Sri Lanka Journal of Medicine **SLJM**

Original Research

Citation: Kiridana DVK Vidanapathirana G Vidanapathirana NS et al., 2023. Characteristics associated with successful treatment outcome in children with overweight and obesity at a tertiary care clinic in Sri Lanka. Sri Lanka Journal of Medicine, pp 6-17.
DOI: https://doi.org/10.4038/sljm.v32i1.365

Characteristics associated with successful treatment outcome in children with overweight and obesity at a tertiary care clinic in Sri Lanka

Kiridana DVK[1], Vidanapathirana G[2], Vidanapathirana NS[3], Tennakoon S[4]

[1]Department of Paediatrics, Faculty of Medicine, University of Peradeniya
[2]Department of Medical Laboratory Science, Faculty of Allied Health Sciences, University of Peradeniya
[3]Department of Physiology, Faculty of Medicine, University of Peradeniya

Correspondence:
Dr. Kiridana DVK (VK), MD, MRCPCH, DCH, MBBS
Department of Paediatrics,
Faculty of Medicine,
University of Peradeniya, Sri Lanka
E-mail: vkiridana@yahoo.co.uk

https://orcid.org/0000-0002-3388-1954

Abstract

Background: Lack of response to childhood obesity management programmes is a global concern. Western studies show that the age and the body mass index of the child at the commencement of the treatment, frequency of clinic visits and parental level of education affect the outcome of such treatment programmes.
Objectives: To identify factors associated with z-BMI reduction in children with overweight or obesity who underwent a 6-month clinic-based obesity management programme.
Methods: A retrospective analysis of medical records was carried out on children between 2 and 15 years of age who had undergone a weight management programme of 6 months duration at the Teaching Hospital, Peradeniya between 2017 and 2020. Reduction in z-BMI was considered as the successful treatment outcome. Anthropometric, demographic and lifestyle factors at the first and the last visits were extracted and described using means with 95% confidence intervals. Adherence to treatment was evaluated under the categories of diet, physical activity and behavioural modification. Logistic regression was applied to create a model that explains the effect on the treatment outcome.
Results: Out of 401 subjects, 94 (23.44%) completed follow up. Eighty subjects (85.1%) achieved a mean z-BMI reduction of 1.981±0.584.
The Logistic regression returned a model with screen time as the only statistically significant explanatory variable for changes in BMI. Compared to no screen time those with screen times of over 4 hours were 5.85 (CI 1.25 – 27.28) times more likely to have a negative response.
Conclusion: Strategies to minimize screen time are needed to enhance the effectiveness of weight management interventions.

Keywords: childhood obesity, obesity management, Lifestyle modification, diet, physical activity, behavior, treatment outcome

Received: 2022-10-16 **Accepted revised version: 2023-07-12** **Published: 2023-08-20**

INTRODUCTION

The prevalence of childhood overweight and obesity has increased at an alarming rate over the past three decades. Majority of obese and overweight children live in developing countries where the rate of increase is 30% higher than developed countries [1]. The global prevalence of childhood obesity in 2016 was 7.8% in boys and 5.6% in girls [2,3]. A recent Sri Lankan survey showed a prevalence of childhood obesity at 10.3% and overweight at 11.3% [4]. A study conducted in the same draining area of Teaching Hospital Peradeniya, where this study was conducted, found a prevalence of 7.81% overweight and 6.79% obesity among a group of school children [5].

An analysis of 79 studies by Pulgaron ER revealed that childhood obesity is associated with metabolic risk factors, asthma and major psychological comorbidities. A review on childhood obesity and adult morbidities Without intervention, two-thirds of obese children are likely to transition into obese adults and develop non-communicable diseases at a younger age [6,7].

Management of childhood overweight and obesity include dietary, physical activity and behavioural modifications [8]. Most studies published to date demonstrate either low or only short-term benefit from lifestyle modification programmes. Analysis of 30 clinical trials involving 14326 participants concluded that physical activity interventions had only a limited success on BMI reduction [9].
A review of 3 well designed randomized controlled trials on the effectiveness of weight management programmes for pre-school children based on physical activity intervention and parental health education did not show a statistically significant response in 1 year follow up [11].

Gori and et al have meta-analysed 72 studies on the effectiveness of educational and lifestyle interventions where 39 studies with combined diet and physical activity programmes demonstrated positive results [12]. They also revealed that programmes lasting less than 1 year were more efficacious.

