Original Article

DOI: 10.7860/JCDR/2024/71173.19671

Effectiveness of Nurse-led Yoga Intervention on Body Composition and Biochemical Parameters in Overweight and Obese Adolescents: A Pilot Study

Nursing Section

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ABSTRACT

Introduction: Obesity in children has been on the rise globally, and India is no exception. Rapid urbanisation, changing dietary patterns, and sedentary lifestyles are contributing factors to this alarming trend. Understanding the prevalence and factors associated with childhood obesity in urban areas is crucial for developing targeted interventions and public health strategies.

Aim: To investigate the effects of a nurse-led yoga intervention on body composition and biochemical parameters in overweight and obese adolescents (11-13 years) in schools.

Materials and Methods: This pilot randomised controlled study used a true experimental study design, specifically the pretest and post-test control group design. Data collection was conducted in schools of Puducherry. A total of 18 overweight and obese adolescents, nine in the experimental group and nine in the control group, were included. The experimental group performed a nurse-led yoga intervention three times a week for 60 minutes for six months from March 2022 to August 2022. Study outcomes on body composition and biochemical parameters such as lipid profile, adiponectin, leptin, Apolipoprotein A, and Apolipoprotein B were measured at baseline and six months after the nurse-led yoga intervention. Data analysis was performed using Social Sciences Software {Statistical Package for the Social Sciences (SPSS) version 25.0}. Both descriptive and inferential statistical tests, such as the one-way Analysis of Variance (ANOVA) F-test, repeated measures ANOVA F-test, and paired t-test, were conducted.

Results: A significant difference was noted in fat percentage, water, intracellular fluid, extracellular fluid, and body fat mass index between the pretest and post-test ($p<0.05$), and no significant difference was observed in Basal Metabolic Rate (BMR) and fat-free mass index ($p>0.05$) in the experimental group. The nurse-led yoga intervention significantly improved Low-density Lipoproteins (LDL), Apolipoprotein A, and adiponectin levels; however, there were no significant differences in Fasting Blood Sugar (FBS), total cholesterol, High-density Lipoproteins (HDL), Apolipoprotein B, or LDL in the experimental group. The control group showed no significant difference between the pretest and post-test in FBS, total cholesterol, LDL, HDL, Apolipoprotein A, or Apolipoprotein B ($p>0.05$).

Conclusion: The nurse-led yoga intervention positively impacted body composition and biochemical indicators in overweight and obese adolescents.

Keywords: Apolipoprotein, Body mass index, Obesity

INTRODUCTION

Childhood obesity has become a significant public health concern globally [1]. As of 2022, approximately one in eight individuals worldwide is classified as obese, with rates doubling in adults and quadrupling in adolescents since 1990 [2]. In the United States, one in three adults and one in six children are obese [3]. India follows closely behind, with a high prevalence of childhood obesity, varying by region and gender [4].

The Coronavirus Disease 2019 (COVID-19) pandemic worsened obesity rates globally [5]. In Karnataka, 35.9% of children aged 11-17 are overweight, and 25.5% are obese [6]. Gender disparities exist, with significantly higher rates among girls in Chandigarh and Telangana [7,8]. In Puducherry in 2015, adolescents aged 10-18 years had a 14% prevalence of overweight and obesity. Urban and private school students had higher rates (14.8% and 18.7%, respectively) compared to rural and government school students (9.9% and 7%, respectively) [9]. A recent study in urban private schools found 18% of 11-14-year-olds affected compared to 6% in government schools in Puducherry [10].

Factors such as socio-economic shifts, urbanisation, lifestyle changes, and inadequate physical activity contribute to this epidemic [11]. Obesity arises from a combination of physiological, psychological, environmental, socio-economic, and hereditary factors [12]. Modifiable risk factors include high-calorie diets, sedentary lifestyles, inadequate sleep, and chronic stress [13]. Addressing childhood obesity requires comprehensive, community-driven approaches, including lifestyle changes, physical activity, nutritional education, and interventions such as yoga.

Yoga, rooted in ancient Indian tradition, is recognised for its holistic benefits on physical, mental, and emotional health [14]. Research has shown yoga's efficacy in improving strength, cardiovascular health, respiratory function, and metabolic rate, contributing to weight management and reducing cardiovascular risk factors [15]. Despite the growing interest in yoga, limited research [16,17] has explored its effects on specific body composition and metabolic parameters among overweight and obese adolescents.

The present study aimed to address this gap by investigating the impact of a nurse-led yoga intervention on body composition and biochemical parameters such as lipid profile, adiponectin, leptin, Apolipoprotein A, and Apolipoprotein B in overweight and obese adolescents. By assessing these parameters, the study seeks to provide valuable insights into the role of yoga in promoting holistic health and well-being among adolescents struggling with obesity.

