



Ashtanga yoga for children and adolescents for weight management and psychological well being: An uncontrolled open pilot study

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A B S T R A C T

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Objective: The objective of this pilot study was to determine the effect of yoga on weight in youth at risk for developing type 2 diabetes. Secondly, the impact of participation in yoga on self-concept and psychiatric symptoms was measured.

Methods: A 12-week prospective pilot Ashtanga yoga program enrolled twenty children and adolescents. Weight was measured before and after the program. All participants completed self-concept, anxiety, and depression inventories at the initiation and completion of the program.

Results: Fourteen predominately Hispanic children, ages 8–15, completed the program. The average weight loss was 2 kg. Weight decreased from 61.2 ± 20.2 kg to 59.2 ± 19.2 kg ($p = 0.01$). Four of five children with low self-esteem improved, although two had decreases in self-esteem. Anxiety symptoms improved in the study.

Conclusion: Ashtanga yoga may be beneficial as a weight loss strategy in a predominately Hispanic population.

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1. Introduction

Pediatric overweight has reached epidemic proportions. Rates of overweight and obesity in children and adolescents are 30% and 15%, respectively.¹ The problem is more pronounced in ethnic minorities such as Mexican-Americans with current estimates of overweight and obesity at 41% and 23%, respectively.² Due to high rates of overweight in pediatrics, complications such as diabetes, hypertension, and heart disease are bound to affect this population much earlier. In addition, being overweight may be associated with psychological distress, increasing the risk for developing depression or anxiety, and decreasing quality of life in this population.^{3–5} As a result, self-concept, especially in females, may be affected. Therefore, finding ways to decrease weight and establish healthier lifestyles is crucial.

One of the many challenges in decreasing weight in children and adolescents is finding physical activities that are of interest. Ashtanga yoga is composed of a series of “asanas,” or postures, connected with a breathing technique “pranayama” that links the

movements of one posture to the next. The asanas are static and held for approximately five breaths each. Each asana presents either a flexibility or strength challenge to the individual. The end of each yoga practice consists of five to ten minutes of meditation or relaxation. Ashtanga yoga is often referred to as “power yoga” as it is more aerobic in nature.

The primary objective of this study was to determine the effect of yoga on children and adolescents weight and any abnormal metabolic parameters in those at risk for the development of type 2 diabetes. The secondary objective of this study was to determine the impact of participation in yoga on self-concept and psychiatric symptoms such as depression or anxiety.

2. Methods

The Institutional Review Board approved this prospective pilot study. Consent and assent were obtained from the participants and their parents.

Participants were recruited by posting an advertisement in local newspapers and community locations. Interested youth were screened by one of the principal investigators (PI) for eligibility. Children and adolescents, ages 8–15 years, were eligible to participate if they had at least one of the following risk factors for type 2 diabetes as defined by the American Diabetic Association: overweight, first degree relative with type 2 diabetes, or Hispanic/

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African American descent. Exclusion criteria included diagnosis of diabetes, recent infection or condition known to cause inflammation, history of smoking or current smoking, pregnancy, or inability to provide assent. All eligible children and adolescents were invited to attend an introductory session. At the end of the introductory session, each child received a yoga mat.

Upon enrollment, demographic information, weight, and height were recorded. Each participant's weight and height was plotted on a Center's for Disease Control and Prevention (CDC) growth chart and body mass index (BMI) percentiles were determined. Classification was assigned as underweight, normal weight, overweight, or obese according to CDC classification. The participants had a physical exam to determine their ability to participate. Any participant with abnormal physiological findings was referred to their primary care physician.

The participants returned in two days for fasting laboratory analysis. Serum concentrations of glucose, total cholesterol (TC), high density lipoprotein (HDL), triglycerides, and cardiac specific C-reactive protein (CRP) were analyzed. Low density lipoprotein (LDL) cholesterol was calculated based on TC and triglycerides. Upon completion of the 12-week program, the laboratory analyses were repeated if they were initially abnormal.

