Iran J Public Health, Vol. 44, Supple. No. 1, Mar 2015, pp.35-44

Original Article

Screen Time and Its Relation to Cardiometabolic Risk among Children and Adolescents: The CASPIAN-III Study

Saeid SAFIRI [1,2], *Roya KELISHADI* [3], **Mostafa QORBANI* [4,5], *Abbas ABBASI-GHAHRAMANLOO* [2], *Mohammad Esmaeil MOTLAGH* [6,7], *Gelayol ARDALAN* [7], *Gita SHAFIEE* [5], *Zeinab AHADI* [5], *Maryam SANAEI* [5], *Hamid ASAYESH* [8], *Bagher LARIJANI* [9], **Ramin HESHMAT* [5]

1. Dept. of Public Health, School of Nursing & Midwifery, Maragheh University of Medical Sciences, Maragheh, Iran
2. Road Traffic Injury Research Center, Department of Statistics & Epidemiology, Tabriz University of Medical Sciences, Tabriz, Iran
3. Dept. of Pediatrics, Child Growth and Development Research Center, and Faculty of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran
4. Dept. of Community Medicine, School of Medicine, Alborz University of Medical Sciences, Karaj, Iran
5. Chronic Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran
6. Dept. of Pediatrics, Ahvaz University of Medical Sciences, Ahvaz, Iran
7. Dept. of School Health, Bureau of Population, Family and School Health, Ministry of Health and Medical Education, Tehran, Iran
8. Dept. of Medical Emergencies, Qom University of Medical Sciences, Qom, Iran
9. Endocrinology and Metabolism Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

***Corresponding Authors:** Email: rheshmat@tums.ac.ir & mqorbani1379@yahoo.com

(Received 10 Dec 2014; accepted 02 Mar 2015)

Abstract

Background: Among chronic non-communicable diseases (CNCDs), the occurrence of cardiovascular diseases and diabetes is more prominent. CNCDs origin in early life; with sedentary habits, notably prolonged screen time (ST), leisure time spent on watching TV and working computer, suggested as one of their risk factors. We aimed to investigate the relationship between ST and cardiometabolic risk factors in a nationally representative sample of Iranian children and adolescents.

Methods: In this analytical cross-sectional study, 5,625 school students aged 10-18 were studied in the third national survey of a school-based surveillance program. For ensuring representativeness of sample, subjects were selected using multistage random cluster sampling method from urban and rural areas of 27 provinces in Iran (2009-10). ST was assessed through validated self-administered questionnaire, and cardiometabolic factors were determined. In addition, metabolic syndrome components were defined based on the Adult Treatment Panel III criteria modified for the pediatric age group. In addition, high total cholesterol (TC), high low-density lipoprotein cholesterol (LDL-C), and generalized obesity were assessed as other cardiometabolic risk factors.

Results: Mean age was 14.73±2.41. While, positive significant association was found between ST and abdominal obesity, blood pressure, levels of LDL-C and triglycerides ($P < 0.05$), it was reversely correlated with HDL-C level ($P < 0.05$). However, there was positive but not statistically significant association between ST and odds of metabolic syndrome ($P = 0.32$).

Conclusion: The association between ST and some metabolic syndrome components, reducing ST should be considered as one of the preventive strategies among children and adolescents.

Keywords: Metabolic syndrome, Screen time, Physical activity, Children, Adolescent, Cardiometabolic risk factors, Iran

Introduction

Cardiometabolic risk factors include elevated blood pressure and serum levels of glucose and lipid. Physical inactivity, high body mass index (BMI), unhealthy diet and tobacco smoking contribute to higher risks of developing cardiovascular and metabolic conditions (1). Nowadays, prevalence of cardiometabolic risk factors is increasing rapidly among children and adolescents in Iran (2-4). Since the process of (CNCDs) is believed to begin early in life, interest in childhood precursors to these diseases is increasing. Behavioral and biological risk factors persist from childhood into adulthood. Several risk factors including overweight, dyslipidemia and high blood pressure are tracking from childhood to adult life linked to adult diseases. Fortunately, many of these risk factors are modifiable (5). Among these risk factors, physical inactivity has a fundamental role.

According to the reports of WHO, about 1.9 million deaths worldwide are attributable to physical inactivity each year (6). In adults, sedentariness is associated with a higher risk of premature mortality and cardiovascular disease, overweight and obesity, and insulin resistance (7-11).

Studies have shown, ST is most known among the all-sedentary activities and the majority proportion of Australian, European, and North American teenagers spend more than 2 hours per day in front of screens. (12-14). Among these, Iran is classified as countries with high screen time and it has been reported that ST in Iran is about 53% and 33.4% among the students during holidays and school days, respectively (15). There is evidence indicating that ST is associated with obesity and poor dietary habits and cardiometabolic biomarkers in adults (16-19).

Studies in developing countries such as Iran is rare and only a few studies have examined the association between ST and metabolic risk among children and adolescents in developed countries (20-23) and the findings of these studies are controversial and needs further investigation. This study aimed to evaluate the association between screen time and cardiometabolic risk factors among a nationally-representative sample of Iranian children and adolescents.

