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Research Article

STUDY ON SCREEN VIEWING PATTERN AND ITS OUTCOMES IN RELATION TO HEALTHY EATING, BODY COMPOSITION INDICES AND COGNITION AMONG ADOLESCENTS

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Abstract: Screen viewing has increased over the years and its association with overall nutritional status and cognitive development has been supported with little casual evidences. The duration of watching screens (TV, mobile phones, gaming screens and computers) was more than six hours a day by all the adolescents aged 16-18 years randomly selected from Punjab. Among different categories the adolescents from rural background, adolescents studying in private schools and mostly boys were viewing the screens more as compared to their counterparts. Consequently, these groups reported higher BMI, poor healthy eating index and lower attention span and reasoning ability. The HEI of all the adolescents needed improvement as it was lying in the range of 51-80. Higher screen-usage was positively correlated with BMI and negatively correlated with HEI score, attention span and reasoning ability.

Keywords: *Screen viewing, Healthy Eating Index, BMI, Attention span, Reasoning ability*

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Introduction

The time of adolescent is considered as an important phase of development characterised by physiological development of cognition, emotion and social maturity which is influenced by electronic media. With the introduction of smart cell phones and easily accessible internet on these phones, they have become an integral part of life of adolescents in terms of using social media, gaming (offline as well as online), recreational viewing, socializing especially social media, watching movies, music *etc*. However, they are getting drowned into their virtual worlds. Mobile technology has enabled today's teens to engage with screens all around the clock, whether travelling from school to home or going on a holiday or while eating out or even in bed before sleeping.

To some extent the addiction to mobile phones can be taken as addiction towards internet. Internet addiction is significantly linked to inadequate intake of fruits and vegetables, increased consumption of carbonated drinks, increased consumption of fast food and sedentary lifestyle [1]. Adolescents who used a lot of screens especially TV, showed higher BMI after 2 years of usage. Not only do the screens have an effect on weight gain but they also affect hunger and satiety as they increase energy intake, which may be due to commercials and advertisements related to food [2]. Obesity has been linked to physical inactivity since forever and physical inactivity is the root cause of many degenerative diseases. Excess usage of screens has led to pains in different body parts which may be due to improper posture while using screens for extended period of time, thus, further limiting physical activity [3]. Reduction of screen time throughout adolescence is an effective strategy for reducing undesirable weight gain. Reduction in screen time is related to a larger relative reduction of a bigger absolute overweight leading to a greater potential of obesity incidence.

Excess childhood TV viewing act as a risk factor for the development of attention problems and the effects can be long-lasting. A vicious cycle gradually develops between excessive use, mental stress and poor academic scores.

The risk of developing such problems can be reduced if parents follow the guidelines of the American Academy of Paediatrics [4] to limit child's exposure to screens to only two hours per day [5]. Internet represents a powerful socio-cultural means of body image relevance for adolescent girls [6].

Despite controversy, screens like computers, tablets, smartphone, televisions *etc* have got a permanent fix in the lives of modern children. Given that this digital genie cannot be put back in the lamp, it has become an obligation on researchers to recognise the pathways of its actions and the extent to which exposure to these screens might affect children [7]. This technological advancement is needed to be studied because of it is clear and big part of youth time and its effects on utility, or welfare are unknown. Thus, the present study explores the usage of screens and also to find its association with nutritional status and selected cognitive abilities of the adolescents.

Materials and Methods

The population of study consisted of school children of age 16-18 years. The subjects were selected from two districts (Ludhiana and Pathankot) of Punjab. The data was collected in the months of December-2019 to February-2020. The respondents were also asked to record the total hours spent on all the screens on daily basis. The screens reported in the study included TV, computer/PC, gaming screens and mobile phones. Height and weight of the respondents was noted and BMI was calculated. The 24- hour recall method was used for three consecutive days for dietary intake assessment. Indian Nutrition Software (Diet Cal) [8] was used to calculate average daily nutrient intake and daily intake of different food groups. The nutrient intake and food intakes were compared with Estimated Average Requirement of Indians [9]. The percentage adequacy of nutrients and food intakes were also calculated. Healthy Eating Index (HEI) was computed proportionately to the recommended number of servings and amount consumed by the subjects.

