

Regional Disparities in Sedentary Behaviors and Meal Frequency in Iranian Adolescents: The CASPIAN-III Study

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Background: The prevalence of obesity is increasing among Iranian youngsters like other developing countries.

Objectives: This study was conducted to assess regional disparities in sedentary behaviors and meal frequency in Iranian adolescents.

Patients and Methods: In this national survey, 5682 students aged 10 - 18 years from urban and rural districts of 27 provinces of Iran were selected via stratified multi-stage sampling method. The country was classified into four sub-national regions, based on criteria of the combination of geography and socioeconomic status (SES). Mean of meal frequency and physical activity levels as well as prevalence of omitting meals and sedentary behavior were compared across regions with different SES after stratifying with sex and age group.

Results: Meal frequency in lower socio-economic regions was significantly higher than two other regions in 10 - 13 and 10 - 18 years old groups (P trend < 0.001). However, the mean of working hours with computer was linearly increased with increasing the SES in studied regions (P trend < 0.001), whereas the corresponding figure was not significant for the mean of watching TV (P trend > 0.05). Frequency of adolescents omitting their meals was higher in higher SES regions especially in West Iran (P < 0.001) in 10 - 13 years old age group. Having personal computer and working with it more than two hours per day mainly was observed in central Iran which ranked as the highest SES group.

Conclusions: Efforts to ensure Iranian youth meet healthy food habits and screen time guidelines include limiting access to screen technologies and encouraging parents to monitor their own screen time is required.

Keywords: Adolescent; Obesity; Behavior

1. Background

The prevalence of obesity is increasing among Iranian youngsters like other developing countries (1, 2). A complex interaction between environmental and behavioral factors is known to be underlying cause of childhood obesity (3). Sedentary behaviors (television, video and computer) are related to health outcomes independent of physical activity, because sedentary behaviors may displace the available time for participation in physical activity, resulting in overall lower energy expenditure (4). Some of the studies revealed that the obesogenic effect of television (TV) viewing in youngsters may be due to increasing food intake than to decreased physical activity levels (5, 6). Also, snacking play an important role in emerging of overweight and obesity (7). Some of the

dietary behaviors linked with obesity are as follows: increased number of meals eaten outside home (8), larger portion sizes of meals at restaurants and fast-food take-aways (9), and increased consumption of soft drinks (10, 11). Sociodemographic factors may be explaining the association between sedentary behaviors and food intake. Families with lower economic status buy less-nutritious, energy-dense foods owing to their reduced cost. These families may prefer watching TV during their leisure time (12). Information about the contexts of snacking in adolescents or how snacking may influence other dietary habits, like meal skipping is lacking. Also few studies have examined trends of sedentary behaviors among youth in developing nations.

2. Objectives

This study is conducted to compare the mean of meal frequency and physical activity level in a nationally representative sample of Iranian adolescents living in different regions with diverse socio-demographic patterns and to determine whether meal and snacking patterns are associated with gender, age level, or region of residence.

3. Patients and Methods

This national level cross-sectional study was performed in 2009 - 2010 as the third survey of the school-based surveillance system entitled Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable Disease (CASPIAN-III) Study in Iran. It was a multicentre study performed among 5682 school students (96% participation rate), aged 10 - 18 years, living in urban and rural areas of 27 provinces in Iran. Details on the study protocol have been described before (13, 14) and here we report it in brief. Approval for the study was granted by ethics committees and other relevant national regulatory organizations. The Data and Safety Monitoring Board of the project closely supervised the quality control and quality assurance of the survey at the national level. The project team obtained written informed consent from parents and oral assent from students. They selected school students by multistage random cluster sampling. Schools were stratified according to location (urban or rural), and the socioeconomic characteristics of their catchment area, taking into consideration the proportion of the different types of schools (public or private) to avoid socioeconomic bias. Questionnaires in the Farsi language were prepared based on the questionnaires used in the WHO STEP-wise approach to non-communicable diseases (Tools version 9.5) and the WHO Global School-based Student Health Survey (GSHS). Students filled in a validated food frequency questionnaire. The validity of our questionnaire's content was affirmed by a panel of experts; item analysis and reliability measures were assessed in a pilot study. Data on physical activity level and time screen of students was gathered through a questionnaire. The students' PA pattern was assessed by the questionnaire in which nine different metabolic equivalent (MET) levels were ranged on a scale from sleep/rest (0.9 METs) to high-intensity physical activities (> 6 METs); this instrument was assessed by comparison with measurement of physical activity by accelerometry and keeping a PA diary (15). The questionnaire had previously been modified and validated among Iranian young people (16), and was found to be significantly associated with the results obtained using the International Physical Activity Questionnaire (IPAQ) (17). For each activity level, the MET-value was multiplied by the time spent at that particular level. The MET-time at each level was added to obtain a total over 24 hours MET-time, representing the PA level on an average weekday. Energy expenditure was estimated by multiplying the total 24-hour MET-time

by the body weight. In the current study, we categorized the PA level according to the tertiles computed in the population studied, and scored it from one to three corresponding to the first to the third tertile. The data entry staff entered data for all forms. And questionnaires twice and checked for completeness and inconsistencies. The data checking process was conducted first at the district and then at the national level (13). Classification of Iran into four sub-national regions was based on previously published paper by Farzadfar et al. (18). The sub-national regions were defined based on criteria of the combination of geography and SES using principal component analysis. According to this classification, the Southeast and the Central region have the lowest and highest SES, respectively. SES was an index consisted of variables from the 2006 census, including literacy, family permanent income (family assets) and employment rate.

3.1. Statistical Analyses

Continuous and categorical variables are expressed as mean (standard deviation) and number (percentage), respectively. The differences in prevalence of meal frequencies, time spent watching television and/or at a computer across regions were tested by using the Pearson Chi-square test. Comparison of means of these variables across regions was investigated by ANOVA; significant findings were further analyzed using post hoc tests (Tukey). A P value of < 0.05 was considered as statistically significant. All statistical analyses were performed using programs available in the STATA package.