However, as described by Blomquist et al, dropout rates between 25-33% from clinic-based weight management programmes indicate that lack of compliance is a major drawback in the achievement of weight reduction and stabilizing body weight over longer periods of time [13].
Therefore, identifying factors affecting the response to lifestyle modifications is necessary to plan strategies to achieve better outcomes. Among the studies that evaluated such predictors, a clinic-based weight management programme involving 662 children revealed that starting treatment at a younger age was associated with a significantly low post treatment-z-BMI [13].

Studies on the outcome of weight management interventions and the factors determining the success of such treatment programmes are, however, lacking from low and low-middle income countries including Sri-Lanka.

The objectives of this study were to identify factors associated with successful BMI reduction in children with overweight or obesity and to evaluate the efficacy of those factors in leading to a positive outcome.

METHODS

Study design and participants

This study was based on retrospective medical record review of subjects aged 1 to 15 years attending the multi-disciplinary obesity management clinic between 2017 and 2020 at Teaching Hospital, Peradeniya.

Subjects with overweight or obesity who have completed 6 months follow up visits were considered for the analysis. Overweight was defined as BMI for age between +1SD and +2SD and BMI for age > +2SD as obesity. Children with chronic medical conditions, physical disability and cognitive impairment in whom the full lifestyle modification intervention could not be implemented were excluded. Out of 417 potential subjects with a first visit at 1-15 years within the review period, sixteen (3.83%) children were excluded. Another 307 (73.6%) children have not completed the 6 months follow up. The final

outcome analysis sample of 94 (22.5%) who have completed 6 months follow up visits were identified.

The study was approved by the ethics review committee of the Faculty of Medicine, University of Peradeniya.

Obesity management programme

This multidisciplinary paediatric obesity management clinic provides individualized care to children and adolescents. The team consists of a Clinical Nutritionist, a Consultant Paediatrician, and Paediatric Medical Officers. The main goal of the obesity management programme is reduction of body weight through lifestyle modification.

The anthropometric measurements are taken by trained doctors according to WHO standards [14]. Body weight is measured with the subject wearing light clothing to the nearest 0.1kg using the pre-calibrated digital scale. Height measurements are taken to the last completed 0.1cm using the GIMA portable stadiometer. BMI for age z-score is calculated and the WHO 2007 growth reference was used to determine the BMI for age z-scores in the subjects. Waist circumference is measured with a flexible measuring tape with the subject dressed in light clothing, standing upright, feet slightly apart and abdomen relaxed. Waist circumference is taken at the narrowest point of the torso above the umbilicus and below the rib cage.

The treatment consists of a dietary plan and behavioral modification. All patients are followed up monthly for the first 3 months and 2 monthly thereafter.

At each follow up visit, children and families are individually seen by doctors and the lifestyle intervention is continually reinforced. The nutrition and physical activity goals are refined and monitored, and barriers to implementation are addressed.

Adherence to lifestyle modifications were evaluated under the categories of diet, physical activities, sedentary time and sleep duration. Behavioural variables were assessed including food craving and motivation.
Positive response was taken as reduction of BMI z-score and negative response was taken as an increment of the BMI z-score during the follow up period.

Data analysis

Data was entered into SPSS version 25 and described using proportions and means with 95% confidence intervals. Anthropometric variables including relative weight, height, body mass index (BMI) for age, z-BMI and waist circumference were described with the means with 95% confidence intervals.

For establishing associations between independent categorical variables and the dependent variable (reduction or maintence of the z-BMI), chi square was used. Regression analysis was applied to explore associations between dependent variable and multiple independent variables.

Chi square was used to compare the categorical data while the t test was used to compare the parametric data related to the baseline demographic, clinical, and lifestyle characteristics of the groups.

A logistic regression model was applied to identify statistically significant associations with treatment response. Response to lifestyle modification programme was taken as the dependent variable while the characteristics significant at $p < 0.05$ in univariate analyses were taken as possible covariates in the model.

RESULTS

Out of 401 subjects meeting the inclusion criteria, 94 (22.54%) subjects have completed 6 months follow up visits. The ethnic diversity of our study population closely represents the national figures. The majority of the study group were Sinhalese (87.2%) while 4.3% and 8.5% were Tamils and Muslims respectively.
Baseline characteristics of the subjects with 6 months follow up visits and without 6 months

follow up have been compared in Table 1. No statistically significant differences were found between the subjects for sex, ethnicity, and birth weight.