HEI score was calculated based on the sum of scores of 13 components, each of which related to different expects of a healthful diet [10]. Overall, a higher total HEI score indicates a diet that aligns better with dietary recommendations. The cognitive development was assessed through attention span and reasoning ability. Attention span was assessed with the help of D2 Attention Span test by Brickenkamp [11]. Reasoning abilities were assessed by Qualitative Aptitude/ Reasoning test from NCERT, Problem Solving Assessment (PSA) [12].

Results and Discussion

The data collected in the present study was before the COVID-19 scenario where comparatively screen viewing was quite less as compared to today's scenario, as now everything is being conducted online- school classes, meeting, webinars *etc*, that has substantially increased the time for screen viewing. The COVID-19 pandemic had altered many facets of life like physical activity, diet, and screen time *etc*.

Screen-viewing assessment

The average duration of watching screens per day was 6.68±1.74 hours in rural adolescents which was non-statistically different from urban adolescents (6.22±1.83 hours) [Table-1]. A significant (p=0.038) higher usage of screens was seen in private school adolescents than the government school adolescents. [Table-1] also reveals that boys' duration of screen-viewing was more than girls though there was no statistical difference. On an average all the adolescents under study were viewing screens for more than six hour per day.

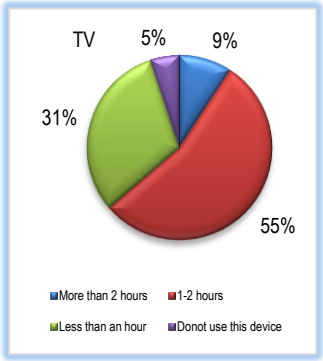
Table-1 *Duration of screen-use of total population (n=240)*

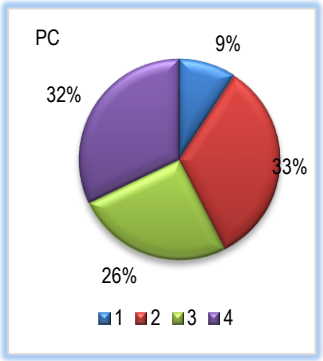
Category	Duration (hrs.)	SD	t-value	p-value
Background				
Rural (n=120)	6.68	1.74	1.972	0.05
Urban (n=120)	6.22	1.83		
School-type				
Private (n=120)	6.69	1.78	2.083	0.038
Government (n=120)	6.21	1.79		
Gender				
Boys (n=118)	6.61	1.73	1.381	0.168
Girls (n=122)	6.30	1.85		

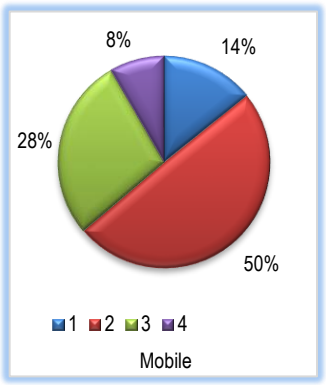
Television alone has been found to contribute 2.8 hours of screen-time on daily basis in Indian population which can be due to its presence in every household nowadays [13]. Even bullying has been found to draw adolescent's attention towards them to the extent of internet addiction in China [14] as a mediator to escape the real world. On the contrary to the results obtained in the current research, private school teenagers were also found to be more disciplined in case of screen-time and physical activity as compared to public school counterparts [15].

Duration of individual screen use

Most of the screen gadget like TV, PC and mobile phones were used on regular basis by the respondents spending 1-2 hours duration per day on each of these gadgets [Fig-1]. The least used screen by most of the respondents under study was gaming screens. The main purpose of using these gadgets was for the entertainment purpose, learning new concepts, obtaining information and for just passing the leisure time.







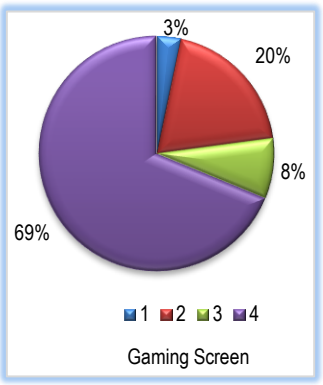


Fig-1 Duration of use of a particular screen

Masthi *et al*., [16] concluded that private students' use of internet (60.95%) was higher than public schools (39.05%). They also concluded that private school children were more susceptible to social media addiction as compared to public school and majority of the respondents were even suffering from mild addiction. Amongst the genders, boys have been found to use screens for more time as compared to girls [17] and boys were likely to spend more time on technological activities while girls on social activities [18]. Prolonged screen-time has also been correlated to increase the risk towards depression [19], tobacco use [20] and reduced cognitive ability of adolescents [17].