4. Results

The participants of this study included 5682 students aged 10 - 18 years old. The number of subjects in Southeast (lowest SES), North-Northeast (second low SES rank), West (second high SES rank) and Central (highest SES) regions were 567 (10.0%), 1075 (18.9%), 2372 (41.7%) and 16618 (29.4%), respectively. No significant difference was found in age and sex ratio across the regions ($P > 0.05$). Table 1 shows the mean daily meal frequency, hours of watching TV, working with computer, and screen time activity of adolescent participants of the study based on their sex and age group. Meal frequency in lower socio-economic regions (Southeast and North-Northeast) was significantly higher than in two other regions (West and Central) in 10 - 13 and 10 - 18 years old groups ($P \text{ trend} < 0.001$). However, the mean of working hours with computer was linearly increased as the SES of regions increased ($P \text{ trend} < 0.001$), whereas the corresponding figure was not significant for the mean of watching TV ($P \text{ trend} > 0.05$). Nearly mean of all three variables shown in Table 1 was significantly higher in girls compared to boys in different age groups and regions except for the lowest SES region. Frequency of adolescents omitting meals was higher in higher SES regions especially in West Iran ($P < 0.001$) in 10 - 13 years old age group and as SES increased between

regions, male adolescents omitted their meals more than did girls (Table 2). Having personal computer and working with it more than two hours per day mainly was observed in central Iran which ranked as the highest SES group. North-Northeast and West were similar regarding these variables and adolescents residing in Southeast region had the lowest working with computer (Table 3), as well as physical activity between regions. Both physical activity hours per day and participation in a sport class at school were higher in male than in female subjects and in central region-which was the highest SES-compared to other regions (Table 4).

5. Discussion

To our best knowledge, this is the first study in developing countries to address identifying the meal frequency pattern and sedentary behavior in adolescent of sub-national regions of Iran and one of the few in the international literature. Regarding physical activity level, our study focused on some key behaviors such as watching TV, using computer, and playing video games. Based on our findings, having personal computer and working with it mainly was observed in central Iran which ranked as the highest SES group. North-Northeast and West were similar regarding these variables and adolescents residing in Southeast region had the lowest working with computer among regions. The opposite association observed between SES group and computer use may be related to economical access. That is, families residing in lower SES regions may not be able to afford a home computer. A study conducted by Carson et al. revealed that girls living in low SES neighborhoods engaged in significantly more weekly screen time and TV/movie minutes compared to girls living in high SES neighborhoods. Consistent with our study, children living in low SES neighborhoods were more likely to use video games and less likely to use computers compared to children living in high SES neighborhoods. Also, children living in medium SES neighborhoods were less likely to use computers compared to children living in high SES neighborhoods (19). A few studies that have assessed temporal trends in screen time among children in developed nations, revealed that a significant increase in both screen time and the proportion of youngsters spending two or more hours per day on screen time over the last decade (20-22). These trends are consistent with previous studies from developed countries (20, 21), but reveal more rapid increases than previously reported because of economic transitioning which is occurring in these countries. Rapid increase in the family income has caused ownership of televisions, video players and computers, and prevalence of child obesity (23). There are not data on trends of sedentary behaviors among Iranian children or adolescents and only small cross-sectional assessments were conducted on this regard. Future studies should examine the physical activity level changes of these age groups after efforts for design-

ing screen time guidelines. Studies among Western youth in the developed countries such as USA (24), UK (25), France (21), Canada (26) and Australia (27, 28) conducted between 1999 and 2006, have reported that the average screen time among Western youth was approximately 2.5 hours per day. In Mexico City, youth watched TV for 2.4 hours per day and videos for 0.9 hours per day in 1997, with a 40% of youth exceeding the screen time guidelines (29). Daily mean of national screen time in our study was about 2.8 hours and was similar to other studies in developing countries reported 2.7 hours per day of screen time among their youth in 2005 - 2006 (30). These findings are in contrast to other findings from Asian based studies that indicate screen time is lower among youth in a range of Asian countries compared with Western and South American youth. However, screen use in Asia was related to the economic prosperity of the country (4, 31) and in the present study it was different in the four SES based regions in the country. One of the first studies in Latin America showed an increase of 60 minutes in the overall screen time from age 11 to 15 years. Also, using computer increased, TV viewing declined, and no changing was observed in time spent playing video games. Boys reported more hours of screen time than girls (32). Our study revealed that screen time increased in early adolescents, consistent with above study. Greater screen time among boys in comparison with girls was observed. A study conducted in Australia revealed that watching TV/videos/DVDs and using computer for fun were the most popular sedentary behavior among students, corresponding with more than one-half of all sedentary time spent by Australian adolescents (28). In a study of American adolescents, no difference in mean time of watching TV/video between sexes was observed. However, boys spent more time playing computer games than girls, whereas girls spent more time sitting and listening to music and talking on the telephone than boys (33). In Spanish children, males also spent more time for playing computer games and engaged in more time spent in all screen-viewing behaviors than females (34). A systematic review involving only prospective studies revealed that there is insufficient evidence for the socioeconomic determinants of sedentary behavior (35). Consistent with other studies we found sedentary activities differed between boys and girls (36, 37). Therefore future screen time and sedentary behavior research among children and adolescents should be consider the moderating effects of gender as well as assessing explanations for these effects. Our study explored meal frequency of adolescents and the association of region with skipping meals. Frequency of adolescents omitting their meals was higher in higher SES regions especially in West Iran in 10 - 13 years old age group and as SES increased between regions; male adolescents more omitted their meals than girls. The increasing prevalence of snacking has been considered as a potentially important influence on energy regulation and rapid increasing of obesity in adolescents (38).

