e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(11); 2047-2054

Original Research Article

Effectiveness of Structured Diet and Physical Activity Interventions on Weight Reduction and Lipid Profile in Obese School-Aged Adolescents: A Study in the Urban Field Practice Area of a Tertiary Care Hospital

Vandana Pandit[1], Nitesh Chauhan[2], Sunil Kumar Singh[3]

[1]Assistant Professor, Department of Community Medicine, Hind Institute of Medical Sciences, Ataria, Sitapur, Uttar Pradesh

[2]Associate Professor, Department of Community Medicine, Amrita School of Medicine, Faridabad, Haryana

[3]Assistant Professor, Department of Community Medicine, Hind Institute of Medical Sciences, Ataria, Sitapur, Uttar Pradesh

Received: 25-09-2024 / Revised: 23-10-2024 / Accepted: 26-11-2024
Corresponding Author: Dr. Sunil Kumar Singh
Conflict of interest: Nil

Abstract:

Background: Obesity is a significant health problem, with increasing involvement of young population worldwide. The risk of being overweight and obese in adolescence begins with what a child is fed on during childhood and the physical activity they do.

Aim & Objective: To evaluate the effectiveness of structured diet and physical activity interventions on weight reduction and lipid profile in obese school-aged adolescents.

Materials and Methods: A total of 120 children and adolescents were recruited for a study conducted at their school between March 2022 and October 2024. All 120 participants were classified as either overweight or obese. Among them, 70 overweight children and adolescents (29 males and 41 females) with a mean age of 12.6 ± 3.7 years (ranging from 6 to 18 years) enrolled in the first stage of the program. Out of these, 55 completed the first stage and were assessed after four weeks. Subsequently, 30 participants continued to the second stage and were evaluated after 12 weeks, while 20 participants completed the third stage, with an assessment conducted at 20 weeks.

Results: The baseline characteristics of the 70 participating children and adolescents 57 (84%) were classified as obese, 13 (16%) as overweight, and 22 had a BMI z-score above 3 standard deviations, indicating severe obesity. 48% of participants had elevated triglyceride (TG) levels. The mean percentiles for flexibility and muscle strength among all participants were 51.0 ± 30.5 and 49.6 ± 33.1, respectively, indicating values close to the median of the normative range.

Conclusion: This study provides evidence that Structured Diet and Physical Activity Interventions programmes can be successful in promoting healthy behaviour increasing habitual physical activity and diet. Elevated PA at school has a positive effect on the BMI and body composition of children who are overweight or obese

Keywords: Obesity, Lipid Profile, Physical Activity Interventions, Structured Diet, Adolescents, BMI.

Introduction

Adolescents as a vulnerable group require special attention and nutritional care because of the negative nutritional consequences that may occur among them as a result of inadequate consumption of healthy foods and physical inactivity. Overweight and obesity in childhood and in adolescents are emerging as one of the major public health of concern in the last few decades. Overweight and obesity conditions develop when there is an imbalance between calories consumed and calories expended mostly due to inadequate consumption of healthy foods and physical inactivity that cut-across all age groupings. It is known to be associated with substantial loss of quality of life and social stigmatization that may trigger depression, anxiety, low self-esteem, feelings of guilt and chronic diseases development in the crop of individuals that may constitute a higher percentage of the world labour force in few years to come. [1] The risk of being overweight and obese in adolescence begins with what a child is fed on during childhood. The foods children are fed on have been attributed to the nature and the risk of diseases in adult life which could manifest in different diseases conditions such as coronary heart diseases, type 2 diabetes, stroke, and certain forms of cancer, hypertension and mental disorders. Snacking and fast food consumption have being identified as a contributory factor to the development of childhood overweight and obesity in Nigeria[1] Physical activity (PA) has been defined as any bodily movement produced by skeletal muscles that requires energy expenditure (WHO, 2014). Physical inactivity is the 4th leading factor of global mortality and increasing physical inactivity has been seen worldwide with 1 in 3 adults not being so active which prompted the WHO member states in 2013 to agree to reduce physical inactivity by 10% by 2025. Childhood is a crucial time to learn basic life skills on sufficient levels of physical activity in order to attain healthy body weight considering high prevalence of physical inactivity among the school aged adolescent.[2] Low-levels of physical activity and physical fitness are considered powerful predictors of detrimental health outcomes, such as all-cause mortality, cardio-vascular disease events and cancer events[3,4] It is known that children and adolescents meeting recommended levels of physical activity (at least 60 minutes of moderate-to-vigorous intensity physical activity on a daily basis) have multiple health benefits.[5] In spite of this evidence, a significant number of young people do not accomplish this recommendation, as it was recently observed in Spanish and European adolescents.[6]