Body Mass Index (BMI) of respondents

The average BMI of all the adolescents under study was 20.69±3.98 kg/m2. BMI was found to be higher in rural adolescents (21.19±4.20) as compared to urban adolescents (20.19±3.71) though it was statistically non-significant [Table-2]. Private school children had significantly (<0.0001) higher BMI (22.20±4.12) than government school children (19.18±3.22). Gender differences were also seen for the BMI, as boys had a higher BMI (21.08±4.29) as compared to girls (20.31±3.64) though no significant difference was found. There is a significant positive correlation between screen viewing and BMI of the respondents (r=0.127, p=0.049). Thus, one of the reasons for higher BMI among rural children, those studying in private schools and for boys could probably be the higher screen viewing that led to less physical activity among these adolescents.

Table-2 *Comparison of school-children according to BMI*

Category	BMI	SD	t-value	p-value
Background				
Rural (n=120)	21.19	4.20	1.953	0.052
Urban (n=120)	20.19	3.71		
School-type				
Private (n=120)	22.20	4.12	6.316	<0.0001
Government (n=120)	19.18	3.22		
Gender				
Boys (n=118)	21.08	4.29	1.501	0.135
Girls (n=122)	20.31	3.64		

Higher usage of screen has been found to be related to higher BMI and thus compromised physical activity. Screen time has increased by 59 ± 112 min/d and 62 ± 130 min/d during week and weekend days, respectively during the lockdown [21]. Increased screen time was found to be associated with depression, loneliness and stress. Maintaining and enhancing physical activity participation and limiting screen time may mitigate the mental health consequences [22]. Adolescents were found to be worst affected due to this pandemic which can be due to online classes as well as social media involvement on different screens [23]. Screen time increased by 4.85 hour per day [24] which had a direct effect on the increase in obesity prevalence from 10.5% to 12.6% [25]. A high BMI was reported in rural adolescents as in the present study that was seen along with higher prevalence of overweight/obesity as compared to under-nutrition [26]. On the contrary some reported that more of the urban school adolescents were overweight/ obese [27].

Food and nutrient intake of the respondents

The data pertaining to dietary intake of all the respondents revealed the mean intake of milk and milk products(p=0.002), pulses, sugar, fats and other vegetables were found significantly higher in urban adolescents as compared to rural adolescents [Table-3]. This higher intake of the food groups translated into higher intake of nutrients like carbohydrates (p=0.032) and calcium (p=0.006) [Table-4]. Similarly, significantly higher (p<0.0001) consumption of milk and sugar as well as fats (p=0.001) was observed in government school going adolescents while private school going adolescents consumed more of the other vegetables (p<0.0001). Thus, a higher intake of calcium(p=0.007) and fat (p<0.001) was reported in government adolescents. As for the gender, girls had significantly higher consumption of milk and milk products and sugar as compared to boys. Also, a higher consumption of cereals and pulses was reported in the girl respondents though it was statistically non-significant from the boys. There was no significant difference in the nutrient intake among the genders. The overall assessment of food and nutrient intake among the adolescents revealed that irrespective of the category, all the adolescents were having inadequate intake of all the food groups when compared with the ICMR2010 recommendations [Fig-2] which further translated into poor nutrient intake among the adolescents as compared to the Estimated Average Requirements given by ICMR 2020[Fig-3].