Table 1. Daily Meal Frequency, Watching TV, Working With Computer, and Screen Time Activity (Mean \pm SD) of Participants Based on Region, Sex and Age Group: The CASPIAN-III Study ^{a,b}

Variables	Southeast				North-Northeast				West				Central				National				P-Trend
	Boys (n = 144)	Girls (n = 130)	Total (n = 274)	P value	Boys (n = 249)	Girls (n = 252)	Total (n = 501)	P value	Boys (n = 542)	Girls (n = 508)	Total (n = 1050)	P value	Boys (n = 375)	Girls (n = 418)	Total (n = 793)	P value	Boys (n = 1311)	Girls (n = 1308)	Total (n = 2618)	P value	
Meal frequency, times/day ^c																					
10 -13, y	2.30 ± 0.68	2.40 ± 0.61	2.35 ± 0.65	0.227	2.31 ± 0.70	2.39 ± 0.60	2.35 ± 0.63	0.152	1.87 ± 0.93	2.00 ± 0.99	1.93 ± 0.96	0.031	2.05 ± 0.87	2.18 ± 0.88	2.12 ± 0.88	0.038	2.05 ± 0.86	2.17 ± 0.87	2.11 ± 0.87	< 0.001	
14-18, y	2.17 ± 0.64	2.30 ± 0.64	2.24 ± 0.64	0.068	2.22 ± 0.65	2.32 ± 0.63	2.27 ± 0.64	0.072	2.17 ± 0.66	2.36 ± 0.61	2.27 ± 0.64	< 0.001	2.18 ± 0.68	2.35 ± 0.66	2.27 ± 0.67	< 0.001	2.19 ± 0.66	2.34 ± 0.63	2.26 ± 0.65	< 0.001	
10-18, y	2.24 ± 0.66	2.35 ± 0.62	2.29 ± 0.65	0.038	2.26 ± 0.66	2.35 ± 0.62	2.31 ± 0.64	0.021	2.04 ± 0.81	2.20 ± 0.81	2.12 ± 0.81	< 0.001	2.12 ± 0.77	2.26 ± 0.78	2.20 ± 0.78	< 0.001	2.15 ± 0.76	2.26 ± 0.75	2.19 ± 0.76	< 0.001	
Watching TV, h/d																					
10-13, y	3.18 ± 0.97	3.50 ± 1.04	3.33 ± 1.01	0.009	3.18 ± 1.12	3.41 ± 1.11	3.29 ± 1.12	0.021	3.29 ± 1.08	3.41 ± 1.08	3.34 ± 1.08	0.073	3.41 ± 1.04	3.52 ± 2.07	3.47 ± 1.66	0.355	3.29 ± 1.07	3.45 ± 1.47	3.37 ± 1.29	0.001	
14 -18, y	3.82 ± 1.06	3.71 ± 1.04	3.77 ± 1.05	0.377	3.45 ± 1.12	3.61 ± 1.10	3.53 ± 1.11	0.084	3.73 ± 1.07	3.69 ± 1.01	3.71 ± 1.04	0.496	3.63 ± 1.10	3.70 ± 0.99	3.66 ± 1.05	0.293	3.66 ± 1.09	3.68 ± 1.03	3.67 ± 1.06	0.543	
10 -18, y	3.50 ± 1.06	3.61 ± 1.05	3.55 ± 1.06	0.206	3.32 ± 1.12	3.51 ± 1.11	3.42 ± 1.12	0.005	3.53 ± 1.10	3.56 ± 1.06	3.55 ± 1.08	0.496	3.53 ± 1.08	3.61 ± 1.61	3.57 ± 1.38	0.203	3.49 ± 1.10	3.57 ± 1.26	3.53 ± 1.18	0.006	
Working computer, h/d																					
10 -13, y	1.66 ± 1.33	1.62 ± 0.97	1.64 ± 1.17	0.775	1.63 ± 0.85	1.95 ± 1.22	1.80 ± 1.07	0.001	2.06 ± 1.10	2.11 ± 1.25	2.08 ± 1.17	0.546	1.99 ± 1.11	2.33 ± 1.35	2.17 ± 1.25	< 0.001	1.91 ± 1.10	2.10 ± 1.27	2.00 ± 1.19	< 0.001	
14 -18, y	1.97 ± 1.15	2.20 ± 1.19	2.08 ± 1.17	0.102	1.70 ± 1.06	1.91 ± 1.14	1.80 ± 1.11	0.023	1.99 ± 1.08	2.27 ± 1.28	2.12 ± 1.18	< 0.001	1.93 ± 1.08	2.33 ± 1.46	2.13 ± 1.30	< 0.001	1.92 ± 1.09	2.21 ± 1.31	2.06 ± 1.21	< 0.002	
10 -18, y	1.82 ± 1.25	1.93 ± 1.13	1.87 ± 1.19	0.295	1.67 ± 0.97	1.93 ± 1.18	1.80 ± 1.09	< 0.001	2.02 ± 1.09	2.19 ± 1.27	2.10 ± 1.18	0.001	1.96 ± 1.09	2.33 ± 1.40	2.15 ± 1.27	< 0.001	1.92 ± 1.09	2.16 ± 1.29	2.03 ± 1.20	< 0.001	
Screen time activity, h/d ^d																					
10 -13, y	4.82 ± 1.70	5.08 ± 1.47	4.94 ± 1.60	0.186	4.82 ± 1.43	5.35 ± 1.79	5.09 ± 1.64	< 0.001	5.33 ± 1.67	5.51 ± 1.71	5.42 ± 1.69	0.106	5.39 ± 1.66	5.84 ± 2.70	5.63 ± 2.28	0.006	5.19 ± 1.64	5.53 ± 2.09	5.36 ± 1.88	< 0.001	
14 -18, y	5.79 ± 1.58	5.90 ± 1.73	5.85 ± 1.65	0.604	5.14 ± 1.70	5.52 ± 1.70	5.33 ± 1.71	0.009	5.73 ± 1.61	5.94 ± 1.72	5.83 ± 1.66	0.033	5.56 ± 1.64	6.03 ± 1.87	5.79 ± 1.77	< 0.001	5.57 ± 1.65	5.88 ± 1.77	5.72 ± 1.71	< 0.015	
10 -18, y	5.31 ± 1.71	5.51 ± 1.66	5.41 ± 1.69	0.174	5.00 ± 1.59	5.44 ± 1.74	5.22 ± 1.68	< 0.001	5.55 ± 1.65	5.75 ± 1.73	5.64 ± 1.69	0.008	5.48 ± 1.65	5.94 ± 2.31	5.71 ± 2.03	< 0.001	5.40 ± 1.66	5.72 ± 1.93	5.56 ± 1.80	< 0.001	