Methods

This study was based on the third national survey of a school-based surveillance program entitled Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable disease (CASPIAN-III) study. Overall, 5625 students with age of 10-18 yr were included in this survey in 2009-10. The methodology of this survey was described in detail in earlier reports (24).

The study was approved by the Ethical Committee of Tehran and Isfahan University of Medical Sciences and other relevant national regulatory organizations. Written informed consent and oral assent were obtained from parents and students, respectively. Detailed operational manual was used for coordinating the involved study team. Monitoring and calibration of equipments was done according to the study protocols. Finally, different levels of quality control were done by the Data and Safety Monitoring Board of the project.

Study population

Study sample was obtained through multistage cluster sampling method from the urban and rural areas of twenty- seven provinces of Iran. Based on the information bank of Ministry of Education, schools were listed and clustered and then some schools were selected from each clusters. Finally, some students were included in the survey from the selected schools and those with chronic disease and taking medications were excluded from study.

Data Collection

Demographic information was obtained from all study subjects through interview with subjects and their parents. Finally, family based characteristics was asked including: family history of chronic diseases (hypertension, dyslipidemia, diabetes, and obesity), parental level of education (the highest total years of schooling), possessing a family private car and type of home.

Study protocols - oriented physical examinations were done by a team of trained physicians, nurses, and healthcare providers using the calibrated instruments. Weight was recorded in light clothing to the nearest 0.1 kg on a SECA digital weighing scale (SECA, Germany) and height was measured without shoes to the nearest 0.1 cm. Waist circumference (WC) was measured using a non-elastic tape to the nearest 0.1 cm over skin, midway between the iliac crest and the lowest rib in standing position. Body Mass Index (BMI) was calculated as weight divided by squared height (kg/m2). First and fifth Korotkoff sounds were considered as systolic and diastolic blood pressure (SBP/DBP), respectively (25).

Blood samples were taken from the antecubital vein between 8:00 and 9:30 a.m., after the students were guided by study team to be fast for 12 hours before the sampling. The samples of blood were centrifuged for 10 min at 3000 rpm within 30 min of venipuncture.

As described in previous studies (26), fasting blood sugar (FBS) (mg/dl), total cholesterol (TC) (mg/dl), high-density lipoprotein-cholesterol (HDL-C) (mg/dl), low-density lipoprotein cholesterol (LDL-C) (mg/dl), and triglycerides (TG) (mg/dl) were measured enzymatically by autoanalyzers. HDL-C was determined after dextran sulfate-magnesium chloride precipitation of non-HDL-C (27). LDL- C was calculated in serum samples with TG ≤400 mg/dl according to the Friedewald equation (28). FBS, LDL-C, HDL-C and TG were measured. All the biochemical analyses were done in the Central Provincial Laboratory according to the standards of the National Reference Laboratory.

According to modified Adult Treatment Panel III (ATP III) criteria, which are for children and adolescents, subjects were classified as having metabolic syndrome if they had at least three of the following criteria (29). Waist- to- height ratio (WHtR) of more than 0.5 was considered as abdominal obesity (24-29); Elevated BP: either systolic or diastolic BP ≥90th percentile for age, sex and height; Low HDL-C: HDL-C <50 mg/dl; High TG: TG ≥100 mg/dl) was taken as the 90th percentile value for age; High FBS: FBS levels of ≥100 mg/dl.

In the present study, five previous criteria in addition to three parameters of high total cholesterol (TC), high LDL-C and general obesity were considered as cardiometabolic risk factors. High TC and LDL_C were defined according to the recent recommendations by the American Heart Association (total cholesterol ≥200 mg/dL, LDL-C>110 mg/dL) (30).

Based on the definitions provided by Centers of Disease Control and Prevention (CDC), BMI > 95th percentile and BMI = 85-94th percentile were considered as obese and overweight, respectively (26, 31).

In present study, the ST behavior of the children was assessed through the questionnaire. Continuous scale was used for measuring this variable; average number of hours per day, which is spent on watching TV/VCDs and working with computer (PC). For the analysis of correlates of ST, Firstly, ST was considered as continuous scale, and then according to the international ST recommendations, watching TV, working computer and ST was categorized into two groups ; less than 2 hours per day (Low), and more than 2 hours per day (High) (32, 33).

Statistical analysis

Quantitative and qualitative variables were presented as mean (SD) and frequency (%), respectively. Independent *t*-Test and Pearson's chi-squared test were used in the univariate analysis for quantitative and qualitative variables respectively. Different Logistic regression models were used in the multivariate analyses to evaluate the association of ST with each of the cardiometabolic risk factors, for adjusting potential confounders.

Four models were used in the analysis as follow: Model I, the crude association (without adjustment); Model II, adjusted for age, gender, and living place; Model III, family history and socio-economic status were added to the Model II; Model IV, BMI was added to model III. . Findings of logistic regression were presented in terms of odds ratio (OR) and 95% confidence interval (CI).

