How Screen Time Affects Greek Schoolchildren's Eating Habits and Sleep?

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Article

How Screen Time Affects Greek Schoolchildren's Eating Habits and Sleep?

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Abstract: Background: Television (TV), video games, PC and devices such as tablets and smart phones have become part of everyday life at an ever-younger age. Increased screen time correlates with unhealthy eating habits and reduced sleep duration among children. **Methods**: 374 children aged 9-12 years and their parents (n=159), from 3 schools in Lemnos and 5 schools in Thessaloniki, Greece, took part in this cross-sectional study. The children completed the KIDMED score and a questionnaire about their physical activity, time spent watching TV, PC and playing electronic games, the frequency of cooking or shopping with their parents, the frequency of eating fast food and soft drinks. Statistical analysis was performed with SPSSS-29.0, using One Way ANOVA, T-test, Cross Tabulation, Reliability Statistics, Bivariate, Bonferoni, Post-hoc, Kolmogorov – Smirnov and Pearson chi-square. **Results:** There was a statistically significant difference between soft drinks consumption and hours of television viewing (p=0.03). A statistically significant difference detected between television (p=0,024), video games (p=0,028), all screen categories (p=0,011) and fast-food consumption. The more hours children spent in front of screens, the less adherence they had to the Mediterranean Diet. Sleep hours and screen time were correlated (p=0.002). **Conclusions**: The results suggest that screen time seem to be interrelated and affect children's eating behaviors and sleep duration. The study concluded that the longer the screen time the unhealthier dietary habits and lifestyle profile have schoolchildren. Future research should focus on reducing screen time, as a means of improving dietary patterns, sleeping and potentially reducing childhood obesity.

Keywords: screen time; sleep; KidMed; children; primary school; schoolchildren; eating habits; parents

1. Introduction

Screen time (ST) is becoming an important factor influencing dietary habits in children. It encompasses the duration spent using screens, including computers, televisions, video games, smartphones and tablets. Excessive screen time has been associated with body weight, reduced sleep duration and various mental health issues in children [1]. Numerous cross-sectional and prospective studies indicate a link between unhealthy eating habits and television watching among children. Increased television viewing time correlates with higher consumption of sugary drinks and non-whole grain products [2]. Furthermore, watching TV is linked to poorer dietary choices and lower intake of fruits and vegetables among children [3]. Moreover, a rise in sedentary behaviors, such as screen time and lack of physical activity, is connected to unhealthy eating patterns in European adolescents. There is also growing evidence of a shift from the traditional Mediterranean Diet (MD) towards a preference for energy-dense foods typical of Western diets, particularly in Mediterranean regions [4]. While engaging in high-quality screen activities can fulfill certain educational and entertainment needs, excessive exposure to screens may negatively impact children's physical health, cognitive abilities and psychosocial development. Consequently, managing screen time during childhood and adolescence is essential, balancing the associated risks and benefits [5].

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The American Academy of Pediatrics (AAP) advises that children under 18 to 24 months should completely avoid screen media, while children older than this age should limit their screen time to no more than one hour per day [5, 6]. The World Health Organization (WHO) states that infants in their first year should not be exposed to digital screens. For children aged 2 to 5 years, screen time should be restricted to a maximum of one hour daily [5, 7]. The Canadian Pediatric Society has issued similar guidelines, recommending that children younger than 2 years avoid screens entirely and that those aged 2 to 5 limit their screen time to less than one hour per day [8]. Concerns are increasing regarding the effects of screen time, particularly on mobile phones, on the health and well-being of children and adolescents. The American Academy of Sleep Medicine suggests that children should get at least 9 hours of sleep, while adolescents need at least 8 hours; those who fall short of these recommendations are considered to have insufficient sleep [9]. Additionally, there is a relationship between screen time and inadequate sleep in children [10, 11], which can contribute to obesity in childhood and adolescence through hormonal mechanisms that influence eating behaviors [11]. Sufficient sleep is crucial for the growth, development, daily functioning and overall health of youngsters. Lack of sleep is known to negatively impact the health and well-being of children and adolescents. Indeed, increased screen time has been associated with reduced sleep duration, delayed bedtime and poorer sleep quality [12].

The present study aimed on the one hand to investigate the connection between screen time and dietary habits in children aged 9 to 11 years and on the other hand to explore this association in relation to their sleep quality. Research focusing on this age group is particularly crucial, as lifestyle behaviors, such as poor diet, are changeable and often formed during childhood or young adulthood. The transition from childhood to adolescence brings about various stressors that can significantly affect individuals' health-related lifestyle decisions.

2. Materials and Methods

2.1. Participants and Study Procedures

This is a cross-sectional study using a sample which was composed of Greek schoolchildren aged between 9-11 years old (n = 373) and their parents (n=159). Data was collected between May 2022 and July 2022. Children and their parents/guardians (hereon referred to as “parents”) were recruited from 8 elementary schools located in Thessaloniki and Lemnos. To include students from different city areas (north, south, east, west and central), one school per region was randomly selected. 15 primary public schools in the town (10 schools) and on the island (5 schools) were invited to participate in the study and only 8 of those agreed to participate (5 schools from Thessaloniki and 3 schools from Lemnos). Participating in public schools were equally spread over the area of Thessaloniki and Lemnos. The parents of 70% of children gave written informed consent and only these children participated in the research. Informed consent was obtained from parents two weeks before the data collection day. We visited schools where children's eating/ physical habits and watching screen time were investigated using printed questionnaires. After informing the children about the purpose of our visit, they began to complete their questionnaires. Questionnaires were self-reported by the pupils at school in the presence of a researcher who was available to answer any possible questions. The participants completed a diet and lifestyle questionnaire, which included a self-reported measure of screen viewing and a food frequency questionnaire (FFQ). We didn’t take any anthropometric measurements (weight or height) of children; we relied on the weight and height that the parents themselves reported to us about their children in their electronic questionnaires. The parents were invited to answer a similar questionnaire with their kids at the same period, electronically, via the Google Forms platform and we asked to be completed by one parent of each child.

