Original Article

Association Of Sleep, Physical Activity, Sedentary Behavior, And Screen Time With Obesity Among Children In The Pediatric-Endocrine Unit

Shireen Qasim Bham[1*], Fatima Zahra[2], Farhan Saeed[1], Umer Hayat Ahmed Sharif[3], Ayesha Khatoon[1], Ibrahim Bukhari[4]

[1]Department of Pediatrics, Liaquat College of Medicine and Dentistry, Karachi, Pakistan
[2]Department of Medicine, Liaquat College of Medicine and Dentistry, Karachi, Pakistan
[3]Dow University of Health Sciences, Karachi, Pakistan
[4]Department of Pediatrics, Sindh Government Hospital Liaquatabad, Karachi, Pakistan

ARTICLE INFO

ABSTRACT

The frequency of stunting, pallor, zinc, and iron deficiencies serves as evidence that the globe is undergoing a rapid epidemiological and nutritional transition that is characterised by persistent nutritional insufficiencies. **Objectives:** Our study aimed to observe the association of physical activity, sedentary behavior, sleep, and screen time with obesity in children of our community. **Methods:** A case-control study was conducted at the Department of Pediatrics and Endocrinology from 1st September 2019 to 1st March 2020. Participants were healthy children from 5 to 15 years of age. The participants (overweight or obese) and controls were selected from the same population based on BMI. We divided the sedentary activity into less than 4 hours and more than 4 hours. **Results:** In this study, 53% of children were boys and 47% were girls with a mean age of 7.9 in the non-obese group and 8.9 in the obese group. The majority (75.5%) were age group less than or equal to 10 years. The participants with more sleeping time were 57% less likely to develop obesity (OR: 0.424 with 95% CI of 0.19-0.94, P-value: 0.03) whereas participants with more sedentary activity were 6% more likely to develop obesity (OR:6.38 with 95% CI of 2.49-16.38, P-value: <0.01). **Conclusion:** This study concluded that sedentary activity is significantly associated with overweight/obesity whereas sleep has negative relation with overweight/obesity making them, a potential risk factor for childhood obesity.

INTRODUCTION

The world is going through a fast epidemiological and nutritional change described by relentless nutritional insufficiencies, as proven by the prevalence of stunting, pallor, zinc, and iron deficiencies. Correspondingly, there is a continuous increase in the prevalence of diabetes, obesity, and other nutritional-related chronic diseases (NRCDs) like cardiac illness, and a few types of malignancies. Childhood obesity is more prevalent in developed countries but in developing countries, its prevalence is also increasing [1]. Most of the world's population lives in countries where overweight and obesity kill more people than underweight. Around 38 million children under the age of 5 were overweight or obese in 2019. Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016 [2]. The study in New Zealand revealed a 17 % prevalence of overweight at the age of 26 years due to watching TV for >2 hours as a contributing factor [3]. Pakistan has an estimated prevalence of childhood obesity between 15% and 20%. The proportion of obese and overweight children in Karachi was found to be 6% and 19% respectively. The combined prevalence is 37.3% of overweight and obesity (15.2%

obese, 22.1% overweight) in school children of Sialkot city [4]. Practices that impact increased weight gain include consumption of a high-calorie diet, low-nutrient value foods, and beverages, sleep routines, and the use of medicines. Lack of physical activity and spending too much time watching television or other screen devices can lead to a gain in weight [5]. Poor sleep is progressively common in children and the relationship between short sleep duration in early childhood and obesity is found consistently. There is internationally growing evidence that decreases in the length of sleep children acquire are conversely connected with obesity and overweight [6]. The adaptive reactions of the numerous childhood obesity phenotypes are affected by social, cultural, ethnic, environmental, behavioral, and parental factors. These elements include dietary consumption, sedentary behavior, physical activity level, family structure (parental weight), perception of overweight, feeding practices, socioeconomic status, and more [7]. Attributable to the increased risk of overweight adolescents becoming obese adults, a key objective of obesity prevention is to engage children and adolescents in physical activity and sport [8]. Few studies have been done so far, and to identify the various burden in different age groups both in children and adults. There is a need for a detailed review and dissemination of the existing knowledge, to determine the extent of the burden of obesity and its distribution among various high-risk groups can result in a better understanding of this important public health issue. This indicates the need for formulating preventive guidelines and policies to prevent childhood obesity. Our study aims to observe the association of physical activity, sedentary behavior, sleep, and screen time with obesity in children of our community. The previous studies have collected data from different primary schools and there was a need to have local community data so that we can correlate it with international data.

