Does spending more time on electronic screen devices determine the weight outcomes in obese and normal weight Saudi Arabian children?

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ABSTRACT

الأهداف: جمع البيانات والتحقق فيما إذا كان امتلاك ومدة استخدام الأجهزة الإلكترونية تحدد حالة الوزن لدى الأطفال السعوديين الحضريين في سن المدرسة.

المنهجية: أجريت دراسة مقطعية متعددة المراكز، من ديسمبر 2015 إلى مارس 2016، في الرياض. تم تقسيم ما مجموعه 1023 طفل، تتراوح أعمارهم ما بين 9.00 و11.99 عامًا، إلى مجموعتين (الوزن الطبيعي والسمنة)، وتم تقسيمهم حسب الجنس. تم اختيار المشاركين عشوائيا باستخدام تقنية أخذ العينات العنقودية الطبقية متعددة المراحل. تم جمع البيانات عن طريق استبيان ذاتي لجمع بيانات سلوكيات الجلوس، حيث شمل قياس أوزان المشاركين وأطوالهم ومحيط الخصر ونسبة الدهون في الجسم وحساب مؤشر كتلة الجسم.

النتائج: الساعات التي قُضيت في مشاهدة التلفزيون/قارئ الاقراص/الفيديو لم تكن مختلفة بشكل كبير بين المجموعات المشاركة حتى بين الجنسين، سواء كان ذلك خلال أيام الأسبوع أو في عطلة نهاية الأسبوع. كانت ساعات استخدام الأجهزة الإلكترونية مختلفة اختلافًا كبيرًا بين المجموعات، وخاصة بين الأولاد. كان الأطفال الذين يعانون من السمنة، وخاصة خلال أيام الأسبوع، أعلى استخداماً للأجهزة اللوحية والهواتف المحمولة. كان الجهاز الإلكتروني الأكثر امتلاكاً هو الجهاز اللوحي (67.1% و70.2% بين مجموعة الوزن الطبيعي والسمنة على التوالي). جاء في المرتبة الثانية امتلاك أجهزة ألعاب الفيديو، في الغالب من قبل الأولاد أكثر من الفتيات. امتلاك الهواتف الذكية وجد أعلى بكثير في مجموعات السمنة، خاصة الأولاد.

الخلاصة: استخدام الأجهزة اللوحية الحديثة بدأ يحل محل مشاهدة التلفزيون. إن الاستخدام المفرط للإنترنت، ومشاهدة أجهزة الشاشات، وخاصة الهواتف الذكية والأجهزة اللوحية، يرتبطان بزيادة خطر الإصابة بالسمنة في عينة الدراسة.

Objectives: To gather data and investigate if ownership and duration of using electronic devices determines the weight status in an urban Saudi school-aged child.

Methods: A multicenter, cross-sectional study conducted in Riyadh, Saudi Arabia between December 2015 and March 2016. A total of 1023 child were randomly selected, aged 9.00 to 11.99 years. The participants were divided into 2 groups (normal weight and obese), and further stratified by gender. A self-paced questionnaire was used to collect sedentary behaviors data, in addition to the anthropometric measurements and body fat composition of the participants.

Results: Hours spent watching TV/DVD/videos were not significantly different between the participating groups or both genders, be it during weekdays (p=0.75) or on weekends (p=0.93). Electronic device utilization hours were significantly different between the groups, specifically in boys. Obese children, particularly during weekdays, had higher utilization rates of tablets and mobile phones at p<0.01 in weekdays and weekends. The most popular electronic device owned was a tablet (67.1% among normal weight and 70.2% obese groups). This was followed by gaming consoles owned, predominantly by boys rather than girls. Ownership of a smartphone was significantly higher in the obese group p=0.01), especially in boys (p=0.01).

Conclusion: Using modern electronic screen devices has begun to replace TV viewing. Excessive use of internet, and watching electronic screen devices, especially mobiles and tablets, have been associated with the increasing risk of obesity in urban Saudi school-aged child.

