Yoga Training Improves Metabolic Parameters in Obese Boys

Dae Yun Seo
SungRyul Lee
Arturo Figueroa
Hyoung Kyu Kim
Yeong Ho Baek

See next page for additional authors

Follow this and additional works at: https://digitalcommons.unomaha.edu/hperfacpub

Part of the Health and Physical Education Commons, and the Kinesiology Commons

Please take our feedback survey at: https://unomaha.az1.qualtrics.com/jfe/form/SV_8cchtFmpDyGfBLE
Authors
Dae Yun Seo, SungRyul Lee, Arturo Figueroa, Hyoung Kyu Kim, Yeong Ho Baek, Yi Sub Kwak, Nari Kim, Tae Hoon Choi, Byoung Doo Rhee, Kyung-Soo Kim, Byung Joo Park, Song-young Park, and Jin Han
Yoga Training Improves Metabolic Parameters in Obese Boys

Dae Yun Seo¹, SungRyul Lee¹, Arturo Figueroa², Hyoung Kyu Kim¹, Yeong Ho Baek³, Yi Sub Kwak⁴, Nari Kim¹, Tae Hoon Choi¹, Byoung Doo Rhee¹,², Kyung Soo Ko⁴,⁵, Byung Joo Park¹, Song Young Park¹, and Jin Han¹

¹National Research Laboratory for Mitochondrial Signaling, Department of Physiology, College of Medicine, Cardiovascular and Metabolic Disease Center, Inje University, Busan 614-735, Korea, ²Department of Nutrition, Food and Exercise Sciences, College of Human Sciences, Florida State University, Tallahassee, FL 32306, USA, ³Department of Physical Education, Pusan National University, Busan 609-735, ⁴Department of Physical Education, Dong-Eui University, Busan 614-714, ⁵Department of Sport and Leisure Studies, Andong Science College, Andong 760-790, ⁶Department of Internal Medicine, College of Medicine, Inje University, Seoul 100-032, ⁷Division of Leisure & Sports Science, Dong Seo University, Busan 617-716, Korea

Abstract

Yoga has been known to have stimulatory or inhibitory effects on the metabolic parameters and to be uncomplicated therapy for obesity. The purpose of the present study was to test the effect of an 8-week of yoga-asana training on body composition, lipid profile, and insulin resistance (IR) in obese adolescent boys. Twenty volunteers with body mass index (BMI) greater than the 95th percentile were randomly assigned to yoga (age 14.7±0.5 years, n=10) and control groups (age 14.6±1.0 years, n=10). The yoga group performed exercises three times per week at 40 ~ 60% of heart-rate reserve (HRR) for 8 weeks. IR was determined with the homeostasis model assessment of insulin resistance (HOMA-IR). After yoga training, body weight, BMI, fat mass (FM), and body fat % (BF %) were significantly decreased, and fat-free mass and basal metabolic rate were significantly increased than baseline values. FM and BF % were significantly improved in the yoga group compared with the control group (p<0.05). Total cholesterol (TC) was significantly decreased in the yoga group (p<0.01). HDL-cholesterol was decreased in both groups (p<0.05). No significant changes were observed between or within groups for triglycerides, LDL-cholesterol, glucose, insulin, and HOMA-IR. Our findings show that an 8-week of yoga training improves body composition and TC levels in obese adolescent boys, suggesting that yoga training may be effective in controlling some metabolic syndrome factors in obese adolescent boys.

Key Words: Yoga (asana), Obesity, Body composition, Lipid profile, HOMA-IR

INTRODUCTION

The primary cause of obesity is a chronic storage of excess energy [1], and physical inactivity is pivotal in its development [2]. The epidemic of obesity in adolescence has been expanded in the past several years [3]. Increases in body fat mass during adolescence may be related to the development and acceleration of cardiovascular risk factors [4], including hyperlipidemia [5], and insulin resistance [6]. Long-term insulin resistance may cause type 2 diabetes and a subsequent increase in morbidity and impaired glucose tol-

180, June, 2012

Accepted May 12, 2012

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/3.0) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Table 1. Baseline clinical characteristics of the study population

| Participants (n=20) |  |
|--------------------|---|
| Age (years)        | 14.65±0.74 |
| Height (cm)        | 164.28±8.39 |
| Weight (kg)        | 77.91±9.09 |
| BMI (kg/m²)        | 28.80±1.70 |
| Fat-free mass (kg) | 26.31±5.28 |
| Fat mass (kg)      | 30.01±4.58 |
| Body fat (%)       | 38.81±6.24 |
| BMR                | 1403.50±191.23 |

1All participants were Korean adolescent males recruited in Busan. 2 Values are presented as means±SEM. BMI, body mass index; BMR, basal metabolic rate.

