# Promoting Healthier Futures: A Six-Month Program for Childhood Obesity Reduction and Lifestyle Enhancement

Sabah Mohammed[1,2*], Abdulahad[1]

[1]Department of Community Medicine, Hawler Medical University, College of Medicine, Erbil, Iraq.
[2]Sulaimani Polytechnic University, Darbandkhan Technical Institute, Nursing Department, Sulaimani, Iraq.
*Correspondence to: Sabah Mohammed (E-mail: sabah.mohammed@spu.edu.iq)

## Abstract

**Objectives:** This study aimed to evaluate the impact of a six-month family-based intervention and follow-up intervention on the body mass index and children's lifestyle in Erbil City among 5 to 19 years old. The intervention specifically targeted parents to the educational program and intended to reduce the Body Mass Index of children and change sedentary behavior. On the other hand, the educational program included minimizing the consumption of high-fat and carbohydrate-containing, increasing the consumption of fruits and vegetables, and soft drinks. In addition, it assessed exposure to multi-screen devices and evaluated sleep quality.

**Methods:** Weight, height, waist circumference, and hip circumference were measured by portable stadiometer and weight-calibrated electronic scales and BMI was calculated at the baseline and after six months of intervention. The research employed various methodologies and conducted a family-based educational program through a printed booklet. The questionnaire was used at baseline and after six months of intervention, and IBM SPSS Statistics version 25 was used for data analysis, paired sample $t$-test and MacNemar Chi-square were used.

**Results:** The BMI was reduced after six months of intervention. The mean difference was 0.435, however, there were no more differences for hip and waist circumference, on the other hand, the sedentary behaviour lifestyle was changed from poor daily lifestyle practice to good practice.

**Conclusion:** The results of this research suggest that the implementation of a complete intervention produces favourable outcomes in terms of lifestyle modifications and a decrease in BMI among children who are obese or overweight. Although, daily practice was notable changed from poor daily practice to good practice.

**Keywords:** BMI, obesity, overweight, children, intervention

## Introduction

According to the World Health Organization (WHO), the prevalence rate of obesity and overweight has substantially grown over the world among children in the last decade. There was a recorded prevalence of over 340 million children and adolescents between the ages of 5 and 19 who were classified as overweight or obese, obesity is a significant public health concern affecting children and adult populations.[1] Individuals who exceed the optimal weight range, which is assessed as healthy for their specific height, are categorised as either overweight or obese. The issue of childhood obesity is a great burden in terms of the child's health and well-being.[2] Overweight and obesity tend to exhibit an increased prevalence and severity as well as a greater impact throughout later stages of life. However, longitudinal studies have shown that their detrimental consequences are even more pronounced when acquired during the early stages of life.[3]

The comprehensive and effective addressing of childhood obesity requires the consideration and incorporation of social and family settings.[4] Children who are overweight or obese have short-term mental and physical health problems and are more likely to remain overweight as adults, being overweight as an adult is a major risk factor for lifestyle-related illness and death.[5] There is more evidence that treating childhood obesity with a family-based method that focuses on food, exercise, and attitude change works to decrease BMI.[6]

Energy consumption has often been presented by researchers as the primary factor responsible for the substantial rise in the prevalence of overweight persons.[7] Various dietary variables, including the use of sugar-sweetened beverages, larger portion sizes, dining outside the home, and the consumption of energy-dense foods (e.g., energy drinks), have been identified as contributors to excessive energy intake.[8] Eating snacks between meals has often been recognised as a significant factor in the notable rise of overweight persons. Furthermore, the correlation between snacking and body weight has also produced consistent findings.[9]

It is essential to acknowledge the significance of physical exercise since it was approved that engaging in physical activity throughout the early stages of life is established as the basis for maintaining a consistent routine of physical activity throughout daily life.[7] Physical exercise is a very suitable approach for attention to a healthy life, it has many additional advantages and has a role in regulating body weight and enhancing body composition, including benefits to psychological and social well-being.[10]

The Healthy Eating and Lifestyle Programme (HELP) is a scientifically supported intervention that incorporates many components intending to improve the desire to make positive changes in children aged 5 to 19 who are classified as obese and seeking assistance in weight management.[11,12] Family-based weight management strategies have been extensively used to challenge the issue of obesity in the pediatric population, including both children and adolescents. Gaining insight into the complicated and ever-changing aspects of family environments is an essential/requirement in achieving the goal of comprehending the underlying factors, preventive measures, and therapeutic approaches concerning childhood obesity.[10] This study aims to encourage families to healthy lifestyle to reduce obesity and overweight in children.