Materials and Methods

A total of 120 children and adolescents were recruited for a study conducted at the schools of Mathura District of Uttar Pradesh between March 2022 and October 2024. The recruitment process involved visiting the school, performing anthropometric measurements, and selecting participants who met the inclusion and exclusion criteria. All eligible participants and their parents were contacted, and detailed information about the lifestyle modification program was provided. All 120 participants were classified as either overweight or obese. Among them, 70 overweight children and adolescents (29 males and 41 females) with a mean age of 12.6 ± 3.7 years (ranging from 6 to 18 years) enrolled in the first stage of the program. Out of these, 55 completed the first stage and were assessed after four weeks. Subsequently, 30 participants continued to the second stage and were evaluated after 12 weeks, while 20 participants completed the third stage, with an assessment conducted at 20 weeks. Written informed consent was obtained from all participants and their parents before the study began.

Three stages of the program: Stage one: The first four weeks consisted of knowledge building. The main goal was to quickly help participants and parents understand the causes and effects of obesity and obtain relevant knowledge about nutrition and daily activity requirements conducive to a healthy lifestyle by oral introduction and an instruction manual. 2) Stage two: Weeks 5-12 consisted of habit consolidation. Participants recorded their diet and activity arrangements daily and established more structured goals with the team. They gradually reached the set amount of activity and started to engage in sports, such as jogging and skipping rope, during this period. 3) Stage three: Weeks 13-20 consisted of self-monitoring. Nutrition and physical exercise education was reduced from twice a month to once a month. Keeping patients in an active intervention twice a month is most effective in promoting weight loss. However, extended programs were not easily accepted by all patients in this area due to long school hours and academic activities. We aimed to train participants to self-monitor weight, daily activity, and diet every day. This stage focused on requiring the participants to continuously increase their daily activity and reduce sugar and fat intake without professional supervision.

In this study, we present the results of this program in terms of body weight, height, BMI measurements and performance of physical activities. We measured participants' bodies at every visit, including height, weight, and circumferences of the thorax, waist, and hip. BMI (kg/m2) was calculated as the weight in kilograms divided by the square of the height in meters. To compare BMI among different ages and sexes, the BMI z-score was transformed from the Growth Reference of the World Health Organization (WHO).

Degree of fatty liver was graded as score 0 to 9 according to ultrasonic appearance of liver echotexture, liver-diaphragm differentiation in echo amplitude, hepatic echo penetration and clarity of hepatic blood vessels. Serum biochemistry, including total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), triglycerides (TG), and alanine aminotransferase (ALT) were assessed.

Physical fitness was assessed by body composition, cardiopulmonary endurance, muscle strength and endurance, explosive power, and flexibility. For the evaluation of cardiopulmonary endurance, 800-m run and 6-min walking tests were performed. For the evaluation of muscle strength and endurance, 1-min sit-up performance was used. The standing long jump was used to measure explosive power. For the evaluation of flexibility, the sit-and reach test was used to measure tightness in the lower back and hamstring muscles.

Observations: The baseline characteristics of the 70 participating children and adolescents, 57 (84%)

were classified as obese, 13 (16%) as overweight, and 22 had a BMI z-score above 3 standard deviations, indicating severe obesity (defined as BMI greater than 120% of the 95th percentile for age and sex). The height z-scores of the participants were consistent with percentiles ranging from the 85th to 97th and were comparable across both children and adolescents.