MATERIALS AND METHODS

The present pilot Randomised Controlled Trial (RCT) employed a pretest and post-test control group design. Data collection was conducted in selected schools in Puducherry. One government and one private school were chosen and assigned using a coin toss, with

the private school as the experimental group and the government school as the control group. The schools were located within 13 km of Pondicherry Institute of Medical Science. Institutional Ethics Committee clearance (IRB- PIMS/Ph.D. (N)/19/24) was obtained from the College of Nursing, Pondicherry Institute of Medical Sciences. Data were collected from March 2022 to August 2022.

Inclusion criteria:

- Adolescents aged 11-13 years from urban government or private schools.
- Boys and girls with Body Mass Index (BMIs) above the 87th percentile in the new World Health Organisation (WHO) Body Mass Index (BMI) Charts [18].
- Parental consent was given and willing to participate.
- Attending school regularly.

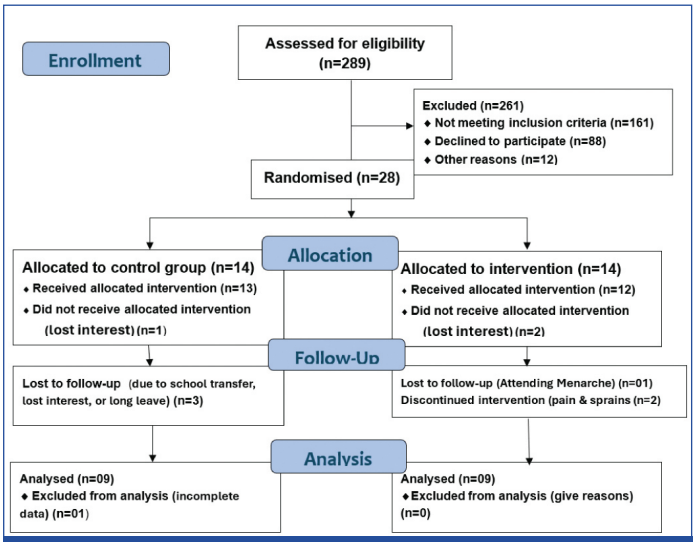
Exclusion criteria:

- Chronic medical problems.
- Physical or mental disabilities.
- Recent surgery (past six months).
- Regularly practicing yoga.
- On medication for weight management.

Sample size calculation: The sample size was calculated using the formula: $n=2(\sigma)^2 (Z\alpha+Z\beta)^2/d^2$. Utilising data from previous studies [19] with parameters: $\sigma=1.85$, $\alpha=1.96$, $\beta=1.28$, $d=1.0$, resulted in 72 adolescents per group. With 10% attrition, the calculated size was 79 per group. The pilot study was conducted with 10% of the total sample from the main study. A total of 18 overweight and obese adolescents, nine from each school in the experimental and control groups were included.

Study Procedure

A total of 289 male and female adolescents were screened for weight and height. Overweight and obesity were categorised using revised WHO BMI charts. Informed consent was obtained from parents, and assent was obtained from the adolescents. Schools were randomised into control and experimental groups using simple random sampling. The Consolidated Standards of Reporting Trials (CONSORT) flow diagram for enrollment of the study participants has been provided in [Table/Fig-1]. A total of 18 overweight and obese adolescents, nine from each school, were included. Pretests were conducted on body composition (free fat mass, fat percentage, total fat mass, cellular hydration status, and basal body metabolism) and biochemical parameters (lipid profile, fasting blood sugar, adiponectin, leptin, Apolipoprotein A, and Apolipoprotein B). Body composition was assessed using the Body Stat QuadScan 4000. Two electrodes were attached to the hand and leg. Anthropometric values, age, and activity level were entered into the instrument, which was calibrated before the test. For biochemical parameters, a trained phlebotomist collected a 5 mL fasting blood sample from the antecubital vein under a doctor's supervision. Breakfast was provided on both pre- and post-test days. The blood sample was tested for blood sugar, lipids, Apolipoprotein A and B, adiponectin, and leptin. The experimental group participated in a nurse-led yoga intervention three times a week for 60 minutes from 3 pm to 4 pm for six months under the investigator's supervision. Post-tests on body composition and biochemical parameters were conducted for both groups six months after the nurse-led yoga intervention [Table/Fig-2].



[Table/Fig-1]: CONSORT 2010 flow diagram.

