "adolescence" or "teenagers" or "youth"))
Results: 14
Limited to Peer-Reviewed, Academic Journals: 5

CINAHL
Date Range for Database: 1937-present
Search Conducted: 7/19/19
yoga AND (TI(weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") OR AB(weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") OR MH("Body Weight Changes" OR "Weight Reduction Programs" OR "Weight Control" OR "Obesity" OR "Pediatric Obesity")) AND ((TI(child* OR adolescen* OR teen* OR youth OR pediatric) OR AB(child* OR adolescen* OR teen* OR youth OR pediatric) OR MH("Child" OR "Adolescence"))
Results: 59
Limited to Academic Articles: 33

SPORTDiscus
Date Range for Database: 1975-present
Search Conducted: 7/19/19
yoga AND (TI(weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") OR AB(weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") OR DE("weight loss" or "body weight" or "obesity" or "overweight children" or "overweight teenagers")) AND (TI(child* OR adolescen* OR teen* OR youth OR pediatric) OR AB(child* OR adolescen* OR teen* OR youth OR pediatric) OR DE("children" or "teenagers" or "youth" or "pediatrics"))
Results: 28
Limited to Academic Journals: 7

PubMed
Search Conducted: 7/23/19
("yoga"[All Fields]) AND (weight[Title/Abstract] OR obes*[Title/Abstract] OR overweight[Title/Abstract] OR adiposity[Title/Abstract] OR BMI[Title/Abstract] OR "body mass index"[Title/Abstract] OR "body weight"[MeSH] OR "Body Weight Changes"[MeSH] OR "Weight Reduction Programs"[MeSH] OR "weight loss"[MeSH] OR "Overweight"[MeSH] OR "Obesity"[MeSH] OR "Pediatric Obesity"[MeSH]) AND (child*[Title/Abstract] OR adolescen*[Title/Abstract] OR teen*[Title/Abstract] OR youth [Title/Abstract] OR pediatric[Title/Abstract] OR Child[MeSH] OR Adolescent[MeSH] OR Pediatrics[MeSH])
Results: 84

Web of Science Core Collection
Date Range for Index: 1900-present
Search Conducted: 7/23/19
ALL FIELDS: (yoga AND (weight OR obes* OR overweight OR adiposity OR BMI OR "body mass index") AND (child* OR adolescen* OR teen* OR youth OR pediatric))
Results: 65