Table 1: Distribution of study subjects as per BMI classifications

Classification	Frequency (n)	Percentage (%)
Obese	57	84
Overweight	13	16
Total	70	100

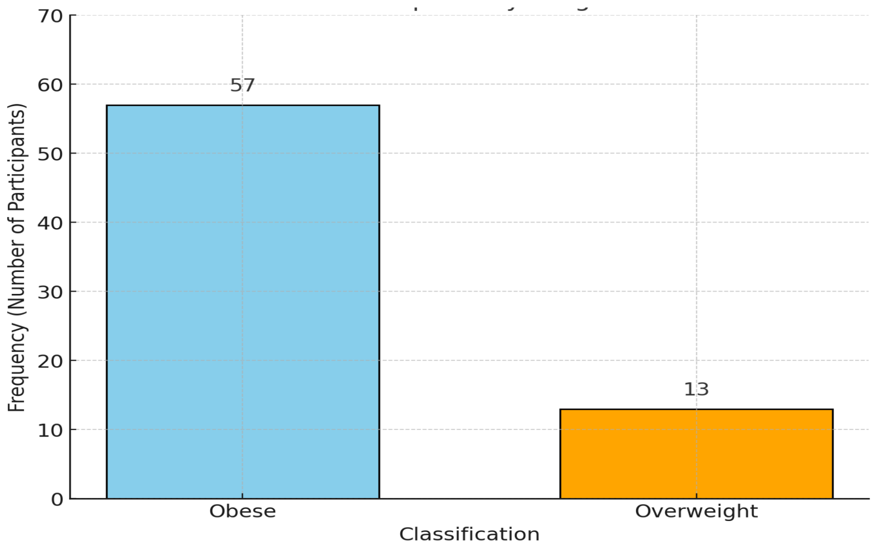

Figure 1: Distribution of study subjects as per BMI classification

Serum biochemistry analysis revealed that 48% of participants had elevated triglyceride (TG) levels (>170 mg/dL), 44% had elevated low-density lipoprotein cholesterol (LDL-C) levels (>110 mg/dL), and 64% had elevated TG levels based on age-specific cut-offs (children 0–9 years: >75 mg/dL; adolescents 10–19 years: >90 mg/dL). Additionally, 19% of the participants had elevated alanine aminotransferase (ALT) levels (>40 U/L), while 32% showed low levels of high-density lipoprotein cholesterol (HDL-C) (<45 mg/dL).

Six participants were diagnosed with dyslipidemia, characterized by mild elevations in total cholesterol (TC) and LDL-C levels, moderate-to-severe elevations in TG levels, and low HDL-C levels.

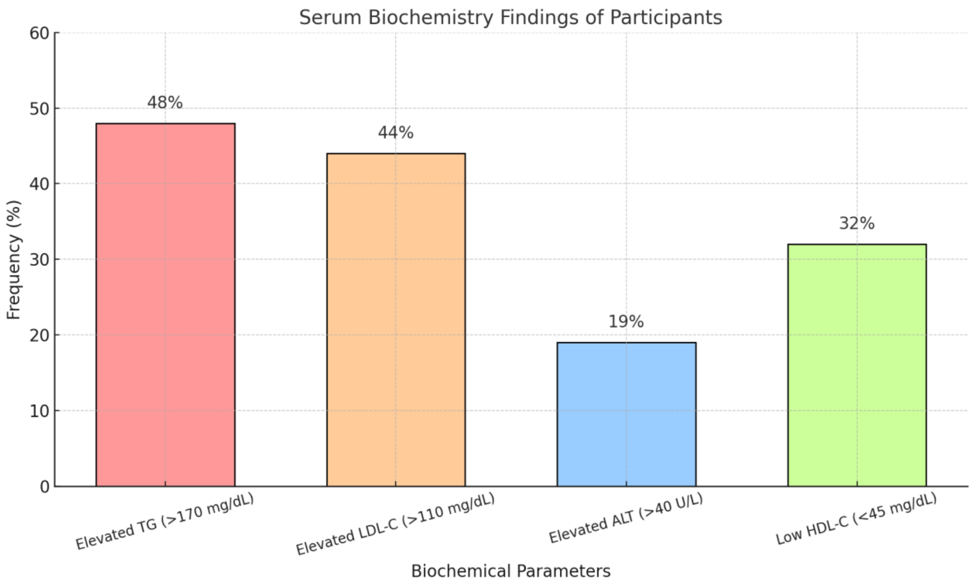

Figure 2: Serum biochemistry findings of the study subjects

The mean percentiles for flexibility and muscle strength among all participants were 51.0 ± 30.5 and 49.6 ± 33.1, respectively. However, the mean percentiles for cardiopulmonary function (4.5 ± 8.7) and explosive power (22.2 ± 22.2) were notably below the norm.