Nurse-led yoga intervention: The experimental group took part in a yoga intervention programme led by a nurse. The programme consisted of practicing yoga three times a week for 60 minutes, from 3 pm to 4 pm, over six months, supervised by the investigators. During the program, the participants performed various asanas, following specific repetitions and time durations. The warm-up exercises included Surya Namaskar, standing, sitting, prone, and supine asanas. Additionally, the participants practiced Bhramari pranayama and Nadi Shodhana pranayama for three minutes each.

Outcome measure: The investigator assessed adolescent and family socio-demographic profiles using a 19-item self-structured questionnaire. The questionnaire was devised based on previous studies [20-22] by the investigator. The questionnaire achieved a Content Validity Index (CVI) score of 100%, except for monthly family income and parents' education (0.86), suggesting adherence to the Modified Kuppuswamy socio-economic scale.

STATISTICAL ANALYSIS

Data entry was conducted using Microsoft Excel, and analysis was performed using SPSS version 25.0 Descriptive statistics, including frequency, percentage distribution, mean, and standard deviation, were used to summarise the data. Inferential statistical tests, such as the one-way repeated measures ANOVA, paired t-test, and Pearson's correlation coefficient, were used to analyse the data.

RESULTS

A total of 289 male and female adolescents were screened for weight and height and categorised for obesity using revised WHO BMI charts for girls and boys. Among these, 113 (39.1%) had a normal BMI, 48 (16.6%) were underweight, 84 (29.1%) were overweight, and 44 (15.2%) were obese. Among them, 18 overweight and obese adolescents were included.

The experimental group had a higher proportion of overweight adolescents 5 (55.6%) compared to the control group 3 (33.3%). Conversely, the control group had more obese adolescents 6 (66.7%) compared to the experimental group 4 (44.4%). A total of 7 (77.8%) participants were either 12 or 13 years old, with slightly more 12-year-olds 4 (44.5%) in the experimental group and more 13-year-olds 6 (66.7%) in the control group. The majority were female in both groups [Table/Fig-2].

The study revealed that both groups predominantly belonged to nuclear families. All families in the experimental group lived in urban areas. All adolescents in the experimental group followed a non vegetarian diet, compared to the majority (8, 88.9%) in the control group. Most families in both groups had 5-6 or 2-4 members, with only a small percentage outside these ranges. Daily wages were the most common occupation for fathers, while mothers were predominantly employed as daily wage earners or were housewives. Both groups had a positive history of obesity [Table/Fig-3].

The prevalence of diabetes mellitus among fathers was notable in both groups. Additionally, the experimental group exhibited a higher prevalence of thyroid problems (2, 22.2%) among mothers, contrasting with a higher prevalence of asthma among mothers (2, 22.2%) and hypertension (1, 11.1%) among fathers in the control group [Table/Fig-4].

Demographic variables		Experimental group		Control group	
		Frequency	Percentage	Frequency	Percentage
Obesity classification	Overweight	5	55.6	3	33.3
	Obese	4	44.4	6	66.7
Age of the child	11 years	2	22.2	2	22.2
	12 years	4	44.5	1	11.1
	13 years	3	33.3	6	66.7
Birth order of the child	1	6	66.7	3	33.3
	2	3	33.3	3	33.3
	3	-	-	2	22.3
	4	-	-	1	11.1
Gender	Male	3	33.3	4	44.4
	Female	6	66.7	5	55.6
Number of siblings	0	2	22.2	1	11.2
	1	7	77.8	4	44.4
	≥2	-	-	4	44.4
Class studying	6th Std	2	22.2	1	11.1
	7th Std	2	22.2	1	11.1
	8th Std	5	55.6	7	77.8

[Table/Fig-2]: Frequency and percentage distribution of demographic profiles of overweight and obese adolescents in the experimental and control groups (N=18).