## Methodology

### Design and Setting

The present research implemented a six-month educational program family-based intervention within the context of a one-group, quasi-experimental design. In this experimental design, a variable of interest is assessed both before and after to intervention within the same group of participants.[13] From December 2021 to May 2022, The inclusion criteria for participants consisted of students who met the eligibility requirement of being overweight, as determined by a body mass index (BMI)-for-age value equal to or above the median plus one standard deviation, the limitation of the study excluded all children less than 5 years and adults more than 19 years old, furthermore exclude all family and children, not a permanent resident in Erbil city to minimize missing follow up intervention program.

### Data Collection

The household survey was undertaken to find out the prevalence rate of obesity among children in Erbil City, 1200 children participated in the study, and 364 children from 5–19 years were obese and overweight for both males and females. Erbil City was split into 6 municipalities, and randomly from each municipality children were for the study, altogether 78 children consented to engage in the intervention program, but 5 of them did not complete the program and were lost to follow-up due to shifting location.

At the initial visit, every child who participated was coded and documented height, weight, waist circumference, and hip circumference. Demographic data taken and age were catagorised into three different age groups. The crowding index of families and economic status were scored and catgorised. Furthermore, a booklet was provided for each family and child, which included an educational program, and in every visit data was recorded to indicate the habit and consuming food and all aspects structured in the educational program, each aspect had a goal to achieve, by the booklet assisted to achieve these goals and enabled to monitor the program. At the conclusion session, the program was assessed by questions and collecting height, weight, hip, and waist circumference after 6 sessions. These variables were computed BMI and compared before and after the Intervention. The questionnaire was used before and after intervention which included questions about the child's lifestyle, diet, and daily exercise. Based on that, a 55-score scale was developed to assess the difference in good practice the child might have experienced following the intervention program. The present study evaluated sleep quality by interviewing parents on their children's bedtime and total sleep duration within 24 hours. Responses were collected both before and after the implementation of an intervention program.



### Anthropometric Measurements

The height of the participants was assessed using a portable stadiometer (Model 214 Road Rod, Seca Corp, Hanover, MD, USA) with measurements rounded to the closest 0.1 centimeter (cm), excluding the use of shoes. Weight was measured using previously calibrated electronic scales (electronic digital weighing scale Medel Cristal, ref: 92081, Italy) to the closest 0.1 kg, with participants wearing light clothes and excluding all heavy clothes, especially coats, and jackets. The BMI and Z-scores were calculated using the WHO parameters from 2007, which take into account the individual's sex and age. The cut-off values for classifying individuals as overweight were defined as being equal to or more than one standard deviation (1SD) above the median, while the cut-off criteria for classifying individuals as obese were defined as being equal to or greater than two standard deviations (2 SD) above the median. The waist circumference (WC) was assessed by using a flexible and retractable measuring tape (SECA) positioned halfway between the lower rib and the top of the iliac crest, after a moderate expiration. The measurement of the hips is taken from the narrowest point of the child's waist. The measurement was taken by locating the highest point of the hips, (just above the bully point), and around a flexible tape to measure the distance in centimeters until the two endpoints met.

### Intervention Components

The Intervention program included eating healthy foods, engaging in regular physical exercise, reducing the amount of sugar and carbohydrates consumed, improving the quality of sleep, and spending less time on electronic devices and smartphones by the children. The intervention program was prepared and printed out to every child and family based on five elements of the educational program to transform the environments of children, each family took sessions to explain the consist of the program and every session lasted around 20–30 minutes. The program was developed for six months and each family was followed up and visited each month respectively. Family and children participated in the program at least four sessions and the maximum was six sessions and visited according to availability and time for sessions.

Each family participated by their own decision and the staff orally questioned them about their desire to join the program. The team was taught adequately and consisted of three persons. One of them was female because of cultural concerns it was useful to explain the program and weight, height, waist, and hip for female children measured by female members, and male children measured by male members.