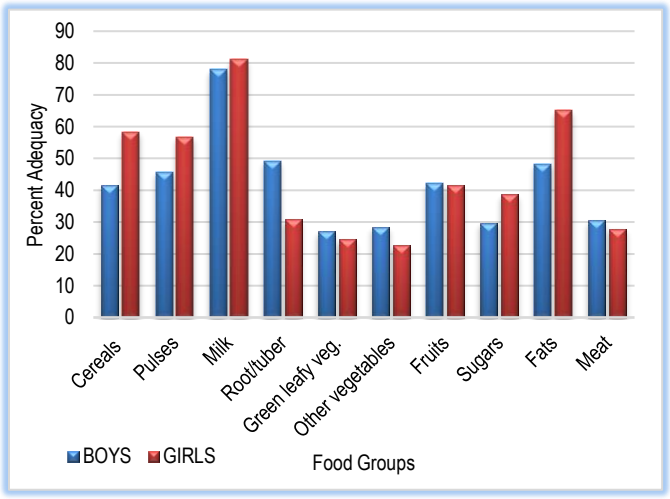


Fig-2 Percentage adequacy of food groups (calculated against ICMR 2010)

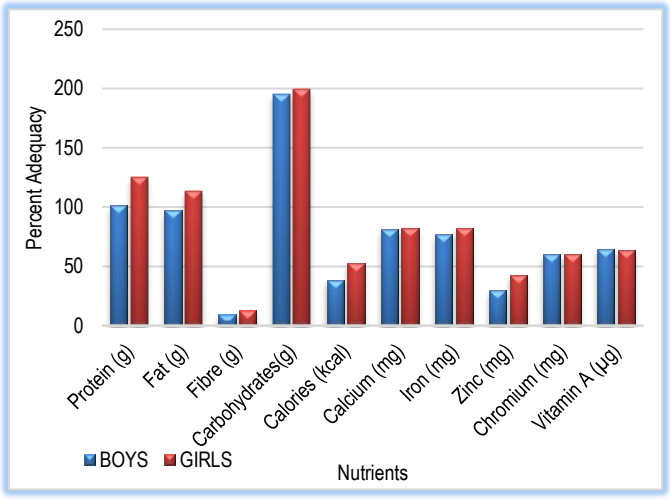


Fig-3 Percentage adequacy of nutrients (calculated against ICMR 2020)

Excess usage of screens during the pandemic has also found to increase the consumption of alcohol, smoking, and intake of sweetened foods [28]. Increased electronic device use and screen time exposure undoubtedly promotes poor dietary habits [29]. Not only do the screens have an effect on weight gain but they also affect hunger and satiety as they increase energy intake, which may be due to commercials and advertisements related to food [2]. The current study also found a similar correlation *i.e.*, higher was the screen-use of an adolescent, less healthy food was consumed. Excess screen time (>5 hours) was also seen to be associated with higher consumption of sugar-sweetened beverages, inadequate physical activity and compromised sleep [30]. Overall dietary intake of adolescents in the current sample population also was compromised. None of the food group was being consumed in appropriate proportions as recommended by ICMR (2010) [31]. Research concluded that dietary diversity was more in elder adolescents (15-19 years) than the younger ones (10-14 years) which can be due to increase in the quantity of food consumed [32]. Researches have also emphasised the need for dietary diversity among adolescents [33]. Current as well as other studies have shown that adolescents' diet has been compromised quality wise [34, 35]. The results in present research reported that the diet of the adolescents is deficient in all the major nutrients which are in accordance with the previous research studies [36- 39]. Nutrient intakes of both urban and rural adolescents were compromised but rural ones are more affected [40]. In agreement to the results of the current research, two-third of the Indian population were estimated to be micronutrient deficient and their diet were found to be mainly deficient in iron and vitamin A [41].

Healthy Eating Index (HEI)

Healthy eating index (HEI) components were grouped into two categories

Adequacy components and moderation components [Table-5]. Adequacy components represented the food groups, subgroups, and dietary elements that are to be encouraged. For these components, higher scores reflected higher intakes, because higher intakes of these food groups were desirable. Moderation components represented the food groups and dietary elements that are to be limited. For moderation components, higher scores represented lower intakes, because lower intakes of these foods were more desirable. Overall, a higher total HEI score indicates a diet that aligns better with dietary recommendations.

Adequacy Components

As clear from [Table-5], dairy scores were found to be the best among all the adolescents (between 8 to 9 out of 10) which could be the reason for good total protein score (nearly 3 out of 5) among the adolescents. There was a significant higher intake of dairy (p=0.002) and total protein foods (p=0.01) among urban adolescents as compared to rural adolescents. Fatty acid score was minimum (less than 2 out of 10) which reflects an image of imbalanced fatty acid consumption which can be due to monotonous use of fats and oils in their household. The adolescents in government schools with lower screen viewing as compared to private adolescents had significantly (p<0.0001) higher intake of dairy, whole grains and total protein foods. No significant variation was seen the food scores among different genders.

