

ABSTRACT

BACKGROUND:

Obesity in adolescents is a worldwide epidemic. Obesity is known to cause heart disease, diabetes, cancer and stroke, the top 4 causes of death. Overeating energy-dense, nutrient-poor foods and a sedentary lifestyle have led to an epidemic of obesity and type 2 diabetes all over the world. It is a global health problem. Apart from physical problems there are psychological issues which affect the health of the individual. Obesity can be described as a “New World Syndrome” causing an enormous socioeconomic and public health burden in developed, developing and in poor countries of the world. Yoga intervention module specially designed is known to reduce obesity & enhance psychological wellbeing.

AIMS:

To study the physiological, anthropometric and psychological changes of yoga practices of Integrated Approach of Yoga Therapy, IAYT in overweight and obese adolescents.

OBJECTIVE:

To study the effect of IAYT on adolescent obesity.

(11 to 17 years age group) with the help of :

- Anthropometric assessments
- Physiological assessments
- Bio chemical markers (Pilot study)
- Psychological assessments
- Cognitive assessments

METHODS:

Design: Randomised control trial

Setting: Schools in Pune, Maharashtra, India

Study one: Pilot study and study two: Main study.

Intervention: The intervention was (4 weeks for pilot study & 5 weeks for Main Study)

Yoga program (module specially designed for obesity and validated by *yoga* experts) 5 days a week comprising of breathing practices, loosening exercises, *asanas* (physical postures), *pranayama* (breathing practices), meditation, devotional sessions and counseling on concepts of philosophy of *yoga* like yogic counseling and happiness analysis. The control group was following normal activities like reading, singing, painting, craft, indoor games like chess etc. for 5 days a week for 60 minutes and also had dedicated and interactive sessions on lifestyle change. Both the groups were matched for time on intervention and attention.

In Study one (pilot study) 23 adolescents with obesity who consented were randomly assigned to receive *yoga* or normal activities if they satisfied the selection criteria, 14 in the *Yoga* group & 9 in the Control group. There were no drop outs as it was a residential program.

In study two (main study), 100 adolescents with obesity who were eligible, 53 subjects who consented were randomly assigned to receive *yoga* or normal activities as per the selection criteria., 25 in the *yoga* group & 28 in the control satisfied the selection criteria .

Outcome Measures: For study one (Pilot): The assessments were --

Socio demographic data

- Age
- Gender
- Educational standard

Anthropometric Assessments:

- Mid arm, waist, abdominal and hip circumference were obtained using a simple centimetre measuring tape
- Systolic and diastolic pressure (mm of Hg) were obtained using sphygmomanometer

Physiological & Bio Chemical Assessments

- Fasting blood sugar (FBS)
- Lipid profile- total cholesterol (mmol/l) , SR HDL., SR LDL, SR VLDL
- Triglycerides (mmol/l) HDL/ LDL ratio obtained through a lab test on blood sample by a lab technician.

Clinical Assessments

- Blood pressure
- Pulse rate
- Weight (kg)
- Height (cm)

Outcome measures: for study 2(main): The assessments were --

Socio demographic data

- Age
- Gender
- Educational standard

Anthropometric Assessments:

- Mid arm, waist, abdominal and hip circumference were obtained using a simple centimetre measuring tape
- Body composition using Melton body composition instrument
- Systolic and diastolic pressure (mm of Hg) were obtained using sphygmomanometer

Clinical Assessments

- Blood pressure
- Pulse rate
- Weight (kg)
- Height (cm)

Physical Fitness Test:

- Sit ups in standing position
- Flamingo balance test

BMI Parameters: Body composition using Melton body composition

- Total body fat percentage

- Resting metabolism
- Subcutaneous fat (whole body)
- Muscle percentage (whole body)
- Subcutaneous fat (arms)
- Muscle percentage (arms)
- Subcutaneous fat (trunk)
- Muscle percentage (trunk)
- Subcutaneous fat (legs)
- Muscle percentage (legs)

Psychological tests

- Body awareness questionnaire (BAQ)
- Child eating behavior questionnaire (CEBQ)
- Rosenberg self - esteem scale (RSES)

Cognitive tests

- Digit letter substitution test
- Six letter cancellation Test

Assessments were conducted on Pre (baseline) Post (after 4 weeks for Study one-Pilot & after 5 weeks for Study two-main) intervention.

Data collection was done and the qualified staff were available to provide unbiased guidance. All forms were thoroughly screened for completeness of responses. Results were analysed using SPSS software version 20.