Table 2. Design of the yoga-asana training protocol

| Time    | Contents (Intensity) | Type |
|---------|----------------------|------|
| 10 min  | Warm up              |      |
| 40 min  | Seated forward bend  | Type |
|         | Bound angle pose     |      |
|         | Wide angle seated forward bend |      |
|         | Stretches the lower back and the shoulders | |
|         | Weight over to the right foot, lifting the left foot off the floor | |
|         | Extended triangle pose | |
|         | Stretches legs and arms | |
|         | Bend from the hip joints to slowly lower toes to the floor above and beyond head | |
|         | Lie on back on the floor with knees bent, feet on the floor | |
|         | Lie on your belly with hands alongside torso, palms up | |
|         | Sit on the floor with knees bent, feet on the floor, and lean back onto forearms | |
| 10 min  | Relaxation           | Deep relaxation pose |

HRR, heart-rate reserve; RPE, rating of perceived exertion (RPE); THR, the targeted heart rate (intensity% ×(HRR+HRresting)).
Yoga Training Improves Metabolic Parameters

Introduction

The study included 20 Korean boys 14.7±0.7 years of age who were classified as obese (BMI 28.80±1.70 kg/m²). No significant differences in all parameters were found between groups at baseline (Table 1). Changes in body composition before and after 8 weeks the control and yoga groups are shown in Table 3. Body weight and BMI significantly (p<0.05) decreased after yoga training but not after the control period. FM was significantly (p<0.05) decreased with yoga training and control period, but the change was significantly (p<0.05) greater in the yoga group. BF % decreased with yoga training by 4.3% compared with no significant decrease in the control group. BMR was increased in the yoga training group by 44 kcal/day but there was no significant change in the control group.

The changes in blood lipids, glucose, and insulin in both groups are shown in Table 4. The lipid profile, glucose, and insulin were normal range in all participants before and after the study. TC was significantly (p<0.01) decreased in the yoga group. TG was not significantly decreased in the yoga group. LDLc was slightly increased and HDLc was decreased in the control and yoga groups (p<0.05). No significant changes were found in glucose, insulin, and HOMA-IR in both groups. The change in glucose, insulin, and HOMA-IR was less in the yoga group than the control group.

Table 3. Changes in body composition following an 8-week yoga-asana training

| Measure                  | Control (n=10) | Yoga (n=10) | p-valuea |
|-------------------------|---------------|-------------|----------|
| Age (years)             | 14.60±0.96†   | 14.70±0.48  |          |
| Height (cm)             | 165.19±10.33  | 163.85±6.34 |          |
| Weight (kg)             | 79.43±10.83   | 78.13±10.44 | 1.30     |
| BMI (kg/m²)             | 29.04±2.11    | 29.57±2.97  | 0.53     |
| Fat-free mass (kg)      | 27.51±5.92    | 28.06±5.79  | 0.55     |
| Fat mass (kg)           | 29.65±4.86    | 27.58±5.29** | 2.07     |
| Body fat (%)            | 37.65±6.49    | 36.15±6.55  | 1.50     |
| BMR (kcal/day)          | 1443.20±216.52| 1459.10±205.51| 15.90    |

1Values are presented as mean±SEM. 2Control versus Yoga group. Diff, post value−pre value; BMI, body mass index; BMR, basal metabolic rate. *p<0.05, pre value vs post value; **p<0.01, pre value vs post value; ***p<0.001, pre value vs post value.
DISCUSSION

The present study was designed to determine the impact of an 8-week of yoga-asana training on body composition, lipid profile, and insulin resistance in obese adolescent males. We studied adolescent boys because males are typically unfamiliar with yoga and most have not explored the benefits of yoga training. The major finding of the present study was that an 8-week of yoga-asana training improved body weight, BMI, FM, BF %, FFM, BMR, and TC compared to baseline values in obese adolescent boys.