In all analyses, design of sampling and cluster correlations was considered. All statistical analyses were done using Stata version 10. *P*-value <0.05 was considered as statistically significant.

Results

The study participants consisted of 5,625 students (50.2% boys, 69% from rural areas) aged 14.73 ± 2.41 years. The mean height, weight, BMI, WC and WHtR of urban students were significantly higher than rural students, as well as average TV watching time in continuous scale (*P* <0.001). Watching TV, working with computer, and ST, all of them showed significant association with residential status (*P* <0.001) (Table 1).

Table 1: Demographic characteristics and anthropometric measures by residency status: The CASPIAN III study

		Rural Mean ±SD	Urban Mean ± SD	Total Mean ± SD	*P*-value
Age (Yr)		14.71±2.36	14.73±2.45	14.73±2.41	0.756
Height (cm)		152.91±13.80	154.56±14.05	154.16±13.95	<0.001
Weight (Kg)		44.69±13.62	48.08±15.39	47.17±15.00	<0.001
BMI (Kg/m²)		18.74±3.74	19.68±4.19	19.42±4.10	<0.001
WC		66.51±18.15	69.59±21.94	68.72±20.69	<0.001
WHtR		0.435±0.10	0.450±0.13	0.44±0.12	<0.001
Watching TV (h/day)		2.27±0.92	2.40±0.87	2.36±00.89	<0.001
Working with computer (h/day)		1.53±1.70	1.61±1.60	1.59±1.63	0.086
ST (h/day)		1.75±0.84	1.91±0.87	1.86±0.87	<0.001
		N(%)	N(%)	N(%)	
Watching TV					
≤2		1236(33.7)	653(40.0)	1889(35.6)	<0.001
>2		2437(66.3)	978(60.0)	3415(64.4)	
Working with computer					
≤2		2949(79.3)	1383(83.5)	4332(86.6)	<0.001
>2		771(20.7)	274(16.5)	1045(19.4)	
ST(watching TV and working with computer)					
≤2		1914(52.3)	958(58.9)	2872(54.3)	<0.001
>2		1749(47.7)	669(41.1)	2418(45.7)	
Family history					
HTN	No	1500(50.0)	642(51.6)	2142(50.5)	0.345
	yes	1499(50.0)	602(48.4)	2101(49.5)	
Hyperlipidemia	No	1677(57.6)	738(60.6)	2415(58.5)	0.071
	yes	1234(42.4)	479(39.4)	1713(41.5)	
DM	No	1800(62.2)	787(66.2)	2587(63.4)	0.016
	yes	1094(37.8)	402(33.8)	1496(36.6)	
Abdominal obesity	No	1657(60.1)	697(59.9)	2354(60.0)	0.907
	Yes	1101(39.9)	467(40.1)	1568(40.0)	
Type of home (%)					
Rented home		818(22.9)	170(10.4)	988(18.9)	<0.001
Personal home		2761(77.1)	1470(89.6)	4231(81.1)	
Personal car (%)					
Yes		1999(54.7)	640(38.8)	2639(49.8)	<0.001
No		1655(45.3)	1009(61.2)	2664(50.2)	

Data are means (SD) unless indicated otherwise. *P*<0.05 is significant. BMI; Body Mass Index, WC; Waist Circumference, HTN; Hypertension, DM; Diabetes mellitus, ST; Screen Time.

According to Table 2, the average hours of screen time and working with computer were significantly higher among the subjects with overweight, abdominal obesity, low HDL-C level and High LDL-C levels (*P* <0.05). Significant association was also found between metabolic syndrome components with screen time and working with computer (*P* <0.05).

Significant positive association was found between BMI, SBP, DBP and WC with screen time, watching TV, and working with computer (*P* <0.05). . Subjects with high screen time had significantly high level of TG and LDL-C (*P* <0.05); and significant negative association was also found between HDL-C and screen tome (*P* <0.05) (Table 3).

High watching TV and working with computer would increase odds of abdominal obesity (*P* <0.05). In addition to, in four models high level working with computer increases significantly odds of Low HDL-C by 34%, 36%, 40%, and 37%, respectively (*P* <0.05). In all of the models, high screen time significantly increases the odds of elevated LDL-C by 67% (*P* <0.05). In crude model, high working with computer significantly increase the odds of hypertension by 42 % (*P* <0.05), but after adjusting to some variables association became non-significant. Findings showed that, high screen time would significantly increase the odds of elevated TG by 35%, after adjusting for age, gender, and living area (*P* <0.05) (Table 4).