The participants completed three inventories to assess baseline self-concept, and evaluate any symptoms of depression and/or anxiety. Self-concept was measured using the Beck Self Concept Inventory for Youth (BSCI-Y) while symptoms of depression and anxiety were measured using the Beck Depression Inventory for Youth (BDI-Y) and Beck Anxiety Inventory for Youth (BAI-Y), respectively. These tests were purchased from PsychCorp and used with permission. The BSCI-Y is a child rated test consisting of 20 statements which assess self-perceptions including competency and self-esteem. The BDI-Y measures the subject's negative thoughts such as sadness, loneliness, and physiologic symptoms associated with depression. The BAI-Y evaluates the participant's fears, worrying, and physiologic symptoms associated with anxiety. The BDI-Y and BAI-Y are also comprised of 20 statements.

All three questionnaires were repeated at the end of the study. They were administered when parents were not present and as outlined in the referenced manual.⁶ Parents of any child with abnormal scores at the beginning or end of the study were referred to their primary care provider to seek psychological services for their child.

The participants attended yoga three days a week for 12 weeks. Each class lasted approximately 1 h and 15 min. To ensure consistency, the same instructor was responsible for modifying the yoga Ashtanga sequence and teaching all classes. The participants did a modified Ashtanga yoga sequence with pranyama and meditation. Initially, the class was not as strenuous to ensure the subjects did not experience fatigue or injury, which may have caused them to dropout or miss a substantial portion of the study. There were no dietary or activity restrictions at any time during the study.

Halfway through the program, the participants received a yoga mat bag. At the end of the study, all participants received a \$50 gift certificate to a local sports store. All parents of the participants also received a \$10 gift certificate for gas.

After completion of the study, surveys were mailed to the parents and children with a self-addressed stamped envelope to be returned to the PI. Parents were assured the surveys were anonymous.

2.1. Statistical evaluation

A sample size was not calculated. Due to funding limitations, the study was designed to have 12 participants complete the entire program. Based on an earlier study, we found a 40% attrition rate.

For this reason, we expected at least 20 participants to enroll in the study.

Baseline demographic characteristics of the study group were reported by descriptive statistics. The primary outcome of changes in weight was analyzed using a two-tailed paired *t*-test. Statistical significance was defined as $p < 0.05$. For secondary psychiatric outcomes, baseline and final raw scores were converted to T-score equivalents and placed in the appropriate categories as established by the Beck Youth Inventories manual. Results and differences of change between pre- and post-measurements were reported.

3. Results

A total of 30 children and adolescents were screened for entry into the study. Of those, 23 attended the introductory session. Three did not complete the medical examination, 20 enrolled, and 14 completed the study. Of the participants that did not complete the study, one dropped due to a hospitalization not related to the study, one had transportation issues, and two left for summer vacation. Two participants dropped out without giving a reason. Overall, participants attended $72.9 \pm 17.2\%$ (range 41.7–100%) of classes. The attrition rate for the study was lower than anticipated with 70% completing the study.

Baseline subject demographics of the children and adolescents who completed the study are provided in Table 1. The average age was 11.7 ± 1.5 years. Most participants were female and of Mexican-American descent. The average initial weight for the children was 61.2 kilograms (kg) with an average BMI of 26.4 kg/m^2 . Weight classifications are illustrated in Fig. 1. Past medical history is listed in Table 2. Fig. 2 depicts family history, with regards to presence of diabetes, dyslipidemias, or hypertension in either first or second-degree relatives.

The mean baseline weight was $61.2 \pm 20.2 \text{ kg}$ and decreased to $59.2 \pm 19.2 \text{ kg}$ ($p = 0.01$), which correlated with changes in BMI from 26.4 ± 6.6 to $25.6 \pm 6.2 \text{ kg/m}^2$ ($p = 0.01$). On average, participants had a 2 kg weight loss (-2 ± 2.1 , -5.9 – 0.5). Of the 14 participants, 11 had weight loss, one had no change in weight, and two had weight gain. However, despite the weight loss, no child could be reclassified into a lower weight category. The most significant weight loss was by a 13 year old female who lost 5.9 kg. She had attended 75% of classes. However, when accounting for all participants, there were no correlations between weight loss and the number of classes attended.