Family profile		Experimental group		Control group	
		Frequency	Percentage	Frequency	Percentage
Types of family	Nuclear family	8	88.9	7	77.8
	Joint family	1	11. 1	2	22.2
Size of the family	2-4	3	33.4	-	-
	5-6	4	44.4	3	33.3
	>7	2	22.2	6	66.7
Dietary pattern	Vegetarian	-	-	1	11.1
	Non-vegetarian	9	100.0	8	88.9
Area of residence	Rural	-	-	4	44.4
	Urban	9	100.0	5	55.6
Monthly income of the family	≥40,430	-	-	-	-
	20, 210-40, 429	2	22.2	3	33.3
	15, 160-20, 209	4	44.4	1	11.1
	10,110-15, 159	2	22.2	3	33.3
	6060-10,109	1	11.1	1	11.1
	2021-6059	-	-	1	11.1
	≤2020	-	-	-	-
Educational qualification of father	Graduate	-	-	-	-
	Diploma	1	11.1	3	33.33
	High school	8	88.9	1	11.1
	Middle school	-	-	2	22.2
	Primary school	-	-	-	-
	Illiterate	-	-	3	33.3
Father's occupation	Government	-	-	-	-
	Private	1	11.1	1	11.1
	Business	-	-	1	11.1
	Farmer	2	22.2	-	-
	Daily wages	6	66.7	7	77.8
	Unemployed	-	-	-	-
Educational qualification of mother	Graduate	4	44.4	-	-
	Intermediate or Diploma	-	-	-	-
	High school	4	44.4	7	77.8
	Middle school	-	-	-	-
	Primary school;	1	11.1	-	-
	Illiterate	-	-	2	22.2
Mother occupation	Government	-		-	-
	Private	2	22.2	1	11.1
	Business	0	-	-	-
	Farmer	0	-	-	-
	Daily wages	2	22.2	8	88.9
	Housewife	5	55.6	-	-
Family obesity history	Yes	9	100.0	8	88.9
	No	-	-	1	11.1
Number obese people in the family	1	5	55.6	6	75
	2	4	44.4	2	25

[Table/Fig-3]: Frequency and percentage distribution of family profiles in the experimental and control groups of overweight and obese adolescents (N=18).

Associated health problems		Experimental group		Control group	
		Frequency	Percentage	Frequency	Percentage
Associated health problems in mother	Hypertension	-	-	1	11.1
	Diabetes mellitus	-	-	-	-
	Thyroid problem	2	22.2	1	11.1
	Asthma	-	-	2	22.2
	None	7	77.8	5	55.6
Associated health problems with the father	Hypertension	-	-	1	11.1
	Diabetes mellitus	2	22.2	1	11.1
	Hypothyroidism	-	-	-	-
	Heart problem	-	-	1	11.1
	None	7	77.8	6	66.7

[Table/Fig-4]: Frequency and percentage distribution of the associated health problems among parents of overweight and obese adolescents in experimental and control groups (N=18).

The findings showed no significant differences in body composition between the experimental and control groups of overweight and obese adolescents before intervention, as indicated by the p-values ≥0.05 Non Significant (NS) [Table/Fig-5].

Body composition	Experimental group (Mean±SD)	Control group (Mean±SD)	't' value	p-value
Fat (%)	31.9±5.7	28.5±4.7	1.4	0.19
Water (%)	51.6±4.4	54.0±3.5	1.3	0.21
Extracellular fluid (%)	24.3±3.0	25.4±1.5	1.0	0.35
Intracellular fluid (%)	28.6±3.6	30.8±3.5	1.3	0.21
Basal metabolic rate	1561.0±317.2	1534.1±181.0	0.2	0.82
Body fat mass index	8.7±33.1	7.0±1.3	1.5	0.16
Fat-free mass index	17.9±2.5	17.5±1.4	0.45	0.65

[Table/Fig-5]: Comparison of pretest body composition in overweight and obese adolescents in the experimental and control groups (N=18).
p≥0.05 NS: Non significant; Student's independent t-test

The findings showed no significant differences in post-test body composition between the experimental and control groups of overweight and obese adolescents, as indicated by the p-values ≥0.05 (NS) [Table/Fig-6].

Body composition	Experimental group (Mean±SD)	Control group (Mean±SD)	't' value	p-value
Fat (%)	28.5±4.7	28.7±4.7	0.1	0.93
Water (%)	54.0±3.5	54.0±3.7	0.0	1.00
Extracellular fluid (%)	25.4±1.4	25.3±2.2	0.1	0.91
Intracellular fluid (%)	30.8±3.5	29.9±4.5	0.5	0.64
Basal metabolic rate	1534.1±181.0	1469.3±142.3	0.8	0.4
Body fat mass index	7.0±1.3	6.8±1.4	0.3	0.8
Fat-free mass index	17.5±1.4	16.8±0.8	1.3	0.22

[Table/Fig-6]: Comparison of post-test body composition in overweight and obese adolescents in the experimental and control groups.
p≥0.05; NS: Non significant; Students independent t-test

Before intervention, there were no significant differences in the pretest biochemical variables between the experimental and control groups (p>0.05) [Table/Fig-7].