The physiological effects of yoga training that have been previously reported include the inhibition of body weight gain, reductions in cholesterol levels, and blood pressure, and improvement in immune function as well as beneficial psychological effects [34-39]. In the study, our subjects participated in less physical activities than their non-obese peers during school days and at weekends, and their physical activity during the evenings and weekends was much lower than that during school days. Home- and family-based physical activity that can be performed alone may be the best way to increase energy consumption in obese adolescents because they are less likely to participate in group physical activities [24]. Although the obese person do not participate in dynamic exercise programs, they can participate in static exercise program, such as pilates exercise [40].

Body weight is a main metabolic syndrome factor [41]. Weight loss is related to the reduction in the risk for diabetes and cardiovascular disease through improvements in blood pressure, TG, and HDLc in obese subjects [42,43]. In the present study, the small body weight loss observed after yoga training is explained by the combined decrease in FM and the increase in FFM. Consistent with our findings, similar increase in FFM have been reported after 8 weeks of resistance exercise training in obese and lean adolescent [44,45] and Benavides and Caballero [46] reported that yoga training was a significantly decreased body weight in children. In contrast to our findings, 8 weeks of endurance exercise training did not show changes in body composition in obese adults [47]. The increase in FFM was a significant predictor for the decreases in body weight and FM [44]. Our findings of weight loss accompanied by reduced FM and increased FFM, major determinants of resting energy expenditure, indicate that yoga training is a potential adjunct treatment for obesity in adolescents. The decrease in body weight, BMI, FM, and BF % in the yoga group may have been related to an increase in FFM, and BMR following yoga training. In this context, yoga-asana training provides an alternative option for increasing the physical activity levels required to improve body composition and BMR in obese adolescents, as shown with conventional exercise training programs [48,49].

We did not observe a clear positive effect of yoga on blood lipids, with the exception of a decrease in TC. Cholesterol is a key contributor to the development of heart disease, stroke, and other vascular diseases [50]; thus, a reduction in TC following the yoga-asana training is a promising finding. Several studies have confirmed that the yoga training significantly increases HDLc and decreases TG, and LDLc [51-53]. It is well known that yoga training, which is alternative exercise training, provides health benefits. In the present study, however, a significant decrease in HDLc was observed in both the yoga and control groups. Although significant reductions in HDLc following a high-fiber, low-fat diet, and exercise intervention have been reported [54,55], the effect of lifestyle interventions on HDLc are controversial [56]. Our finding is similar to those of Sun et al. [56] who observed that a decrease in HDLc following exercise with dietary intervention in overweight adolescents. Moreover, decreases in TC and HDLc have been reported in the control group and after 12 weeks of resistance and aerobic exercise training in overweight and obese adults with type 2 diabetes [57]. Of note, improvement in HDLc is not observed after resistance exercise training in adolescents [44]. However, the mechanism for the decreased in HDLc is not clear, and the clinical relevance of this small reduction warrants further investigation. Because the adolescent period is highly metabolically active, it is possible that an unknown factor may have interfered with or masked the positive effects of yoga training on HDLc levels that has been demonstrated in previous studies.

Damodaran et al. [58] reported that 3 months of yoga training significantly decreased plasma glucose concentrations, whereas a study by Elder et al. [59] showed no significant impact of yoga training on glucose levels. Obese adolescents who participated in regular exercise had lower insulin levels and HOMA-IR than those who did not exercise regularly [50]. Our results showed no significant between or within the group differences in glucose, insulin,
Yoga Training Improves Metabolic Parameters

This study was supported by Priority Research Centers Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2010-0020224).