A lower initial BMI (p=0.043) and higher level of maternal education (p=0.042) were at significant levels in the positive response group.

Table 1: Comparison of the baseline characteristics of the subjects enrolled in the multidisciplinary obesity management clinic using the chi-square test.

	Characteristic N (%)	Total N=401	Follow-up group		P value *Chi square test for independence (χ^2, df)
			With 6 months Follow up N=94	Without 6 months follow up N= 307	
Sex	Male Female	220 (54.9) 181 (45.1)	54 (57.4) 40 (42.6)	166 (54.07) 141 (45.93)	*0.57 (2.088,1)
Ethnicity	Sinhalese Tamils Muslims	343 (85.5) 19 (4.7) 39 (9.8)	82 (87.2) 4 (4.3) 8 (8.5)	261 (85.1) 15 (4.8) 31 (10.1)	*0.66 (123.14, 2)
Maternal Education	Up to G.C.E.Ordinary Level G.C.E. Advance Level Diploma Degree	282(70.3) 95 (23.7) 7 (1.7) 17 (4.2)	48 (51.06) 38 (40.4) 1 (1.06) 7 (7.44)	234 (76.2) 57 (18.5) 6 (1.9) 10 (3.3)	*0.04 (66.26, 3)
Paternal Education	Up to G.C.E.Ordinary Level G.C.E. Advance Level Diploma Degree	247(61.6) 132 (32.9) 5 (1.2) 17 (4.2)	52 (55.3) 36 (38.3) 0 6 (6.4)	195(63.5) 96 (31.3) 5 (1.6) 11 (3.6)	*0.46 (75.47, 3)
Birth weight	<2.5 kg 2.5-3.5 kg >3.5kg NA#	45 (11.2) 248 (61.8) 66 (16.4) 42 (10.6)	14 (14.9) 58 (61.7) 17 (18.1) 5 (5.3)	31 (10.1) 190 (61.8) 49 (15.9) 37 (12.2)	*0.16 (17.81, 2)
Age category	< 10 years ≥10 years	132 (32.9) 269 (67.1)	34 (36.2) 60 (63.8)	98 (31.9) 209 (68.1)	*0.42(7.19, 2)

Table 2: Comparison of the baseline characteristics of the subjects enrolled in the multidisciplinary obesity management clinic using the t- test.

Characteristic	Total N=401	Follow-up group		P value t test for difference between means
		With 6 months Follow up N=94	Without 6 months follow up N= 307	
[a]Age in years (SD)	10.7 (3.2)	9.9 (3.5)	10.7 (3.2)	**0.06
[a]Initial BMI kg/m^2 (SD)	26.2 (4.2)	25.5(3.3)	26.6 (4.8)	**0.04

Subjects in the 6 months follow up group (n=94) had an average age of 9.9 (SD±3.484). The weight of the children ranged between 10.9kg and 87.70kg at the initial visit which changed to a range between 11.95kg and 87.7kg after the completion of 6 months follow up. The mean BMI of the study group at the initial visit and after following up was 25.502 kg/m^2 (SD ±3.290) and 24.919 kg/m^2 (SD ±4.228) respectively. The mean BMI z-score of the study group was 1.937 (SD ±0.742) at the initial visit and it has been declined to 1.670 (SD ±0.743) after 6 months follow up.

According to the findings, 85.1% (n=80) has shown a positive response while 14.9% (n=14) had a negative response. Baseline characteristics including age, weight, height, BMI, z-BMI and the waist circumference were compared between the positive and the negative response groups (Table2).

Among the positive responders with the mean age10.27 (SD±3.330), 58.7% (n=45) were boys and 41.3% (n=33) were girls. Average weight at the initial visit was 52.25±15.972kg and was 52.150 ±15.372kg at the completion of 6 months follow up.

In addition, mean BMI of the positive responders at the initial visit and at the end of the study period was 25.75±3.125kg/$m^2$and 25.23±3.195kg/m^2 respectively. Mean z-BMI of the study group on the two occasions was 1.981±0.584 and 1.624±0.531respectively.