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2.1.1. Inclusion and Exclusion Criteria

The Inclusion criteria included: 1) pupils aged 9-11 years; 2) pupils enrolled in public elementary schools; 3) pupils who had returned the informed consent form authorizing their participation, signed by their parents or guardians.

Exclusion criteria were: 1) pupils with a physical disability or having a limitation for doing any activity usually carried out by children due to any health issue, 2) pupils who had health problems and needed to follow a special dietary pattern that excludes certain foods from their diet or who had been diagnosed with a food disorder such as anorexia nervosa, bulimia nervosa, dysphagia etc., 3) pupils and parents who didn't speak Greek with sufficient fluency were excluded from the study to avoid errors in the research.

2.1.2. Ethical Approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki of 1975 and all procedures involving research study participants were approved by the Ethical Review Board of the Ministry of Education and Religious Affairs and the Ethical Committee of University of the Aegean, approved the study before its commencement (approval No. 22/13 February 2022).

2.2. Measures

Parents' self-reported body weight and height data were used to calculate their Body Mass Index (BMI). Parents' weight status was assessed using BMI, calculated using the formula: weight (kg)/height (m2). The weight status variable was classified into four categories: Underweight, Healthy Weight, Overweight and Obesity [13]. The BMI-for-age cut-off points of the WHO child growth standards were used for children [14].

2.3. Demographic and Socioeconomic Characteristics

Sociodemographic information about parents including age, gender, smoking and socioeconomic status (SES) was collected. SES was assessed through the following questions: educational level, type of profession, income and number of family members. Parental educational level was classified as low (lower general secondary education, lower vocational training and primary school or less), medium (intermediate vocational training, higher general secondary training and pre-university education) or high (completed higher vocational training and University) based on the highest completed education level of both parents. Type of profession was classified as private or public employee, freelancer, self-employed, domestic worker and farmer. Income was classified as low, medium and high.

2.4. Dietary Assessment

Children's questionnaire includes questions about how many meals consume every day, the frequency of breakfast consumption and school snacks and the frequency of fast foods consumption, Functional Foods and beverages. To evaluate adherence to the Mediterranean Diet by the pupils the KIDMED score was used. The KIDMED score classify participants into three categories: low adherence (3 or fewer points), medium adherence (4–7 points) and high adherence (8 or more points) [15].

Parents indicated the frequency (number of everyday and weekend days) of glasses per day of coffee/ wine/ soft drinks consumption. To evaluate adherence to the Mediterranean Diet by the parents, the MedDiet Score was used. In particular, for the consumption of food items that are close to the Mediterranean diet scores 0 for rare or no consumption, to 5 for almost daily consumption, were assigned, whereas, for the consumption of foods that are away from this traditional diet (like meat and meat products), the opposite scores were assigned (i.e., 0 for almost daily consumption to 5 for rare or no consumption). For alcohol consumption, score 5 for the consumption of less than 3

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wine glasses per day and, progressively, score 0 for the consumption of more than 7 wine glasses per day. Thus, the range of the diet score is between 0 and 55 [16].

Participants reported the frequency of consumption of Functional Food items based on daily, weekly and monthly intakes over the past year. A FFFQ (Functional Food Frequency Questionnaire) with 50 food items (more natural and some enriched Functional Foods) was given to the subjects using the following categories of frequency consumption: never, rarely, two to three times a month, once to two times a week, three to five times a week, daily. Functional Foods were selected according to the position paper of Papagianni et al. who developed and validated a new FFFQ which includes 48 food groups and 28 individual foods (food subgroups), for a total of 76 food groups, which were categorized mainly based on the major food groups they belong to, but also on their bioactive component [17]. We decided to select these 50 Functional Foods to be included in the questionnaire, thinking that 1. They are more widespread and more frequently consumed by children and parents than other Functional Foods we had on our list, and 2. That we were limited in time and couldn't include more than 50 FFs in the questionnaire for the participants to answer.

2.5. Physical Activity

Children's activity behavior items included in the study were playing outside and participating in organized sports (hours/ week). Parents were asked to indicate the average number of days per week and weekends that they spent time on physical activity (none, 1-2 times/ week, 3-4 times/ week, >4 times/ week).

2.6. Screen Time

To assess children's TV watching time and screen time, pupils responded to the question "On average how many hours per day do you watch TV' and 'How many hours per day do you spend in front of screens. Screen as detected as playing on the computer, playing video games, using tablet or/ and a mobile phone. Response options were 1 = none; 2 = 1-2 hours a day; 3 = 2-3 hours a day; 4 = 3-4 hours a day; 5 = >4 hours a day.

To consider increased use of screen devices, the recommendation of the American Academy of Pediatrics was used, which considers more than two hours/day for children over 2 years old as excessive use [18]. Pupils who reported use lower than the cutoff point they were considered as low/normal screen use.

2.7. Sleep Duration

While some of the dangers of blue light may have been overhyped in recent years, screen use too close to bedtime can harm sleep quality. And sleep is important enough to childhood development that the World Health Organization made sleep one of the focuses of their latest recommendations [19]. Children's sleep duration was measured with the questions: 'How many hours do you sleep per day'. The questionnaire asked for sleep behavior on weekdays and not on weekends, because it is more constant than sleep behavior on weekends.

2.8. Home Environment

The physical home environment was measured with the number of TVs and computers in the household. Pupils responded to the question 'How many televisions do you have in your home' and 'How many computers do you have at home'. Response options were 1 = one; 2 = two; 3 = three; 4 = >3.