Significant reductions in body weight, BMI, BMI z-score, waist circumference, waist-to-hip ratio, and waist-to-height ratio were observed by the end of the first stage (4 weeks) and second stage (12 weeks). By the third stage (20 weeks), BMI, BMI z-score, waist circumference, waist-to-hip ratio, and waist-to-height ratio showed continued significant reductions.

For the 15 participants who completed all three stages, mean body weight decreased consistently from weeks 0 to 12 but showed a slight increase from weeks 12 to 20. However, BMI and BMI z-scores demonstrated continuous reductions throughout the 20 weeks.

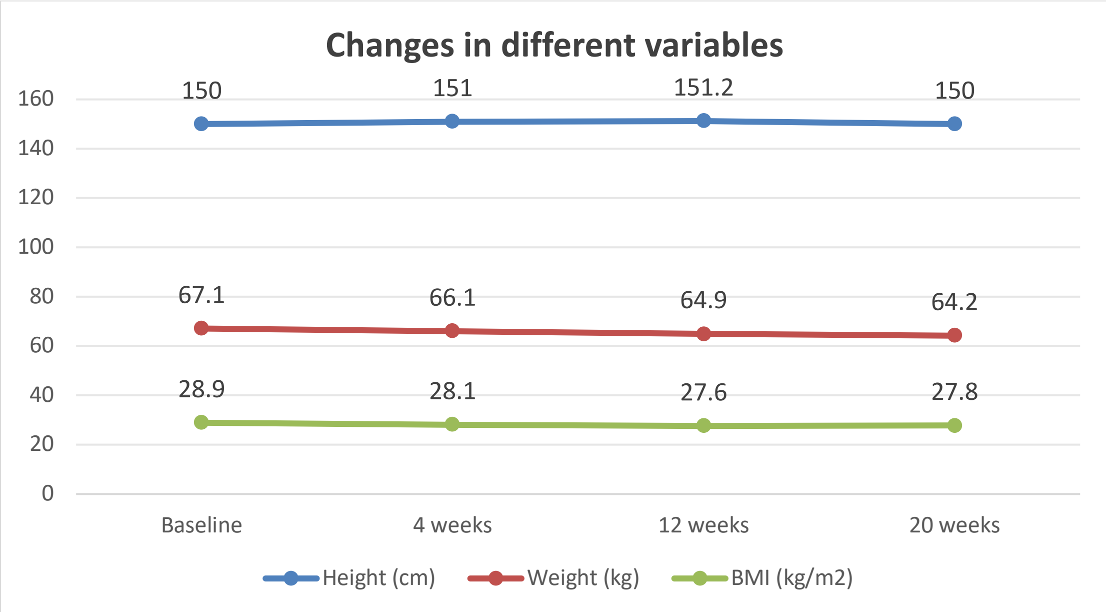

Figure 3: Changes in the different variables of the study subjects as per time

Although there was no significant change in mean plasma lipid profiles between the second and third stages (mean assessment interval: 23.3 ± 8.1 weeks), triglyceride levels significantly decreased in 25 participants whose baseline levels exceeded the reference value. These levels dropped from 157.3 ± 95.0 mg/dL to 115.1 ± 40.6 mg/dL (P = 0.047). Physical fitness performance showed marked improvements. By week 4, significant progress was noted in three of the five assessed items, and by week 12, four items showed significant improvement. The 1-minute sit-up test improved significantly across all stages (4 to 12 weeks and 12 to 20 weeks). Flexibility and 800-meter run performance improved significantly at weeks 4 and 12 but plateaued by week 20. No significant changes were observed in the 6-minute walking test. Overall, the most substantial progress occurred within the first two stages, with significant improvements in four of five fitness items by week 12.