Keywords: obesity, electronic devices, Saudi children, screens watching

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The dramatic increase in the use of electronic screen devices, along with all kinds of media, has encouraged sitting and discouraged walking and other physical activities, especially among children and youth age ≈ 5 to 24 years old. Currently, most epidemiological studies have tested this hypothesis, especially around the concept of "television (TV) viewing". Evidence supports the contention that excessive screen time sitting is correlated with increased body mass index (BMI) among children and adolescents aged between 2 and 18 years.[1] However, it is critical to examine if excessive media-based inactivity is characteristic only of obese children who are normally not very active, prior to concluding that this high frequency of sitting in front of a screen as "a single marker of inactivity" may unfairly implicate school-aged children's increasing weight.[2] Therefore, understanding the differences regarding screen-based inactivity between normal weight and obese children, may help us to better understand this relationship and the consequences this has for children's weight status.

Most studies; however, have not fully examined the ownership of new electronic screen devices, specifically smartphones and tablets, and children's use of these devices. Our study advances previous analyses by considering this relatively new piece of technology. New screen devices, such as mobiles and tablets, may override TV viewing in children,[3] and this necessitates an examination of their link to obesity. It is evident that more research is required to better comprehend the links between indicators of media-based inactivity behaviors and poor health outcomes, such as obesity.[4]

In the past few years, Saudi Arabia has emerged as a developing country experience dramatic changes in increased sedentary lifestyles due to its astonishing economic growth.[5] Increasingly, contemporary life in Saudi Arabia involves additional time sitting coupled with physical inactivity, which has risen dramatically in recent decades.[6] The major influences on this change are the rise of new technologies that people now own and control,[7] combined with the problem of the limited availability of facilities and places suitable for outdoor/indoor activities where children can play. Saudi Arabia has a desert climate that is generally not helpful for engaging in physical activities for a substantial part of the year.[5] This lifestyle has seen increased usage of media-based activity by children, not only with traditional ones, such as TVs and computers screens, but also with new screen technologies including smartphones, tablets, and other mobile entertainment devices. Due to globalization, these mobile screen devices can be used everywhere, and at any time. This phenomenon is coupled with accelerated growth in technical applications and media that many children and young people find attractive and convenient.

Limited research on this topic has been documented in Saudi Arabia, with no evidence on the differences between normal weight and obese children, with specific references to the time spent using new screen devices. The aim of this study, therefore, is to examine in-depth if there are differences between obese and normal weight Saudi Arabian school-aged boys and girls, specifically regarding the ownership and duration spent on various electronic screen devices. In addition, this study evaluates whether the association of weight status varies between time spent on TV screens, computer, video gaming, and smartphone/tablets devices. This study hypothesizes that obese children of both genders have more ownership and therefore greater use of these electronic screen devices.

Methods. The methodology details for this study are documented elsewhere.[8] Briefly, data used to accomplish the cross-sectional study was collected between December 2015 and March 2016 in Riyadh, Saudi Arabia. The city is geographically organized into 5 major areas (north, south, east, west, and the center), where 2 private school and 2 government primary schools (one school for each gender) have met the criteria for random selection of convenience samples. Accordingly, students in grades 4, 5, and 6 reach the criteria for selection due to the unique body mass index (BMI) percentile attributes according to CDC data.[9] Subsequently, the selected class range was grouped as follows: a) normal weight (BMI between 25th and 75th percentiles) and b) obese group (BMI >95th percentile).

Among the 1023 eligible students aged between 9.00 and 11.99 years from the complete sample, there were 497 obese and 526 normal weight children.

This research attained the ethical threshold where 2 important institutions tendered their authorization. The first was the Saudi Ministry of Health - Institutional Review Board (Approval no. 15-336E) and the second was the University of Queensland Behavioral and Social Sciences Ethical Review Committee (Approval No. 2015001629). Furthermore, the Ministry of Education in Saudi Arabia approved the collection of study data in the selected schools.