Moderate components

Moderate components are those components which have to be consumed in moderate amount. Therefore, more the score, lesser was the consumption. Amongst these components, sodium and added sugar score was best (ten out of ten) because of its consumption being in limit in adolescents' diet. Refined grains score was also good (more than seven out of ten) which indicated that the children consumed less of processed food items and junk foods. The worst score was of saturated fat (between 2-4 out of ten) which further clarifies the fact that fat intake of adolescents is imbalanced. No significant difference was observed among different categories for these moderate food components.

Overall, HEI score

The average overall HEI score for rural adolescent was 55.82 and for urban adolescent was 55.89 with no significant difference. The overall HEI score of private school adolescents was 55.75 which was statistically non-significant from government school adolescents (55.96). HEI scores were from the total score of 100 which means that the diet of the adolescents needs a lot of improvement in terms of the quality of food as it fell in the range of 51-80. Children are required to have the basic knowledge of the diet that they are consuming so that they along with their parents can make informed decisions. Though a minor difference exists in the overall scores of girls and boys, but the scores of girls (56.75±8.369) was higher than their male counterparts (54.93±8.564).

Table-3 *Food group intake of the respondents*

Food group	Rural (n=120)		Urban (n=120)		t-value	p- value	Private (n=120)		Government (n=120)		t-value	p- value	Boys (n=118)		Girls (n=122)		t-value	p- value
	Mean	SD	Mean	SD			Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Cereals (g)	187.63	74.02	191.26	70.62	-0.389	0.698	75.99	6.93	68.39	6.24	-0.682	0.496	186.49	70.49	192.3	74.01	-0.622	0.534
Pulses(g)	40.63	31.22	43.17	25.99	-0.685	0.494	40.92	29.95	42.88	27.47	-0.528	0.598	41.19	30.68	42.58	26.74	-0.375	0.706
Milk and milk products (ml)	364.21	185.7	432.13	151.15	-3.107	0.002	350.38	175.41	445.96	155.82	-4.463	<0.0001	390.3	178.84	405.78	166.21	-0.694	0.178
Root/tuber(g)	71.38	64.4	63.71	71.78	0.871	0.385	62.46	76.29	72.63	58.79	-1.156	0.249	73.81	76.93	61.48	58.10	1.398	0.241
Green leafy veg.(g)	35	85.65	16.67	53.97	1.984	0.049	30.00	83.61	21.67	58.24	0.896	0.371	27.12	80.23	24.59	63.39	0.27	0.491
Other vegetables(g)	43.33	58.51	58.58	67.3	-1.873	0.062	65.25	72.05	36.67	49.67	3.578	<0.0001	56.95	67.01	45.16	59.38	1.44	0.169
Fruits(g)	42.71	57.77	40.83	57.49	0.252	0.801	48.54	64.39	35.00	49.05	1.833	0.068	42.16	59.73	41.39	55.53	0.103	0.739
Sugars(g)	8.58	5.69	10.04	5.59	-2.001	0.047	7.50	5.18	11.13	5.59	-5.206	<0.0001	8.94	6.02	9.67	5.33	-0.995	0.044
Fats (g)	22.41	8.86	24.5	8.08	-1.91	0.057	21.58	8.74	25.33	7.90	-3.493	0.001	24.14	9.01	22.79	8.00	1.232	0.601
Meat(g)	16.83	46.59	12.33	44.09	0.768	0.443	15.00	51.02	14.17	39.01	0.142	0.887	15.25	48.89	13.93	41.77	0.224	0.52