REFERENCES

1. Goran MI, Treuth MS. Energy expenditure, physical activity, and obesity in children. Pediatr Clin North Am. 2001;48:931-953.
2. Kennedy RL, Chokkalingham K, Srinivasan R. Obesity in the elderly: who should we be treating, and why, and how? Curr Opin Clin Nutr Metab Care. 2004;7:3-9.
3. Quak SH, Furnes R, Lavine J, Baur LA. Obesity Working Group. Obesity in children and adolescents. J Pediatr. 2003;142:368-372.
4. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. Pediatrics. 1999;103:1175-1182.
5. Kavey RE, Daniels SR, Lauer RM, Atkins DL, Hayman LL, Taubert K. American Heart Association. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. J Pediatr. 2003;142:368-372.
6. Caseres M, Teran CG, Rodriguez S, Medina M. Prevalence of insulin resistance and its association with metabolic syndrome criteria among Bolivian children and adolescents with obesity. BMC Pediatr. 2008;8:31.
7. Fogt-Campagna A, Pettitt DJ, Engelgau MM, Burrows NR, Geiss LS, Valdez R, Beckles GL, Saadidine J, Gregg EW, Williamson DF, Narayan KM. Type 2 diabetes among North American children and adolescents: an epidemiologic review and a public health perspective. J Pediatr. 2000;136:664-672.
8. Steinberger J, Daniels SR; American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee (Council on Cardiovascular Disease in the Young); American Heart Association Diabetes Committee (Council on Nutrition, Physical Activity, and Metabolism). Obesity, insulin resistance, diabetes, and cardiovascular risk in children: an American Heart Association scientific statement from the Atherosclerosis, Hypertension, and Obesity in the Young Committee (Council on Cardiovascular Disease in the Young) and the Diabetes Committee (Council on Nutrition, Physical Activity, and Metabolism). Circulation. 2003;107:1448-1453.
9. See E, Park EJ, Park MK, Kim DK, Lee HJ, Hong SH. Differential expression of metabolism-related genes in liver of diabetic obese rats. Korean J Physiol Pharmacol. 2010;14:99-103.
10. Tzotzas T, Evangelou P, Kiortsis DS. Obesity, weight loss and conditional cardiovascular risk factors. Obes Rev. 2011;12:e282-289.
11. Jayasinghe SR. Yoga in cardiac health (a review). Eur J Cardiovasc Prev Rehabil. 2004;11:369-375.
12. Vaze N, Joshi S. Yoga and menopausal transition. J Midlife Health. 2010;1:56-58.
13. Collins C. Yoga: intuition, preventive medicine, and treatment. J Obest Gynecol Neonatal Nurs. 1998;27:563-568.
14. Birdie GS, Legedza AT, Super RB, Bertisch SM, Eisenberg DM, Phillips RS. Characteristics of yoga users: results of a national survey. J Gen Intern Med. 2008;23:1653-1658.
15. Innes KE, Selfe TK, Taylor AG. Menopause, the metabolic syndrome, and mind-body therapies. Menopause. 2008;15:1005-1013.
16. Pollen PR, Nagamia SH, Mehta PK, Thompson WR, Benardot D, Hammond R, Parrott JM, Sola S, Khan BV. Effects of yoga on inflammation and exercise capacity in patients with chronic heart failure. J Card Fail. 2008;14:407-413.
17. Vempati RF, Telles S. Yoga-based guided relaxation reduces sympathetic activity judged from baseline levels. Psychol Rep. 2002;90:487-494.
18. Menshikova EV, RitoV VB, Toledo FG, Ferrell RE, Goodpaster BH, Kelley DE. Effects of weight loss and physical activity on skeletal muscle mitochondrial function in obesity. Am J Physiol Endocrinol Metab. 2005;288:E18-20.
19. Weyer C, Linkeschowa R, Heise T, Giesen HT, Spraul M. Implications of the traditional and the new ACSM physical activity recommendations on weight reduction in dietary treated obese subjects. Int J Obes Relat Metab Disord. 1998;22:1071-1078.
20. Church T. Exercise in obesity, metabolic syndrome, and diabetes. Prog Cardiovasc Dis. 2011;53:412-418.
21. Ross R, Després JP. Abdominal obesity, insulin resistance, and the metabolic syndrome: contribution of physical activity/exercise. Obesity (Silver Spring). 2009;17 Suppl 3:S1-2.
22. Buemann B, Tremblay A. Effects of exercise training on abdominal obesity and related metabolic complications. Sports Med. 1996;21:191-212.
23. Shubair MM, Koldis J, McKeilbe RS, Arthur HM, Sharma AM. Metabolic profile and exercise capacity outcomes: their relationship to overweight and obesity in a Canadian cardiac rehabilitation setting. J Cardiopulm Rehabil. 2004;24:403-413.
24. Page A, Cooper AR, Stamatikas E, Foster LA, Crowne EC, Sabin M, Shield JP. Physical activity patterns in nonobese and obese children assessed using minute-by-minute accelerometry. Int J Obes (Lond). 2005;29:1070-1076.
25. Hagnás M, Moore W, Rundle A. Does practicing hatha yoga satisfy recommendations for intensity of physical activity which improves and maintains health and cardiovascular fitness? BMC Complement Altern Med. 2007;7:40.
26. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000;320:1240-1243.
McGuigan MR, Tatasciore M, Newton RU, Pettigrew S. Eight weeks of resistance training can significantly alter body composition in children who are overweight or obese. J Strength Cond Res. 2009;23:80-85.