METHODS

A case-control study was conducted at the Department of Pediatrics and Endocrinology at Darul Sehat hospital, Karachi from 1st September 2019 to 1st March 2020. The sample size was calculated by the Raosoft® sample size software. Whereas presumed and estimated prevalence of 15% of childhood obesity in Pakistan. Hereby consider a 95% confidence interval (CI), 5% margin of error, and 80% power to detect such difference. An estimated sample of 200 patients was recruited for the study using Open Epi software. Ethical approval was sought from the ethical review board committee of the Darul Sehat Hospital, Liaquat University of Medicine and Dentistry (reference number: DSH/IRB/2021/0034). The respondents were selected by consecutive sampling and an interview-based questionnaire was administered. Subjects included from outpatient department visiting their consultant for any illness accompanying their mother along with their sibs. Participants were healthy children from 5 to 15 years of age. Children with chronic illness and comorbidities were excluded from the study. The cases (overweight or obese) and controls were selected from the same population based on BMI. Their BMI was calculated by recording their heights (in cm) with a fixed measuring scale and weight (in Kg) by weighing scale in the triage by trained staff. Overweight and obese were defined by the WHO index of BMI for AGE as having >85th percentile and <95th percentile respectively [9-10]. Written informed consent was taken from parents. Variables such as age, gender, grading of class, duration of physical activity, duration of sleep, sedentary activity, and duration of screen time were asked from the participants and entered on the structured questionnaire. Physical activity was assessed as any activity done in school in the morning and at home in the evening. It is graded as less than 60 min and more than 60 min. Sleep duration was categorized as less than 9 hours and more than 9 hours. We divided the sedentary activity (other than screen time) into less than 4 hours and more than 4 hours with activities being playing indoor games like monopoly, scrabble, board games, doing school work, and taking Islamic lessons at home [11]. Screen time was categorized as less than 2 hours and more and 2 hours spent on the laptop, mobile phones, watching television, playing video games, and using a desktop [12]. Data were stored and analyzed using IBM-SPSS version 23.0, Counts with Percentages reported for qualitative data sets, and Mean and 95% Confidence intervals reported for quantitative parameters. An independent sample t-test was used to compare the mean between obese and non-obese samples. Pearson Chi-Square test was used to test the association of obesity with studied parameters, with an odds ratio of 95%. Confidence intervals were also reported. The binary logistic forward LR method was used to develop the model for obesity after including the parameters with a p-value greater than 0.5 from the Chi-Square test. P-values less than 0.05 were considered statistically significant. Bar diagrams are also used to give a graphical presentation of data.

RESULTS

The baseline characteristics of the studied sample are shown in Table 1. In the study sample of 200, 75.5% were age group less than or equal to 10 years, 53% of children were male, 60% samples had sleeping time more than 9 hours per day, 42% samples had physical activity more than 60 minutes per day, family history of obesity was present among 54% samples, there were 71.4% samples found with less than four hours sedentary activity per day, 46%

samples found with less than two hours of screen time per day.

Characteristics		N	%
Age Group	<=10 years	151	75.5
	>10 years	49	24.5
Sex	Male	106	53.0
	Female	94	47.0
Sleeping Time (Per day)	< 9 Hours	80	40.0
	>9 Hours	120	60.0
Physical Activity (Per day)	<60 min	116	58.0
	> 60 Min	84	42.0
Family History of Obesity	Positive	108	54.0
	Negative	92	46.0
Sedentary Activity (Per day)	< 4 Hours	95	71.4
	> 4 Hours	38	28.6
Screen Time (Per day)	< 2 Hours	92	46.0
	> 2 Hours	108	54.0

Table 1: Baseline Characteristics of Studied Samples (n=200)

Table 2 reports the mean with a 95% confidence interval of quantitative parameters, result showed obese samples have significantly higher mean age, height, weight, and BMI as compared to non-obese samples with p<0.05.

Parameters	Total (n=200)	Non Obese (n=100)	Obese (n=100)	P-value
	Mean (95% C.I)	Mean (95% C.I)	Mean (95% C.I)	
Age	8.4 (8.1 – 8.8)	7.9 (7.4 -8.5)	8.9 (8.4 – 9.4)	<0.01*
Height (cm)	127.6 (125 -130)	123.8 (120 -127)	131.4 (127 -135)	<0.01*
Weight (kg)	31.6 (29.7 – 33.5)	24.2 (22.6 -25.7)	39.1 (36.2 -42.0)	<0.01*
BMI	18.7 (18.1 – 19.3)	15.4 (14.9 – 15.8)	22.0 (21.3 -22.8)	<0.01*

Table 2: Mean Comparison of Quantitative Parameters of Study

Table 3 gives the chi-square association of studied parameters with obesity, results showed sedentary activity per day gives a significant association with obesity. All other parameters were found statistically insignificant.