Table-4 *Nutrient intake of the respondents*

Food group	Rural (n=120)		Urban (n=120)		t-value	p- value	Private (n=120)		Government (n=120)		t-value	p- value	Boys(n=118)		Girls (n=122)		t-value	p- value
	Mean	SD	Mean	SD			Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Protein (g)	45.31	14.413	47.22	13.834	-1.047	0.296	45.45	14.93	47.08	13.294	-0.893	0.373	45.76	14.894	46.75	13.391	-0.542	0.588
Fat (g)	37.76	18.089	40.61	11.989	-1.443	0.151	34.72	14.17	43.65	15.298	-4.693	<0.0001	38.77	16.566	39.59	14.196	-0.41	0.682
Fibre (g)	4.94	2.392	8.04	18.486	-1.821	0.071	8.17	18.526	4.8	1.836	1.983	0.05	6.43	12.668	6.54	13.831	-0.066	0.947
Carbohydrates (g)	185.38	54.143	208.81	105.457	-2.165	0.032	205	107.414	189.19	51.629	1.453	0.148	194.61	92.803	199.5	75.848	-0.446	0.656
Calories (kcal)	1260.2	336.502	1320.4	324.984	-1.41	0.16	1259.45	334.893	1321.17	326.501	-1.445	0.15	1273.51	362.462	1306.56	299.09	-0.769	0.443
Calcium (mg)	651.52	261.914	739.09	227.477	-2.765	0.006	651.96	251.555	738.65	239.047	-2.736	0.007	690.12	248.051	700.32	250.22	-0.317	0.751
Iron (mg)	14.26	27.036	14.38	28.035	-0.034	0.973	15.33	28.403	13.31	26.61	0.568	0.57	13.84	28.459	14.78	26.614	-0.263	0.793
Zinc (mg)	4.57	1.83	4.83	1.808	-1.14	0.255	4.92	2.175	4.48	1.351	1.869	0.063	4.36	1.681	5.03	1.896	-2.861	0.005
Chromium (mg)	0.02	0.093	0.03	0.095	-0.809	0.419	0.04	0.13	0.02	0.024	2.075	0.04	0.03	0.095	0.03	0.094	-0.082	0.935
Vitamin A (µg)	243.32	174.06	321.62	515.502	-1.577	0.117	284.08	523.382	280.86	158.736	0.065	0.949	310.52	525.264	255.33	160.92	1.093	0.276

Table-5 *Healthy eating index (HEI) of subjects*

SN	Components	Max. score	Rural (n=120)		Urban (n=120)		t-value	p-value	Private (n=120)		Government (n=122)		t-value	p-value	Boys (n=118)		Girls (n=122)		t-value	p-value
			Mean	SD	Mean	SD			Mean	SD	Mean	SD			Mean	SD	Mean	SD		
(A) Adequacy components																				
1	Total fruits	5	1.23	1.922	1.33	2.022	0.393	0.695	1.49	2.021	1.08	1.902	1.645	0.101	1.23	1.954	1.34	1.99	-0.421	0.674
2	Whole fruits	5	1.23	1.922	1.33	2.022	0.393	0.695	1.49	2.021	1.08	1.902	1.645	0.101	1.23	1.954	1.34	1.99	-0.421	0.674
3	Total vegetables	5	1.13	1.053	1.28	1.061	1.038	0.3	1.32	1.152	1.09	0.944	1.655	0.099	1.34	1.119	1.07	0.981	1.955	0.052
4	Greens and beans	5	2.3	1.026	2.34	1.073	0.307	0.759	2.31	1.129	2.33	0.964	-0.184	0.854	2.24	1.01	2.4	1.081	-1.216	0.225
5	Whole grains	10	4.33	2.269	3.98	2.068	-1.279	0.202	3.4	2.06	4.91	2.025	-5.72	<0.0001	4.11	2.218	4.2	2.138	-0.308	0.759
6	Dairy	10	8.3	1.734	9.32	3.097	-3.138	0.002	8.23	3.064	9.38	1.75	-3.57	<0.0001	8.53	3.009	9.07	2.001	-1.642	0.104
7	Total protein foods	5	3.14	1.233	3.6	1.536	-2.55	0.011	2.95	1.454	3.79	1.229	-4.842	<0.0001	3.36	1.533	3.39	1.282	-0.161	0.873
8	Sea food and plant proteins	5	1.44	0.818	1.44	0.776	0	1	1.5	0.917	1.38	0.651	1.137	0.257	1.4	0.828	1.48	0.763	-0.83	0.408
9	Fatty acids	10	0.68	1.992	1.85	2.818	3.703	<0.0001	1.6	2.767	0.93	2.172	2.076	0.039	0.86	2.116	1.66	2.784	-2.473	0.014
(B) Moderation components																				
10	Refined grains	10	7.85	3.072	7.33	3.321	-1.271	0.205	7.64	2.936	7.53	3.462	0.261	0.794	7.73	3.223	7.45	3.191	0.671	0.503
11	Sodium	10	9.94	0.49	10	0	1.304	0.194	9.94	0.49	10	0	-1.304	0.195	10	0	9.94	0.486	1.304	0.195
12	Added sugars	10	10	0	10	0	0	1	10	0	10	0	0	1	10	0	10	0	0	1
13	Saturated fats	10	2.38	3.223	3.3	3.933	1.975	0.05	3.55	3.799	2.13	3.292	3.087	0.002	2.62	3.506	3.06	3.725	-0.94	0.348
	Total Healthy eating index score	100	55.82	8.447	55.89	8.581	0.068	0.946	55.75	8.947	55.96	8.057	-0.19	0.85	54.93	8.564	56.75	8.369	-1.659	0.099