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Anthropometric measurements. The study required the measurement of anthropometric variables of waist circumference (WC), height, and weight. Measurements were undertaken by trained data collectors using standard protocols. Waist circumference was measured at the level of the umbilicus to the nearest 0.5 centimeter (cm), by used a simple tape measure, and it recorded as specified in the CDC children anthropometric reference percentile data.[10] Measurement of height was registered to the nearest cm, while that of weight to the nearest 100 grams excluding clothes and shoes using the same device (Calibrated portable Seca scale). The next step involved the calculation of BMI in kg/cm^2. Subsequently, Bioelectrical Impedance Analysis was used, by device (Omron BF511, model HBF-511B-E), to analyze body composition, and then classified according to the method proposed by McCarthy et al.[11]

Sedentary data. A self-report method involving questionnaires on participants' sedentary behaviors was used in our study and is widely acceptable, valid and reliable.[12,13] Data on screen-based behaviors were collected using a variety of questionnaires, with specific queries gathering data on the time children spent watching TVs, computers, video games, and other new electronic screen devices, for example smartphones, tablets on a daily basis. A child's time spent using these screen devices was determined by the same question for each device. Each question investigated the weekdays and weekends separately to include duration usually spent watching/using, with the answers to each device categorized as follows: a) I do not watch or use; b) 0.5 to <1 hour, c) 1 to <2 hour, d) 2 to <3 hour, e) 3 to <4 hour, and f) ≥4 hours. In addition, details of the specific screen device(s) owned (for example, smartphones, tablets, game consoles), were recorded. These questionnaire booklets were sent to parents/guardians to be completed at home.

Statistical analysis. The study utilizes descriptive statistics where the mode of representation is proportions or means ± standard deviations (SD). The t-test determines age distribution for the obese and normal weight groups. The Chi-square served to establish if there is a significant relationship or association between any of the groups and the dependent variable. The final step involved the use of logistic regression to test the impact of the dependent variable on the possibility of grouping a child under the obese group. All data were analyzed using the Statistical Package for Social Sciences, version 24 (IBM Corp, Inc, Chicago, IL, USA). For the purposes of this study, the level of significance was set as $p<0.05$

Results. A total of 1200 eligible children had their parents' consent to take part in this study. The total number of children accepted into the sample that meet our eligibility criteria was 1023. This final sample represented different locations in Riyadh, and the group stratification was 497 obese and 526 normal weight children.

Table 1 shows the anthropometric data collected in the study organized by the number of children for each age group and mean±SD. The data stratification is by gender for each classification, either obese or normal weight. It is important to note that there was no significant variation in age distribution in either of the groups for both boys and girls. Also, waist circumference

Table 1 - Anthropometric measurements of sample children categorized as normal weight (≥25th & ≤75th P) and obese (≥ 95th P) of body mass index for age percentile.

Measurements	Boys			Girls			Normal weight group (n=526)	Obese group (n=497)	Odd ratio (95%CI)
	Normal weight (n=236)	Obese (n=232)	Odd ratio (95%CI)	Normal weight (n=290)	Obese (n=265)	Odd ratio (95%CI)			
Children			p=0.394			p=0.578			p=0.26
Age groups (years)									
09 - <10	81 (34.3)	79 (34.1)	Ref	92 (31.8)	88 (33.2)	Ref	173 32.9%	167 33.6%	Ref
10 - <11	89 (37.9)	76 (32.8)	1.14 (0.73-1.76)	104 (35.9)	84 (31.7)	1.18(0.78-1.78)	193 (36.7)	160 (32.2)	1.16(0.86-1.56)
11 - <12	66 (28.0)	77 (33.2)	0.83 (0.53-1.31)	94 (32.0)	93 (35.1)	0.96(0.64-1.45)	160 (30.4)	170 (34.2)	0.90(0.67-1.23)
Age in years (mean ± SD)	9.94±0.79	9.99±0.82	p=0.461†	10.01±0.80	10.02±0.82	p=0.863†	9.98±0.79	10.01±0.82	p=0.544†
Weight (kg)	33.7±6.2	55.8±10.4	0.000‡	34.8±7.0	53.0±11.5	0.000‡	34.3±6.6	54.3±11.1	0.000‡
Height (cm)	138.7±7.1	141.4±7.6	0.011‡	139.3±8.4	139.9±7.9	0.011‡	139.0±7.8	140.9±7.8	0.022‡
Waist circum. (cm)	67.9±6.7	86.3±9.4	0.000‡	65.8±7.0	78.9±8.4	0.000‡	66.8±6.9	82.3±9.6	0.000‡
Body fat (%)	20.1±6.4	35.5±3.4	0.000‡	22.8±6.0	35.9±3.6	0.000‡	21.6±6.3	35.7±3.5	0.000‡
BMI (kg/m^2)	17.4±2.0	27.7±3.3	0.000‡	17.8±2.1	26.5±2.8	0.000‡	17.6±2.0	27.1±3.1	0.000‡