Table 2: Cardiometabolic measures and screen time: The CASPIAN III study

		Mean ± SD Screen time (h/day)	***p* value**	**Mean ± SD watching TV (h/day)**	***p* value**	**Mean ± SD Working with computer (h/day)**	***P*-value**
Obesity	No	1.86±0.86	0.127	2.36±0.89	0.056	1.59±1.63	0.892
	Yes	1.92±0.87		2.44±0.86		1.58±1.64	
Overweight	No	1.85±0.86	0.005	2.36±0.89	0.111	1.58±1.63	0.035
	Yes	1.97±0.91		2.43±0.87		1.75±1.63	
Abdominal obesity	Normal	1.84±0.86	<0.001	2.35±0.90	0.010	1.56±1.62	0.015
	Abnormal	1.96±0.90		243±0.86		1.71±1.65	
HTN	Normal	1.86±0.87	0.058	2.36±0.89	0.873	1.59±1.63	0.051
	Abnormal	1.96±0.90		2.37±0.88		1.79±1.65	
High DBP	Normal	1.86±0.86	0.483	2.37±0.89	0.694	1.59±1.63	0.853
	abnormal	1.91±0.90		2.34±0.89		1.61±1.60	
High SBP	Normal	1.87±0.87	0.222	2.36±0.89	0.641	1.60±1.63	0.433
	Abnormal	1.94±0.89		2.39±0.88		1.70±1.65	
Low HDL-C	Normal	1.83±0.86	0.002	2.38±0.88	0.223	1.45±1.57	<0.001
	Abnormal	1.92±0.91		2.34±0.90		1.78±1.70	
High FBS	Normal	1.84±0.88	0.188	2.36±0.89	0.421	1.52±1.62	0.776
	Abnormal	1.89±0.83		2.39±0.86		1.54±1.56	
High TG	Normal	1.85±0.87	0.007	2.36±0.89	0.099	1.53±1.61	0.010
	Abnormal	1.98±0.89		2.44±0.85		1.77±1.68	
High TC	Normal	1.87±0.87	0.210	2.36±0.89	0.259	1.60±1.64	0.852
	Abnormal	1.94±0.85		2.43±0.85		1.85±1.63	
High LDL-C	Normal	1.85±0.87	0.011	2.37±0.89	0.413	1.55±1.61	<0.001
	Abnormal	2.02±0.88		2.42±0.87		2.01±1.79	
Met components (n)							
0		1.79±0.86	<0.001	2.33±0.90	0.483	1.39±1.56	<0.001
1		1.89±0.88		2.39±0.88		1.66±1.65	
2		1.98±0.90		2.38±0.87		1.80±1.66	
3		2.07±0.91		2.42±0.86		1.71±0.16	
4		2.02±0.99		2.45±0.88		1.84±0.43	

All values are means ± SDs, BMI; Body Mass Index, FBS; Fasting Blood Sugar, TG; Triglycerides, HDL-C; High Density Lipoprotein-Cholesterol, TC; Total Cholesterol, LDL-C; Low-Density Lipoprotein Cholesterol, SBP; Systolic Blood Pressure; DBP; diastolic Blood Pressure.

Table 3: Mean ±SD of cardiometabolic values according Screen time, watching TV and Working with computer categories: The CASPIAN III study

	Screen time			watching TV			Working with com		
	Low Mean ± SD	High Mean ± SD	*P*-value	Low Mean ± SD	High Mean ± SD	*P*-value	Low Mean ± SD	High Mean ± SD	*P*-value
BMI (kg/m²)	19.14±4.07	19.79±4.12	<0.001	18.95±3.97	19.71±4.15	<0.001	19.32±4.07	19.88±4.20	<0.001
SPB(mmHg)	102.56±13.76	103.92±14.03	<0.001	102.19±13.85	103.72±13.92	<0.001	102.93±13.91	104.25±13.77	0.007
DPB(mmHg)	65.25±10.78	66.20±10.62	0.001	65.01±10.88	66.03±10.61	0.001	65.42±10.66	66.75±10.93	<0.001
WC(cm)	67.94±22.79	69.68±18.46	0.002	67.41±22.20	69.47±20.13	<0.001	68.36±22.45	70.12±11.82	0.012
WHtR	0.44±0.14	0.44±0.10	0.955	0.445±0.137	0.446±0.126	0.646	0.44±0.14	0.44±0.063	0.456
FBS (mg/dl)	87.84±13.40	87.51±14.54	0.446	87.53±13.92	87.77±13.92	0.594	87.85±14.05	86.95±13.07	0.091
TG (mg/dl)	91.42±38.94	94.24±42.79	0.022	90.01±94.16	94.16±41.39	0.001	92.62±39.40	92.57±44.63	0.975
HDL-C (mg/dl)	47.12±14.50	45.35±14.29	<0.001	46.56±15.09	46.14±14.04	0.386	46.60±14.11	44.99±15.25	0.005
TC (mg/dl)	148.18±31.35	149.05±32.25	0.357	147.68±31.87	149.07±31.68	0.159	148.48±31.24	148.48±33.70	0.997
LDL-C (mg/dl)	82.89±26.94	85.66±27.77	0.005	83.38±27.27	84.59±27.39	0.235	83.76±27.24	85.89±27.74	0.083
MetS (+)	0.109±2.35	0.034±2.51	0.088	-0.132±2.44	0.002±2.42	0.125	-0.065±2.42	0.031±2.37	0.355

All values are means ± SDs, Low Screen Time; less than 2 hours per day, High Screen Time; more than 2 hours per day, BMI; Body Mass Index, FBS; Fasting Blood Sugar, TG; Triglycerides, HDL-C; High Density Lipoprotein-Cholesterol, TC; Total Cholesterol, LDL-C; Low-Density Lipoprotein Cholesterol, SBP; Systolic Blood Pressure; DBP; diastolic Blood Pressure.