From the second to the third stage, the frequency of visits decreased, and the focus shifted from consolidating habits to self-monitoring. A comparison of the effectiveness between these two stages revealed that significant reductions in BMI, BMI z-score, waist circumference, waist-to-hip ratio, and waist-to-height ratio occurred between weeks 4 and 12. However, for those who completed both stages, there were no further changes in these parameters from weeks 12 to 20

Follow-up data on weight and height were available for 81% (35 out of 43) of the subjects who completed the program, including 28, 16, and 10 participants from the first, second, and third stages, respectively. The follow-up was conducted at an average interval of 24.2 ± 12.3 weeks after their last visit. The lifestyle modification program effectively controlled weight gain, with participants recording a mean weight increase of only 1.9 ± 2.8 kg over six months. The BMI z-score for the 35 participants continued to decrease significantly during this period (2.75 ± 0.84 vs. 2.56 ± 0.78, P = 0.011). Among adolescents, body weight, BMI, and BMI z-score were maintained. In children, the BMI z-score decreased significantly, with an average reduction of 0.31 ± 0.46 (P = 0.006).

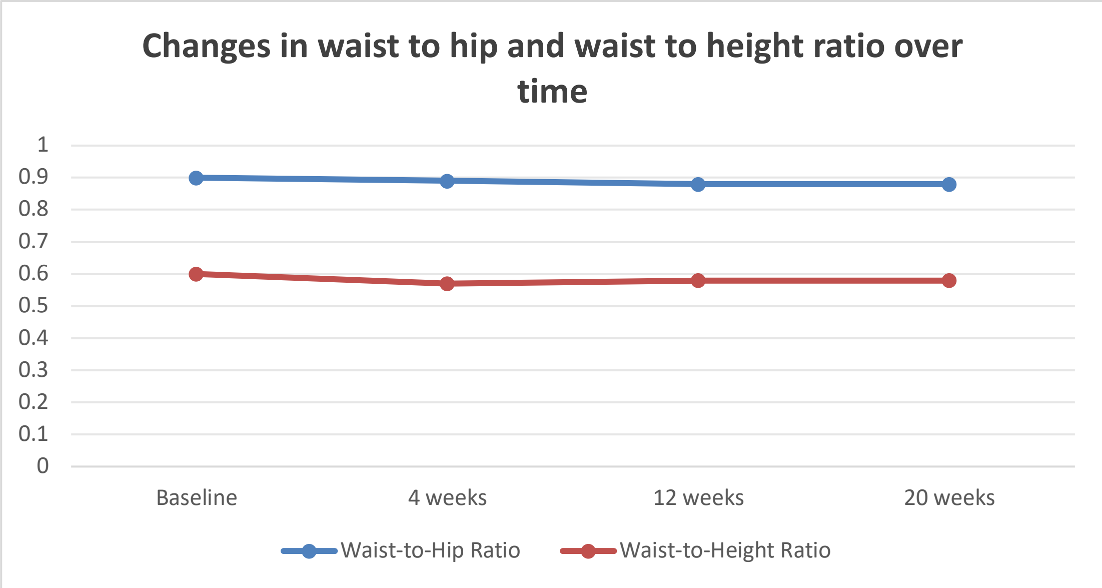

Figure 4: Changes in waist to hip and waist to height ratio over time

Table 2: Variations of the different physical fitness test over time

Variable	Baseline Mean ± SD	4 Weeks Mean ± SD	12 Weeks Mean ± SD	20 Weeks Mean ± SD	P-Value
Sit and Reach Test (cm)	27.5 ± 9.8	30.8 ± 9.8	26.0 ± 8.7	28.7 ± 7.1	0.127
One-minute Sit-ups (times)	25.1 ± 11.3	29.6 ± 10.5	33.9 ± 10.7	34.9 ± 12.7	0.002
800 m Run (s)	475.1 ± 107.8	452.4 ± 78.5	434.8 ± 77.4	481.3 ± 100.6	0.052
Six-minute Walking Test (m)	536.7 ± 94.1	544.3 ± 81.8	548.7 ± 87.9	527.4 ± 98.3	0.633
Standing Long Jump (cm)	114.2 ± 32.8	117.9 ± 31.3	103.1 ± 31.9	99.2 ± 33.1	113.4 ± 35.4 0.027

Discussion

Overweight and obesity among school-aged children have become significant public health concerns. The health effects of obesity in children may be much more serious than in people who gain excess body weight in adulthood [7,8]Unfortunately, in many countries, there is a lack of epidemiological knowledge of and control over the phenomenon of excess body weight that would allow for the monitoring of the trend and reacting quickly.