^a Data are presented as Mean \pm SD.^b Differences between boys and girls was reported by t-test and between regions were reported using ANOVA.^c Mean of daily meals and snacks consumed by each group.^d Mean of hours spending for watching TV and working with computer.

Table 2. Prevalence of Various Meal Patterns (%) in Participants by Region, Sex and Age Group: The CASPIAN-III Study ^a

Age Groups	Southeast			North-Northeast			West			Central			National ^b		
	Boys	Girls	Total	P Value ^c	Boys	Girls	Total	P Value ^c	Boys	Girls	Total	P Value ^c	Boys	Girls	Total
10 - 13, y				0.548				0.013				0.003			< 0.001
3 meals	63 (48.5)	63 (48.5)	126 (46.0)		123 (49.4)	125 (49.6)	248 (49.5)		169 (31.2)	201 (39.6)	370 (35.3)		487 (37.4)	580 (44.6)	1067 (41.0)
2 meals (skip-ping breakfast)	26 (18.1)	27 (20.8)	53 (19.3)		42 (16.9)	34 (13.5)	76 (15.2)		81 (15.0)	71 (14.0)	152 (14.5)		217 (16.7)	186 (14.3)	403 (15.5)
2 meals (skip-ping lunch)	12 (8.3)	14 (10.8)	26 (9.5)		13 (5.2)	26 (10.3)	39 (7.8)		29 (5.4)	30 (5.9)	59 (5.6)		72 (5.5)	103 (7.9)	175 (6.7)
2 meals (skip-ping dinner)	4 (2.8)	3 (2.3)	7 (2.6)		2 (0.8)	14 (5.6)	16 (3.2)		20 (3.7)	14 (2.8)	34 (3.2)		44 (3.4)	50 (3.8)	94 (3.6)
1 meal (eating breakfast)	12 (8.3)	5 (3.8)	17 (6.2)		9 (3.6)	10 (4.0)	19 (3.8)		13 (2.4)	14 (2.8)	27 (2.6)		43 (3.3)	40 (3.1)	83 (3.2)
1 meal (eating lunch)	5 (3.5)	1 (0.8)	6 (2.2)		14 (5.6)	11 (4.4)	25 (5.0)		63 (11.6)	14 (2.8)	77 (7.3)		100 (7.7)	40 (3.1)	140 (5.4)
1 meal (eating dinner)	13 (9.0)	11 (8.5)	24 (8.8)		26 (10.4)	15 (6.0)	41 (8.2)		34 (6.3)	36 (7.1)	70 (6.7)		107 (8.2)	77 (5.9)	183 (7.1)
14 - 18, y				0.453				0.704				< 0.001			< 0.001
3 meals	47 (33.1)	57 (39.0)	104 (36.1)		109 (38.0)	125 (45.3)	234 (41.6)		225 (34.4)	311 (49.5)	536 (41.8)		53 (35.4)	699 (47.3)	1234 (41.3)
2 meals (skip-ping breakfast)	38 (26.8)	33 (22.6)	71 (24.7)		71 (24.7)	53 (19.2)	124 (22.0)		183 (28.0)	115 (18.3)	298 (23.2)		411 (27.2)	278 (18.8)	689 (23.1)
2 meals (skip-ping lunch)	10 (7.0)	17 (11.6)	27 (9.4)		17 (5.9)	17 (6.2)	34 (6.0)		34 (5.2)	46 (7.3)	80 (6.2)		76 (5.0)	102 (6.9)	178 (6.0)
2 meals (skip-ping dinner)	7 (4.9)	5 (3.4)	12 (4.2)		16 (5.6)	13 (4.7)	29 (5.2)		21 (3.2)	23 (3.7)	44 (3.4)		69 (4.6)	67 (4.5)	136 (4.6)
1 meal (eating breakfast)	7 (4.9)	2 (1.4)	9 (3.1)		10 (3.5)	12 (4.3)	22 (3.9)		30 (4.6)	23 (3.7)	53 (4.1)		58 (3.8)	57 (3.9)	115 (3.8)
1 meal (eating lunch)	6 (4.2)	4 (2.7)	10 (3.5)		7 (2.4)	7 (2.5)	14 (2.5)		32 (4.9)	27 (4.3)	59 (4.6)		77 (5.1)	54 (3.7)	131 (4.4)
1 meal (eating dinner)	12 (8.5)	14 (9.6)	26 (9.0)		28 (9.8)	23 (8.3)	51 (9.1)		70 (10.7)	41 (6.5)	111 (8.7)		139 (9.2)	99 (6.7)	238 (8.0)
0 meal	15 (10.6)	14 (9.6)	29 (10.1)		29 (10.1)	26 (9.4)	55 (9.8)		59 (9.0)	42 (6.7)	101 (7.9)		145 (9.6)	122 (8.3)	267 (8.9)
10 - 18, y				0.160				0.110				< 0.001			< 0.001
3 meals	110 (38.5)	120 (43.5)	230 (40.9)		232 (43.3)	250 (47.3)	482 (45.3)		394 (33.0)	512 (45.1)	906 (38.9)		1022 (36.3)	1279 (46.0)	2301 (41.2)
2 meals (skip-ping breakfast)	64 (22.4)	60 (21.7)	124 (22.1)		113 (21.1)	87 (16.5)	200 (18.8)		264 (22.1)	186 (16.4)	450 (19.3)		628 (22.3)	464 (16.7)	1092 (19.5)
2 meals (skip-ping lunch)	22 (7.7)	31 (11.2)	53 (9.4)		30 (5.6)	43 (8.1)	73 (6.9)		63 (5.3)	76 (6.7)	139 (6.0)		148 (5.3)	205 (7.4)	353 (6.3)
2 meals (skip-ping dinner)	11 (3.8)	8 (2.9)	19 (3.4)		18 (3.4)	27 (5.1)	45 (4.2)		41 (3.4)	37 (3.3)	78 (3.3)		113 (4.0)	117 (4.2)	230 (4.1)
1 meal (eating breakfast)	19 (6.6)	7 (2.5)	26 (4.6)		19 (3.5)	22 (4.2)	41 (3.9)		43 (3.6)	37 (3.3)	80 (3.4)		101 (3.6)	97 (3.5)	198 (3.5)
1 meal (eating lunch)	11 (3.8)	5 (1.8)	16 (2.8)		21 (3.9)	18 (3.4)	39 (3.7)		95 (7.9)	41 (3.6)	136 (5.8)		177 (6.3)	94 (3.4)	271 (4.8)
1 meal (eating dinner)	25 (8.7)	25 (9.1)	50 (8.9)		54 (10.1)	38 (7.2)	92 (8.6)		104 (8.7)	77 (6.8)	181 (7.8)		246 (8.7)	176 (6.3)	422 (7.5)
0 meal	24 (8.4)	20 (7.2)	44 (7.8)		49 (9.1)	43 (8.1)	92 (8.6)		191 (16.0)	170 (15.0)	361 (15.5)		377 (13.4)	347 (12.5)	724 (12.9)