The study procedures obtained approval from the Ethics Committee of the College of Medicine at Hawler Medical University and the registered number was (7-3-2022). The researcher's team explained the program for families and children, and after that, they got permission from the parents by verbal acceptance for parents and children. All measuring procedures and intervention activities were explained to him.

### Parent's Participation

The objective of the parents' engagement component was to familiarize them with the intervention program and provide them with nutrition education, therefore enhancing their understanding of healthy lifestyle choices and eating habits. The parental component education included sessions with a duration ranging from 20 to 60 minutes that was presented.

### Outcome and Analysis

The primary variables assessed in this research included anthropometric measures, specifically BMI, hip circumference,

and waist circumference, before and after the implementation of the educational program. Anthropometric data, which is body weight, measured in kilograms (kg) using an electronic digital weighing scale, Medel Cristal, reference number: 92081, manufactured in Italy), were assessed at the beginning of the study and again after a period of six months. BMI is determined by dividing an individual's weight in (kg) by the square of their height (in square meters). The measurement of waist and hip circumference (in centimeters) was conducted during the first assessment and again after a period of six months. In addition, education and occupational levels for parents recorded. Crowding index for families validated depending on family size and number of rooms with house spaicing.[14] Socioeconomic class was scored depending on type houseing, education levels, types of occupations, position of cars and monthly encome by asking tricky question, based on that scores explored the economic status and divided in to three category.[15]

After six months of intervention, the questionnaires were collected and the data were entered into SPSS to analyse them, at the end of the program weight, height, waist, and hip circumference were measured and the weight was measured by the same scale and height, waist, and hip circumference measured by a meter. T-test was used to discover mean differences between before and after intervention. Nevertheless, the conclusion of the intervention course was evaluated by a series of questions administered to assess the program before and after the intervention. The responses to these questions were then categorised into two groups: poor practice and good daily practice and the answers scored from negative to positive responses. The attitudes were scored by good or poor behaviour. if the response was more than 50% measured good daily practice if less than 50% defined poor daily practice. Ultimately, MacNemar test was used to present the differences. And the *P*-value is considered 0.05.

## Results

Male participation was 57.7%, and female 42.3%. Three age groups were studied: 60.3% of them were 10–14 years, 12.8% were 15–18 years, and 26.9% were 5–9 years. The majority of children attended school (80.8%) while 19.2% did not. Most fathers had an elementary education of 29.5%, while intermediate, secondary, and college education was 17.9%. Most mothers were illiterate 28.2%, although 13% of fathers had higher education, and only 1.3% of mothers in higher education levels. Regarding the crowding index, 55.1% lived in moderate families there were 4–7 individuals in the same family or residence, while 9% had more than eight members. Most of their families had adequate money for everyday needs 85.9%, exceeded needs 2.6%, and not enough for daily needs 11.5% (Table 1).

Table 2 presents results indicating that the mean and standard deviation (SD) differences between pre and post-intervention was 0.435 ± SD 0.486, (95% CI: 0.321 to 0.548, *P* = 0.0001). The observed mean difference is determined to be statistically significant. The study found that there was a mean difference of 0.041 ± SD 2.09, (95% CI: –0.447 to 0.529, *P* = 0.867) in waist circumference between the pre and post-intervention measurements, the difference was not statistically significant. Similarly, the mean difference in hip circumference was –0.137 ± SD 1.575, (95% CI: –0.504 to 0.230, *P* = 0.460), which was also not statistically significant.

The *P*-value used to determine statistical significance, is considered to be less than 0.05 for significance. The majority of families and children responded and continued the intervention program, however only 5 of the children were not included in the analysis because of changing location.

Based on the data shown in Table 3, the prevalence of poor practice before the intervention was recorded at 21.9%, while the occurrence of poor practice in everyday life decreased to 6.8% after the intervention. Before the intervention, observed that good daily practices were 78.1%. After following the intervention, the rate of adherence to these practices in daily life improved to 93.2%. The observed *P*-value was determined to be 0.027. The findings of the result demonstrated statistical significance, indicating a notable impact on the educational practice subsequently to the implementation of the intervention program.