Parameters		Non Obese (n=100)	Obese (n=100)	OR (95% C.I)	P-Value
Age Group	<=10 years	81.0	70.0	1.8 (0.9 - 3.5)	0.07
	>10 years	19.0	30.0		
Sex	Male	52.0	54.0	0.9 (0.5 – 1.6)	0.77
	Female	48.0	46.0		
Sleeping Time (Per day)	< 9 Hours	35.0	45.0	0.6 (0.3 – 1.1)	0.14
	>9 Hours	65.0	55.0		
Physical Activity (Per day)	<60 min	57.0	59.0	0.9 (0.5 – 1.6)	0.77
	> 60 Min	43.0	41.0		
Family History of Obesity	Positive	53.0	55.0	0.9 (0.5 – 1.6)	0.77
	Negative	47.0	45.0		
Sedentary Activity (Per day)	< 4 Hours	87.9	55.2	5.8 (2.4 -14.2)	<0.01*
	> 4 Hours	12.1	44.8		
Screen Time \ (Per day)	< 2 Hours	46.0	46.0	0.9 (0.5 – 1.7)	0.99
	> 2 Hours	54.0	54.0		
	> Twice a Week	15.0	14.0		

Table 3: Chi-Square Association of Studied Parameters with Obesity

Table 4 reports the results of the developed model for obesity using binary logistic regression forward LR method, results showed, that sedentary activity was significantly positively associated with obesity whereas sleeping time gives a significantly negative association with obesity, and the p-value was found less than 0.05.

Parameters	OR	95% C.I. for OR		P-value
		Lower	Upper	
Sleeping Time	0.424	0.19	0.94	0.03*
Sedentary Activity	6.387	2.49	16.38	<0.01*

*p<0.05 was considered statistically significant for the Odds ratio

Table 4: Logistic Regression Model for Obesity using Forward LR Method

DISCUSSION

The epidemic of obesity is a potential concern in the childhood population as it is becoming a worldwide trend. In our study, we found that sleep and sedentary activity are potential risk factors for overweight and obesity in children. On the other hand, physical activity and screen time did not show any significant effect on obesity and overweight. Variation in sleep duration has been recognized as a dominant risk factor for causing childhood obesity. A firm and thorough association has been linked between sleep duration and obesity through multiple studies [8]. Our study has shown a significant negative association between sleep duration with obesity. Although 55 % of children slept more than 9 hours per day logistic regression analysis showed a negative association with a significant p-value. A local study done on school children showed a positive association between sleep duration and obesity. 52 % of children having slept 8 hours or more was associated with significantly higher odds of obesity [13]. A meta-analysis of 11 studies, reveals participants with a shorter duration of sleep have twice the chances of being obese/overweight as compared to participants with a long duration of sleep [14]. Studies done in school showed an association between the increase in weight gain and going to bed late in children aged 8 to 17 years independent of sleep duration [8, 15]. Several mechanisms have been proposed to show the link between obesity and decrease sleep duration with the most common being a reduced physical activity, low energy expenditure with excessive food intake especially high-calorie food, and late going to bed. Multiple studies have supported this theory that less sleep duration is associated with low levels of leptin [13]. The considerable rise in hunger leads to weight gain as a short-term issue and consequently going towards obesity as a long-term complication [16]. In our study, we explored the positive association between a sedentary lifestyle and obesity/ overweight in our children. Previously such data has been collected from children of different primary schools which concluded that television viewing and working on the computer and video games have a