Values are presented as number and percentages (%). BMI: body mass index, †t test. ‡Significant p-value

and body %fat parameters measured for both groups fell within the correct clinical range. As expected, the study yielded statistically significant (p=0.001) results differences in weight, height, WC, %fat, and BMI between the groups, as the cohort was identified and selected appropriately.

A comparison of the type of screen devices owned by Saudi Arabian children, between obese and normal weight, is summarized in Table 2. The analysis revealed that the obese group owned more smartphones than children of normal weight (odds ration [OR]=1.37, 95% confidence interval [CI]=1.05-1.79, p=0.019), particularly amongst boys (OR=1.60, 95% CI=1.10-2.31, p=0.012). However, no statistical differences emerged between gender or group and weight status for owned tablets or game consoles. Among all children, our data showed that there is more ownership of tablets rather than mobile phones being recorded at 67.4% versus (vs) 41.7% for boys and 69.9% vs 22.6% for girls. Moreover, game consoles were more popular with boys than girls at 66.2% vs 9.2%.

Daily screen watching hours during weekdays are shown in Table 3, including the OR of children categorized as obese. Our data varies between the groups, especially in the boys. The time spent watching TV/DVD/videos revealed no statistical differences for obese or normal weight groups. In comparison, however, the duration of computer or internet use (p=0.001), playing video games (p=0.005), using smartphones and tablet devices (p<0.001), were all positively associated with an increased risk of being obese. This data was specifically the case among boys. For all screen devices, the percentage of normal weight children who did "not watch or use a screen" was higher compared to the obese group.

Daily screen duration hours during weekends are shown in Table 4, including the OR of children categorized as obese. Same as for the weekdays, data showed no relationships between the duration of using TV/DVD/videos and weight status. The exception was the duration of playing video games and weight status, but this had no relationship as well. However, differences in being obese or of normal weight regarding the duration of using a computer or internet were found between groups (p=0.003), and trends were evident between genders. The duration of using smartphones and tablet devices >4 hours/day was positively related to obesity between groups (p<0.001), and in the boys (p=0.001).

Discussion. Saudi Arabian society has undergone dramatic lifestyle changes in recent decades. Despite this, limited research has been done on electronic screen devices ownership and duration habits of Saudi Arabians, especially those of children. Our study reports the prevalence of screen watching factors among boys and girls, aged 9 to 12 years. Our study highlights that duration of using a mobile screen device is positively associated with the occurrence of obesity in Saudi Arabian children, which was not seen in the normal weight group. Interestingly, these factors affected boys and girls differently. Computer/internet use, playing video games, and mobile screen devices, were significantly associated with obesity in boys, but not in girls. Moreover, the aforementioned screen devices contributed to a higher risk of being obese in both groups. However, importantly and interestingly, duration on traditional screens (TV, DVD, and Videos) did not indicate a difference in the weight status for either group. One of the merit of this study is to obtain information on how many electronic screen devices are owned by Saudi children among different groups (normal weight vs obese) and genders. It is also the first to make an in-depth comparison of screen utilization habits, example between normal weight and obese children in Saudi Arabia.