## Discussion

This research revealed a correlation between family income and the rise in body weight and obesity. Specifically, 88.5% of families had sufficient income to meet their daily demands and even beyond them. It was evidence to proof that a higher income is associated with an increase in body weight. While, study done in Jordan discovered a strong correlation between family income and weight gain (Okour et al., 2019).[16] In contrast, studies conducted in the United States and European nations have shown a correlation between low income or poverty region with higher rates of obesity and body weight (Demment, Haas, & Olson, 2014; Ayala-Marín et al., 2020).[17,18]

The findings of a comprehensive and continuing educational intervention aimed at parents and children, to address the issues of childhood overweight and obesity via BMI reduction and lifestyle modifications, showed favorable outcomes in terms of lifestyle changes and BMI reduction. At the six-month mark, there was a reduction in BMI in the post-intervention group compared to the pre-intervention group. Furthermore, the research discovered a notable rise in the consumption of vegetables and fruits, a decrease in the consumption of high-fat, snacks, high-carbohydrate meals, and sweetened beverages, an increase in physical activity, and a decrease in sedentary behaviour. It is well established that BMI has been associated with a potential decline, a study conducted for eight years of intervention has found an association between health promotion and changes in BMI.[19] The study was designed for six months of family-based intervention as mentioned the daily poor practice changed from 21.9% poor practice to 6.8% after the period of intervention. However, the changing of waist and hip circumferences not significantly changed might be due to the time of intervention and the gap between visits. The study yielded the same comparable outcomes in the Maxicon school intervention, which used a family-based approach for a duration of six months.[20]

This research reported that the rise in daily vegetable and fruit intake leads to a decrease in BMI and results align with similar trends found in a study conducted in Norway, where there has been a notable increase in the consumption of fruits and vegetables leads to decreased BMI.[21] Consumption of fruits and vegetables has the potential to mitigate the prevalence of obesity in youngsters, as these food groups possess the ability to facilitate fat oxidation while containing relatively low caloric content.[22] Other research done in the United

Table 1.  **Represent socio-demographic distributions of the study population**

| Socio-demographic criteria | | Frequency | Percentage (%) |
|---|---|---|---|
| Sex | Male | 45 | 57.7 |
| | Female | 33 | 42.3 |
| Age groups | 5–9 years | 21 | 26.9 |
| | 10–14 years | 47 | 60.3 |
| | 15–18 years | 10 | 12.8 |
| Attend to school | Yes | 63 | 80.8 |
| | No | 15 | 19.2 |
| Father education | Illiterate | 15 | 19.2 |
| | Read & write | 10 | 12.8 |
| | Primary | 23 | 29.5 |
| | Intermediate/Secondary | 14 | 17.9 |
| | Institution/College | 14 | 17.9 |
| | Higher education | 1 | 13 |
| | Not alive | 1 | 1.3 |
| Mother education | Illiterate | 22 | 28.2 |
| | Read & write | 8 | 10.3 |
| | Primary | 21 | 26.9 |
| | Intermediate/Secondary | 11 | 14.1 |
| | Institution/College | 15 | 19.2 |
| | Higher education | 1 | 1.3 |
| | Not alive | 0 | 0 |
| Crowding index | 3 and less | 28 | 35.9 |
| | 4–7 member | 43 | 55.1 |
| | 8 and more | 7 | 9 |
| Family income | Not enough for daily needs | 9 | 11.5 |
| | Enough for daily needs | 67 | 85.9 |
| | Exceeds needs | 2 | 2.6 |

Table 2.  **Demonstrate mean differences between pre and post-intervention**

| Mean | | Paired samples test | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Paired differences | | | | | | | |
| | | Mean | Std. deviation | Std. error mean | 95% Confidence interval of the difference | | t* | Df* | Sig. (2-tailed) |
| | | | | | Lower | Upper | | | |
| Pair 1 | BMI - BMI2 | .435 | .486 | .057 | .321 | .548 | 7.653 | 72 | .000 |
| Pair 2 | Waist circumference in cm - Waist post-intervention | .041 | 2.09 | .245 | −.447 | .529 | .168 | 72 | .867 |
| Pair 3 | Hip circumference in cm - Hip post-intervention | −.137 | 1.575 | .184 | −.504 | .230 | −.743 | 72 | .460 |

*t*, *t*-test; Df*, Degree of freedom.