2.9. Statistical Analysis

Statistical analyses were performed using IBM SPSS for Windows, version 29.0. Differences in characteristics between boys and girls were studied by chi-squared tests of association and between fathers and mothers, by chi-squared tests of association and independent samples t-tests.

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Associations between variables related to screen time (TV viewing, tables, videogaming etc.), eating habits and BMI, MedDiet Score or Kidmed were explored with chi-squared tests of association and One-Way Analysis of Variance (ANOVA) with Bonferroni corrections, respectively. Two-Step Cluster Analysis was utilized to explore family segments relative to dietary habits (BMI of parents and children, MedDiet score, Kidmed score, parents' consumption of functional food, children's consumption of natural functional food, and children's number of meals per day). The associations of the extracted family clusters with demographic, dietary variables and screen time were explored by chi-square tests. Normality of continuous variables was assessed by Kolmogorov-Smirnov tests. The statistical significance level was set at an alpha value of < 0.05.

3. Results

This study included 373 schoolchildren (162 girls and 211 boys) aged 9 to 11 years, of 4th, 5th and 6th grade of primary school. The study was conducted in two areas, in Thessaloniki (city) and in Lemnos (island - province) in eight schools from different regions. Five schools from Thessaloniki and three schools from Lemnos were randomly selected to participate. Schoolchildren's descriptive characteristics are shown in Table 1.

A total of 138 (37.0%) schoolchildren spent 1-2 hours of screen time per day and 91 (24.4%) schoolchildren spent ≥ 3 hours of screen time per day. Half of the children (50.7%) watch television for 1 hour per day. Moreover, 118 (31.6%) children played video games 2 – 3 hours per day. It was noticed that girls spend more hours in front of screens, watching TV and playing video games, compared to boys (Table 1).

Regarding sleep duration, 46 (12.3%) participants answered that they were sleeping 7 or fewer hours and 235 (63%) participants were sleeping 8-9 hours. As for their dietary habits, 203 (54.4%) pupils, slightly more than half of the sample, consume breakfast every day before leaving home. 242 from 373 (64.9%) children consumed soft drinks. KIDMED index results showed us that 33 (8,8%) pupils had very low diet quality, 130 (34.9%) pupils had average Mediterranean Diet adherence, improvement needed to adjust intake to Mediterranean patterns and 103 (27.6%) had good adherence to the principles of the Mediterranean Diet (Table 1).

Table 1. Descriptive characteristics of children, total and by gender.

		Gender						*Chi-square test of association* p-value
		Total		girl		boy		
		N	%	N	%	N	%	
Region	**City (Thessaloniki)**	253	67.6%	119	73.5%	134	63.2%	.036
	Island (Lemnos)	121	32.4%	43	26.5%	78	36.8%	
Frequency of watching TV	none	7	2.0%	3	2.0%	4	2.0%	.812
	1-2 times/ week	73	20.7%	32	21.3%	41	20.3%	
	3-4 times/ week	89	25.3%	34	22.7%	55	27.2%	
	every day	183	52.0%	81	54.0%	102	50.5%	
Watching TV (h/d)	none	8	2.3%	3	2.0%	5	2.5%	.367
	1 hour	190	54.4%	74	49.3%	116	58.3%	
	2-3 hours	125	35.8%	60	40.0%	65	32.7%	
	>4 hours	26	7.4%	13	8.7%	13	6.5%	
Screen time (laptop, computer, tablet, mobile phone)	1-2 hours/week	69	19.4%	26	17.0%	43	21.2%	.067
	3-4 hours/ week	58	16.3%	18	11.8%	40	19.7%	
	1-2 hoyrs/ day	138	38.8%	62	40.5%	76	37.4%	
	>3 hours/ day	91	25.6%	47	30.7%	44	21.7%	
Video gaming (h/d)	0-1 hours	129	42.3%	37	28.7%	92	52.3%	<.001*
	2-3 hours	118	38.7%	57	44.2%	61	34.7%	
	4 or more hours	58	19.0%	35	27.1%	23	13.1%	
Sleeping time (h/d)	≤7 hours	46	12.6%	24	15.1%	22	10.7%	.466
	8 hours	99	27.1%	42	26.4%	57	27.7%	
	9 hours	136	37.3%	61	38.4%	75	36.4%	
	≥10 hours	84	23.0%	32	20.1%	52	25.2%	

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Breakfast consumption frequency	every day	204	71.1%	82	73.2%	122	69.7%	.693
	1-2 times/ week	38	13.2%	15	13.4%	23	13.1%	
	3-5 times/ week	45	15.7%	15	13.4%	30	17.1%	
Beverage consumption	YES	242	65.8%	113	70.6%	129	62.0%	
	NO	126	34.2%	47	29.4%	79	38.0%	
Fast food consumption/ week	none	87	23.5%	34	21.3%	53	25.2%	.437
	every day	21	5.7%	11	6.9%	10	4.8%	
	1-2 times/ week	230	62.2%	104	65.0%	126	60.0%	
	3-4 times/ week	32	8.6%	11	6.9%	21	10.0%	
KIDMED score (0–12)	poor score <3	33	12.4%	16	15.0%	17	10.7%	.307
	medium score 4-7	130	48.9%	55	51.4%	75	47.2%	
	high score >8	103	38.7%	36	33.6%	67	42.1%	

*p<0.05.

3.1. Children's Screen Time and Eating Habits

Further data analysis was applied to estimate the effect of screen time categories on specific dietary habits (Table 2). Specifically, chi-square associations showed that skipping breakfast, consuming fast food and soft drinks frequently, were associated with increased screen time. In detail, comparisons between all categories of screen time showed that the longer the screen time the increased the odds of unhealthy dietary habits in children.