Discussion

In the present study, the associations between screen time and cardiometabolic risk factors were assessed. ST was positively associated with abdominal obesity, blood pressure, levels of LDL-C, HDL-C level and triglycerides. Generally, the odds of metabolic syndrome increased by higher screen time, but this association were not significant.

Our findings indicating positive significant association between abdominal obesity and screen time which is confirmed by a systematic review of mainly European and American papers (34, 35). Other studies indicated positive significant associations between obesity and screen time among Canadian children and adolescents (36, 37). Although some studies have not focused specifically on screen time but negative significant association has been reported between BMI and physical activity level (38, 39).

In the present study, negative significant association was found between HDL-C and screen time, but after adjustment for age and some variables, this association was not significant. Self reported screen time (but not objectively measured total sedentary time) was independently associated with reduced HDL cholesterol concentrations in a cohort of 536 children at risk for obesity (40). Our findings are consistent with the study of Colley et al., and did not show any significant association between HDL-C and screen time, independent of age (41). In the present study, in both crude and adjusted models, working with computer showed negative significant association with HDL-C. It suggests that the association of working with computer with depressed HDL-C was more important than the corresponding figure for TV watching. According to our findings significant association was found between LDL-C and screen time and these findings is confirmed by the study of Nang et al. on a multiethnic Asian population and showed that, LDL-C is significantly associated with screen time after adjustment for age, sex, ethnicity, and education (42). The study of Cliff et al. indicated no association between LDL-C and sedentary behaviors (43). Likewise, in the study of Altenburg et al. among obese Dutch adolescents, no association was reported between LDL-C and screen time but unexpectedly significant association was found between LDL-C and working with computer (44). This significant association was also found between HDL-C and working with computer, and it might suggest that working with computer is more important in increasing the LDL-C level.

Table 4: Odds ratio (95% CI) for cardiometabolic risk factors according to Screen time, Watching TV and Working with computer categories: The CASPIAN III study

	Screen time (High Vs. Low)			**Watching TV** (High Vs. Low)			**Working with computer** (High Vs. Low)		
	OR	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***
Abdominal obesity									
Model I[1]	1.12	0.97-1.29	0.120	1.20	1.03-1.40	0.020	1.29	1.09-1.54	0.003
Model II[2]	1.07	0.92-124	0.371	1.18	1.01-1.39	0.035	1.23	1.03-1.47	0.022
Model III[3]	1.15	0.96-1.39	0.26	1.23	1.02-1.52	0.026	1.22	0.98-1.53	0.071
Elevated HTN									
Model I	1.19	0.93-1.51	0.153	1.00	0.77-1.28	0.997	1.42	1.07-1.87	0.013
Model II	1.04	0.81-1.33	0.747	0.88	0.68-1.14	0.342	1.34	1.01-1.79	0.039
Model III	0.96	0.72-1.27	0.757	0.76	0.57-1.02	0.073	1.38	0.99-1.92	0.053
Model IIII	0.89	0.66-1.19	0.436	0.71	0.53-0.97	0.029	1.30	0.92-1.82	0.126
Elevated FBS									
Model I	1.09	0.93-1.29	0.266	0.98	0.83-1.17	0.894	1.07	0.87-1.32	0.477
Model II	1.03	0.87-1.22	0.705	0.95	0.79-1.13	0.589	0.94	0.76-1.16	0.590
Model III	1.05	0.87-1.28	0.569	1.01	0.82-1.24	0.884	0.97	0.76-1.25	0.867
Model IIII	1.05	0.87-1.28	0.585	1.01	0.83-1.24	0.892	0.97	0.76-1.24	0.840
Elevated TG									
Model I	1.32	1.06-1.64	0.012	1.19	0.94-1.50	0.141	1.03	0.78-1.35	0.816
Model II	1.35	1.07-1.69	0.009	1.12	0.88-1.43	0.324	1.02	0.77-1.35	0.868
Model III	1.20	0.92-1.57	0.173	1.03	0.78-1.36	0.808	0.95	0.67-1.35	0.797
Model IIII	1.14	0.86-1.50	0.345	0.99	0.74-1.33	0.990	0.84	0.59-1.21	0.357
Low HDL-C									
Model I	1.15	1.01-1.32	0.030	0.95	0.82-1.09	0.463	1.34	1.14-1.58	<0.001
Model II	1.12	0.98-1.29	0.094	0.91	0.79-1.06	0.257	1.36	1.15-1.61	<0.001
Model III	1.06	0.96-1.16	0.22	0.84	0.71-0.99	0.047	1.40	1.15-1.71	0.001
Model IIII	1.02	0.87-1.20	0.786	0.84	0.71-0.99	0.039	1.37	1.13-1.68	0.002
Elevated TC									
Model I	1.06	0.83-1.36	0.606	1.09	0.84-1.42	0.494	1.21	0.90-1.62	0.206
Model II	1.06	0.82-1.37	0.626	1.11	0.84-1.45	0.43	1.27	0.94-1.71	0.117
Model III	1.13	0.84-1.52	0.393	135	0.98-1.86	0.060	1.37	0.96-1.94	0.078
Model IIII	1.11	0.82-1.48	0.485	1.34	0.97-1.84	0.071	1.32	0.93-1.88	0.116
Elevated LDL-C									
Model I	1.40	1.04-1.89	0.025	1.13	0.82-1.55	0.447	1.21	0.84-1.73	0.293
Model II	1.51	1.11-2.04	0.008	1.21	0.87-1.68	0.238	1.26	0.87-1.81	0.206
Model III	1.67	1.16-2.40	0.005	1.51	1.02-2.25	0.039	1.40	0.91-2.15	0.116
Model IIII	1.65	1.15-2.38	0.006	1.51	1.01-2.25	0.040	1.38	0.90-2.11	0.134
BMI>30									
Model I	1.05	0.88-1.27	0.545	1.19	0.97-1.45	0.083	1.07	0.85-1.34	0.559
Model II	1.08	0.89-1.31	0.396	1.23	1.00-1.52	0.042	1.09	0.86-1.38	0.446
Model III	1.11	0.87-1.41	0.399	1.20	0.93-1.55	0.158	1.04	0.76-1.42	0.791
MetS									
Model I	1.18	0.84-1.67	0.325	1.14	0.79-1.35	0.460	1.50	1.01-2.22	0.040
Model II	1.07	0.75-1.53	0.672	1.07	0.73-1.57	0.710	1.41	0.94-2.10	0.089
Model III	0.97	0.63-1.50	0.886	1.06	0.66-1.68	0.815	1.40	0.85-2.32	0.184
Model IIII	0.93	0.58-1.49	0.772	1.02	0.62-1.70	0.923	1.17	0.68-2.02	0.558