Biochemical variables	Experimental group (Mean±SD)	Control group (Mean±SD)	't' value	p-value
Fasting blood sugar (mg/dL)	103.9±20.4	92.3±7.7	1.7	0.13
Total cholesterol (mg/dL)	165.9±22.7	165.0±27.0	0.08	0.94
Triglycerides (mg/dL)	107.1±19.9	123.0±86.8	0.5	0.60
High-density lipoprotein (mg/dL)	40.0±5.2	40.0±7.5	0.0	1.00
Low-density lipoprotein (mg/dL)	111.7±21.1	106.4±26.4	0.5	0.64
Apolipoprotein A (mg/dL)	115.9±29.4	121.3±27.7	0.6	0.52
Apolipoprotein B (mg/dL)	107.9±42.7	111.9±39.6	2.2	0.83
Leptin (ng/mL)	33.9±21.6	37.8±32.6	1.1	0.29
Adiponectin (ng/mL)	1.47±0.53	1.21±0.28	0.96	0.34

[Table/Fig-7]: Comparisons of pretest biochemical variables in the experimental and control groups of overweight and obese adolescents (N=18).
NS: Non significant; p>0.05; Students independent t-test

The findings showed no significant differences in post-test biochemical variables between the experimental and control groups of overweight and obese adolescents, as indicated by the p-values ≥0.05 (NS) [Table/Fig-8].

Biochemical variables	Experimental group (Mean±SD)	Control group (Mean±SD)	't' value	p-value
Fasting blood sugar (mg/dL)	92.3±7.7	85.3±9.7	1.7	0.11
Total cholesterol (mg/dL)	165.0±27.1	154.3±31.1	0.8	0.45
Triglycerides (mg/dL)	123.0±16.8	95.9±50.7	1.5	0.16
High-density lipoprotein (mg/dL)	40.0±7.5	38.0±7.1	0.581	0.57
Low-density lipoprotein (mg/dL)	106.4±26.4	102.3±27.1	0.3	0.75
Apolipoprotein A (mg/dL)	129.8±32.6	108.0±16.0	1.8	0.10
Apolipoprotein B (mg/dL)	115.9±29.4	126.2±21.9	0.8	0.41
Leptin (ng/mL)	35.7±28.5	44.2±21.6	0.713	0.49
Adiponectin (ng/mL)	1.86±0.18	1.73±1.89	0.205	0.84

[Table/Fig-8]: Comparison of post-test biochemical variables in overweight and obese adolescents in the experimental and control groups (n=18).
p≥0.05; NS: Non significant; Students independent t-test

In the experimental group, a significant decrease in the fat percentage and body fat mass index (p<0.05) and a significant increase in water, intracellular fluid, and extracellular fluid were observed post-intervention. However, no significant differences were observed in basal metabolic rate and fat-free mass index (p>0.05). No significant differences were noted in the control group when comparing parameters before and after intervention (p>0.05) [Table/Fig-9].

The pre- and post-test biochemical variables in overweight and obese adolescents in the experimental and control groups is displayed in [Table/Fig-10]. Nurse-led yoga intervention led to significant improvements in LDL (p=0.001), Apolipoprotein A (p=0.02), and adiponectin levels (p=0.04), while other variables showed no significant changes in the experimental group. No significant differences were found in the control group's biochemical variables.

DISCUSSION

Childhood obesity is a significant healthcare crisis, posing medical, behavioural, emotional, and psychological challenges for affected children. With the rising prevalence of overweight and obesity among children, there is an urgent need for public health interventions and increased awareness about obesity's health implications. Obesity during adolescence is particularly concerning due to its association with immediate and long-term health issues, including increased risks of diabetes, cancer, and Cardiovascular Diseases (CVDs) later in life [23].

The present study explored the impact of nurse-led yoga training on body composition and biochemical variables among overweight and obese adolescents, comparing outcomes between experimental and control groups. Our findings indicate that yoga practice significantly reduced fat percentage, water content, intracellular fluid, extracellular fluid, and body fat mass index. These results align with previous studies, such as Kumar D et al., which showed significant reductions in weight and body fat percentage in obese children following four months of yoga practice [7]. Another study by Bhaskar A and SM V found similar improvements in muscle strength, flexibility, and cardiorespiratory fitness, along with reductions in BMI, body fat percentage, and body fat mass [24]. N Nongkhai MP et al., conducted a 12-week study with 50-minute yoga sessions three times per week, demonstrating a decrease in body fat mass among female obese adolescents [25]. Conversely, another study found no significant changes in body fat percentage among obese female university students after a 12-week yoga intervention [26].

In this study, the nurse-led yoga intervention also led to significant decreases in LDL cholesterol and increases in Apolipoprotein A and adiponectin levels. Another study demonstrated that 12 weeks of yoga practice significantly improved High-density Lipoproteins (HDL), LDL, and total cholesterol levels in sedentary individuals [27]. Yadav R et al., found a significant increase in adiponectin levels after eight weeks of practice [28].