Cooking with parents and the hours that they spent playing video games was found to be statistically significant (p=0.035). In addition, it was found statistically significant difference between frequency of taking homemade snacks to school and hours in front of screens (p=0.026). The more hours the children spent in front of screens, the less often they took homemade snacks to school. Also, there is a statistically significant difference between hours in front of screens and daily breakfast consumption (p=0.010). Specifically, as the hours that children spend in front of screens increase, so do the percentage of children who eat breakfast daily. Further, it was found that there was a statistically significant difference between soft drinks consumption and hours of television viewing (p=0.03). As the hours of TV viewing increased, so did the percentage of children who consumed soft drinks (from 50% increased to 88,5%). It was noticed the same with the hours that pupils spent in front of screens and the soft drinks consumption (p=0.001). Pupils who are in front of screens for >3 hours consume soft drinks by 77%.

Regarding fast food consumption, we found a statistically significant difference with television (p=0,024), video games (p=0,028) and all screen categories (p=0,011). The longer the screen time, the higher the frequency of fast-food consumption per week. Also, it wa found the same results in video games.

Table 2. Data analysis to evaluate the influence of various screen time categories on children's specific dietary habits**.**

		Hours/day in front of screens (laptop, computer, tablet, mobile phone)								Chi-square test of association
		1-2 hours/week		3-4 hours/ week		1-2 hours/ day		>3 hours/ day		
		N	%	N	%	N	%	N	%	**p-value**
Cooking with parents	YES	46	67.6%	44	77.2%	93	67.9%	51	56.0%	.057
	NO	22	32.4%	13	22.8%	44	32.1%	40	44.0%	
Supermarket with parents	YES	61	91.0%	51	87.9%	130	94.2%	74	83.1%	.057
	NO	6	9.0%	7	12.1%	8	5.8%	15	16.9%	
Frequency of	1-2 times/ week	6	9.5%	8	14.8%	12	9.9%	14	18.9%	.026*

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taking in school homemade snack	3-5 times/ week	7	11.1%	13	24.1%	30	24.8%	23	31.1%	
	every day	50	79.4%	33	61.1%	79	65.3%	37	50.0%	
Daily breakfast consumption	YES	63	92.6%	45	77.6%	110	80.3%	64	71.1%	.010*
	NO	5	7.4%	13	22.4%	27	19.7%	26	28.9%	
Beverage consumption	YES	31	47.0%	37	66.1%	92	67.6%	70	76.9%	.001*
	NO	35	53.0%	19	33.9%	44	32.4%	21	23.1%	
Fast food consumption per week	none		44.8%	15	26.3%	22	16.2%	11	12.1%	.011*
	1-2 times/ week	30	44.8%	34	59.6%	98	72.1%	60	65.9%	
	3-4 times/ week	4	6.0%	5	8.8%	9	6.6%	13	14.3%	
	every day	3	4.5%	3	5.3%	7	5.1%	7	7.7%	

		Hours/ day of TV viewing								Chi-square test of association
		0		1 hour		2-3 hours		>3 hours/ day		
		N	%	N	%	N	%	N	%	**p-value**
Cooking with parents	YES	2	100,00 %	47	60,30 %	40	76,90 %	9	56,30%	.156
	NO	0	0,00%	31	39,70 %	12	23,10 %	7	43,80%	
Supermarket with parents	YES	2	66,70%	73	93,60 %	47	90,40 %	12	75,00%	.269
	NO	1	33,30%	5	6,40%	5	9,60%	4	25,00%	
Frequency of taking in school homemade snack	1-2 times/ week	0	0,00%	12	17,40 %	5	10,40 %	0	0,00%	.560
	3-5 times/ week	0	0,00%	14	20,30 %	12	25,00 %	3	21,40%	
	every day	2	100,00 %	43	62,30 %	31	64,60 %	11	78,60%	
Daily breakfast consumption	YES	2	66,70%	64	82,10 %	41	78,80 %	12	75,00%	.680
	NO	1	33,30%	14	17,90 %	11	21,20 %	4	25,00%	
Beverage consumption	YES	4	50.0%	108	58.1%	89	72.4%	23	88.5%	.030*
	NO	4	50.0%	78	41.9%	34	27.6%	3	11.5%	
Fast food consumption per week	none	2	25.0%	54	29.0%	21	16.9%	3	11.5%	.024*
	1-2 times/ week	2	25.0%	110	59.1%	84	67.7%	18	69.2%	
	3-4 times/ week	2	25.0%	12	6.5%	14	11.3%	3	11.5%	
	every day	2	25.0%	10	5.4%	5	4.0%	2	7.7%	

	Hours *video gaming* / day					
	0	1	2	3	4	≥5 ώρες

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		N	%	N	%	N	%	N	%	N	%	N	%	p-value
Cooking with parents	YES	37	78.7%	62	76.5%	51	66.2%	24	58.5%	18	60%	14	50%	.035*
	NO	10	21.3%	19	23.5%	26	33.8%	17	41.5%	12	40%	14	50%	
Supermarket with parents	YES	45	95.7%	74	92.5%	72	93.5%	37	90.2%	26	86.7%	23	82.1%	.269
	NO	2	4.3%	6	7.5%	5	6.5%	4	9.8%	4	13.3%	5	17.9%	
Frequency of taking in school homemade snack	every day	36	76.6%	47	62.7%	33	50.8%	20	58.8%	11	42.3%	18	72.0%	.243
	1-2 times/ week	1	2.1%	10	13.3%	14	21.5%	3	8.8%	8	30.8%	2	8.0%	
	3-5 times/ week	10	21.3%	18	24.0%	18	27.7%	11	32.4%	7	26.9%	5	20.0%	
Daily breakfast consumption	YES	38	80.9%	68	84.0%	59	76.6%	30	73.2%	21	72.4%	18	64.3%	.680
	NO	9	19.1%	13	16.0%	18	23.4%	11	26.8%	8	27.6%	10	35.7%	
Beverage consumption	YES	25	54.3%	50	62.5%	53	69.7%	29	70.7%	26	86.7%	27	96.4%	<.001*
	NO	21	45.7%	30	37.5%	23	30.3%	12	29.3%	4	13.3%	1	3.6%	
Fast food consumption per week	none	14	29.8%	18	22.5%	15	19.7%	5	12.5%	3	10.0%	1	3.6%	.028*
	every day	0	0.0%	3	3.8%	6	7.9%	2	5.0%	4	13.3%	2	7.1%	
	1-2 times/ week	29	61.7%	51	63.7%	49	64.5%	30	75.0%	17	56.7%	23	82.1%	
	3-4 times/ week	4	8.5%	8	10.0%	6	7.9%	3	7.5%	6	20.0%	2	7.1%	