Table 3 provides the results of the initial laboratory parameters. Two participants had abnormal lipid panels and elevated CRP. One of the patients with abnormal lipid panels was previously diagnosed with hyperlipidemia and was being managed with dietary modifications. The lipid profiles in both of these participants improved. TC decreased from 203 and 222 mg/dL to 200 and 212 mg/dL, respectively. HDL increased from 64 and 55 mg/dL to 66

Table 1

Baseline demographic and hemodynamic parameters, Ashtanga Yoga for Youth, McAllen, Texas, May–August 2006.

Age (years)	11.7 ± 1.5 (8.8–14.7)
Gender <i>n</i> (%)	Female 11 (79) Male 3 (21)
Ethnicity <i>n</i> (%)	Mexican-American 12 (85.7) Bi-racial 2 (14.2)
Weight (kg)	61.2 ± 20.2 (29.1–91.4)
Body Mass Index (kg/m^2)	26.4 ± 6.6 (16.6–36.2)
Hemodynamics	
Systolic blood pressure (mmHg)	110.5 ± 9.1 (94–130)
Diastolic blood pressure (mmHg)	63.8 ± 13.3 (40–82)
Heart rate (beats/minute)	73.7 ± 8.1 (56–84)

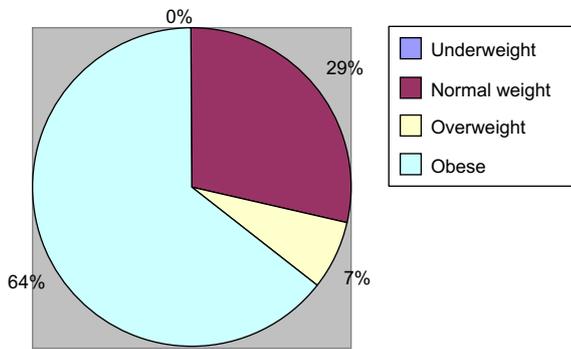


Fig. 1. % of children/adolescents classified into underweight, normal, at risk for overweight and overweight, Ashtanga Yoga for Youth, McAllen, Texas, May–August 2006.

and 58 mg/dL, respectively. Both patients with elevated CRP had decreases after the completion of the study, from 5.9 (both participants) to 2.7 and 2.8 mg/dL.

Of the 14 participants completing the study, three initially had low self-esteem scores while two had very low self-esteem scores. After the study, four of these five participants had improvements. On the contrary, two participants demonstrated lower self-esteem compared to baseline. Three participants showed elevated symptoms of depression that improved after the study. However, two had mild increases in symptoms of depression after completion of the study. Two participants with elevated symptoms of anxiety at baseline showed improvements at the end of the study. Additionally, none of the participants showed an increase in anxiety by the end of the study. Individual participant results are listed in Table 4.

Only three (21%) parents and children returned the surveys. All comments were positive; however, due to the limited data, no conclusions can be delineated from the surveys.

4. Discussion

This is the first study published using yoga to address the problems of overweight in children and adolescents. Overweight in childhood can lead to many negative health consequences into adulthood, particularly type 2 diabetes. Therefore, weight management at a younger age may serve as a preventative strategy for overall health. Several studies have shown benefits in glycemic control in adult patients with type 2 diabetes but none have been published evaluating the prevention of diabetes with weight control.⁷ In addition, no other study has evaluated the role of yoga in any disease state in a predominately underserved Mexican-American population. In fact, very limited studies of weight loss in overweight or obese Hispanic populations have been completed.⁸ Only one study has been completed in Hispanic adolescent females; however, the focus was not on physical activity but on carbohydrate ingestion.⁹ With such high rates of overweight in Hispanic children, studies involving increases in any form of physical activity are necessary. The high attendance rate indicated the participants and their parents were accepting of yoga as an aid for weight loss. Other

Table 2 Past medical history of participants, Ashtanga Yoga for Youth, McAllen, Texas, May–August 2006.