Body composition	Group	Pre-test Mean±SD	Post-test Mean±SD	MD	't' value	p-value
Fat (%)	Experimental group	31.9±5.7	28.5±4.7	3.4	4.8	0.001** (S)
	Control group	27.1±5.0	28.7±4.7	1.6	0.2	0.82
Water (%)	Experimental group	51.6±4.4	54.0±3.5	2.4	5.0	0.001** (S)
	Control group	55.3±4.0	54.0±3.7	1.3	0.0	0.97
Extracellular fluid (%)	Experimental group	24.3±3.0	25.4±1.4	1.1	3.9	0.01** (S)
	Control group	25.9±2.6	25.3±2.2	0.6	0.1	0.90
Intracellular fluid (%)	Experimental group	28.6±3.6	30.8±3.5	2.0	4.3	0.001** (S)
	Control group	30.2±3.9	29.9±4.5	0.3	0.7	0.51
Basal metabolic rate	Experimental group	1561.0±317.2	1534.1±181.0	26.9	1.7	0.13
	Control group	1492.3±265.0	1469.3±142.3	23.0	1.4	0.21
Body fat mass index	Experimental group	8.7±3.1	7.0±1.3	1.7	3.4	0.01** (S)
	Control group	6.8±2.3	6.8±1.4	0.0	0.6	0.56
Fat-free mass index	Experimental group	17.9±2.5	17.5±1.4	0.4	0.2	0.81
	Control group	17.7±2.1	16.8±0.8	0.9	1.7	0.13

[Table/Fig-9]: Comparison of pretest and post-test body composition among overweight and obese adolescents in the experimental and control groups (N=18).
S: Significant p≤0.001**; p≥0.05; Students paired t-test MD: Mean difference

Biochemical variables	Groups	Pre-test (mean±SD)	Post-test (mean±sd)	Mean difference	t-value	p-value
Fasting blood sugar (mg/dL)	Experimental group	103.9±20.4	92.3±7.7	11.6	2.1	0.08
	Control group	87.0±6.1	85.3±9.7	1.7	1.9	0.10
Total cholesterol (mg/dL)	Experimental group	165.9±22.7	165.0±27.1	0.9	1.4	0.21
	Control group	152.7±33.5	154.3±31.1	1.7	1.3	0.21
Triglycerides (mg/dL)	Experimental group	107.1±19.9	123.0±16.8	-15.9	0.1	0.91
	Control group	105.4±38.3	95.9±50.7	9.6	1.7	0.11
High-density lipoprotein (mg/dL)	Experimental group	40.0±5.2	40.0±7.5	0.0	0.9	0.37
	Control group	47.0±20.3	38.0±7.1	9.0	0.6	0.57
Low-density lipoprotein (mg/dL)	Experimental group	111.7±21.1	106.4±26.4	5.2	6.3	0.001** (S)
	Control group	96.1±44.7	102.3±27.1	-6.2	1.9	0.10
Apolipoprotein A (mg/dL)	Experimental group	115.9±29.4	129.8±32.6	13.9	2.4	0.02** (S)
	Control group	121.3±27.7	108.0±16.0	-7.9	0.7	0.51
Apolipoprotein B (mg/dL)	Experimental group	107.9±42.7	115.9±29.4	-4.0	0.8	0.44
	Control group	111.9±39.6	126.2±21.9	-14.3	1.95	0.08
Leptin (Ng/mL)	Experimental group	33.9±21.8	35.7±28.5	1.82	1.54	0.125
	Control group	37.8±32.6	44.2±21.6	-6.4	1.88	0.10
Adiponectin (ng/mL)	Experimental group	1.47±0.53	1.86±0.18	0.41	2.01	0.04** (S)
	Control group	1.21±0.28	1.73±1.89	0.52	1.90	0.06

[Table/Fig-10]: Comparisons of pretest and post-test biochemical variables in overweight and obese adolescents in the experimental and control groups (N=18).
S: Significant p≤0.05**; p≥0.05; MD: Mean difference

However, this study did not observe significant changes in fasting blood sugar, triglycerides, total cholesterol, HDL, and Apolipoprotein B levels. This contrasts with other studies [29,30], such as Shetty B et al., demonstrated notable lipid profile reductions following yoga in overweight and obese adults. In overweight individuals, triglycerides decreased from 210.8 to 137.7, and total cholesterol from 191.9 to 181.0. In obese individuals, triglycerides dropped from 182.2 to 154.7, and total cholesterol from 230.7 to 217.3. A 16-week study with six sessions per week showed that yoga significantly reduced body fat percentage and Body Mass Index while increasing HDL levels in obese women compared to a control group [31]. The findings of the previous study highlight that even a short-term yoga intervention can lead to significant reductions in weight, body fat, LDL cholesterol, and total cholesterol while increasing HDL cholesterol.