Kingdom examined the potential benefits of consuming a nutritious diet, namely one that includes fruits and vegetables, in reducing obesity and overweight in youngsters.[7]

The results showed a decline in the prevalence of television viewing and the level of exposure to computer or video games after six months of intervention. Watching TV and playing computer games and other multi-screen users by children play a role in increasing BMI, the current study focused on decreasing and minimizing exposure to multi-screen the same result found in other studies.[4] The study done in the United States demonstrated that there was a substantial positive correlation between the number of hours spent watching television each day and the rate of acceleration in children's BMI growth trajectory, there exists a notable correlation between the number of hours spent watching television and the BMI of children, specifically, children who watch four hours of television per day, as contrasting to one hour per day, are at a higher risk of exceeding the 85th percentile of BMI, this percentile is commonly recognised as an indicator an increased likelihood of obesity in children.[23] In this study one of the goals was to decrease the spent time watching TV and computer games with family help to reduce BMI, another study demonstrated that gaming addiction was due to obesity and overweight.[24]

The educational program aimed to address the issue of sleep quality among children, with the involvement of researchers and parents. The program sought to promote the importance of children adhering to an early bedtime routine and obtaining enough sleep. The primary objective was to mitigate the risk of increased BMI and avoid the onset of obesity and overweight conditions. A study in Bangladesh findings

Table 3.  **Displays the percentages of bad practice and good practice observed before and after the intervention**

| Pre-intervention * Post-intervention crosstabulation | | | | | | |
|---|---|---|---|---|---|---|
| | | | Post intervention | | Total | Exact sig. (2-sided)* |
| | | | Poor practice | Good practice | | |
| Pre intervention | Poor practice | Count | 2 | 14 | 16 | |
| | | % Within pre intervention | 12.5% | 87.5% | 100.0% | |
| | | % Within post intervention | 40.0% | 20.6% | 21.9% | |
| | Good practice | Count | 3 | 54 | 57 | |
| | | % Within pre intervention | 5.3% | 94.7% | 100.0% | 0.027 |
| | | % Within post intervention | 60.0% | 79.4% | 78.1% | |
| Total | | Count | 5 | 68 | 73 | |
| | | % Within pre intervention | 6.8% | 93.2% | 100.0% | |
| | | % Within post intervention | 100.0% | 100.0% | 100.0% | |

*MacNemar test.

indicate that there is an association between short sleep duration and both overweight/obesity and underweight among teenagers. Therefore, ensuring sufficient sleep may act as an effective technique for preventing obesity throughout the developmental phases.[25] In a previous study, it was observed that children with a delayed bedtime and wake-up time had a notable elevation in their BMI in comparison to those with an earlier bedtime and wake-up time, despite both groups having equivalent sleep durations.[26]

It was observed that the scores for the responses improved after the intervention. The prevalence of sleep insufficiency is widespread among teenagers in Bangladesh and China, with a notable correlation between shorter sleep duration and an increased likelihood of being overweight or obese.[25,27] Previous research discovered that individuals who have sufficient sleep lead to help to reduce the prevalence of obesity in both pediatric and adult populations.[25,27] In another research conducted, it was shown that there is a positive correlation between shorter sleep duration and an increase in Swedish children's BMI Z-score by 0.09 units. This suggests that a reduced amount of sleep may potentially elevate the likelihood of overweight and obesity among children. It is recommended that parental educational interventions take into account the incorporation of suitable sleep habits as a component of initiatives aimed at addressing the onset of childhood obesity.[28] Furthermore, a study in Greece found that there was a correlation between the length and patterns of sleep and the weight status of children. It is recommended that interventions be devised to provide parental education on the significance of appropriate sleep duration and the cultivation of good sleep patterns in promoting the healthy development of their children.[29]

## Conclusion

The findings of this intervention demonstrated favorable outcomes in terms of BMI decrease, as well as improvements in dietary and physical activity behaviours, and the presence of food options within the household. The primary intervention that yielded the greatest impact involved altering the duration allocated to sedentary behaviors, particularly those involving sitting and television viewing. This was followed by

an enhancement in physical activity levels and the adoption of favorable nutrition-related practices, such as heightened vegetable consumption and reduced intake of fatty and high-carbohydrate foods. Hence, it can be inferred that shifts in parental attitudes had a role in promoting children's engagement in structured activities, such as sports and physical education programs, after school hours. Additionally, these changes in attitudes also contributed to a decrease in the accessibility of high-risk food proportion. There has been a general trend towards less time spent engaging in activities such as watching television, using computers, or playing video games.