Table-6 *Comparison of cognitive scores on the basis of background*

SN	Rural (n=120)		Urban (n=120)		t-value	p-value	Private (n=120)		Government (n=120)		t-value	p-value	Boys (n=118)		Girls (n=122)		t-value	p-value
	Mean	SD	Mean	SD			Mean	SD	Mean	SD			Mean	SD	Mean	SD		
TN	137.98	60.42	191.85	78.5	5.957	<0.0001	147.63	78.44	182.21	67.22	3.667	<0.0001	160.44	68.653	169.54	80.946	0.938	0.349
E	191.2	69.48	167.23	81.85	-2.445	0.015	225.42	56.39	133.02	65.82	-11.68	<0.0001	180.7	76.293	177.68	77.43	-0.305	0.761
CP	91.26	67.3	115.28	82.11	2.478	0.014	57.98	55.77	148.56	65.68	11.515	<0.0001	101.28	74.278	105.32	77.759	0.412	0.681
R A (out of 25)	6.96	2.87	8.08	4.49	-2.312	0.022	5.44	3.75	9.6	2.49	10.105	<0.0001	7.31	3.887	7.74	3.717	0.867	0.387

Major difference in the score was made by refined grains score, saturated fat score and dairy score. The diet of both girls and boys needs to be improved in terms of quality as well as quantity nonetheless

There is a significant negative correlation between screen viewing and HEI of the respondents (r = -0.134, p=0.038). Overall score reveals that adolescents studying in private schools and those living in rural areas had lower HEI score than their counterparts which could be due excess usage of screen on daily basis as the screen-viewing assessment reveals similar results.

Consumption of food outside home and neglecting home-cooked food has been found to reduced HEI score but higher income has been found to increase HEI score [42]. Reduced fruits and vegetable consumption and increased fast food and carbonated drinks consumption has been found to decrease HEI score. All the adolescents in the present study irrespective of the category were having poor HEI. Similar dietary habits were found in internet addicted Chinese adolescents belonging to urban sector [1]. Children need to have the basic knowledge of the diet they are consuming so that they along with their parents can make informed decisions [43]. Therefore, additional efforts are needed to improve diet quality in children and adolescents [44]. The consumption of excessive amounts of saturated fatty acids as compared to unsaturated ones is the major reason for imbalanced fatty acid ratio. Irrespective of gender, school-type or background, all the adolescents in the present study have been found to have an imbalanced fatty acid ratio. Similar results have been seen in European adolescents [45].

Cognitive assessment

Assessment of Cognition was done by attention span scores and reasoning ability scores [Table-6]. Amongst the school-types, significantly higher (p<0.0001) attention was found in government school going adolescents with higher Concentration Performance (CP) and least Number of Errors. On the basis of background urban adolescents had significantly higher (p<0.05) attention span (CP score) than rural adolescents. Girls had a higher attention span than boys though it was statistically non-significant. Reasoning ability was scored out of 25. Reasoning ability was found to be even less than the average value thus indicating that all the adolescents under study were having poor reasoning ability. Further it was seen that adolescents of government schools had significantly higher (p<0.0001) reasoning ability as compared to private school adolescents. Also, a significantly higher (p=0.22) reasoning ability was reported in urban adolescents as compared to rural adolescents. Amongst the gender, better reasoning ability was seen in girls as compared to boys with no significant difference. A significant negative correlation was seen between screen-use and reasoning ability (r= -0.024, p= 0.039) and attention span (r=-0.001, p=0.045). Attention score was found to have a significant (p<0.001) positive correlation with physical activity (r=0.272, p=0.000) and reasoning ability (r=0.473, p=0.000). Reasoning ability was also found to have a significant positive correlation with physical activity (r=0.353, p=0.000).When compared to the screen viewing assessment, it was seen that the adolescents who viewed screens for longer duration *i.e.*, rural dwelling adolescents, going to private schools and male adolescents had lower attention span and reasoning ability as compared to their counterparts indicating that screen usage directly affects the cognition of the users especially in the growing age *i.e.*, adolescence.