Increasing physical activity and limiting sedentary habits, as well as eating well, are essential for battling excess weight and corpulence in children and adolescents. Obesity is a significant factor influencing anthropometric measurements and body composition.

In our study we observed that among 70 participating children and adolescents, 57 (84%) were classified as obese, 13 (16%) as overweight, and 22 had a BMI z-score above 3 standard deviations, indicating severe obesity. A high prevalence of 25%(overweight) & 7%(obesity) was reported by Kapil et al [9]. Sony Jagadesan et al [10] and Khadilkar et al [11] in Chennai also found very high prevalence of 18.1% (overweight)and 21.2% (obesity) respectively. Various studies from South India [12,13]revealed that the prevalence ranging between 11% -25% higher than the prevalence of present study. In contrast to our study, lower prevalence was reported by Ambili Remesh [14] et al who indicated that prevalence of overweight / obesity to be 8.75% and 4.82% respectively and Goyal et al[15] in surat city reported the prevalence of overweight and obesity was found to be 6.55% and 13.9%. Anita rani et al [16] in their study revealed a significant association between age group and obesity.

Serum biochemistry analysis revealed that 48% of participants had elevated triglyceride (TG) levels, 44% had elevated low-density lipoprotein cholesterol (LDL-C) levels, and 64% had elevated TG levels. Additionally, 19% of the participants had elevated alanine aminotransferase (ALT) levels, while 32% showed low levels of high-density lipoprotein cholesterol (HDL-C). Six participants were diagnosed with dyslipidemia, characterized by mild elevations in total cholesterol (TC) and LDL-C levels, moderate-to-severe elevations in TG levels, and low HDL-C levels. . Cai et al. [17] demonstrated that childhood obesity prevention programmes had a significant desirable effect on LDLc and HDLc, but only 15% of interventions improved other lipids outcomes and 55% had no significant effects. Also, A previous study observed similar findings to that improved lipid profile of children [18]. These findings suggest that NEI (nutrition education intervention) implemented at relatively short duration (1 hour per week for 6 weeks) could have positive effects on the lipid profile, knowledge and attitude of school children. Although in our study there was no significant change in mean plasma lipid profiles between the second and third stages (mean assessment interval: 23.3 ± 8.1 weeks), triglyceride levels significantly decreased in 25 participants whose baseline levels exceeded the reference value.

The World Health Organization (WHO) has recommended moderate to vigorous physical activity practice for children and adolescents daily in order to reduce sedentary lifestyles. The physical activity also reduces symptoms of anxiety and depression, build self-confidence and develop neuromuscular awareness (coordination and movement control) of adolescents and maintain healthy body weight among them.The mean percentiles for flexibility and muscle strength among all participants in our study were 51.0 ± 30.5 and 49.6 ± 33.1, respectively. However, the mean percentiles for cardiopulmonary function (4.5 ± 8.7) and explosive power (22.2 ± 22.2) were notably below the norm, highlighting the need for improvement in these areas. We observed that significant reductions in body weight, BMI, BMI z-score, waist circumference, waist-to-hip ratio, and waist-to-height ratio were observed by the end of the first stage (4 weeks) and second stage (12 weeks). By the third stage (20 weeks), BMI, BMI z-score, waist circumference, waist-to-hip ratio, and waist-to-height ratio showed continued significant reductions. Both Seema jain et al[19] and Avula Laxmaiah et al [13] found that physical in activity was significantly associated with overweight / obesity. Similarly Krutarth et al [20] revealed that low level of physical activity was significantly associated with overweight / obesity.

In the present study, for the 15 participants who completed all three stages, mean body weight decreased consistently from weeks 0 to 12 but showed a slight increase from weeks 12 to 20. However, BMI and BMI z-scores demonstrated continuous reductions throughout the 20 weeks.