The age of the negative responders varied from 2 years to 13 years while the mean age was 8.36 (SD±4.012). Mean weight at the initial visit and the completion of 6 months follow up was 39.457±14.583kg and 39.68±19.415kg respectively. In addition, mean BMI of the negative responders on the two occasions was 24.044±3.923kg/$m^2$and 23.10±7.855 kg/m^2. Mean z-BMI of the study group was 1.688±1.310 and 1.953±1.509 respectively.
There was a significant difference in the initial weight (p=0.006) and height (p=0.014) between the positive response group and the negative response group.
Further baseline characteristics at the initial visit were compared and according to the findings, majority of the positive responders were more than 10 years of age (67.5%) in the positive response group. Time spent for tuition classes on weekdays (p=0.046), paternal education (p=0.045) and number of clinic visits (p=0.002) have shown a significant difference between the two groups.

Table 4: comparison of the baseline characteristics of the positive and the negative responders at the initial visit

Characteristic	Total group N=94 N (%)	Positive responders n=80 N (%)	Negative responders n=14 N (%)	P value
Age category < 10 years ≥ 10 years	 31 (32.9) 63 (67.1)	 26 (32.5) 54 (67.5)	 5 (35.7) 9(64.3)	 0.075
Gender Male Female	 54 (57.4) 40 (42.6)	 47 (58.7) 33 (41.3)	 7 (50) 7 (50)	 0.127
Ethnicity Sinhalese Tamils Muslims	 82 (87.1) 4 (4.4) 8 (8.5)	 71 (88.75) 2 (2.5) 7 (8.75)	 11 (78.6) 2 (14.3) 1 (7.1)	 0.350

Birth weight				
<2.5 kg	13 (13.8)	11 (13.75)	2 (14.3)	
2.5-3.5 kg	56 (59.6)	48 (60)	8 (57.1)	
>3.5kg	17 (18.1)	16 (20)	1 (7.1)	0.376
NA	8 (8.5)	5 (6.25)	3 (21.5)	
Maternal education				
Up to G.C.E.Ordinary Level	44 (46.8)	38 (47.5)	6 (42.9)	
G.C.E. Advance Level	42 (44.7)	35(43.75)	7 (50)	0.123
Diploma	2 (2.1)	1 (1.25)	1 (7.1)	
Degree	6 (6.4)	6(7.5)	0	
Paternal education				
Up to G.C.E.Ordinary Level	50 (53.2)	41 (51.25)	9 (64.3)	
G.C.E. Advance Level	38 (40.4)	33 (41.25)	5(35.7)	0.046*
Diploma	00 (00)	00 (00)	00 (00)	
Degree	6 (6.4)	6 (7.5)	00 (00)	
No. of visits				0.002*
<6 visits	25 (26.6)	19 (23.75)	6 (42.9)	
6-10 visits	29 (30.8)	21 (26.25)	8 (57.1)	
>10 visits	40 (42.6)	40 (50)	0	
Transport method				
By vehicle	66 (70.2)	56 (70)	10 (71.4)	0.717
By walking	28 (29.8)	24 (30)	4 (28.6)	
Availability of a TV in the bedroom				
Yes	6 (6.4)	5 (6.25)	1 (7.1)	0.805
No	88 (93.6)	75 (93.75)	13 (92.9)	
Screen time (hours/day)				
Not watching	14 (14.9)	11 (13.75)	3 (21.4)	
< 1 hour	19 (20.2)	16 (20)	3 (21.4)	0.615
1-2 hours	27 (28.7)	25 (31.25)	2 (14.3)	
2-4 hours	26(27.6)	20(25)	6 (42.9)	
≥ 4 hours	8 (8.6)	8 (10)	00 (00)	
Consumption of deep-fried food (per week)				
< 1 time/ week	23 (24.5)	20 (25)	3(21.4)	0.176
1-6 times / week	57 (60.6)	50 (62.5)	7 (50)	
7 times / week	9 (9.6)	6 (7.5)	3(21.4)	
>7 times / week	5 (5.3)	4 (5)	1 (7.1)	
Consumption of salty food				
< 1 time/ week	16 (17.1)	14 (17.5)	2 (14.3)	
1-6 times / week	40 (42.6)	35 (43.75)	5 (35.7)	0.761
7 times / week	33 (35.1)	26 (32.5)	7 (50)	
>7 times / week	5 (5.2)	5 (6.25)	0	