BP; Blood Pressure, TG; Triglycerides, FBS; Fasting Blood Sugar, HDL-C; High Density Lipoprotein-Cholesterol, TC; Total Cholesterol, LDL-C; Low-Density Lipoprotein Cholesterol, MetS; Metabolic Syndrome, ST; screen time, PA; physical activity./ Abdominal obesity; (WHtR > 0.5), Elevated HTN; SBP or DBP ≥90th percentile for age, sex and height, Elevated FBS; FBS levels of ≥100 mg/dl, Elevated TG; TG ≥100 mg/dl, Low HDL-C; HDL-C <50 mg/dl, Elevated TC; total cholesterol ≥200 mg/dL, Elevated LDL-C; LDL-C>110 mg/dL), BMI>30 kg/m2; MetS; Having the at least three of the five criteria.

Model I: crude model; /Model II is adjusted for age, area, and gender; /Model III is adjusted additionally for family history and socio-economic status; /Model IV is adjusted additionally for BMI in all abnormalities except obesity (BMI was not adjusted where the dependent variable was abdominal obesity).

Based on our findings, elevated BP was significantly associated with working with computer (but not with screen time and watching TV); this association was independent of age, living area, and gender. Our finding regarding the lack of association of hypertension with screen time and watching TV was not concordant with some previous studies (45-47). However, our findings on the non-significant association of the time spent on watching TV with elevated BP are in line with the study of Nang et al. (42) and Altenburg et al. (44).

Findings of the present study showed positive significant association between TG and screen time, after adjusting for age, area, and gender. These findings are consistent with the study of Chau et al. in the Norway, but not with that of Altenburg et al. (44, 48).

In this cross sectional study, the causality of significant associations could not be specified and it is not clear whether screen time leads to cardiometablic risk factors or other mechanisms exist. Cohort design is suggested for future studies to omit this limitation. Secondly, screen-time and physical activity data were based on self-reports that may be subject to recall bias. Third, screen time was not analyzed separately by weekday and weekend, which may contribute to an inaccurate estimation of screen time. Finally, some of possible contributing factors, as eating snacks or drinking soft drinks during ST were not integrated into this study. A next step could be assessing the clustering of multiple life style risk factors associated with high ST levels in Iranian adolescents. A large sample size, which was representative of all parts and strata of Iranian child and adolescent population is considered as one of the strengths of this study.

Conclusion

Our finding reveals positive association between ST and odds of metsyn components inc. abdominal obesity decreased serum level of HDL-C and increased TG and LDL-C and blood pressure. Therefore, prevention approach focusing on reducing ST among children and adolescents is required.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, and/or falsification, double publication) have been considered carefully.