In our study, longer durations were shown among obese children regarding computer/internet use, video

Table 2 - Screen devices owned and weight status categorized as normal weight (≥25th & ≤75th P) and obese (≥95th P) of body mass index for age percentile.

Child ownership	Boys				Girls				Normal weight group	Obese group	*P*-value	OR 95%CI
	Normal weight	Obese	*P*-value	OR 95%CI	Normal weight	Obese	*P*-value	OR 95%CI				
Smartphones	85 (36.0)	110 (47.4)	0.012*	1.60 (1.10-2.31)*	62 (21.4)	63 (23.8)	0.514	1.14(0.76-1.70)	147 (27.9)	173 (34.8)	0.019*	1.37(1.05-1.79)*
Tablets (iPad)	149 (63.1)	165 (71.1)	0.067	0.69(0.47-1.02)	204 (70.3)	184 (69.4)	0.778	1.05(0.73-1.52)	353 (67.1)	349 (70.2)	0.299	0.86(0.66-1.13)
Game consoles (PlayStation)	151 (63.9)	159 (68.5)	0.298	0.81(0.551.19)	23 (7.9)	28 (10.5)	0.289	0.73(0.41-1.30)	174 (33.0)	187 (37.6)	0.218	0.85(0.65-1.10)

Values are presented as numbers and percentages (%). *p<0.05: OR - odds ration: CI - confidence interval, *Significant p-values

Table 3 - Daily screen duration hours during weekdays of Saudi Arabian children categorized as normal weight (≥25th & ≤75th P) and obese (≥95th P) of body mass index for age percentile.