^a Data are presented as No. (%).^b P value trend between number of meals and regions stratified by age groups (P < 0.001 for age groups 10 - 13 year and 10 - 18 year and P = 0.010 for 14 - 18 years old).^c P value between number of meals and sex stratified by regions and age groups (Chi-squared test).

Table 3. Screen Time Activity Level (%) of Participants by Region, Sex and Age Group: The CASPIAN-III Study^a

Variables	Southeast				North-Northeast				West				Central				National				
	Boys	Girls	Total	PValue _c	Boys	Girls	Total	PValue _c	Boys	Girls	Total	PValue _c	Boys	Girls	Total	PValue _c	Boys	Girls	Total	PValue _c	P-Trend _b
Family Possesses Personal Computer, %																					
10 - 13, y																					
Yes	46 (31.9)	40 (30.5)	86 (31.3)	0.801	93 (37.7)	95 (38.0)	188 (37.8)	0.936	187 (34.8)	141 (28.7)	328 (31.9)	0.034	181 (49.6)	203 (51.1)	384 (50.4)	0.670	508 (39.3)	479 (37.7)	986 (38.5)	0.441	<0.001
No	98 (68.1)	91 (69.5)	189 (68.7)		154 (62.3)	155 (62.0)	309 (62.2)		350 (65.2)	351 (71.3)	701 (68.1)		184 (50.4)	194 (48.9)	378 (49.6)		786 (60.7)	791 (62.3)	1577 (61.5)		
14 - 18, y																					
Yes	48 (33.6)	72 (49.0)	120 (41.4)	0.008	110 (38.2)	109 (38.8)	219 (38.5)	0.884	220 (33.4)	233 (36.2)	453 (34.8)	0.289	240 (57.8)	228 (57.0)	468 (57.4)	0.810	618 (41.1)	642 (43.6)	1260 (42.4)	0.170	<0.001
No	95 (66.4)	75 (51.0)	170 (58.6)		178 (61.8)	172 (61.2)	350 (61.5)		438 (66.6)	410 (63.8)	848 (65.2)		175 (42.2)	172 (43.0)	347 (42.6)		886 (58.9)	829 (56.4)	1715 (57.6)		
10 - 18, y																					
Yes	94 (32.8)	112 (40.3)	206 (36.5)	0.063	203 (37.9)	204 (38.4)	407 (38.2)	0.873	407 (34.1)	374 (33.0)	781 (33.5)	0.572	421 (54.0)	431 (54.1)	852 (54.0)	0.967	1126 (40.2)	1121 (40.9)	2246 (40.6)	0.622	<0.001
No	193 (67.2)	166 (59.7)	359 (63.5)		332 (62.1)	328 (61.6)	659 (61.8)		788 (65.9)	761 (67.0)	1549 (66.5)		359 (46.0)	366 (45.9)	725 (76.0)		1672 (59.8)	1620 (59.1)	3292 (59.4)		
Watching TV																					
10 - 13, y																					
≤ 2, h/d	47 (32.6)	27 (20.8)	74 (27.0)	0.027	93 (37.3)	69 (27.5)	162 (32.4)	0.019	186 (34.6)	142 (28.7)	328 (31.8)	0.040	98 (26.6)	111 (26.9)	209 (26.7)	0.920	424 (32.6)	349 (27.1)	773 (29.9)	0.002	
> 2, h/d	97 (67.4)	103 (79.2)	200 (73.0)		156 (62.7)	182 (72.5)	338 (67.6)		351 (65.4)	353 (71.3)	704 (68.2)		271 (73.4)	302 (73.1)	573 (73.3)		876 (67.4)	940 (72.9)	1815 (70.1)		
14 - 18, y																					
≤ 2, h/d	22 (15.4)	24 (16.3)	46 (15.9)	0.826	66 (22.8)	58 (20.5)	124 (21.7)	0.497	136 (20.5)	98 (16.6)	234 (18.6)	0.074	98 (22.7)	64 (14.7)	162 (18.7)	0.003	322 (21.1)	244 (16.7)	566 (19.0)	0.003	0.196
> 2, h/d	121 (84.6)	123 (83.7)	244 (84.1)		223 (77.2)	225 (79.5)	448 (78.3)		528 (79.5)	494 (83.4)	1022 (81.4)		334 (77.3)	371 (85.3)	705 (81.3)		1206 (78.9)	1213 (83.3)	2419 (81.0)		
10 - 18, y																					
≤ 2, h/d	69 (24.0)	51 (18.4)	120 (21.3)	0.102	159 (29.6)	127 (23.8)	286 (26.7)	0.033	322 (26.8)	240 (22.1)	562 (24.6)	0.009	196 (24.5)	175 (20.6)	371 (22.5)	0.062	746 (26.4)	593 (21.6)	1339 (24.0)	<0.001	0.030
> 2, h/d	218 (76.0)	226 (81.6)	444 (78.7)		379 (70.4)	407 (76.2)	786 (73.3)		879 (73.2)	847 (77.9)	1726 (75.4)		605 (75.5)	673 (79.4)	1278 (77.5)		2082 (73.6)	2153 (78.4)	4234 (76.0)		