Acanthosis Nigricans	3 (21.4)
Allergic rhinitis	5 (35.7)
Asthma	3 (21.4)
Headaches	3 (21.4)
Dyslipidemia	2 (14.3)

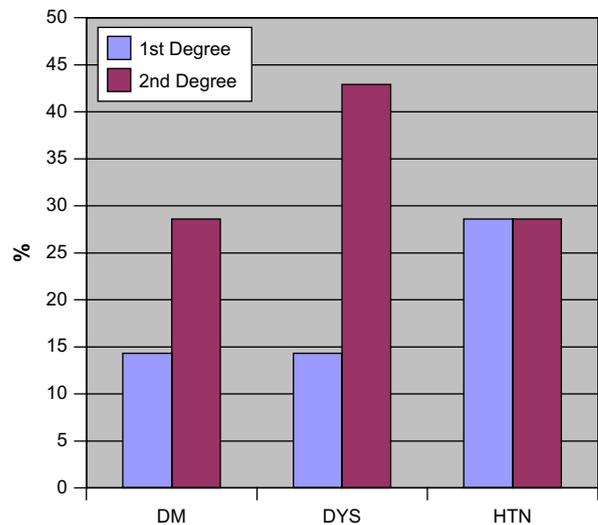


Fig. 2. % of children with first and second-degree relative with diabetes, dyslipidemia, and hypertension at time of enrollment, Ashtanga Yoga for Youth, McAllen, Texas, May–August 2006; DM = diabetes mellitus, DYS = dyslipidemia, HTN = hypertension.

studies of physical activity in children or adolescents have reported similar attrition rates anywhere from 10% to 45%.¹⁰

The weight loss found in this study is consistent with goals for weight loss in children and adolescents of one kg per month.¹¹ Seven clinical trials involving physical activity found either modest significant differences in weight or BMI similar to the weight loss we found in our study, or no differences at all.^{10,12} The most weight loss reported by these studies was 5.9 kg in a three month trial, with a subsequent 9.9 kg loss after 15 months.¹³ Another study found a sustained decrease in BMI of 1.7 kg/m² (although with an increase in weight) versus control over 12 months.¹² Most of these studies, however, incorporated lifestyle modifications in addition to physical activity whereas this yoga study focused entirely on physical activity. A study evaluating the effect of Pilates on overweight adolescent females found a decrease in the mean weight of 0.5 kg after a four week program.¹⁴ The higher rates of weight loss found in our study could be attributed to the increase aerobic activity of Ashtanga yoga.

While overall improvements in self-concept were seen in six participants, three patients had improvements in symptoms of depression and anxiety decreased in both participants with elevated anxiety. One parent also commented to the PI that the program not only gave her daughter a way to loose weight, but provided her confidence. The positive outcomes may be due to the calming effects produced by yoga. One study in adolescents children with irritable bowel syndrome (IBS) demonstrated lower anxiety after 4 weeks of recorded Hatha yoga practice at home compared to a control group.¹⁵ Another study evaluated the use of

Table 3 Baseline laboratory parameters, Ashtanga Yoga for Youth, McAllen, Texas, May–August 2006.

Laboratory Parameter	Normal values	Baseline values (mean ± SD)
Glucose (mg/dL)	80–120	86.4 ± 10.1
Total cholesterol (mg/dL)	<200	168 ± 30.5
LDL (mg/dL)	<130	91.0 ± 21.9
HDL (mg/dL)	>35	51.0 ± 11.9
TG (mg/dL)	<200	132.4 ± 59.7
CRP (mg/dL)	<3	1.0 ± 2.1

LDL = low density lipoprotein; HDL = high density lipoprotein; TG = triglycerides; CRP = C-reactive protein.

Table 4

Individual participants initial, final, and changes in self-concept, anxiety, and depression scores, Ashtanga Yoga for Youth, McAllen, Texas, May–August 2006.