In the author's opinion, the variability in results across studies suggests that the frequency and duration of yoga practice are critical factors influencing its effectiveness. The short duration of the intervention and the lack of control over participants' diets may have impacted the observed effects. Additionally, the use of different methods for measuring body composition across studies introduces variability, making it challenging to compare results. However, identifying the most effective components of yoga is difficult due to the wide variety of asanas practiced. Future research should address these limitations by exploring the long-term effects of yoga interventions on obesity management.

Limitation(s)

The study was limited to a three-day per week six-month yoga program. Lack of control over dietary habits may influence results. A small sample size may impact statistical power. Six months may be insufficient to observe significant health changes.

CONCLUSION(S)

The study emphasises the potential of nurse-led yoga interventions to enhance body composition and certain biochemical markers in overweight and obese adolescents. The findings are consistent with other research showing the advantages of yoga for weight management and metabolic health. The study emphasises yoga as a holistic approach to managing obesity. The findings advocate for integrating yoga as a regular physical activity in schools.

REFERENCES

[1] WHO. Obesity Update 2017. Diabetologe [Internet]. 2017;13(5):331-41. Available from: www.oecd.org/health/obesity-update.htm.
[2] World Health Organization (WHO). Obesity and Overweight (WHO Fact sheet 311). Available from: https://www.who.int/mediacentre/factsheets/fs311/en/. Accessed 2024 May 17.
[3] Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. JAMA. 2010;303(3):235-41.
[4] Singh S, Awasthi S, Kapoor V, Mishra P. Childhood obesity in India: A two-decade meta-analysis of prevalence and socio-economic correlates. Clin Epidemiol Glob Health. 2023;23:101390. Doi: 10.1016/j.cegh.2023.101390. Epub 2023 Aug 29.
[5] Stavridou A, Kapsali E, Panagouli E, Thirios A, Polychronis K, Bacopoulou F, et al. Obesity in children and adolescents during the COVID-19 pandemic. Children (Basel). 2021;8(2):135.
[6] Chaitali G, Mangala S, Hemalatha AJ, Pradeep C, Subrahmanyam G. Childhood and adolescent overweight and obesity- A public health challenge in India. Int J Sci Stud. 2014;2(4):17-19.
[7] Kumar D, Gogia VS. Prevalence of overweight and obesity among adolescents in an urban North Indian school: A cross-sectional study. Indian J Phy Med Rehab. 2018;29(2):47-52.
[8] Chandra N, Anne B, Venkatesh K, Teja GD, Katkam SK. Prevalence of childhood obesity in an affluent school in Telangana using the recent IAP growth chart: A pilot study. Indian J Endocr Metab. 2019;23(4):428-23.
[9] Prasad RV, Bazroy J, Singh Z. Prevalence of overweight and obesity among adolescent students in Pondicherry, South India. Int J Nutr Pharmacol Neurol Dis. 2016;6:72-75.
[10] Gayathri D, Syamily, Kulandaivel M. Prevalence of overweight and obesity among adolescents in South Indian population. Int J Med Res Rev. 2020;8(6):404-09.
[11] Ayala GX, Monge-Rojas R, King AC, Hunter R, Berge JM. The social environment and childhood obesity: Implications for research and practice in the United States and countries in Latin America. Obes Rev. 2021;22(S3):e13246. Available from: https://doi.org/10.1111/obr.13246.
[12] Vajid A, Bashir S. Determinants of childhood obesity: A regression analysis of socio-economic and environmental factors. EPRA International Journal of Research and Development. 2024;9(5):65-72. Doi: 10.36713/epra16754.
[13] Yankey O, Amegbor PM, Essah M. The effect of socio-economic and environmental factors on obesity. Int J Appl Geospatial Res. 2021;12(4):58-74. Doi: 10.4018/ijagr.2021100104.
[14] Varsha, Sharma A, Tripathy S. A review on effect of yoga on obesity. International Ayurvedic Medical Journal {online} 2020. Available from: http://www.iamj.in/posts/images/upload/5310_5314.pdf.
[15] Pramanik M, Rajkumar NCJ. Yoga as a complementary therapy for obesity prevention in childhood and adolescent obesity: A systematic review. Int J Health Sci. 2022;6(S3):7669-82.
[16] Isayeva AS, Vovchenko MM, Galchynska VY. Blood lipids and anthropometric parameters in healthy subjects practicing yoga or resistance training in leisure time. What matters: Type or intensity of physical activity? Pol Merkur Lekarski. 2021;49:203-08.
[17] Misra P, Sharma G, Tandon N, Kant S, Sangral M, Rai SK, et al. Effect of community-based structured yoga program on Hba1c level among type 2 diabetes mellitus patients: An interventional study. Int J Yoga. 2021;14(3):222-28. Doi: 10.4103/ijoy.ijoy_150_21.