Working with computer													
10-13, y	0.859			0.002			0.133			< 0.001			< 0.001
≤ 2, h/d	116 (85.9)	109 (85.2)	225 (85.6)	207 (85.2)	184 (74.2)	391 (79.6)	429 (82.8)	382 (79.1)	811 (81.0)	289 (81.6)	270 (68.4)	559 (74.6)	1042 (83.3)
> 2, h/d	19 (14.1)	19 (14.8)	38 (14.4)	36 (14.8)	64 (25.8)	100 (20.4)	89 (17.2)	101 (20.9)	190 (19.0)	65 (18.4)	125 (31.6)	190 (25.4)	209 (16.7)
14-18, y	0.164			0.063			0.005			< 0.001			< 0.001
≤ 2, h/d	112 (80.6)	103 (73.6)	215 (77.1)	235 (82.5)	210 (76.1)	445 (79.3)	518 (81.6)	422 (74.8)	940 (78.4)	332 (78.9)	274 (65.2)	606 (72.1)	1197 (80.9)
> 2, h/d	27 (19.4)	37 (26.4)	64 (22.9)	50 (17.5)	66 (23.9)	116 (20.7)	117 (18.4)	142 (25.4)	259 (21.6)	89 (21.1)	146 (34.8)	235 (27.9)	283 (19.1)
10-18, y	0.221			0.001			0.002			< 0.001			< 0.001
≤ 2, h/d	228 (83.2)	212 (79.1)	440 (81.2)	442 (83.7)	394 (75.2)	836 (79.5)	947 (82.1)	804 (76.8)	1751 (79.6)	621 (80.1)	544 (66.7)	1165 (73.3)	2239 (82.0)
> 2, h/d	46 (16.8)	56 (20.9)	102 (18.8)	86 (16.3)	130 (24.8)	216 (20.5)	206 (17.9)	243 (23.2)	449 (20.4)	154 (19.9)	271 (33.3)	425 (26.7)	492 (18.0)
Screen time activity													
10-13, y	0.126			0.298			0.567			0.890			0.142
≤ 4, h/d	49 (36.6)	34 (27.6)	83 (32.3)	80 (33.9)	71 (29.5)	151 (31.7)	114 (23.1)	94 (21.5)	208 (22.3)	72 (21.5)	79 (21.1)	151 (21.3)	315 (26.2)
> 4, h/day	85 (63.4)	89 (72.4)	174 (67.7)	156 (66.1)	170 (70.5)	326 (68.3)	380 (76.9)	343 (78.5)	723 (71.7)	263 (78.5)	296 (78.9)	559 (78.7)	885 (73.8)
14-18, y	0.572			0.043			0.269			0.057			< 0.001
≤ 4, h/d	16 (11.6)	19 (13.9)	35 (12.7)	74 (26.6)	52 (19.3)	126 (23.0)	93 (15.3)	70 (13.0)	163 (14.2)	70 (17.2)	60 (15.0)	130 (16.1)	253 (17.7)
> 4, h/day	122 (88.4)	118 (86.1)	240 (87.3)	204 (73.4)	217 (80.7)	421 (77.0)	515 (84.7)	468 (87.0)	983 (85.8)	338 (82.8)	339 (85.0)	677 (83.9)	1179 (82.3)
10-18, y	0.330			0.035			0.244			0.563			0.022
≤ 4 h/d	65 (23.9)	53 (20.4)	118 (22.2)	154 (30.0)	123 (24.1)	277 (27.1)	207 (18.8)	164 (16.8)	371 (17.9)	142 (19.1)	139 (18.0)	281 (18.5)	568 (21.6)
> 4 h/d	207 (76.1)	207 (79.6)	414 (77.8)	360 (70.0)	387 (75.9)	747 (72.9)	895 (81.2)	811 (83.2)	1706 (82.1)	601 (80.9)	635 (82.0)	1236 (81.5)	2064 (78.4)

^a Data are presented as No (%); (Chi-squared test).

^b P value between screen time activities and physical activity variables with regions stratified by age groups.

^c P value between screen time activities and physical activity variables with sex stratified by regions and age groups.