Consumption of sweets < 1 time/ week 1-6 times / week 7 times / week >7 times / week	 35 (37.2) 48 (51.1) 10 (10.6) 1 (1.1)	 30 (37.5) 41 (51.25) 8 (10) 1 (1.25)	 5(35.7) 7 (50) 2(14.3) 0	 0.239
Having breakfast (/week) Never 1 day 2 days 3 days 4 days Everyday	 16 (17.1) 1 (1.1) 4 (4.3) 3(3.1) 3 (3.1%) 67 (71.3%)	 11 (13.75) 1 (1.25) 4 (5) 2 (2.5) 3 (3.75%) 59 (76.75%)	 5 (35.7) 1(7.1) 0 8(57.2%)	 0.704
Engaging in physical activities (hour/day) Not doing < 1 hour 1-2 hours 2-4 hours ≥ 4 hours	 23 (24.5%) 30 (31.9%) 30 (31.9%) 6 (6.4%) 5 (5.3%)	 17 (21.25%) 28 (35%) 25 (31.25%) 5(6.25%) 5(6.25%)	 6 (42.9%) 2 (14.3%) 5 (35.7%) 1(7.1%) 0	 0.494
Attending tuition classes on weekdays Not attending < 1 hour 1-2 hours 2-4 hours ≥ 4 hours	 45 (47.8%) 8 (8.5%) 22(23.4%) 14 (14.8%) 5 (5.3%)	 36 (45%) 7 (8.75%) 20 (25%) 12 (15%) 5 (6.25%)	 9 (64.3%) 1(7.1%) 2(14.3%) 2(14.3%) 0	 0.045*
Attending tuition classes on weekends Not attending < 1 hour 1-2 hours 2-4 hours ≥ 4 hours	18 (19.1%) 1 (1.1%) 23 (24.5%) 39 (41.5%) 13 (13.8%)	12 (15%) 0 17 (21.25) 38 (47.5%) 13 (16.25%)	6 (42.9%) 1 (7.1%) 6(42.9%) 1 (7.1%) 0	0.075

*p<0.05

Table 5: Adherence to lifestyle modification in the positive response group and the negative response group

Lifestyle modification	Total group	Positive responders	Negative responders	P value
Dietary Habits Adhered Not adhered	 77 (81.9%) 17 (18.1%)	 68 (85%) 12 (15%)	 9 (64.3%) 5 (35.7%)	 0.065
Screening time Do not watch < 1 hr 1-2 hrs	 9 (9.6%) 18 (19.1%) 52 (55.4%)	 6 (7.5%) 17 (21.25%) 47 (58.75%)	 3 (21.4%) 1(7.2%) 5 (35.7%)	 0.405

2-4 hrs	15 (15.9%)	10 (12.5%)	5 (35.7%)	
Sleep-duration 8-10 hrs 10-12 hrs	 84 (89.4%) 10 (10.6%)	 73 (91.25%) 7 (8.75%)	 11(78.6%) 3 (21.4%)	 0.158
General physical activities Engaged Not engaged	 77 (81.9%) 17 (18.1%)	 68 (85%) 12 (15%)	 9 (64.3%) 5 (35.7%)	 0.065
Structured activities Engaged Not engaged	 32 (34.1%) 62 (65.9%)	 30(37.5%) 50 (62.5%)	 2 (14.3%) 12 (85.7%)	 0.093
Motivation Yes No	 53 (56.4%) 41 (43.6%)	 49 (61.25%) 31 (38.75%)	 4 (28.6%) 10 (71.4%)	 0.024*
Food craving Yes No	 17 (18.1%) 77 (81.9%)	 15 (18.75%) 65 (81.25%)	 2 (14.3%) 12 (85.7%)	 0.690

*$p<0.05$

The adherence to treatment at the end of 6 months was compared between the 2 groups considering 7 lifestyle factors as predictors of response. (Table 3). A statistically significant difference in the level of motivation is seen between the two groups (p=0.024).

Table 6: Likelihood of influence of individual intervention factors on weight reduction – bivariate logistics regression.

Lifestyle intervention		Beta	Odds Ratio	P value
*Adhered to diet		-1.1	0.3	0.73
Screen time***	None			
	Less than 1 hour	0.0	1.0	1.00
	1-2 hours	2.1	8.5	0.06
	More than 2 hours	1.6	4.7	0.03
**Sleep duration (<10/>10 hours)		1.5	2.8	0.17
*Physical activity		-1.1	0.3	0.73
*Structured physical activity		-1.2	0.3	0.11
*Motivation (no/yes)		-1.3	0.3	0.03
*Food cravings		-0.3	0.7	0.69

*Coded as 0 -negative and 1 -positive, 0 was the reference category

**Coded as 1-ess than 10 hours and 2 more than 10 hours – reference category 1

***Coded 1 to 4 – reference category 1 (none)

Table 7: Logistic regression model examining association of lifestyle modifications with the reduction or maintenance of z-BMI.