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;15:110-114.

Vogelsang TW, Hanel B, Kristoffersen US, Petersen CL, Melshen J, Holmquist N, Larsson B, Kjaer A. Effect of eight weeks of endurance exercise training on right and left ventricular volume and mass in untrained obese subjects: a longitudinal MRI study. Scand J Med Sci Sports. 2008;18:354-359.

Wong PC, Chia MY, Tsou IW, Wannaiheong GK, Tan B, Wang JC, Tan J, Kim CG, Bøg H, Lim D. Effects of a 12-week exercise training programme on aerobic fitness, body composition, blood lipids and C-reactive protein in adolescents with obesity. Ann Med Surg (Tokyo). 2008;7:286-290.

Szentz DC, Duscha BD, Johnson J, Ketchum K, Aiken LB, Samson GP, Houmard JA, Bales CW, Kraus WE. Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRRIDE—a randomized controlled study. Arch Intern Med. 2004;164:31-38.

Levine GN, Keaney JF Jr, Vita JA. Cholesterol reduction in cardiovascular disease. Clinical benefits and possible mechanisms. N Engl J Med. 1995;332:512-521.

Mahajan AS, Reddy KS, Sachdeva U. Lipid profile of coronary risk subjects following yoga lifestyle intervention. Indian Heart J. 1999;51:37-40.

Manchanda SC, Narang R, Reddy KS, Sachdeva U, Prabhakaran D, Dharmansad H, Rajani M, Brijlari R. Retardation of coronary atherosclerosis with yoga lifestyle intervention. J Assoc Physicians India. 2000;48:87-894.

Bijlani RL, Vempati RP, Yadav RK, Roy RB, Gupta V, Sharma R, Mehta N, Mahapatra SC. A brief but comprehensive lifestyle education program based on yoga reduces risk factors for cardiovascular disease and diabetes mellitus. J Altern Complement Med. 2005;11:267-274.

Roberts CK, Vaziri ND, Barnard ND. Effect of diet and exercise intervention on blood pressure, insulin, oxidative stress, and nitric oxide availability. Circulation. 2002;106:2530-2532.

Roberts CK, Won D, Pruthi S, Kurtovic S, Sindhu RK, Vaziri ND, Barnard ND. Effect of a short-term diet and exercise intervention on oxidative stress, inflammation, MMP-9, and monocyte chemoattractant activity in men with metabolic syndrome factors. J Appl Physiol. 2006;100:1657-1665.

Sun MX, Huang XQ, Yan Y, Li JW, Zhang WJ, Chen JF, Zhang YM, Wang ZZ, Wang L, Shi XC, Li J, Xie XM. One-hour after-school exercise ameliorates central adiposity and lipids in overweight Chinese adolescents: a randomized controlled trial. Chin Med J (Engl). 2011;124:929-932.

Jorge ML, de Oliveira VN, Resende NM, Paraiso LF, Calixto YM, Wang ZZ, Wang L, Shi XC, Li J, Xie XM. One-hour after-school exercise ameliorates central adiposity and lipids in overweight Chinese adolescents: a randomized controlled trial. Chin Med J (Engl). 2011;124:929-932.

Dumordaran A, Malathi A, Patil N, Shah N, Suryavanshi, Manathe S. Therapeutic potential of yoga practices in modifying cardiovascular risk profile in middle aged men and women. J Assoc Physicians India. 2002;50:633-640.

Elder C, Aickin M, Bauer V, Cairns J, Vuckovic N. Randomized trial of a whole-system ayurvedic protocol for type 2 diabetes. Altern Ther Health Med. 2006;12:24-30.

Balagopal P, George D, Patton N, Yarandi H, Roberts WL, Bayne E, Gidding S. Lifestyle-only intervention attenuates the inflammatory state associated with obesity: a randomized controlled study in adolescents. J Pediatr. 2005;146:342-348.

Salahy BK. Role of yoga in diabetes. J Assoc Physicians India. 2007;55:121-126.