significant association with being overweight and hence the risk of obesity [17]. Unlike previous studies, we categorized sedentary lifestyles and screen time into two distinct groups. We included homework, playing board games, taking Islamic lessons, and other activities not related to screen as the sedentary activity which revealed a significant independent association with overweight/obesity. It was postulated that television viewing leads to an increase in calorie intake as children enjoy high-calorie food while watching Television [18]. A similar study was done in England also shows the association of obesity with Television viewing with a 42% chance of obesity as compared to non-TV leisure time [19]. whereas a study was done in Cameroon showed a significant association between sedentary lifestyle which included homework and listening to music with overweight/obesity. There have been multiple theories explaining this fact. One hypothesis explains that there are more chances of consuming high-energy food and drink while watching Television rather than non-TV sitting where they don't have ample time to eat and drink and need to concentrate more on work thus hampering eating habits [20]. We observed that our children spend a great deal of time doing homework, going to tuition, and taking Islamic lessons. The lack of playgrounds and insecurity of mothers not permitting them to play outside the house, compel them to stay home, and secondly as most of their time is spent on homework and tuition, not much time left for them to indulge in other activities. Although these children were having the habit of eating high-calorie food and drink as their mothers confirmed their eating habits. All these factors explain the sedentary lifestyle as a significant independent risk factor for overweight and obesity. Our study could not conclude any association between screen time and physical activity with obesity as they were equally prevailing in both obese and non-obese children. This is contrary to other studies like Kenney and Gortmaker showed devise use of 5 hours or more and less physical activity was associated with an increased risk of obesity [21]. Similar features were disclosed by Tsitsika et al., that social media usage of 2 hours or more accelerates the chances and risk of obesity [22]. The meta-analysis also revealed a positive association of excessive screen time with overweight/obesity in children [23]. A study done in Thailand did not show any significant difference in physical activity in obese and non-obese children [24]. Although many studies are in favor of this notion still further studies are required for a better understanding with proper measurement of screen usage in children. Most studies including the present study, are mainly questionnaire-based relying on the parents to report their screen time and usage where there is a risk for recall bias. We need to have

proper guidelines with initiative for proper assessment and authenticate instruments to measure the correct screen usage and physical activity depending on the resources and support each country can provide. We need to develop a consensus at the National level to validate tools to assess behavior in our children and the mindset of parents towards risk factors associated with childhood obesity like sedentary habits, use of screen time, physical activity, and sleep patterns so that integrated action can be substantiated to halt the progression of childhood obesity in our society. The strength of our study was that it was done in a community setting that caters to a large area of population, and we used multiple variables which were objectively assessed and questionnaire-based. The limitation we faced was it was a cross-sectional study, we use sleep duration to assess the relationship between sleep and obesity which is a broader term. Different sleep aspects may have concluded exact information. The lack of proper instruments to measure the sedentary lifestyle and physical activity was a drawback for us as we relied on parental understanding and estimates which can alter with different age stratification.

CONCLUSION

This study has shown that sedentary activity is significantly associated with overweight /obesity whereas sleep has negative relation with overweight/obesity making them potential risk factors for childhood obesity. Screen time and physical activity did not show any significant effect on obesity. Parental awareness and timely intervention at all levels should be instituted to reduce the risk factors so that childhood obesity can be controlled at an early age.

REFERENCES

[1] Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. Journal of Family Medicine and Primary Care. 2015 Apr-Jun; 4(2):187-92. doi: 10.4103/2249-4863.154628

[2] Armoon B and Karimy M. Epidemiology of childhood overweight, obesity and their related factors in a sample of preschool children from Central Iran. BMC Pediatrics. 2019 May; 19(1):159. doi: 10.1186/s12887-019-1540-5

[3] Robinson TN, Banda JA, Hale L, Lu AS, Fleming-Milici F, Calvert SL, et al. Screen Media Exposure and Obesity in Children and Adolescents. Pediatrics. 2017 Nov; 140(Suppl 2):S97-S101. doi: 10.1542/peds.2016-1758K

[4] Chattha MN, Nawaz R, Mazhar MI. Obesity;: Prevalence of Obesity In School Children of Sialkot City. The Professional Medical Journal. 2019 Feb; 26(02):247-52

[5] Ahmed J, Laghari A, Naseer M, Mehraj V. Prevalence of and factors associated with obesity among Pakistani schoolchildren: a school-based, cross-sectional study. Eastern Mediterranean Health Journal. 2013 Mar; 19(3):242-7

[6] Miller AL, Lumeng JC, LeBourgeois MK. Sleep patterns and obesity in childhood. Current Opinion in Endocrinology, Diabetes and Obesity. 2015 Feb; 22(1): 41-7. doi: 10.1097/MED.0000000000000125

[7] Nielsen LA, Nielsen TR, Holm JC. The Impact of Familial Predisposition to Obesity and Cardiovascular Disease on Childhood Obesity. Obesity Facts. 2015; 8(5):319-28. doi: 10.1159/000441375

[8] Hills AP, Andersen LB, Byrne NM. Physical activity and obesity in children. British journal of sports medicine. 2011 Sep; 45(11):866-70.