Intervention		Beta	P value	Odds Ratio	95% CI for Odds Ratio	
					Lower	Upper
Screen time (hours)	0 (reference)					
	<1	0.32	0.75	1.34	0.18	10.08
	1-2	2.04	0.09	7.78	0.73	81.63
	2-4	**1.77**	**0.03**	***5.85**	**1.25**	**27.28**
Structured physical activities (reference = not engaging)		-0.24	0.82	0.78	0.95	6.56
Sleep (reference = 8 to 10 hours)		1.15	0.20	3.16	0.54	18.52
Motivation (reference = no motivation)		-1.23	0.16	0.29	0.05	1.63
Constant		0.45	0.73			

Logistic regression was thereafter used to analyze the effect of the intervention as a whole on the outcome. Variables that returned a p value of less than 0.2 in the bivariate analysis were included to build an explanatory model (Table 6). Enter method was used to run the analysis. The Logistic regression returned a model with screen time as the only statistically significant explanatory variable for changes in BMI. Compared to no screen time those with screen times of over 4 hours were 5.85 (CI 1.25 – 27.28) times more likely to have a negative response.

DISCUSSION

Nearly a quarter of children enrolled in the obesity management programme completed the 6 month follow up period. Children with a lower initial BMI (p=0.043, Independent sample, t- test) and higher maternal education levels (p=0.042) were more likely to complete the programme. Previous studies have demonstrated mixed results on the association of age and sex with the follow up of obesity programmes [15,16,17,18,19]. Most of the studies showed no association with the age.

A study carried out among a group of German children to assess the association between socioeconomic status and childhood obesity reported a strong relationship between parental education and child's obesity [20].

The majority of children of the study population have not completed the 6-month duration of follow up. The observation of reduced retention rates is reported in several studies [21,22]. Insufficient awareness on the consequences of childhood obesity and lack of motivation may have contributed towards incomplete follow up.

Eighty children of the 94 who completed the programme achieved reductions in the BMI- z score. The impact of regular participation in an obesity management programme has been described in a prospective multicentre trial from Germany among 167 children who participated in an in-patient treatment programme [8]. According to their findings, after an inpatient treatment lasting 40.4 ± 4.1 (range, 28–49) days, subjects achieved a significant weight reduction. This study identified regular participation in teaching programmes as the most important predictor for effective long-term weight reduction.

Comparison of the baseline characteristics of the positive and the negative response groups at the initial visit revealed that the majority of the positive responders were more than 10 years of age (67.5%). Children in 10-19 years age group have a stronger consideration in physical appearance compared to the pre-adolescent age group. Thus, age may be a predictor of treatment outcome in overweight and obese children [23].

According to a previous study, females were more concerned than males about body weight, and physical appearance across all age groups [24]. However, we did not observe a sex difference with regard to the response to treatment.

Among the characteristics analysed, paternal education (p=0.045) and the number of follow up visits (p=0.002) were higher in the positive response group. Time spent on tuition classes on weekdays (p=0.046) was also higher in this group. Attending after-school tuition classes is an increasing trend in the Sri Lankan education system which substantially increases the sitting time of school children. It may also minimize the time to engage in sports activities. Another interesting observation was high levels of compliance with dietary and physical activity interventions (p=0.065) in both groups. The Sri Lankan socio-cultural context of abiding by health care advises may be a reason for this observation.

Psychological motivation can be used to increase the efficacy of behavioural modifications. Cognitive behavioural therapy is a well-studied intervention in altering unhealthy cognitions, emotions and behaviours [2,25]. This may help to reduce overall food consumption and to encourage making healthy food choices [3].
Our study also reveals a higher level of motivation among the positive response group (p=0.024). Psychological motivation of the child as well as the parents is a major component in our obesity management programme.

The Logistic regression returned a model with screen time as the only statistically significant explanatory variable for changes in BMI. Compared to no screen time those with screen times of over 4 hours were 5.85 (CI 1.25 – 27.28) times more likely to have a negative response. Demographic and dietary factors were not significantly associated with reduction of the z-BMI.