*p<0.05.

Table 3 provides that screen time have a statistically significant difference with MD adherence (p=0.001) and natural FFs consumption (p=0.001). The more hours children spent in front of screens, the less adherence they had to the MD and the less natural FFs consumption. A statistically significant difference is shown in those children who watch TV every day; they have lower KidMed score than those children who watch TV 1-2 times/week. Finally, the more hours they played with video games the lower the adherence they had to MD (p=0,013). The same thing it was observed with natural FFs (p=0,019).

Table 3. Results of One-Way Analysis of Variance (ANOVA) for the association between KIDMED score or Natural Functional Foods consumption and Hours/day in front of screens (laptop, computer, tablet, mobile phone), TV viewing frequency and Hours of video gaming per day.

	Hours/day in front of screens (laptop, computer, tablet, mobile phone)	N	MO	TA	F	p-value
KIDMED score	1-2 hours/ week	66	7,6212	2,42275	7,937	<.001*
	3-4 hours/ week	55	6,7455	2,44357		
	1-2 hours/ day	133	6,7594	2,38731		
	>3 hours/ day	82	5,6585	2,63977		
Natural Functional Foods consumption	1-2 hours/ week	69	3,4695	0,7738	7,227	<.001*
	3-4 hours/ week	58	3,368	0,75888		
	1-2 hours/ day	138	3,1833	0,73704		
	>3 hours/ day	91	2,9504	0,7612		

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	TV viewing frequency	N	MO	TA	F	p-value
KIDMED score	none	7	5,43	4,35	5,4	.001*
	1-2 times/week	72	7,40	2,54		
	3-4 times/week	83	6,92	2,35		
	Every day	172	6,15	2,43		
Natural Functional Foods consumption	none	7	3,27	0,84	9,4	<.001*
	1-2 times/week	73	3,44	0,78		
	3-4 times/week	89	3,40	0,65		
	Every day	183	3,00	0,76		
	Hours of video gaming per day	N	MO	TA	F	**p-value**
KIDMED score	0	47	7,0638	2,6817	2,95	.013*
	1	79	7,0253	2,48573		
	2	73	6,6712	2,53889		
	3	36	6,2222	2,36777		
	4	28	5,4286	2,39488		
	5 or more hours	27	5,5926	2,76321		
Natural Functional Foods consumption	0	48	3,2804	0,79706	2,75	.019*
	1	81	3,3222	0,73073		
	2	77	3,2864	0,79241		
	3	41	3,0342	0,56362		
	4	30	3,0839	0,86578		
	5 or more hours	28	2,8197	0,6679		

*p<0.05.

3.2. Family Clusters (Parent-Child)

We requested parents of the children if they want to participate in our research together with their children. 159 parents accepted (139 mothers and 20 fathers) and were involved in our study. Participant demographic information is available in Table 4.

Table 4. Descriptive characteristics of parents, total and by gender.

		Parents						Chi-square test of association
		Total		Mothers		Fathers		
		N	%	N	%	N	%	p-value
Region	**City (Thessaloniki)**	105	66.0%	92	66.2%	13	65.0%	.917
	Island (Lemnos)	54	34.0%	47	33.8%	7	35.0%	
Occupation type	private employee	54	34.0%	49	35.3%	5	25.0%	.679
	public employee	52	32.7%	44	31.7%	8	40.0%	
	freelancer / self-employed	31	19.5%	26	18.7%	5	25.0%	
	Unemployed / Household / other	22	13.8%	20	14.4%	2	10.0%	
Education	Complete High School	29	18.2%	23	16.5%	6	30.0%	.333
	Institute of Vocational Training	32	20.1%	29	20.9%	3	15.0%	
	College-educated	98	61.6%	87	62.6%	11	55.0%	
Annual income	<15000€	50	31.4%	47	33.8%	3	15.0%	.207
	15000-30000€	88	55.3%	75	54.0%	13	65.0%	

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	>30000€	21	13.2%	17	12.2%	4	20.0%	
Smoking	YES	60	37.7%	53	38.1%	7	35.0%	.787
	NO	99	62.3%	86	61.9%	13	65.0%	
Beverage consumption	NAI	53	33.3%	42	30.2%	11	55.0%	.028*
	OXI	106	66.7%	97	69.8%	9	45.0%	
Fast food consumption/ week	none	62	39.0%	57	41.0%	5	25.0%	.612
	1 time/ ween	73	45.9%	62	44.6%	11	55.0%	
	2 times/ week	18	11.3%	15	10.8%	3	15.0%	
	3-5 times/ week	2	1.3%	2	1.4%	0	0.0%	
	every day	4	2.5%	3	2.2%	1	5.0%	
Exercise/ week	none	45	28.3%	37	26.6%	8	40.0%	.427
	1-2 times/ week	82	51.6%	74	53.2%	8	40.0%	
	>3 times/ week	32	20.1%	28	20.1%	4	20.0%	

*p<0.05.