RESULTS:

Study one: In the yoga group there is significant reduction in weight ($p = 0.000$), diastolic blood pressure ($p = 0.018$), fasting blood sugar ($p = 0.059$), very low density lipoprotein($p = 0.001$), serum triglycerides ($p = 0.001$), BMI ($p = 0.00$), pulse rate ($p = 0.03$), hip circumference ($p = 0.01$), serum total cholesterol ($p = 0.035$) after intervention. There is

significant increase in mid-arm circumference ($p = 0.01$). There is non-significant reduction in systolic blood pressure ($p = 0.08$), waist circumference ($p = 0.45$) & high-density lipoprotein ($p = 0.75$).

In the control group: There is significant reduction in high-density lipoprotein ($p = 0.15$), serum triglycerides ($p = 0.009$) & very low- density lipoprotein ($p = 0.009$). There is reduction in weight ($p = 0.634$), BMI ($p = 0.616$), systolic blood pressure ($p = 0.152$), diastolic blood pressure ($p = 0.055$), waist circumference ($p = 0.621$), fasting blood sugar ($p = 0.851$), serum total cholesterol ($p = 0.260$) & low- density lipoprotein ($p = 0.749$) but without significance. There is significant increase in mid arm circumference ($p = 0.015$). There is reduction in pulse rate ($p = 0.223$) & hip circumference ($p = 0.916$) but without significance.

Between yoga group & control group analysis:

Percentage of improvement (reduction) of weight & serum cholesterol, waist circumference, hip circumference, serum cholesterol, low- density lipoprotein, high- density lipoprotein is more in yoga group than that of control group. Percentage of improvement (reduction) of serum triglycerides & very low -density lipoprotein were more in control group than that of yoga group.

Study two: Main study:

In the yoga group, hip circumference ($p = 0.001$), total body fat percentage ($p = 0.001$), trunk subcutaneous fat ($p = 0.005$) and legs subcutaneous fat ($p = 0.03$) reduced significantly whereas abdominal circumference ($p = 0.376$) reduced but without significance. Trunk muscle percentage ($p = 0.021$) increased significantly. Waist circumference ($p = 0.553$) increased but without significance. Whole body muscle percentage ($p = 0.076$) and legs muscle percentage ($p = 0.187$) increased but without significance. Number of sit ups per minute ($p = 0.566$) decreased but without significance. Weight ($p = 0.018$), BMI ($p = 0.001$), whole body subcutaneous fat ($p = 0.01$), arm subcutaneous fat ($p = 0.021$) reduced significantly whereas systolic blood pressure ($p = 0.30$), diastolic blood pressure ($p = 0.087$) and mid arm circumference ($p = 0.474$) reduced but without significance. Muscle percentage of arms ($p = 0.042$) increased significantly whereas pulse rate ($p = 0.597$), Flamingo balance test ($p = 0.065$) increased but without significance.

Results of psychological assessment within group analysis of Yoga group are, BAQ (Body awareness questionnaire). RES (Rosenberg self-esteem scale, assessments of BAQ ($p = 0.29$))

and RES ($p = 0.35$) increased but without significance. Assessments of CEBQ- (child eating behavior questionnaire)–CEBQ-EF (enjoyment of food) ($p = 0.004$), CEBQ-EOE (emotional over-eating), ($p = 0.009$) and CEBQ-FR (food responsiveness) ($p = 0.001$) decreased with significance. Variables like CEBQ-SR (satiety responsiveness) ($p = 0.08$), CEBQ-SE (slowness in eating) ($p = 0.63$), CEBQ-DD DD (desire to drink) ($p = 0.64$), CEBQ-FF (food fussiness) ($p = 0.37$) and CEBQ-EUE (emotional under-eating) ($p = 0.35$) decreased but without significance.

Cognitive assessments like SLCT (six letter cancellation test) increased with significance ($p = 0.00$), DLST (digit letter substitution test) also increased with significance ($p = 0.00$).