Out of the 94 children in our study population who underwent the obesity management programme with 6 month follow up, 14 children did not achieve reduction in z-BMI. Lack of response is likely to be due to longer screen times, lack of stimulus control and lack of motivation.

Our observation is supported by a randomized trial that has been carried out to assess the effects of reducing television viewing and computer use on childhood obesity [26]. The study concluded that reducing screen time may have an important role in lowering BMI in young children.

An important limitation observed is that a significant proportion of children did not complete the 6 months follow up. A 50% loss to follow up is a finding common to many obesity management programmes [27,28, 29]. The documentation of lifestyle data was based on parental reporting which could be a source of bias since the unhealthy habits may not have fully revealed during the data collection process.

CONCLUSION

Based on these findings, both primary and tertiary care obesity management programmes need to focus on counselling regarding minimizing screen time and improving stimulus control to prevent food craving behaviour. Reinforcement of positive behaviours in these children may enhance the likelihood of adopting a healthy lifestyle for the rest of their lives.

Once identified, the modifiable factors could be addressed using novel approaches and reinforcement.

Author declaration

Authors' contributions:

VK and SK conceptualized the study, VK, SK and GV collected the data, VK and GV analysed and interpreted the data, VK and GV drafted the manuscript, VK, SK and ST refined methodologies and tools, VK, SK, GV and ST revised the manuscript, VK, SK and ST finalized the manuscript. All authors read and approved the final manuscript.

Acknowledgements

Conflicts of Interest:

No conflicts of interest declared by the authors.

Sources of funding:

The study was not funded by any source or funding agency.

Ethics approval and consent to participate:

Ethics approval for this study was obtained from the ethical review board of the Faculty of Medicine, University of Peradeniya. Written permission was taken from the Teaching Hospital, Peradeniya. Written informed consent to participate was obtained from all the respondent parents.

Availability of data and materials:

All data is available in the paper. The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

REFERENCES

1. Facts and figures on childhood obesity. World Health Organization, 2018. Available from: https://www.who.int/end-childhood-obesity/facts/en/ [Accessed on 18 January 2019]
2. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet. 2017; 390:2627–42. https://doi.org/10.1016/S0140-6736(17)32129-3
3. Di Cesare M, Sorić M, Bovet P, Miranda JJ, Bhutta Z, Stevens GA, et al. The epidemiological burden of obesity in childhood: a worldwide epidemic requiring urgent action. BMC Med. 2019; 17:212. https://doi.org/10.1186/s12916-019-1449-8
4. Hettiarachchi J, Jayatissa R, Wickramasinghe SC, Wijeywardena K. Overweight and obesity among adolescent school children in the Colombo education zone. Journal of the Postgraduate Institute of Medicine. 2018 Jun 20;5(1).
5 Kiridana V, Karunaratne R, Ranasinghe JC, Munasinghe TS, Karunadasa UI, Vidanapathirana GU, Abeygoonaratne SP, Perera M, Bogahapitiya A, Jayathilaka G, Udupihilla J. Prevalence of Overweight, Obesity and Metabolic Abnormalities Among 12-15 Year Age Group in an Urban City in Sri-Lanka. Sri Lanka Journal of Medicine. 2021;30(1):16-24(DOI: 10.4038/sljm. v30i1.232)
6 Pulgaron ER. Childhood obesity: a review of increased risk for physical and psychological comorbidities. CLIN THER. 2013; 35(1): A18-32. https://doi.org/10.1016/j.clinthera.2012.12.014
7 Biro FM, Wien M. Childhood obesity and adult morbidities. AM J CLIN NUTR. 2010; 91(5):1499S-505S. https://doi.org/10.3945/ajcn.2010.28701B
8 Schiel R, Kaps A, Stein G, Steveling A. Identification of Predictors for Weight Reduction in Children and Adolescents with Overweight and Obesity (IDA-Insel Survey). InHealthcare 2016; 4(1) p 5. Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/healthcare4010005
9 Metcalf B, Henley W, Wilkin T. Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54). Bmj. 2012; 345:5888. https://doi.org/10.1136/bmj.e5888
10 Bond M, Wyatt K, Lloyd J, Welch K, Taylor R. Systematic review of the effectiveness and cost-effectiveness of weight management schemes for the under-fives: a short report. Health Technol Assess. 2009; 13(61):1-75. https://doi.org/10.1108/cgij.2010.24815bab.004
11 Gori D, Guaraldi F, Cinocca S, Moser G, Rucci P, Fantini MP. Effectiveness of educational and lifestyle interventions to prevent paediatric obesity: systematic review and meta-analyses of randomized and non-randomized controlled trials. Obesity science & practice. 2017;3(3):235-48. https://doi.org/10.1002/osp4.111
12 Blomquist K, Griffin S, Hays E, Schmalz DL, Sease KK. Behavioral and psychological predictors of BMI reduction in children seeking treatment at a hospital clinics family based pediatric weight management program. J Child Obes. 2018;3(2). DOI: 10.21767/2572-5394.100050
13 World Health Organization (2008) Training Course on Child Growth Assessment. Geneva: WHO; available at http://www.who.int/childgrowth/training/en/ (Accessed on 20th January 2019)
14 Luzier JL, Berlin KS, Weeks JW. Behavioral treatment of pediatric obesity: review and future directions. Child Health Care. 2010; 39(4):312-34.