Table 4. Physical Activity level (%) of participants by region, sex and age group: the CASPIAN-III Study^a

Variables	Southeast					North-Northeast					West					Central					National				
	Boys	Girls	Total	P Value ^c		Boys	Girls	Total	P Value ^c		Boys	Girls	Total	P Value ^c		Boys	Girls	Total	P Value ^c		Boys	Girls	Total	P Value ^c	P-trend ^b
Physical activity																									
10 - 13, y																									
<1, h/ week	67 (60.4)	53 (51.0)	120 (55.8)	0.025		108 (55.4)	72 (41.5)	180 (49.0)	0.012		352 (72.6)	251 (62.8)	603 (68.1)			176 (54.5)	174 (50.3)	350 (52.3)	0.503		703 (63.0)	550 (53.8)	1253 (58.7)	< 0.001	< 0.001
1-2, hrs/ week	29 (26.1)	44 (42.3)	73 (34.0)			50 (25.6)	68 (39.5)	118 (32.2)			75 (15.5)	97 (24.2)	172 (19.4)			81 (25.1)	99 (28.6)	180 (26.9)			136 (21.2)	308 (30.1)	543 (25.4)		
> 2, hrs/ wk	15 (13.5)	7 (6.7)	22 (10.2)			37 (19.0)	32 (18.6)	69 (18.8)			58 (12.0)	52 (13.0)	110 (12.4)			66 (20.4)	73 (21.1)	139 (20.8)			176 (15.8)	164 (16.0)	340 (15.9)		
14 - 18, y																									
<1, h/wk	109 (79.0)	81 (64.8)	190 (72.2)	0.033		166 (62.4)	89 (37.4)	255 (50.6)	< 0.001		475 (77.7)	301 (60.7)	776 (70.1)			293 (73.6)	175 (46.9)	468 (60.7)	< 0.001		1043 (73.8)	646 (52.4)	1689 (63.9)	< 0.001	< 0.001
1-2, hrs/ wk	21 (15.2)	34 (27.2)	55 (20.9)			71 (26.7)	104 (43.7)	175 (34.7)			94 (15.4)	127 (25.6)	221 (20.0)			66 (16.6)	141 (37.8)	207 (26.8)			252 (17.8)	406 (33.0)	658 (24.9)		
> 2, hrs/ wk	8 (5.8)	10 (8.0)	18 (6.8)			29 (10.9)	45 (18.9)	74 (14.7)			42 (6.9)	68 (13.7)	110 (9.9)			39 (9.8)	57 (15.3)	96 (12.5)			118 (8.4)	180 (14.6)	298 (11.3)		
10 - 18, y																									
<1, h/wk	176 (70.7)	134 (58.5)	310 (64.9)	0.003		247 (59.4)	161 (39.3)	435 (49.9)	< 0.001		827 (75.5)	552 (61.6)	1379 (69.2)			469 (65.0)	349 (48.5)	818 (56.8)	< 0.001		1746 (69.1)	1196 (53.1)	2942 (61.5)	< 0.001	< 0.001
1-2, h/wk	50 (20.1)	78 (34.1)	128 (26.8)			121 (26.2)	172 (42.0)	293 (33.6)			169 (15.4)	224 (25.0)	393 (19.7)			147 (20.4)	240 (33.4)	387 (26.9)			488 (19.3)	714 (31.7)	1201 (25.1)		
> 2, h/wk	23 (9.2)	17 (7.4)	40 (8.4)			66 (14.3)	77 (18.8)	143 (16.4)			100 (9.1)	120 (13.4)	220 (11.0)			105 (14.6)	130 (18.1)	235 (16.3)			294 (11.6)	344 (15.3)	638 (13.3)		
Participating in sport class at school																									
10 - 13, y																									
0, h/wk	18 (12.7)	13 (10.1)	31 (11.4)	0.529		50 (20.2)	19 (7.6)	69 (13.9)	< 0.001		42 (8.0)	25 (5.4)	67 (6.80)			27 (7.6)	49 (12.3)	76 (10.1)	0.069		137 (10.8)	106 (8.6)	243 (9.7)	0.001	< 0.001
1, h/week	46 (32.4)	34 (26.4)	80 (29.5)			97 (39.3)	72 (28.7)	169 (33.9)			202 (38.6)	156 (34.0)	358 (36.5)			107 (30.2)	113 (28.4)	220 (29.3)			452 (35.7)	375 (30.3)	827 (33.0)		
2, h/wk	66 (46.5)	71 (55.0)	137 (50.6)			79 (32.0)	129 (51.4)	208 (41.8)			235 (44.9)	223 (48.6)	458 (46.6)			177 (50.6)	175 (44.0)	352 (46.8)			557 (44.0)	598 (48.3)	1155 (46.1)		
≥ 3, hrs/ week	12 (8.5)	11 (8.5)	23 (8.5)			21 (8.5)	31 (12.4)	52 (10.4)			44 (8.4)	55 (12.0)	99 (10.1)			43 (12.1)	61 (15.3)	104 (13.8)			121 (9.6)	158 (12.8)	278 (11.1)	< 0.001	< 0.001
14 - 18, y																									
0, h/wk	14 (10.3)	9 (6.7)	23 (8.5)	0.089		25 (8.6)	24 (8.5)	49 (8.6)	0.003		68 (11.3)	28 (5.1)	96 (8.3)			52 (12.4)	18 (4.3)	70 (8.3)	< 0.001		159 (11.0)	79 (5.7)	238 (8.4)	< 0.001	< 0.001
1, h/wk	38 (27.9)	31 (23.0)	69 (25.5)			98 (33.8)	77 (27.4)	175 (30.6)			178 (29.6)	173 (31.5)	351 (30.5)			150 (25.7)	171 (40.6)	321 (38.2)			464 (32.0)	452 (32.6)	916 (32.3)		
2, h/wk	67 (49.3)	63 (46.7)	130 (48.0)			155 (53.4)	145 (51.6)	300 (52.5)			275 (45.7)	253 (46.0)	528 (45.8)			174 (41.4)	185 (43.9)	359 (42.7)			671 (46.3)	646 (46.6)	1317 (46.5)		
≥ 3, h/wk	17 (12.5)	32 (23.7)	49 (18.1)			12 (4.1)	35 (12.5)	47 (8.2)			81 (13.5)	96 (17.5)	177 (15.4)			44 (10.5)	47 (11.2)	91 (10.8)			154 (10.6)	210 (15.1)	364 (12.8)	< 0.001	0.001
10 - 18, y																									
0, h/wk	32 (11.5)	22 (8.3)	54 (10.0)	0.084		75 (14.0)	43 (8.1)	118 (11.0)	< 0.001		110 (9.8)	53 (5.3)	163 (7.6)			79 (10.2)	67 (8.2)	146 (9.2)	0.329		296 (10.9)	185 (7.1)	481 (9.0)	< 0.001	0.001
1, h/wk	84 (30.2)	65 (24.6)	149 (27.5)			195 (36.3)	149 (28.0)	344 (32.2)			380 (33.8)	329 (32.6)	709 (33.2)			257 (33.2)	284 (34.7)	541 (34.0)			916 (33.7)	827 (31.5)	1743 (32.7)		
2, h/wk	133 (47.8)	134 (50.8)	267 (49.3)			234 (43.6)	274 (51.5)	508 (47.5)			510 (45.3)	476 (47.2)	986 (46.2)			351 (45.3)	360 (44.0)	711 (44.6)			1228 (45.2)	1244 (47.4)	2472 (46.3)		
≥ 3, h/wk	29 (10.4)	43 (16.3)	72 (13.3)			33 (6.1)	66 (12.4)	99 (9.3)			125 (11.1)	151 (15.0)	276 (12.9)			87 (11.2)	108 (13.2)	195 (12.2)			275 (10.1)	368 (14.0)	642 (12.0)		