Patient	Baseline BSCI-Y	Final BSCI-Y	Self-Concept Change	Baseline BAI-Y	Final BAI-Y	Anxiety Change	Baseline BDI-Y	Final BDI-Y	Depression Change
1	Average	Above Average	Improved	Average	Average	No Change	Average	Average	No Change
2	Average	Lower than Average	Worsened	Average	Average	No Change	Average	Average	No Change
3	Above Average	Above Average	No Change	Average	Average	No Change	Average	Average	No Change
4	Lower than Average	Above Average	Improved	Average	Average	No Change	Average	Average	No Change
5	Much Lower than Average	Much Lower than Average	No Change	Average	Average	No Change	Average	Mildly Elevated	Worsened
6	Average	Average	No Change	Average	Average	No Change	Average	Average	No Change
7	Average	Lower than Average	Worsened	Average	Average	No Change	Average	Mildly Elevated	Worsened
8	Above Average	Above Average	No Change	Average	Average	No Change	Average	Average	No Change
9	Average	Above Average	Improved	Average	Average	No Change	Average	Average	No Change
10	Lower than Average	Average	Improved	Mildly Elevated	Average	Improved	Mildly Elevated	Average	Improved
11	Much Lower than Average	Average	Improved	Extremely Elevated	Mildly Elevated	Improved	Extremely Elevated	Mildly Elevated	Improved
12	Average	Average	No Change	Average	Average	No Change	Average	Average	No Change
13	Average	Average	No Change	Average	Average	No Change	Average	Average	No Change
14	Lower than Average	Average	Improved	Average	Average	No Change	Moderately Elevated	Mildly Elevated	Improved

Abbreviations: BSCI-Y = Beck Self-Concept Inventory-Youth; BAI-Y = Beck Anxiety Inventory-Youth; BDI-Y = Beck Depression Inventory-Youth.

Sahaja yoga in adolescents with attention deficit hyperactivity disorder (ADHD).¹⁶ After six weeks, the predominantly male participants demonstrated lower rates of anxiety, felt more relaxed, and had higher self-esteem. However, both trials also differ from our study in population demographics (e.g., race, gender, diagnosed psychiatric/physical illness), length of the studies, and style of yoga.

Even though improvements in self-concept, anxiety, and/or depression were seen in six participants, three participants had worsening in self-concept and/or depression. We believe reasons for a decrease in self-esteem or increase in depressive symptoms in these children may be a result of the humbling experience by yoga practice. Some of the participants may have realized that they could not achieve certain poses or progressed slower when compared to their peers. As a result, this may have led them to have a decreased perception of their capabilities. However, it is possible that with additional yoga practices, participants may be able to improve their poses while being more able to accept their limitations. Of note, none experienced an increase in anxiety, suggesting this form of yoga practice may increase self-concept by improving anxiety more so than depressive symptoms.

4.1. Study limitations and strengths

The limitations of our study include a small sample size and lack of control group. Additionally, the length of the study limits the ability to fully evaluate the maintenance of weight loss and measure long-term outcomes. Another limitation is the few biochemical parameters assessed in the study. Ideally, insulin concentrations, and oral glucose tolerance tests would provide a better assessment of the participant's risk factor for pre-diabetes and subsequent type 2 diabetes. Although not recommended by the American Academy of Pediatrics at this time, measuring other anthropometric parameters, such as waist circumference and skin fold thickness, may also be beneficial to determine whether or not there is a decrease in fat mass.¹⁷ Future studies may also measure arterial endothelial dysfunction, as it is associated with overweight in pediatrics.¹⁸ Also, although six participants demonstrated baseline symptoms of depression, anxiety, and/or decreased self-concept, none of the patients had a diagnosed psychiatric illness. As a result, it is difficult to determine if Ashtanga yoga may benefit patients with diagnosed psychiatric illnesses. However, our study is the first performed in predominantly Hispanic population with limited access to yoga and overall results were positive. With future studies, we can incorporate a control group, increase the sample

size, examine additional biological markers, and increase the duration of the yoga program.