[9] Hosseinpanah F, Seyedhoseinpour A, Barzin M, Mahdavi M, Tasdighi E, Dehghan P, et al. Comparison analysis of childhood body mass index cut-offs in predicting adulthood carotid intima media thickness: Tehran lipid and glucose study. BMC Pediatrics. 2021 Nov; 21(1):494. doi: 10.1186/s12887-021-02963-y

[10] Flegal KM, Wei R, Ogden CL, Freedman DS, Johnson CL, Curtin LR. Characterizing extreme values of body mass index-for-age by using the 2000 Centers for Disease Control and Prevention growth charts. The American Journal of Clinical Nutrition. 2009 Nov; 90(5):1314-20. doi: 10.3945/ajcn.2009.28335

[11] Tye LS, Scott T, Haszard JJ, Peddie MC. Physical Activity, Sedentary Behaviour and Sleep, and Their Association with BMI in a Sample of Adolescent Females in New Zealand. International Journal of Environmental Research and Public Health. 2020 Aug;17(17):6346. doi: 10.3390/ijerph17176346

[12] Strasburger VC, Hogan MJ, Mulligan DA, Ameenuddin N, Christakis DA, Cross C, et al. Children, adolescents, and the media. Pediatrics. 2013 Nov; 132(5):958-61.

[13] Jarrin DC, McGrath JJ, Drake CL. Beyond sleep duration: distinct sleep dimensions are associated with obesity in children and adolescents. International Journal of Obesity. 2013 Apr;3 7(4):552-8. doi: 10.1038/ijo.2013.4

[14] Mansoori N, Nisar N, Shahid N, Mubeen SM, Ahsan S. Prevalence of obesity and its risk factors among school children in Karachi, Pakistan. Tropical Doctor. 2018 Oct; 48(4):266-269. doi: 10.1177/0049475518786664

[15] Fatima Y, Doi SA, Mamun AA. Longitudinal impact of sleep on overweight and obesity in children and adolescents: a systematic review and bias-adjusted meta-analysis. Obesity Reviews. 2015 Feb; 16(2):137-49. doi: 10.1111/obr.12245

[16] Bonanno L, Metro D, Papa M, Finzi G, Maviglia A, Sottile F, et al. Assessment of sleep and obesity in adults and children: Observational study. Medicine. 2019 Nov; 98(46):e17642. doi: 10.1097/MD.0000000000017642.

[17] Knutson KL. Sleep duration and cardiometabolic risk: a review of the epidemiologic evidence. Best Practice and Research Clinical Endocrinology and Metabolism. 2010 Oct; 24(5):731-43. doi: 10.1016/j. beem.2010.07.001

[18] Mushtaq MU, Gull S, Mushtaq K, Shahid U, Shad MA, Akram J. Dietary behaviors, physical activity and sedentary lifestyle associated with overweight and obesity, and their socio-demographic correlates, among Pakistani primary school children. International Journal of Behavioral Nutrition and Physical Activity. 2011 Nov; 8:130. doi: 10.1186/1479-5868-8-130

[19] Coombs NA and Stamatakis E. Associations between objectively assessed and questionnaire-based sedentary behaviour with BMI-defined obesity among general population children and adolescents living in England. BMJ Open. 2015 Jun; 5(6):e007172. doi: 10.1136/bmjopen-2014-007172

[20] Navti LK, Atanga MB, Niba LL. Associations of out of school physical activity, sedentary lifestyle and socioeconomic status with weight status and adiposity of Cameroon children. BMC Obesity. 2017 Nov; 4:35. doi: 10.1186/s40608-017-0171-3

[21] Kenney EL and Gortmaker SL. United States Adolescents' Television, Computer, Videogame, Smartphone, and Tablet Use: Associations with Sugary Drinks, Sleep, Physical Activity, and Obesity. The Journal of Pediatrics. 2017 Mar; 182:144-149. doi: 10.1016/j.jpeds.2016.11.015

[22] Tsitsika AK, Andrie EK, Psaltopoulou T, Tzavara CK, Sergentanis TN, Ntanasis-Stathopoulos I, et al. Association between problematic internet use, socio-demographic variables and obesity among European adolescents. European Journal of Public Health. 2016 Aug; 26(4):617-22. doi: 10.1093/ eurpub/ckw028

[23] Li C, Cheng G, Sha T, Cheng W, Yan Y. The Relationships between Screen Use and Health Indicators among Infants, Toddlers, and Preschoolers: A Meta-Analysis and Systematic Review. International Journal of Environmental Research and Public Health. 2020 Oct; 17(19):7324. doi: 10.3390/ijerph17197324

[24] Amini M, Alavi-Naini A, Doustmohammadian AA, Karajibani M, Khalilian A, Nouri-Saeedloo S, et al. Childhood obesity and physical activity patterns in an urban primary school in Thailand. Rawal Medical Journal. 2009 Jan; 34(2):203-6