Screen using habits (daily hours) (weekdays)	Boys				Girls				Normal weight group	Obese group	*P*-value	OR 95%CI
	Normal weight	Obese	*P*-value	OR 95%CI	Normal weight	Obese	*P*-value	OR 95%CI				
TV/DVD/video												
Don't watch or use	13 (5.5)	9 (3.9)	0.167†	Ref	13 (4.5)	15 (5.7)	0.916	Ref	26 (4.9)	24 (4.8)	0.616	Ref
0.5-<1 hour	56 (23.7)	62 (26.7)		1.59(0.63-4.02)	61 (21.0)	48 (18.1)		0.68(0.29-1.56)	117 (22.2)	110 (22.1)		1.01(0.55-1.88)
1-<2 hours	85 (36.0)	83 (35.8)		1.41(0.57-3.47)	73 (25.2)	67 (25.3)		0.79(0.35-1.79)	158 (30.0)	150 (30.2)		1.02(0.56-1.87)
2-<3 hours	39 (16.5)	49 (21.1)		1.81(0.70-4.68)	64 (22.1)	62 (23.4)		0.84(0.37-1.90)	103 (19.6)	111 (22.3)		1.16(0.63-2.16)
3-<4 hours	21 (8.9)	20 (8.6)		1.37(0.48-3.92)	33 (11.4)	34 (12.8)		0.89(0.36-2.16	54 (10.3)	54 (10.9)		1.08(0.55-2.11
≥4 hours	22 (9.4)	9 (3.9)		0.59(0.18-1.86	44 (15.8)	37 (14.7)		0.72(0.30-1.72)	66 (13.0)	46 (9.7)		0.75(0.38-1.47)
Computer/internet												
Don't watch or use	94 (39.8)	42 (18.1)	0.001†	Ref	129 (44.4)	93 (35.1)	0.052	Ref	223 (42.3)	135 (27.2)	0.001†	Ref
½-<1 hour	55 (23.3)	69 (29.7)		2.80(1.69-4.66)†	69 (23.8)	63 (23.8)		1.26(0.82-1.95)	124 (23.6)	132 (26.6)		**1.75(1.27-2.43)**
1-<2 hours	47 (19.9)	61 (26.3)		2.90(1.71-4.91)†	37 (12.8)	43 (16.2)		1.61(0.96-2.69)	84 (16.0)	104 (20.9)		**2.04(1.42-2.92)**
2-<3 hours	25 (10.6)	33 (14.2)		2.95(1.56-5.57)†	21 (7.2)	34 (12.8)		2.24(1.22-4.11)*	46 (8.7)	67 (13.4)		**2.40(1.56-3.70)**
3-<4 hours	3 (1.3)	10 (4.3)		7.46(1.95-28.50)†	19 (6.6)	13 (4.9)		0.94(0.44-2.01)	22 (4.2)	23 (4.6)		1.72(0.92-3.21)
4+ hours	12 (5.1)	17 (7.4)		3.17(1.39-7.22)†	13 (5.2)	19 (7.2)		2.02(0.95-4.31)	25 (5.2)	36 (7.3)		**2.37(1.36-4.13)**
Video games (PlayStation, Xbox, etc.)												
Don't watch or use	105 (44.5)	88 (37.9)	0.009†	Ref	208 (71.7)	190 (71.7)	0.276	Ref	313 (59.5)	278 (55.9)	0.002†	Ref
½-<1 hour	51 (21.6)	44 (19.0)		1.02(0.62-1.68)	45 (15.5)	35 (13.2)		0.85(0.52-1.38)	96 (18.3)	79 (15.9)		0.92(0.66-1.30)
1-<2 hours	41 (17.4)	32 (13.8)		0.93(0.54-1.60)	20 (6.9)	14 (5.3)		0.76(0.37-1.56)	61 (11.6)	46 (9.3)		0.84(0.56-1.28)
2-<3 hours	18 (7.6)	46 (19.8)		3.04(1.65-5.63)†	9 (3.1)	14 (5.3)		1.70(0.72-4.02)	27 (5.1)	60 (12.0)		**2.50(1.54-4.05)**
3-<4 hours	9 (3.8)	10 (4.3)		1.32(0.51-3.40)	2 (0.7)	7 (2.6)		3.83(0.78-18.67)	11 (2.1)	17 (3.4)		1.74(0.80-3.77)
4+ hours	12 (5.1)	12 (5.2)		1.19(0.51-2.78)	4 (2.1)	5 (1.9)		1.36(0.36-5.17)	16 (3.4)	17 (3.5)		1.19(0.59-2.41)
Mobile screen devices												
Don't watch or use	78 (33.1)	47 (20.3)	0.001†	Ref	99 (34.1)	81 (30.6)	0.585	Ref	177 (33.6)	128 (25.8)	0.001†	Ref
½-<1 hour	58 (24.6)	39 (16.8)		1.11(0.64-1.92)	76 (26.2)	61 (23.0)		0.98(0.62-1.53)	134 (25.5)	100 (20.1)		1.03(0.73-1.45)
1-<2 hours	49 (20.8)	43 (18.5)		1.45(0.84-2.51)	48 (16.6)	47 (17.7)		1.19(0.72-1.96)	97 (18.4)	90 (18.1)		1.28(0.89-1.85)
2-<3 hours	27 (11.4)	50 (1.6)		3.07(1.70-5.55)†	28 (9.7)	33 (12.5)		1.44(0.80-2.58)	55 (10.5)	83 (16.7)		2.08(1.38-3.14)†
3-<4 hours	15 (6.4)	30 (12.9)		3.31(1.61-6.80)†	17 (5.9)	23 (8.7)		1.65(0.82-3.30)	32 (6.1)	53 (10.7)		2.29(1.39-3.75)†
4+ hours	9 (3.7)	22 (9.9)		4.05(1.72-9.54)†	20 (7.5)	19 (7.5)		1.16(0.58-2.32)	29 (5.9)	41 (8.6)		1.95(1.15-3.31)†

Values are presented as numbers and percentages (%). *p<0.05: OR - odds ration: CI - confidence interval, †Significant p-values

games, smartphones and tablet devices, but not for TV. Previous studies found TV viewing habits to be associated with weight gain in school-aged children,[1,14] however, our findings do not support this association. There was no difference in duration of TV viewing between groups, or in either gender. It appears as a shift, in terms of sitting behavior among obese children, regarding the duration spent watching TV screen towards time spent accessing other electronic screen devices.