[18] World Health Organization. Growth reference 5-19 years-BMI-for-age (5-19 years) [Internet]. Available from: https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age. (Accessed 2024 May 24).
[19] Ajitha Retnam C. A study to assess the effect of interventional package on obesity and overweight among adolescents 10-19 years in selected schools of Kanyakumari District. Tamil Nadu Dr. MGR Medical University. 2018. Available from: https://www.tnmgrmu.ac.in/images/2021/examination/phd-viva-ajitharetnam-18012021.pdf.
[20] Sood P, Bindra S. Modified Kuppuswamy socio-economic scale: 2022 update of India. Int J Community Med Public Health. 2022;9(10):3841-44. Available from: https://www.ijcmph.com/index.php/ijcmph/article/view/10140. pISSN 2394-6032 | eISSN 2394-6040.
[21] Northwestern Medicine, Center for Lifestyle Medicine. Initial Assessment. Available from: https://www.nm.org/locations/center-for-lifestyle-medicine.
[22] Cleveland Clinic Canada. Weight and Lifestyle Management Questionnaire. Toronto Health and Wellness Centre. Brookfield Place, Toronto, Ontario. Available from: https://studylib.net/doc/8321024/weight-and-lifestyle-management-questionnaire.
[23] Jia W, Liu F. Obesity: Causes, consequences, treatments, and challenges. J Mol Cell Biol. 2021;13(7):463-65.
[24] Bhaskar A, Srinivasan MV. Effects of aerobic training and yogic practices on health related physical fitness basal metabolic rate and lipid profiles of obese adolescents. Int J Eng Res Sport Sci. 2015;2(9):01-04. Available from: https://shodhganga.inflibnet.ac.in:8443/jspui/handle/10603/199871.
[25] Na Nongkhai MP, Yamprasert R, Punsawad C. Effects of continuous yoga on body composition in obese adolescents. Evid Based Complement Alternat Med. 2021;2021:6702767.
[26] Suwannakul B, Sangkarit N, Thammachai A, Tapanya W. Effects of Surya Namaskar yoga on perceived stress, anthropometric parameters, and physical fitness in overweight and obese female university students: A randomised controlled trial. Hong Kong Physiother J. 2024;1-11.
[27] Kannan RS, Arun B, Kumar RK. Effect of yoga and aerobic dance on biochemical variables in sedentary individuals. Int J Phys Educ Sports Health. 2019;6(4):190-93.
[28] Yadav R, Yadav RK, Khadgawat R, Pandey RM, Upadhyay AD, Mehta N. Randomised controlled trial of a 12-week yoga-based lifestyle vs. dietary intervention on cardio-metabolic risk factors and continuous risk score in Indian adults with metabolic syndrome. Behav Med. 2020;46(1):09-20. Doi: 10.1080/08964289.2018.1538098. Epub 2019 Jan 7. PMID: 30615583.
[29] Manna I. Effects of yoga training on body composition and oxidant-antioxidant status among healthy male. Int J Yoga. 2018;11(2):105-10. Doi: 10.4103/ijoy.IJOY_31_17. PMID: 29755218; PMCID: PMC5934944.
[30] Pramanik M, Rajkumar NC, Elayaraja M, Gogoi H. Effects of a 12-week yoga training intervention on blood pressure and body composition in obese female adolescents: A randomised controlled pilot study. Phys Rehabil Recreat Health Technol. 2023;8(3):162-71. Doi: 10.15391/prrht.2023-8(3).05.
[31] Shetty B, Shetty GB, Shantaram M, Manjunath NK. Impact of short-term yoga on anthropometric measures, body composition, and serum lipid profile in overweight and obese adults: A pilot study. Int J Res Med Sci. 2018;6(10):3315-19.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 09, 2024
- Manual Googling: May 10, 2024
- iThenticate Software: Jun 18, 2024 (14%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Apr 08, 2024**
Date of Peer Review: **May 08, 2024**
Date of Acceptance: **Jun 19, 2024**
Date of Publishing: **Jul 01, 2024**