The results of parents' BMI, parents' MedDiet Score and children's BMI total and by gender are in Table 5.

Table 5. Parents' BMI and MedDiet Score/ children's BMI total and by gender.

	Gender						
	Total		**Women/ Girls**		**Men/ Boys**		**t-test**
	M	SD	M	SD	M	SD	**p-value**
Parents' BMI	24.75	4.70	24.35	4.73	27.67	3.27	.004*
children's BMI	18.62	3.12	18.62	3.20	18.60	2.59	.981
Parents' MedDiet Score	34.04	3.17	34.12	3.05	33.50	3.97	.508

*p<0.05.

A statistically significant correlation of children's BMI (Body Mass Index) with KidMed score was found. The higher the KidMed score was, the lower the child's BMI was. That means, the more the children had good adherence to the principles of the Mediterranean Diet, the lower their Body Mass Index ware. In addition, children's BMI is positively related to parents' BMI. The higher the parents' BMI were, the higher the children's BMI were (Table 6).

Table 6. Pearson correlation coefficients for the association of children's BMI, parents' BMI, KIDMED score and MedDiet score.

	Children's BMI	**KIDMED score**
KIDMED score	**-.190***	--
MedDiet score	-0,029	0,144
Parents' BMI	**.314****	-0,118
*p<0.05		
** p< 0.01		

We chose some variables that are important for the parents' health and some variables that are important for the child's health and made specific family profiles (FAMILY CLUSTERS). We put determinant variables in the analysis clusters. We created the 2 groups and correlated them with the screens, physical activity, fast food and sleeping hours. Clusters were produced with the Two-Step Cluster analysis method and the solution's silhouette score was 0.2, indicating a fair cluster quality. Input variables in the cluster analysis were children and parents' BMI scores, MedDiet and KidMed scores, number of meals per day, children and parents' frequency of functional foods' consumption. These variables were selected because of their well-established associations between adherence to the

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Mediterranean diet and children's health outcomes [20]. The Mediterranean lifestyle is beyond a healthy mainly plant-based diet characterized by culture, human contact, moderation and physical activity and has been acknowledged as the most appropriate shield mainly for obesity-related disease prevention, and the roadmap to longevity, wellbeing, and health care sustainability. Several studies in children and adolescents have found an inverse correlation between the degree of adherence to Mediterranean diet and BMI [21]. As well, multiple studies have explored, and they found that there is parental–offspring BMI associations [22]. Although many aspects of diet and lifestyle influence metabolic status and disease trajectory during the life course, emerging findings suggest that the influences of the frequency and timing of meals on health is large [23, 24]. As far as Functional Foods are concerned, they play an important role in maintaining a healthy lifestyle and reducing the risk factors of various diseases. Most foods have a functional element which is responsible for improving the healthy state. All food substances such as fruits, vegetables, cereals, meat, fish and dairy contain functional ingredients [25]. Based on the current literature, we decided to include these variables in the created cluster analysis.

The cluster analysis showed that our sample was divided into 2 groups. We had a total of 137 parent-child groups. The 1st group consisted of 70 parent-child (51.1%) and the 2nd group consisted of 67 parent-child (48.9%). The families which belong to the 1st cluster/ 1st group had higher adherence to MD (both parents and children) and this is associated with lower BMI (both parents and children), higher Functional Foods consumption and more meals of the children per day. The 2nd cluster/ 2nd group had families with lower adherence to MD, higher BMI, lower Functional Foods consumption and a lower number of meals that the children eat per day (Table 7).

Table 7. Family clusters (parent-child).

	Total sample (N=137)		**Family clusters (parent-child dyads)**			
			1st cluster – Families with healthier eating habits (n=70)		**2nd cluster – Families with less healthy eating habits (n=67)**	
	M	**SD**	**M**	**SD**	**M**	**SD**
Parents' BMI	24.68	4.67	22.98_a	3.73	26.47_b	4.92
Children's BMI	18.61	3.00	17.51_a	2.17	19.77_b	3.31
MedDiet score	33.96	3.10	35.49_a	2.89	32.36_b	2.44
Parents' consumption of modified Functional Foods	3.04	.96	3.20_a	1.03	2.88_b	.85
Parents' consumption of natural Functional Foods	3.18	.53	3.42_a	.51	2.92_b	.43
KIDMED score	6.64	2.45	7.76_a	2.10	5.46_b	2.25
Children's consumption of natural Functional Foods	3.19	.69	3.41_a	.71	2.96_b	.58
Number of meals children eat per day	4.58	1.13	4.89_a	.96	4.25_b	1.21

Note 1. Clusters extracted with the Two Step Cluster Method. 2. Values in the same row not sharing the same subscript are significantly different at $p < .05$ in the two-sided independent samples t-tests.

Cluster analysis showed that regarding fast food, children have a worse diet than their parents. We observed no significant difference in fast food between parents, but there is between children

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(p=0.049). In families that adopt a healthier diet in terms of MedDiet score, BMI, FFs consumption, their children's fast-food consumption is lower. Child's sleep hours with cluster were found to be related (p=0.027), marginal relationship parents' exercise with cluster (p=0.068) and screen time with cluster (p=0.065). Soft drinks and cluster weren't found to have association (Table 8).

Table 8. Results of associations between family clusters and various variables.