Television viewing has now been surpassed by the usage of other relatively new aforementioned electronic screen devices.[15,16] Recent advances in information technology are significantly impacting on how youth communicate and consume all kinds of media content. Despite the more prominent sedentary leisure time perhaps being TV viewing, it is nowadays accessed via alternative platforms such as smartphones and tablets. These devices are now smaller, more portable and multifunctional.[4,15] Our data supports the reality that new screen devices are emerging as all-encompassing influences on children's body weight, and this is highlighted in the increased duration of undertaking these activities.

Over the past years, the duration of viewing TV has witnessed a slight decline among children in countries such as the United States,[17] Germany,[18] Brazil,[19] Portugal,[20] and the Czech Republic.[21] Conversely, the time spent on computer and video games has increased exponentially. In reality, one kind of sedentary behavior in this age group has potentially been replaced by another and it shows no sign of abating. Our study showed in Saudi Arabian children, especially obese, there is a significant rise in the duration of using computer/video games and mobile screen devices. In fact, those children who have the highest mobile screen device duration,

Table 4 - Daily screen duration hours during weekends of Saudi Arabian children categorized as normal weight (≥25th & ≤75th P) and obese (≥95th P) of body mass index for age percentile.

Screen using habits (daily hours) (weekends)	Boys				Girls				Normal weight group	Obese group	*P*-value	OR 95%CI
	Normal weight	Obese	*P*-value	OR 95%CI	Normal weight	Obese	*P*-value	OR 95%CI				
TV/DVD/Video												
Don't watch or use	19 (8.1)	9 (3.9)	0.280†	Ref	7 (2.4)	11 (4.2)	0.894	Ref	26 (4.9)	20 (4.0)	0.867	Ref
½-<1 hour	28 (11.9)	27 (11.6)		2.03(0.78-5.28)	34 (11.7)	28 (10.6)		0.52(0.17-1.53)	62 (11.8)	55 (11.1)		1.15(0.58-2.29)
1-<2 hours	41 (17.4)	54 (23.3)		2.78(1.14-6.77)*	45 (15.5)	40 (15.1)		0.56(0.20-1.59)	86 (16.3)	94 (18.9)		1.42(0.74-2.72)
2-<3 hours	48 (20.3)	44 (19.0)		1.93(0.79-4.72)	42 (14.5)	42 (15.8)		0.63(0.22-1.80)	90 (17.1)	86 (17.3)		1.24(0.64-2.38)
3-<4 hours	50 (21.2)	43 (18.5)		1.81(0.74-4.42)	56 (19.3)	50 (18.9)		0.56(0.20-1.57)	106 (20.2)	93 (18.7)		1.14(0.59-2.17)
4+ hours	50 (21.1)	55 (23.7)		2.32(0.96-5.60)	104 (36.6)	94 (35.4)		0.57(0.21-1.54)	154 (29.7)	149 (30.0)		1.25(0.67-2.35)
Computer or internet												
Don't watch or use	51 (21.6)	27 (11.6)	0.024†	Ref	98 (33.7)	57 (21.5)	0.026†	Ref	149 (28.3)	84 (16.9)	0.001†	Ref
½-<1 hour	28 (11.9)	29 (12.5)		1.95(0.97-3.93)	40 (13.8)	43 (16.2)		1.84(1.07-3.17)†	68 (12.9)	72 (14.5)		1.87(1.22-2.87)†
1-<2 hours	45 (19.1)	61 (26.3)		2.56(1.39-4.68)†	40 (13.8)	43 (16.2)		1.84(1.07-3.17)†	85 (16.2)	104 (20.9)		2.17(1.46-3.21)†