In the Control group, Number of sit ups per minute ($p = 0.023$) decreased significantly whereas abdominal circumference ($p = 0.730$), hip circumference ($p = 0.226$), total body fat percentage ($p = 0.876$), trunk subcutaneous fat ($p = 0.186$) and legs subcutaneous fat ($p = 0.162$) reduced but without significance. Waist circumference ($p = 0.244$), trunk muscle percentage ($p = 0.427$) and legs muscle percentage ($p = 0.270$) increased but without significance. Systolic blood pressure ($p = 0.009$), diastolic blood pressure ($p = 0.004$) reduced significantly whereas pulse rate ($p = 0.435$), whole body subcutaneous fat ($p = 0.250$), arm subcutaneous fat ($p = 0.319$) reduced but without significance. Weight ($p = 0.100$), BMI ($p = 0.914$), mid arm circumference ($p = 0.246$), resting metabolism ($p = 0.198$), whole body muscle percentage ($p = 0.290$) and Flamingo balance test ($p = 0.241$) increased but without significance.

Results of psychological assessments within group analysis of control group are BAQ (body awareness questionnaire), assessments BAQ ($p = 0.14$), CEBQ - EOE ($p = 0.08$), CEBQ - SE ($p = 0.09$) decreased but without significance. Variables like RES ($p = 0.04$) and CEBQ - SR ($p = 0.03$) increased with significance. Variables like CEBQ - EF ($p = 0.04$), CEBQ - DD ($p = 0.01$), CEBQ - FF ($p = 0.02$), CEBQ - EUE ($p = 0.01$) and CEBQ - FR ($p = 0.001$) decreased with significance.

Cognitive assessments, SLCT increased but without significance ($p = <0.0371$) & DLST which also increased but without significance ($p = 0.607$).

Analysis of between groups yoga and control shows that abdominal circumference of yoga group decreased significantly than that of control group ($p = 0.05$). Weight, BMI, mid-arm circumference, hip circumference, total body fat percentage, subcutaneous fat of whole body, arm, trunk and legs has been reduced more in yoga group than that of control group but without

significance. Number of sit ups, systolic blood pressure and diastolic blood pressure decreased in control group more than that of yoga group but without significance. Pulse rate is found to be increased in yoga group whereas that of control group is reduced but without significance. Waist circumference is increased more in control group than that of yoga group but without significance. Resting metabolism, muscle percentage of whole body, arm, trunk and legs are increased more in yoga group than that of control group but without significance. Flamingo balance test has been increased more in control group than that of Yoga group but without significance.

Analysis of between yoga and control group shows that BAQ of yoga group is increased where as that of control group is increased but without significance ($p = 0.07$). RES of yoga group has increased where as that of control group is also increased but without significance ($p = 0.28$). CEBQ –EF of yoga group is decreased where as that of control group is decreased but without significance ($p = 0.51$). CEBQ –EOE of yoga group is decreased where as that of control group is also decreased but without significance ($p = 0.43$). CEBQ –SR of yoga group is decreased where as that of control group is increased but with significance ($p = 0.007$). CEBQ –SE of yoga group is decreased where as that of control group is also decreased but without significance ($p = 0.38$). CEBQ –DD of yoga group is decreased where as that of control group is also decreased but without significance ($p = 0.96$). CEBQ –FF of yoga group is decreased where as that of control group is also decreased but without significance ($p = 0.40$). CEBQ –EUE of yoga group is decreased where as that of control group is also decreased but without significance ($p = 0.50$). CEBQ –FR of yoga group is decreased where as that of control group is also decreased but without significance ($p = 0.30$).

Analysis of in between Yoga and control group of cognitive assessments shows that DLST of Yoga group is increased than that of Control group but without significance ($p = 0.60$). SLCT of yoga group is increased than that of control group with significance ($p = <0.001$).

CONCLUSION:

The daily practice of IAYT of 60 minutes in school is useful in managing adolescent obesity. Yoga based intervention is effective to reduce obesity in adolescent children with respect to anthropometric, physical, psychological & cognitive assessments. This study provides evidence to prove efficacy of yoga to manage increased subcutaneous adiposity in trunk, hip and leg region resulting in weight reduction in adolescent children. Abdominal circumference is reduced significantly in yoga group. It is effective in management of weight, serum

triglycerides & very low - density lipoprotein, hip circumference & serum cholesterol. Emotional over eating, enjoyment of food, desire to drink, food fussiness, and satiety responsiveness reduced in the yoga group compared to control. The perception of bodily awareness has increased in the Yoga group. In the Yoga group good concentration, memory and attention were reported. Yoga improves emotional wellbeing in children. Yoga had been reported to have shown the beneficial effects on different psycho-physiological variables. Yoga group has improved better than control group with integrated approach of yoga therapy.

Key words: Yoga Module, obesity, body mass index, abdominal obesity, subcutaneous fat.