		Family Clusters				
		Families with healthier eating habits (n=70)		**Families with less healthy eating habits (n=67)**		***Chi-square test of association***
		N	%	N	%	*p-value*
Parents' fitness program/ week	**none**	13	18.6%	22	32.8%	0.068*
	1-2 times/ week	39	55.7%	36	53.7%	
	>3 times/ week	18	25.7%	9	13.4%	
Watching TV	YES	68	97.1%	65	97.0%	0.674
	NO	2	2.9%	2	3.0%	
TV viewing frequency	none	1	1.5%	2	3.0%	0.708
	1-2 times/ week	18	26.5%	13	19.4%	
	3-4 times/ week	15	22.1%	14	20.9%	
	every day	34	50.0%	38	56.7%	
TV viewing hours	none	1	1.5%	2	3.1%	0.197
	1 hour	40	59.7%	28	43.1%	
	2-3 hours	22	32.8%	26	40.0%	
	>4 hours	4	6.0%	9	13.8%	
Hours /day in front of screens (laptop, PC, tablet, mobile phone)	none	0	0.0%	0	0.0%	0.065*
	1-2 hours/week	17	24.6%	8	12.7%	
	3-4 hours/ week	15	21.7%	16	25.4%	
	1-2 hoyrs/ day	29	42.0%	22	34.9%	
	>3 hours/ day	8	11.6%	17	27.0%	
Supermarket with parents	YES	64	91.4%	59	88.1%	0.515
	NO	6	8.6%	8	11.9%	
Cooking with parents	YES	51	72.9%	42	63.6%	0.273
	NO	19	27.1%	24	36.4%	
Children's sleeping hours/ day	≤7 hours	5	7.2%	12	17.9%	0.027*
	8 hours	14	20.3%	20	29.9%	
	9 hours	30	43.5%	27	40.3%	
	≥10 hours	20	29.0%	8	11.9%	
Videogaming hours/ day	0 hour	11	19.0%	9	15.8%	0.720
	1 hour	18	31.0%	17	29.8%	
	2 hours	17	29.3%	12	21.1%	
	3 hours	6	10.3%	8	14.0%	
	4 hours	3	5.2%	5	8.8%	
	≥5 hours	3	5.2%	6	10.5%	
Frequency of Breakfast consumption in children	every day	45	75.0%	37	74.0%	0.758
	1-2 times/ week	6	10.0%	7	14.0%	
	3-5 times/ week	9	15.0%	6	12.0%	
Frequency of Fast Food consumption in parents	καθόλου	30	42.9%	25	37.3%	0.802
	1-2 φορές/εβδομάδα	38	54.3%	40	59.7%	

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	3 ή περισσότερες φορές/εβδομάδα	2	2.9%	2	3.0%	
Frequency of Fast-Food consumption in children	καθόλου	21	30.0%	19	28.4%	0.049*
	1-2 φορές/εβδομάδα	45	64.3%	35	52.2%	
	3 ή περισσότερες φορές/εβδομάδα	4	5.7%	13	19.4%	
Children's Beverage consumption	YES	43	63.2%	46	68.7%	0.506
	NO	25	36.8%	21	31.3%	
Sweet consumption/ week	none	6	8.6%	1	1.5%	0.231
	every day	13	18.6%	17	25.4%	
	1-2 times/ week	31	44.3%	32	47.8%	
	3-4 times/ week	20	28.6%	17	25.4%	

*p<0.05.

3.3. Children's Screen Time and Sleep

In our sample, most children were sleeping 9 hours (36,5%), 22% of children were sleeping 10 hours or more during the day and a percentage of 12,3% were sleeping 7 hours or less (Table 9).

Table 9. Sleep duration.

Sleep hours/ day	N	%
≤7 hours	46	12.3%
8 hours	99	26.5%
9 hours	136	36.5%
≥10 hours	83	22.3%
They didn't answer	9	2.4%

A statistically significant difference was found between KIDMED Score and hours of sleep (p=0,021). The more hours children sleep, the more adherence had to MD (Table 10).

Table 10. Sleep duration and KIDMED score.

	Sleep hours/ day	N	MO	TA	F	p-value
KIDMED score	≤7 hours	41	6,2683	2,85503	3,27	0,021*
	8 hours	94	6,1489	2,5567		
	9 hours	131	6,6107	2,45756		
	≥10 hours	81	7,2963	2,44665		

*p<0.05.

Sleep hours and screen time were correlated (p=0.002). It seems that children who were sleeping fewer hours spend more hours in front of screens (Table 11).

Table 11. Sleep duration and screen time.

Sleeping hours/ day * Hours/ day in front of screens (laptop, computer, tablet, mobile phone) Crosstabulation										
	Hours/ day in front of screens (laptop, computer, tablet, mobile phone)								**Total**	
	1-2 hours/week		**3-4 hours/ week**		**1-2 hoyrs/ day**		**>3 hours/ day**			
	N	**%**	**N**	**%**	N	%	N	%	N	%

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Sleeping hours/ day	≤7 hours	8	11.8%	5	8.9%	11	8.2%	20	22.5%	44	12.7%
	8 hours	18	26.5%	9	16.1%	37	27.6%	33	37.1%	97	28.0%
	9 hours	22	32.4%	24	42.9%	57	42.5%	23	25.8%	126	36.3%
	≥10 hours	20	29.4%	18	32.1%	29	21.6%	13	14.6%	80	23.1%
Total		68	100.0%	56	100.0%	134	100.0%	89	100.0%	347	100.0%

Note 2. $\chi 2(9)=26.19$, $p = .002$.