The strength aspect of this research is its duration since it spanned over six months. Additionally, the intervention used in this study focused on family and household children. Moreover, both parents and school children actively participated in the intervention. The intervention was implemented in two distinct districts within the city of Erbil, each representing various socioeconomic levels. This selection allows for the potential generalisation of our results to other children and families that share similar sociodemographic features. The program underwent standardisation using organised training and the development of a written plan outlining the tasks to be conducted in each session. The level of parental and child permission to participate in the program was found to be high, along with a strong adherence to the program.

## Limitation of the Research

The limitation of this research was the absence of control over various social, cultural, and community factors. The exclusion of families living in new cities and flats due to security concerns has resulted in their inability to engage in the activities of such areas. In addition, children less than five years old and adults were excluded.

## Recommendation

To enhance the efficacy of an educational program, it is proposed that the program's duration be extended. Additionally, it is recommended that the Ministry of Education and Ministry of Health play a more active role in educational initiatives by

creating short video clips to be presented in schools. Moreover, encouraging increased motivation among students can be achieved through regular parental engagement in school or health center meetings.

Future studies could investigate the consequences in many circumstances, including high socioeconomic level people residing in newly developed urban areas, disadvantaged regions, and diverse ethnic groups.

## Conflict of Interest

None. ■

## References

1. Crespo NC, Elder JP, Ayala GX, Slymen DJ, Campbell NR, Sallis JF, et al. Results of a multi-level intervention to prevent and control childhood obesity among latino children: the aventuras para niños study. Ann Behav Med. 2012;43(1):84–100.
2. Lobstein T, Baur L, Uauy R. Obesity in children and young people: A crisis in public health. Obes Rev Suppl. 2004;5(1):4–104.
3. Wen LM, Baur LA, Rissel C, Wardle K, Alperstein G, Simpson JM. Early intervention of multiple home visits to prevent childhood obesity in a disadvantaged population: A home-based randomised controlled trial (Healthy Beginnings Trial). BMC Public Health. 2007;7:1–8.
4. Flattum C, Draxten M, Horning M, Fulkerson JA, Neumark-Sztainer D, Garwick A, et al. HOME Plus: Program design and implementation of a family-focused, community-based intervention to promote the frequency and healthfulness of family meals, reduce children's sedentary behavior, and prevent obesity. Int J Behav Nutr Phys Act [Internet]. 2015;12(1):1–9.
5. Liu S, Marques IG, Perdew MA, Strange K, Hartrick T, Weismiller J, et al. Family-based, healthy living intervention for children with overweight and obesity and their families: a 'real world' trial protocol using a randomised wait list control design. BMJ Open. 2019;9(10):1–9.
6. Watson PM, Dugdill L, Pickering K, Owen S, Hargreaves J, Staniford LJ, et al. Service evaluation of the GOALS family-based childhood obesity treatment intervention during the first 3 years of implementation. BMJ Open. 2015;5(2):1–14.
7. Folkvord F, Naderer B, Coates A, Boyland E. Promoting fruit and vegetable consumption for childhood obesity prevention. Nutrients. 2022;14(1):1–13.
8. Bestle SMS, Christensen BJ, Trolle E, Biltoft-Jensen AP, Matthiessen J, Gibbons SJ, et al. Reducing young schoolchildren's intake of sugar-rich food and drinks: Study protocol and intervention design for "are you too sweet?" a multicomponent 3.5-month cluster randomised family-based intervention study. Int J Environ Res Public Health. 2020;17(24):1–20.
9. Wouters S, Thewissen V, Duif M, Van Bree RJH, Lechner L, Jacobs N. Habit strength and between-meal snacking in daily life: The moderating role of level of education. Public Health Nutr. 2018;21(14):2595–605.