Acknowledgments

This nationwide survey was conducted as a national surveillance program. The authors forward their sincere thanks to the large team working with this project in different provinces. The authors declare that there is no conflict of interests.

References

1. Lloyd-Jones DM, Hong Y, Labarthe D et al. (2010). Defining and setting national goals for cardiovascular health promotion and disease reduction the American Heart Association's Strategic Impact Goal through 2020 and beyond. *Circulation,* 121(4):586-613.
2. Rahmanian M, Kelishadi R, Qorbani M et al (2014). Dual burden of body weight among Iranian children and adolescents in 2003 and 2010: the CASPIAN-III study. *Arch Med Sci*, 10(1): 96–103.
3. Khashayar P, Heshmat R, Qorbani M et al. (2013). Metabolic syndrome and cardiovascular risk factors in a national sample of adolescent population in the Middle East and north Africa: the CASPIAN III study. *Int J Endocrinol,* 2013:1-8
4. Mehrkash M, Kelishadi R, Mohammadian S et al. (2012). Obesity and metabolic syndrome among a representative sample of Iranian adolescents. *Southeast Asian J Trop Med Public Health,* 43(3):756.
5. McGill HC, McMahan CA, Gidding SS (2008). Are pediatricians responsible for prevention of adult cardiovascular disease? *Nat Clin Pract Cardiovasc Med*, 6(1):1-10.
6. Guilbert J (2003). The world health report 2002-reducing risks, promoting healthy life. *Education for Health*, 16(2):230.

7. Katzmarzyk PT, Church TS, Craig CL et al. (2009). Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc*, 41(5):998-1005.
8. Proper K, Cerin E, Brown W et al. (2006). Sitting time and socio-economic differences in overweight and obesity. *Int J Obes (Lond)*, 31(1):169-76.
9. Helmerhorst HJ, Wijndaele K, Brage S et al. (2009). Objectively measured sedentary time may predict insulin resistance independent of moderate-and vigorous-intensity physical activity. *Diabetes*, 58(8):1776-79.
10. Hu FB, Li TY, Colditz GA et al. (2003). Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. *Jama*, 289(14):1785-91.
11. Hu FB, Leitzmann MF, Stampfer MJ et al. (2001). Physical activity and television watching in relation to risk for type 2 diabetes mellitus in men. *Arch Intern Med*, 161(12):1542-48.
12. Hardy LL, Dobbins TA, Denney-Wilson EA et al. (2006). Descriptive epidemiology of small screen recreation among Australian adolescents. *J Paediatr Child Health*, 42(11):709-14.
13. Marshall SJ, Gorely T, Biddle SJ (2006). A descriptive epidemiology of screen-based media use in youth: a review and critique. *J Adolesc*, 29(3):333-49.
14. Sisson SB, Church TS, Martin CK et al. (2009). Profiles of sedentary behavior in children and adolescents: the US National Health and Nutrition Examination Survey, 2001-2006. *Int J Pediatr Obes*, 4(4):353-9.
15. Jari M, Qorbani M, Motlagh ME et al. (2014). A Nationwide Survey on the Daily Screen Time of Iranian Children and Adolescents: The CASPIAN-IV Study. *Int J Prev Med*, 5(2):224.
16. Hancox R, Poulton R (2005). Watching television is associated with childhood obesity: but is it clinically important? *Int J Obes (Lond)*, 30(1):171-5.
17. Coon KA, Goldberg J, Rogers BL et al. (2001). Relationships between use of television during meals and children's food consumption patterns. *Pediatrics*, 107(1):e7-e.
18. Jakes R, Day N, Khaw K et al. (2003). Television viewing and low participation in vigorous recreation are independently associated with obesity and markers of cardiovascular disease risk: EPIC-Norfolk population-based study. *Eur J Clin Nutr*, 57(9):1089-96.
19. Dunstan D, Salmon J, Owen N et al. (2005). Associations of TV viewing and physical activity with the metabolic syndrome in Australian adults. *Diabetologia*, 48(11):2254-61.
20. Wells JC, Hallal PC, Reichert FF et al. (2008). Sleep patterns and television viewing in relation to obesity and blood pressure: evidence from an adolescent Brazilian birth cohort. *Int J Obes (Lond)*, 32(7):1042-9.
21. Guillaume M, Lapidus L, Bjorntorp P et al. (1997). Physical activity, obesity, and cardiovascular risk factors in children. The Belgian Luxembourg Child Study II. *Obes Res*, 5(6):549-56.
22. Ekelund U, Brage S, Froberg K et al. (2006). TV viewing and physical activity are independently associated with metabolic risk in children: the European Youth Heart Study. *PLoS Med*, 3(12):e488.
23. Martinez-Gomez D, Tucker J, Heelan KA et al. (2009). Associations between sedentary behavior and blood pressure in young children. *Arch Pediatr Adolesc Med*, 163(8):724-30.
24. Kelishadi R, Heshmat R, Motlagh ME et al. (2012). Methodology and early findings of the third survey of CASPIAN study: A national school-based surveillance of students' high risk behaviors. *Int J Prev Med*, 3(6):394.
25. Program NHBPE (2005). *The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents*: US Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, National High Blood Pressure Education Program.
26. Shafiee G, Kelishadi R, Qorbani M et al. (2013). Association of breakfast intake with cardiometabolic risk factors. *Jornal de Pediatria*, 89(6):575-82.
27. McNamara JR, Schaefer EJ (1987). Automated enzymatic standardized lipid analyses for plasma and lipoprotein fractions. *Clinica Chimica Acta*, 166(1):1-8.
28. Friedewald WT, Levy RI, Fredrickson DS (1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical Chemistry*, 18(6):499-502.
29. Expert Panel on Detection & Evaluation (2001). Executive summary of the third report of the