^a Data are presented as No (%); (Chi-squared test).^b P Value between screen time activities and physical activity variables with regions stratified by age groups.^c P value between screen time activities and physical activity variables with sex stratified by regions and age groups.

Many studies revealed a positive association between lower SES and incorrect dietary behaviors like meal skipping (39-41). Other recent studies revealed that eating regularly and not skipping meals have a positive effect on overall quality of life such as academic performance, energy, and emotional functioning (42, 43). In one Australian study, the most commonly reported reasons for skipping breakfast in adolescents included: a lack of time in the morning (52%) and not being hungry (22%). Researchers think snacking on the run and on the way to or from school could be associated with a lack of time and support their finding that snacking in these contexts increased the likelihood of skipping breakfast in adolescents, compared with adolescents who did not snack in these contexts (44). Some Korean studies assessed the various factors that may be associated with adolescents' meal skipping, such as accurate knowledge of nutrition, residential district, parents' job and cigarette smoking, along with the variables like SES (45, 46). These mentioned factors turned out to be important variables in above research as well. An Australian survey demonstrated that more adolescents skipped breakfast (20%) than skipped lunch (12%) or dinner (2%). Meal skipping was associated with gender and region of residence which is similar to our findings. Females were more likely than males to report skipping breakfast and lunch on most days. Also, adolescents from metropolitan regions compared with non-metropolitan adolescents were more likely to report skipping breakfast on most days. Meal skipping was associated with gender and region of residence. Skipping breakfast and lunch in females were more than in males. Similarly, adolescents in metropolitan areas were more likely than their peers from nonmetropolitan areas to skip breakfast (5). Some more studies have also reported a higher frequency of breakfast skipping among female adolescents (44, 47). Recently in a study of meal skipping patterns among fourth grade children from distinct geographical locations in Maryland, USA, researchers found that urban students were more likely to skip breakfast compared with suburban and rural students (48). Based on our findings, Iranian adolescents especially in lower SES regions, did not have proper meal frequency, screen time and physical activity level which can lead to health problems including non-communicable disease in later life. Therefore, efforts to ensure Iranian youth meet healthy food habits and screen time guidelines-include limiting access to screen technologies-and encouraging parents to monitor their own screen time is required.

5.1. Study Limitations and Strengths

Major strength of this study was large-scale sample size which was studied to represent Iranian adolescents in nationwide survey. The sampling and data collection methods were identical in sub-national regions, too. In addition, this study provides a valuable body of informa-

tion about screen time, physical activity levels and meal frequency of adolescents living in different regions of Iran. However, we cannot assume the certain contexts of snacking in subjects (e.g. in the middle of the night, on the way to or from school). Also, since we did not ask students to indicate what kind of foods or drinks they consumed as snacks, we are unable to determine if the nutritional quality of the snacks varied according to the context of snack. So, future research should be assessing whether adolescents consume different types of snacks in different snacking contexts. For example, are adolescents more likely to snack on energy dense foods (chips, chocolate) while watching TV, fruit while doing homework, and milk in the middle of the night?

In conclusion, from a public health perspective, our findings have potential implications for interventions designed to reduce screen time among adolescents. Further studies are needed to expand the body of evidence on predictors and health consequences of screen-time change among adolescents. Future interventions may need to consider environmental factors and be gender specific. In addition, programs to reduce screen time must address the roles of parents and socioeconomic characteristics of families in different regions of Iran.

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Authors' Contributions

Concept/design: Roya Kelishadi, Ramin Heshmat, Mostafa Qorbani; Acquisition of data: Fereshteh Baygi, Gelayol Ardalan; Data analysis/interpretation: Mostafa Qorbani, Roya Kelishadi, Fereshteh Baygi, Fatemeh Mohammadi, Mohammad Esmail Motlagh; Manuscript preparation: Fereshteh Baygi, Fatemeh Mohammadi, Mostafa Qorbani; Critical revision of the manuscript: Roya Kelishadi, Ramin Heshmat; Funds collection: Mohammad Esmail Motlagh, Roya Kelishadi, Ramin Heshmat; Approval of the Article: All of the authors.

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