A study by Eliakem et al.[21]reported a significant decrease in body weight and BMI following a 3 months dietary-behavioural-exercise intervention. Their results further showed that obese children who continued the intervention programme for 6 months maintained a decrease in BMI while those who did not participate gained weight and increased BMI. It could therefore be deduced from this study that the duration of an intervention of this sort may influence anthropometric variables. Factors like changes in the physical environment and accessibility to healthy foods are necessary to promoting positive behavioral and nutritional outcomes in children. This has been emphasized by researches that have shown that limited food availability and accessibility by children is a major setback to achieving a healthy dietary habit regardless of adequate nutrition awareness, knowledge and positive attitude towards healthy nutrition. [22,23]

Follow-up data on weight and height were available in our study for 81% (35 out of 43) of the subjects who completed the program, including 28, 16, and 10 participants from the first, second, and third stages, respectively. The follow-up was conducted at an average interval of 24.2 ± 12.3 weeks after their last visit. The lifestyle modification program effectively controlled weight gain, with participants recording a mean weight increase of only 1.9 ± 2.8 kg over six months. The BMI z-score for the 35 participants continued to decrease significantly during this period (2.75 ± 0.84 vs. 2.56 ± 0.78, P = 0.011). Among adolescents, body weight, BMI, and BMI z-score were maintained. In children, the BMI z-score decreased significantly, with an average reduction of 0.31 ± 0.46. Brueming et al.,[24] reported that relationship exists on the eating behaviour of adolescent and the relationship was significant (p=0.038).

However, the finding agrees with the finding of similar study carried out by [25] on relationship between self-reported dietary intakes and measured physical activity among male students in Saudi Arabia. Alkahatani et al., [25] reported that relationship exist between physical activity level and BMI of the students, and the relationship was significant (p=0.048). The findings on relationships between food consumption and physical activity and BMI for age of participants in this study clearly illustrates that food consumption pattern and physical activity have influence on the participants overweight and obesity status.

Conclusion:

The present study showed that participants who completed all three stages mean body weight decreased consistently from weeks 0 to 12 but showed a slight increase from weeks 12 to 20. School and community-based physical activity interventions as part of an obesity prevention or treatment programme can benefit executive functions of children with obesity or overweight specifically. Similarly, school-based dietary interventions may benefit general school achievement in children with obesity.

These findings might assist health and education practitioners to make decisions related to promoting physical activity and healthy eating in schools. Future obesity treatment and prevention studies in clinical, school and community settings should consider assessing academic and cognitive as well as physical outcomes.

References:

1. Olumakaiye, M. F., Atinmo, T., & Fatiregun, M. A. (2010). Food Consumption Patterns of Nigeria Adolescent and Effect of Body Weight. Journal of Nutrition Education and Behavior Vol 42 (3), pp 144 - 151.
2. Berge, J. M., Wall, M., Bauer, K. W., & Neumark-Sztainer, D. (2010). Parenting Charateristics in Home Environment and Adolescent Overweight: A Latent Class Analysis. Obesity Vol 18 (4), pp 818 - 825.
3. Kodama S, Saito K, Tanaka S, Maki M, Yachi Y, Asumi M, et al. Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: a meta-analysis. JAMA 2009; 301:2024-2035.
4. Blair SN, Kohl HW, 3rd, Paffenbarger RS, Jr., Clark DG, Cooper KH, Gibbons LW. Physical fitness and all-cause mortality. A prospective study of healthy men and women. JAMA 1989; 262:2395-2401.
5. U.S. Department of Health and Human Services; Physical Activity Guidelines Advisory Committee. Physical activity guidelines for Americans. 2008; http: //www.health.gov/ PAguidelines/. Accessed October 7, 2008.
6. Pate RR, Davis MG, Robinson TN, Stone EJ, McKenzie TL, Young JC. Promoting physical activity in children and youth: a leadership role for schools: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. Circutoi'on 2006; 114:1214-1224.
7. Gomula, A.; Nowak-Szczepańska, N.; Danel, D.P.; Koziel, S. Overweight trends among Polish schoolchildren before and after the transition from communism to capitalism. Econ. Hum. Biol. 2015, 19, 246–257.
8. Oblacińska, A. Rozwój fizyczny i samoocena masy ciała. In Pupils' Health in 2018 against the New HBSC Research Model; Mazur, J., Małkowska-Szkutnik, A., Eds.; Instytut Matki i Dziecka: Warsaw, Poland, 2018; pp. 70–81.
9. Kapil U, Singh P, Pathak P, Dwivedi SN. Prevalence of obesity amongst affluent adolescent school children. Indian Pediatrics. 2001; 39:449-521:857-8.
10. Jagadesan S, Harish Ranjani, Miranda P, Unnikrishnan R, Mohan R. Prevalence of Overweight and Obesity Among School Children and Adolescents in Chennai. Indian Paediatrics ; 51:544-7.
11. Khadilkar VV, Khadilkar AV, Cole TJ, Chiplonkar SA, Pandit D. Overweight and obesity prevalence and body mass index trends in Indian children. Int J Pediatr Obes. 2011; 6:216-24.
12. Goyal RK, Shah VN, Saboo BD, Phatak SR, Shah NN, Gohel MC, Raval PB, Patel SS. Prevalence of overweight and obesity in Indian adolescent school going children: its relationship with socioeconomic status and associated lifestyle factors. J Assoc Physicians India. 2010; 58:151-8.
13. Laxmaiah A, Nagalla B, Vijayaraghavan K, Nair M. Factors affecting prevalence of overweight among 12- to 17-year-old urban adolescents in Hyderabad, India. Obesity (Silver Spring). 2007; 15(6):1384-90 54.
14. Remesh A.Prevalence of Adolescent obesity among high school students of kerala, south India.India.Arch Pharm Pract.2012; 3(4):289-92.
15. Goyal JP,Kumar N , Parmar I, Shah VB ,Patel B. Determinants of Overweight and Obesity in affluent adolescent in surat city. Indian Journal of community medicine. 2011; 36: 296-300.
16. Rani MA, Sathiyasekharan BWC .Behavio urial Determinants of Obesity.A Cross sectional study among adolescents in india. J Prev Med Public Health. 2013 Jul; 46(4): 192–200.
17. Cai L, Wu Y, Cheskin LJ, Wilson RF, Wang Y. 2014a. Effect of childhood obesity prevention programmes on blood lipids: a systematic review and meta-analysis. Obes Rev 15:933–944.
18. Williams, D. P., Going, S. B., Lohman, T. G., Harsha, D. W., Srinivasan, S. R., Webber, L. S., & Berenson, G. S. (1992). Body fatness and risk for elevated blood pressure, total cholesterol, and serum lipoprotein ratios in children and adolescents. American Journal of Public Health, 82(3), 358-363.
19. Jain S, Pant B, Chopra H, Tiwari R. Obesity among adolescents of affluent public schools in Meerut. Indian J Public Health 2010; 54:158-60.
20. Krurath B, Oza NU. Obesity among adolescents of ahmedabad city, gujarat, india- a community based cross-sectional study. Int J Biol Med Res. 2012; 3(2): 1554-7.
21. Eliakim, A., Kaven, G., Berger, I., Friedland, O., Wolach, B., &Nemet, D. (2002). The effect of a combined intervention on body mass index and fitness in obese children and adolescents–a cli.
22. Sherman, J., & Muehlhoff, E. (2007). Developing a nutrition and health education program for primary schools in Zambia. Journal of Nutrition Education Behaviour, 39(6), 335-342.

23. Kaiser, L. L., & Townsend, M. S. (2005). Food insecurity among US children: Implications for nutrition and health. Topics in Clinical Nutrition, 20(4), 313-320.
24. Brueming, M., Eisenberg, M., Macheshore, R., Marilyn, S., Story, M. N., & Neumark-Sztainer, D. (2012). The Relationship between Adolescent and their Friends eating Behaviour, Breakfast Fruits,Vegetables,Whole Grain And Daily Intake. Journal of the Academy of Nutrition and Dietetics Vol 112 (10), pp 1608 -1613.
25. Alkhatani, S., Elkilany, A., Al-Mohammadi, A., & Aldushishy, A. (2015). Relationship between self -reported Dietary Intake and measured Physical Activity in Saudi Arabia. Current Research in Nutrition and Food Science Vo l3 (2), pp 130 -139.