National Cholesterol Education Program (NCEP) expert panel on Detection, Evaluation, and Treatment of high blood cholesterol in adults (Adult Treatment Panel III). *JAMA*, 285(19):2486.
30. Balagopal PB, de Ferranti SD, Cook S et al. (2011). Nontraditional risk factors and biomarkers for cardiovascular disease: mechanistic, research, and clinical considerations for youth a scientific statement from the American Heart Association. *Circulation*, 123(23):2749-69.
31. Zimmet P, Alberti G, Kaufman F et al. (2007). The metabolic syndrome in children and adolescents. *The Lancet*, 369(9579):2059-61.
32. Salmon J, Campbell KJ, Crawford DA (2006). Television viewing habits associated with obesity risk factors: a survey of Melbourne schoolchildren. *Med J Aust*, 184(2):64.
33. Strong WB, Malina RM, Blimkie CJ et al. (2005). Evidence based physical activity for school-age youth. *J Pediatr*, 146(6):732-7.
34. Tremblay MS, LeBlanc AG, Kho ME et al. (2011). Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act*, 8(1):98.
35. Saunders TJ, Chaput J-P, Tremblay MS (2014). Sedentary behavior as an emerging risk factor for cardiometabolic diseases in children and youth. *Can J Diabetes*, 38(1):53-61.
36. Saunders T (2011). Potential contributors to the Canadian pediatric obesity epidemic. *Int Sch Res Notices*, 2011(1):1-10.
37. Wennberg P, Gustafsson PE, Dunstan DW et al. (2013). Television viewing and low leisure-time physical activity in adolescence independently predict the metabolic syndrome in mid-adulthood. *Diabetes Care*, 36(7):2090-7.
38. Kelishadi R, Motlagh ME, Roomizadeh P et al. (2013). First report on path analysis for cardiometabolic components in a nationally representative sample of pediatric population in the Middle East and North Africa (MENA): the CASPIAN-III Study. *Ann Nutr Metab*, 62(3):257-65.
39. Kelishadi R, Razaghi EM, Gouya MM et al. (2006). Association of physical activity and the metabolic syndrome in children and adolescents: CASPIAN Study. *Horm Res*, 67(1):46-52.
40. Chaput J-P, Saunders TJ, Mathieu M-È et al. (2013). Combined associations between moderate to vigorous physical activity and sedentary behaviour with cardiometabolic risk factors in children. *Appl Physiol, Nutr Metabol*, 38(5):477-83.
41. Colley RC, Garriguet D, Janssen I et al. (2013). The association between accelerometer-measured patterns of sedentary time and health risk in children and youth: results from the Canadian Health Measures Survey. *BMC Public Health*, 13(1):200.
42. Nang E, Salim A, Wu Y et al. (2013). Television screen time, but not computer use and reading time, is associated with cardio-metabolic biomarkers in a multiethnic Asian population: a cross-sectional study. *Int J Behav Nutr Phys Act*, 10:70.
43. Cliff DP, Okely AD, Burrows TL et al. (2013). Objectively measured sedentary behavior, physical activity, and plasma lipids in overweight and obese children. *Obesity*, 21(2):382-5.
44. Altenburg TM, Hofsteenge GH, Weijs PJ et al. (2012). Self-Reported Screen Time and Cardiometabolic Risk in Obese Dutch Adolescents. *PloS One*, 7(12):e53333.
45. Martinez-Gomez D, Tucker J, Heelan KA et al. (2009). Associations between sedentary behavior and blood pressure in young children. *Arch Pediatr Adolesc Med*, 163(8):724-30.
46. Pardee PE, Norman GJ, Lustig RH et al. (2007). Television viewing and hypertension in obese children. *Am J Prev Med*, 33(6):439-43.
47. Hardy LL, Denney-Wilson E, Thrift AP et al. (2010). Screen time and metabolic risk factors among adolescents. *Arch Pediatr Adolesc Med*, 164(7):643-9.
48. Chau JY, Grunseit A, Midthjell K et al. (2014). Cross-sectional associations of total sitting and leisure screen time with cardiometabolic risk in adults. Results from the HUNT Study, Norway. *J Sci Med Sport*, 17(1):78-84.