Excessive internet use among adolescents not only hampers attention capacities but memory processes and social cognition with acute and sustained alterations [46]. Physical activity also directly affects attention scores [47].

The adolescents who were having a high attention span were also having good reasoning ability and were physically more active. Similar results were observed even in pre-schoolers and toddlers [48]. Another study conducted concluded that parents play a major role in adolescent's screen-viewing pattern, eating pattern and sleeping pattern [49]. In the current research government school adolescents were having better attention span score than private school adolescents [50]. On the contrary, research [51] reported that private school children have higher reasoning abilities based upon their academic performance as compared to government school peers. Another research [52] concluded that higher screen time reduces the cognitive abilities of adolescents. They also observed that reading time increases cognition. Reduced attention towards work and attention deficit hyperactivity disorder (ADHD) has been found to affect decision making and decision handling [53]. Another research [54] in 2020 reported that undergraduates having higher symptoms of attention deficit hyperactivity disorder (ADHD) were less confident in their mathematical and literary skills which affected their performance. A relationship between attention span of adolescents with eating habits was also found that attention was negatively related with BMI (r=-0.206) and glucose intake (r=-0.107) of the adolescent [55]. Acute as well as chronic physical activity interventions in adolescents have also been proven to increase attention, processing speed, cognitive flexibility, working memory and language skills [56]. There is a need to choose healthy foods by reading labels on processed foods [57]. Excess screen can induce ADHD in children along with depression, reduced sleep and increased violent behaviours [58].

Conclusion

The above study concluded that the use of screens was high in rural adolescents as compared to urban adolescents. Also, high incidences of screen viewing were reported in adolescents going to private schools and in the boys. The main purpose of using these gadgets was for the entertainment purpose, learning new concepts, obtaining information and for just passing the leisure time. Higher use of screens led to less physical activity which further had an effect on the weight gain among adolescents thus resulted in increased BMI among adolescents from rural background, going to private schools and mostly boys. The overall food and nutrient intake among the adolescents revealed that irrespective of the category, all the adolescents were having inadequate intake of all the food groups which further translated into poor nutrient intake. Total HEI scores for all the adolescents were in the range of 51-80 which meant that the diet of the adolescents needs a lot of improvement in terms of the quality of food. When compared to the screen viewing assessment, it was seen that the adolescents who viewed screens for longer duration *i.e*., rural dwelling adolescents, going to private schools and male adolescents had lower attention span and reasoning ability as compared to their counterparts indicating that screen usage directly affects the cognition of the users especially in the growing age *i.e*., adolescence. Therefore, actions should be taken to enable adolescents to limit screen viewing and encourage them to eat more healthy food.

The adolescents should not have access to the Internet or TV in their bedrooms, and parents should monitor the media use. Parents should encourage their children to do physical activity, indulge in recreational activity and spend quality time with their wards. Considering the recent situation where due to COVID-19 there is an enormous increase in screen viewing owing to the educational institutions resorted to the use of Internet-based technology to reach out and engage with the students. This current situation needs to be studied in depth for its effect on the nutritional and psychological aspects of the adolescents in relation to unavoidable increase in screen exposure.

Application of research: Screen viewing has increased over the years and its association with overall nutritional status and cognitive development has been supported with little casual evidences. Considering the recent situation where due to COVID-19 there is an enormous increase in screen viewing owing to the educational institutions resorted to the use of Internet-based technology to reach out and engage with the students. This current situation needs to be studied in depth for its effect on the nutritional and psychological aspects of the adolescents in relation to unavoidable increase in screen exposure.

Research Category: Ecology and Environmental Sciences

Abbreviations: BMI-Body Mass Index, HEI-Healthy Eating Index

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