15 Boisvert JA, Harrell WA. Integrative treatment of pediatric obesity: Psychological and spiritual considerations. Integrative Medicine: A Clinician's Journal. 2015; 14(1):40.

16 Koomanaee S, Tabrizi M, Naderi N, Rad AH, Moghaddam KB, Dalili S. Parental Anthropometric indices and obesity in children. Acta Medica Iranica. 2016 ;54(4):270-5.

17 Davison KK, Birch LL. Obesigenic families: parents' physical activity and dietary intake patterns predict girls' risk of overweight. IJO. 2002; 26(9):1186. https://doi.org/10.1038/sj.ijo.0802071

18 Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. Int Rev Psychiatry. 2012;24(3):176-88. https://doi.org/10.3109/09540261.2012.688195

19 Lamerz A, Kuepper-Nybelen J, Wehle C, Bruning N, Trost-Brinkhues G, Brenner H, et al. Social class, parental education, and obesity prevalence in a study of six-year-old children in Germany. IJO. 2005; 29(4):373-80. https://doi.org/10.1038/sj.ijo.0802914

20 Hampl S, Paves H, Laubscher K, Eneli I. Patient engagement and attrition in pediatric obesity clinics and programs: results and recommendations. Pediatrics. 2011 Sep 1;128(Supplement 2): S59-64. DOI: https://doi.org/10.1542/peds.2011-0480E

21 Warschburger P, Kröller K. Loss to follow-up in a randomized controlled trial study for pediatric weight management (EPOC). BMC Pediatr . 2016;16(1):1-9.

22 French SA, Story M, Perry CL. Self-esteem and obesity in children and adolescents: a literature review. Obes. Res. 1995; 3(5):479-90. https://doi.org/10.1002/j.1550-8528.1995.tb00179.x

23 Pliner P, Chaiken S, Flett GL. Gender differences in concern with body weight and physical appearance over the life span. Personality and social psychology bulletin. 1990;16(2):263-73. https://doi.org/10.1177%2F0146167290162007

24 Barlow SE, Dietz WH. Obesity evaluation and treatment: expert committee recommendations. Pediatrics. 1998;102(3): e29-. DOI: https://doi.org/10.1542/peds.102.3.e29

25 Epstein LH, Roemmich JN, Robinson JL, Paluch RA, Winiewicz DD, Fuerch JH, Robinson TN. A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. Arch Pediatr Adolesc Med. 2008;162(3):239-45. doi:10.1001/archpediatrics.2007.45

26 Hampl SE, Borner KB, Dean KM, Papa AE, Cordts KP, Smith TR, Wade KR, Davis AM. Patient attendance and outcomes in a structured weight management program. J. Pediatr. 2016; 176:30-5. https://doi.org/10.1016/j.jpeds.2016.05.032

27 Zeller M, Kirk S, Claytor R, Khoury P, Grieme J, Santangelo M, Daniels S. Predictors of attrition from a pediatric weight management program. J. Pediatr. 2004;144(4):466-70. https://doi.org/10.1016/j.jpeds.2003.12.031

28 Kim HS, Park J, Park KY, Lee MN, Ham OK. Parent involvement intervention in developing weight management skills for both parents and overweight/obese children. Asian Nurs Res. 2016;10(1):11-7. https://doi.org/10.1016/j.anr.2015.07.006