4. Discussion

It was found that there was a statistically significant difference between soft drinks consumption and hours of television viewing, playing video games and hours that pupils spent in front of different categories of screens. As the hours of watching increased, so did the percentage of children who consumed soft drinks. Similar findings observed in a Spanish cross-sectional study. High levels of screen time were associated with a greater frequency of beverage consumption [26]. In the Swedish sample of 2-9 years old children there were associations between screen habits and sweetened beverage consumption [27]. Moreover, in the cross – sectional ToyBox-study which was conducted in several European countries (Belgium, Bulgaria, Germany, Greece, Hungary, Italy, Netherlands, Poland, Spain) have shown that children who spend more time on screens tend to consume more sugary beverages [28]. Identical conclusions reached from cross – sectional survey of Kanyinga and their colleagues, whose target group were adolescents between the ages of 10 and 19 years old. There were inversely associations with consumption of sugar-sweetened beverages (SSBs) and energy drinks (EDs) [29]. Kenney et al. found that TV viewing and other screen device use, including use of smartphones and tablets, increase intake of SSBs, independently of one another [10] as confirmed in our study. Also, screen time was positively associated with soft drink consumption in Huo's and Falbe's studies [1, 30]. Hueso and their colleagues found that Spanish children who spend more time on screens are more likely to consume unhealthy snacks and sugary beverages [31]. One possible reason for these results could be that children who spend more time in front of screens are more likely to passively consume foods high in fats, salt and sugar. This is because they tend to pay less attention to their eating habits while engaged in other activities. Additionally, many advertisements shown during children's television (or online) programming promote foods and beverages that are high in calories, salt, fat and sugar [26].

A statistically significant correlation of children's BMI (Body Mass Index) with KidMed score was found. A strong, inverse association was observed between KIDMED score and children's weight status in a recent cross – sectional study in Greece [21]. Previous findings by Kanellopoulou et al. (2021) among Greek children revealed similar values of the KIDMED index and children's BMI [32]. Furthermore, a recent Greek study among children aged 6–18 years revealed that participants who are overweight/ obese had higher proportions of unhealthy dietary habits than those with normal weight [33]. In line with our findings in a current study that included students from ten geographical areas of Greece, showed that overweight and obese children had lower KIDMED scores compared to normal-weight children [34]. In contrast to our results, new study on Italian children (mean age 11±3.4 years), they didn't find any association between KIDMED scores and BMI [35]. Also, in our research children's BMI was not found to be associated with screen time, but in a cross- sectional study in Germany found that higher screen time was associated with a higher likelihood of being overweight or obese among adolescents [36]. In Robinson's survey found a significant association between increased screen media exposure (such as television, video games and computers) and higher rates of obesity among American children and adolescents [37]. It was observed a similar trend in other recent studies, which indicated that greater screen time was linked to higher BMI [38, 39, 40, 41, 42].

Regarding fast food consumption, we found a statistically significant difference with all kinds of screens (television, video games, tablets, laptops, computers, mobile phones). The longer the screen time, the higher the frequency of fast-food consumption per week. Likewise, these results are in line with a few previous studies that have examined similar hypotheses. In a Spanish Cross-Sectional

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Study with children 1–14 years old, is found that increased leisure screen time is often associated with higher intake of junk food. Children who spend more time on screens may be more likely to consume unhealthy snacks and sugary beverages [43]. Consistently with a study from WHO European Childhood Obesity Surveillance Initiative, screen time was found to be associated with consumption frequencies of energy-dense, micronutrient-poor foods which underline the importance of limiting children's screen time exposure [44]. Finally, in a review conducted a few years ago found evidence that the time spent watching television, playing on the computer and total screen time were inversely related to diet quality among children. The higher consumption of a potentially cariogenic diet was found among children with excessive screen time [45].

Our results show that screen time has a statistically significant difference with MD adherence. The more hours children spent in front of screens, the less adherence they had to the MD. Similar to our results, PASOS study revealed that greater amount of screen time was associated with worse adherence to the MD [11]. In agreement with our findings, the HELENA study investigated that screen time and MD adherence are inversely associated in European adolescents [4]. Further, in a current study investigated the relationship between the use of different types of popular media among 10- to 11-year-old schoolchildren and their commitment to the MD. The findings revealed that engaging in electronic gaming and watching television or streaming content is significantly linked to a reduced adherence to MD [46].

It was noticed that girls on our sample spend more hours in front of screens, watching TV and playing video games, compared to boys. In contrast to research by Ryciak et al. which observed that the average screen time was higher among boys [47].

There has been extensive study into the relationship between time devoted to screen-based forms of entertainment (such as television, video games, and especially in recent years, computers, telephones and tablets), hours of sleep. 38.8% of our sample had poor sleep quality, with 7–8 hours of sleep per night. Sleep hours were correlated with screen time and MD. The more hours children were sleeping, the greater their adherence to the MD. Conversely, fewer hours of sleep were associated with lower adherence to the Mediterranean diet. Additionally, it appears that children who sleep fewer hours tend to spend more time in front of screens. These results are consistent with the results from earlier studies concerning the relationship between sleep duration and dietary habits. Insufficient sleep duration was associated with an unhealthy lifestyle profile among Greek children and adolescents [9]. Spanish children between 1 and 14 years old found to have short sleep duration when patterns of daily leisure screen time were higher [31]. In addition, greater screen time, especially game playing, was associated less sleep duration among Icelandic adolescents [12]. Recently, Sekhar and her colleagues showed that children with low screen time had better sleep efficiency compared to those with high screen time [48].

Our study has several limitations. First: we didn't check the hours that the children's parents spend in front of screens. Second, we didn't measure separately the screen time that kids spent on weekdays and/ or weekends. The last weaknesses is that our sample isn't representative enough of the areas that we researched.

5. Conclusions

Conclusively, increased screen time correlates with poorer dietary habits and insufficient sleep among schoolchildren. There is a positive relationship between screen time and unhealthy eating behaviors. Consequently, the education system should focus on encouraging schoolchildren to participate in physical activities, limit their screen time and consume healthier foods like fruits and vegetables. Intervention programs aimed at decreasing screen time should particularly focus on weekends. In addition, effective strategies aimed at addressing screen time and feeding behaviors need to be created by parents. Parents are crucial in influencing the number of televisions, setting viewing rules and establishing bedtime routines for their children.

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