5. Conclusion

Yoga may be an alternative for weight loss in children and adolescents. Most participants lost an average of 2 kg after a 12-week program which is consistent with other weight loss interventions. Also, participants demonstrated improvements in psychiatric inventories, suggesting Ashtanga yoga may provide mental health benefits. As a result, larger control studies are necessary to fully determine the short- and long-term benefits of yoga in children and adolescents. At this time, a curriculum of yoga in children, YogaEd, has been developed and is incorporated in schools across the nation. Such programs should be beneficial in this population.

Conflict of interest

Neither of the authors has any financial or personal conflicts of interests to disclose.

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References

- Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999–2002. *JAMA* 2004;**291**:2847–50.
- Forrest KY, Leeds MJ. Prevalence and associated factors of overweight among Mexican-American adolescents. *J Am Diet Assoc* 2007;**107**:1797–800.
- Anderson SE, Cohen P, Naumova EN, Jacques PF, Must A. Adolescent obesity and risk for subsequent major depressive disorder and anxiety disorder: prospective evidence. *Psychosom Med* 2007;**69**:740–7.

4. Allen KL, Byrne SM, Blair EM, Davis EA. Why do some overweight children experience psychological problems? The role of weight and shape concern. *Int J Pediatr Obes* 2006;**1**:239–47.
5. Janicke DM, Marciel KK, Ingerski LM, Novoa W, Lowry KW, Sallinen Bj, et al. Impact of psychosocial factors on quality of life in overweight youth. *Obesity (Silver Spring)* 2007;**15**:1799–807.
6. Beck BA, Jolly JB, Steer RA. *Beck youth inventories for children and adolescents: manual*. San Antonio, TX: Harcourt Assessment; 2005.
7. Innes KE, Bourguignon C, Taylor AG. Risk indices associated with the insulin resistance syndrome, cardiovascular disease, and possible protection with yoga: a systematic review. *J Am Board Fam Pract* 2005;**18**:491–519.
8. Lindberg NM, Stevens VJ. Review: weight-loss interventions with Hispanic populations. *Ethn Dis* 2007;**17**:397–402.
9. Byrd-Williams C, Kelly LA, Davis JN, Spruijt-Metz D, Goran MI. Influence of gender, BMI and Hispanic ethnicity on physical activity in children. *Int J Pediatr Obes* 2007;**2**:159–66.
10. Stuart WP, Broome ME, Smith BA, Weaver M. An integrative review of interventions for adolescent weight loss. *J Sch Nurs* 2005;**21**:77–85.
11. Spear BA, Ervin C, Ludwig DS, Saelens BE, Schetzina KE, Taveras EM. Recommendations for treatment of child and adolescent overweight and obesity. *Pediatrics* 2007;**120**:S254–88.
12. Savoye M, Shaw M, Dziura J, Tamborlane WV, Rose P, Guandalini C, et al. Effects of a weight management program on body composition and metabolic parameters in overweight children: a randomized controlled trial. *JAMA* 2007;**297**:2697–704.
13. Mellin LM, Slinkard LA, Irwin Jr CE. Adolescent obesity intervention: validation of the SHAPEDOWN program. *J Am Diet Assoc* 1987;**87**:333–8.
14. Jago R, Jonker ML, Missaghian M, Baranowski T. Effect of 4 weeks of Pilates on the body composition of young girls. *Prev Med* 2006;**42**:177–80.
15. Kuttner L, Chambers CT, Hardial J, Isreal DM, Jacobson K, Evans K. A randomized trial of yoga for adolescents with irritable bowel syndrome. *Pain Res Manag* 2006;**11**:217–23.
16. Harrison Lj, Manocha R, Rubia K. Sahaja yoga meditation as a family treatment programme for children with attention deficit-hyperactivity disorder. *Clin Child Psychol Psychiatry* 2004;**9**:479–97.
17. Barlow S. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity. *Pediatrics* 2007;**120**:S164–92.
18. Woo KS, Chook P, Yu CW, Sung RY, Qiao M, Leung SS, et al. Overweight in children is associated with arterial endothelial dysfunction and intima-media thickening. *Int J Obes Relat Metab Disord* 2004;**28**:852–7.