10. Hoeeg D, Christensen U, Lundby-Christensen L, Grabowski D. Contextual complexities in implementing a family-based childhood obesity intervention: The perspectives of enrolled children and their parents. Children. 2020;7(12):267.
11. Christie D, Hudson LD, Kinra S, Wong ICK, Nazareth I, Cole TJ, et al. A community-based motivational personalised lifestyle intervention to reduce BMI in obese adolescents: Results from the Healthy Eating and Lifestyle Programme (HELP) randomised controlled trial. Arch Dis Child. 2017;102(8):695–701.
12. Khumros W, Vorayingyong A, Suppapitiporn S, Rattananupong T, Lohsoonthorn V. Effectiveness of modified health belief model-based intervention to reduce body mass index for age in overweight junior high school students in Thailand. J Heal Res. 2019;33(2):162–72.
13. Ranganathan P, Aggarwal R. Study designs: Part 5 - Interventional studies (III). Perspect Clin Res. 2020;11(1):47–50.
14. Goodyear RK (Rosemary K, Fabian A, Hay J (Jane), New Zealand. Statistics New Zealand. Finding the crowding index that works best for New Zealand: applying different crowding indexes to census of population and dwellings data for 1986–2006. 2012. 59 p.
15. Omer W, Al-Hadithi T. Developing a socioeconomic index for health research in Iraq. East Mediterr Heal J. 2017;23(10):670–7.
16. Okour, A.M., Saadeh, R.A., Hijazi, M.H., Al Khalaileh, H.E., & Alfaqih, M.A. (2019). Socioeconomic status, perceptions and obesity among adolescents in Jordan. Pan African Medical Journal, 34(1), 148.
17. Demment, M.M., Haas, J.D., & Olson, C.M. (2014). Changes in family income status and the development of overweight and obesity from 2 to 15 years: a longitudinal study. BMC Public Health, 14(1), 417.
18. Ayala-Marín, A.M., Iguacel, I., Miguel-Etayo, P.D., & Moreno, L.A. (2020). Consideration of social disadvantages for understanding and preventing obesity in children. Frontiers in Public Health, 8, 423.
19. Plachta-Danielzik S, Landsberg B, Lange D, Seiberl J, Müller MJ. Eight-year follow-up of school-based intervention on childhood overweight - The Kiel obesity prevention study. Obes Facts. 2011;4(1):35–43.
20. Bacardí-Gascon M, Pérez-Morales ME, Jiménez-Cruz A. Intervención aleatorizada de seis meses en las escuelas, con un seguimiento de 18 meses para la prevención de obesidad infantil en escuelas primarias de México. Nutr Hosp. 2012;27(3):755–62.
21. Bere E, Veierød MB, Bjelland M, Klepp KI. Free school fruit - Sustained effect 1 year later. Health Educ Res. 2006;21(2):268–75.
22. Anggraeni AS, Sukartini T, Kristiawati K. Consumption of Fruit and Vegetable with Risk of Obesity in School-Age Children. J Ners. 2017;12(1):27–32.
23. Danner FW. A national longitudinal study of the association between hours of TV viewing and the trajectory of BMI growth among US children. J Pediatr Psychol. 2008;33(10):1100–7.
24. Apisitwasana N, Perngparn U, Cottler LB. Effectiveness of school- and family-based interventions to prevent gaming addiction among grades 4-5 students in Bangkok, Thailand. Psychol Res Behav Manag. 2018;11:103–15.
25. Anam MR, Akter S, Hossain F, Bonny SQ, Akter J, Zhang C, et al. Association of sleep duration and sleep quality with overweight/obesity among adolescents of Bangladesh: a multilevel analysis. BMC Public Health [Internet]. 2022;22(1):1–9. Available from: https://doi.org/10.1186/s12889-022-12774-0
26. Venkatapoorna CMK, Ayine P, Selvaraju V, Parra EP, Koenigs T, Babu JR, et al. The relationship between obesity and sleep timing behavior, television exposure, and dinnertime among elementary school-age children. J Clin Sleep Med. 2020;16(1):129–36.
27. Chen H, Wang LJ, Xin F, Liang G, Chen Y. Associations between sleep duration, sleep quality, and weight status in Chinese children and adolescents. BMC Public Health [Internet]. 2022;22(1):1136. Available from: https://doi.org/10.1186/s12889-022-13534-w
28. Danial B, Faresjö T, Fredriksson M, Ludvigsson J. Childhood sleep and obesity risk: A prospective cohort study of 10 000 Swedish children. Pediatr Obes. 2023;18(2):1–8.
29. Kanellopoulou A, Notara V, Magriplis E, Antonogeorgos G, Rojas-Gil AP, Kornilaki EN, et al. Sleeping patterns and childhood obesity: An epidemiological study in 1,728 children in Greece. J Clin Sleep Med. 2021;17(5):1093–101.