2-<3 hours	40 (16.9)	53 (22.8)		2.50(1.34-4.65)†	35 (12.1)	39 (14.7)		1.91(1.09-3.35)†	75 (14.3)	92 (18.5)		2.17(1.45-3.26)†
3-<4 hours	35 (14.8)	26 (11.2)		1.40(0.70-2.79)	26 (9.0)	38 (14.3)		2.51(1.38-4.56)†	61 (11.6)	64 (12.9)		1.86(1.19-2.89)†
4+ hours	37 (15.7)	36 (15.6)		1.83(0.95-3.53)	48 (17.6)	45 (17.1)		1.61(0.96-2.71)	85 (16.7)	81 (16.3)		1.69(1.12-2.53)†
Video games (PlayStation, Xbox, and so forth)												
Don't watch or use	49 (20.8)	58 (25.0)	0.129†	Ref	185 (63.7)	148 (55.8)	0.198	Ref	234 (44.4)	206 (41.4)	0.325	Ref
½-<1 hour	30 (12.7)	20 (8.6)		0.56(0.28-1.11)	28 (9.7)	41 (15.5)		1.83(1.08-3.10)	58 (11.0)	61 (12.3)		1.19(0.79-1.79)
1-<2 hours	50 (21.2)	34 (14.7)		0.57(0.32-1.02)	32 (11.0)	27 (10.2)		1.05(0.60-1.83)	82 (15.6)	61 (12.3)		0.84(0.57-1.23)
2-<3 hours	37 (15.7)	43 (18.5)		0.98(0.54-1.75)	18 (6.2)	22 (8.3)		1.52(0.79-2.95)	55 (10.5)	65 (13.1)		1.34(0.89-2.01)
3-<4 hours	34 (14.4)	46 (19.8)		1.14(0.63-2.05)	12 (4.1)	9 (3.4)		0.93(0.38-2.28)	46 (8.7)	55 (11.1)		1.35(0.88-2.09)
4+ hours	36 (15.2)	30 (13.4)		0.70(0.38-1.30)	13 (5.3)	17 (6.8)		1.63(0.76-3.47)	49 (99.8)	47 (9.8)		1.09(0.70-1.69)
Mobile screen devices												
Don't watch or use	27 (11.4)	17 (7.3)	0.001†	Ref	42 (14.5)	40 (15.1)	0.887	Ref	71 (13.4)	57 (11.5)	0.002†	Ref
½-<1 hour	34 (14.4)	13 (5.6)		0.60(0.25-1.46)	4 (14.1)	35 (13.2)		0.93(0.50-1.74)	75 (14.3)	48 (9.7)		0.79(0.48-1.31)
1-<2 hours	41 (17.4)	34 (14.7)		1.31(0.61-2.81)	49 (16.9)	39 (14.7)		0.87(0.48-1.59)	90 (17.1)	73 (14.7)		1.01(0.63-1.60)
2-<3 hours	49 (20.8)	27 (11.6)		0.87(0.40-1.88)	49 (16.9)	52 (19.6)		1.16(0.65-2.08)	98 (18.6)	79 (15.9)		1.00(0.63-1.58)
3-<4 hours	37 (15.7)	34 (14.7)		1.45(0.67-3.13)	31 (10.7)	34 (12.8)		1.20(0.63-2.30)	68 (12.9)	68 (13.7)		1.24(0.76-2.02)
4+ hours	47 (20.3)	106 (46.1)		3.58(1.78-7.19)†	74 (26.9)	64 (24.6)		0.95(0.55-1.63)	121 (23.7)	170 (34.5)		1.75(1.51-2.66)†

Values are presented as numbers and percentages (%). *p<0.05, OR - odds ration, CI: confidence interval, †Significant p-values

also have the highest risk to be obese, in both an absolute and comparative values. Additionally, trending declines in watching TV were observed. Interestingly, these trends were significantly identified for weekdays.

Evidence for a link with obesity is commonly supported for time spent watching TV than other screen devices. It is possible that "TV watching time" is more often combined with "unconscious eating" and snacking. Furthermore, it is more passive and increases exposure to clever food marketing campaigns.[22,23] Electronic devices, such as computers and game consoles, require increased physical interaction and, consequently, "unconscious eating" of high energy-dense snacks was shown to be less pronounced.[24] However, smartphones and tablets have features that imitate the characteristics of TVs, computers, and video games. Consequently, these characteristics may be highly considered to yield a greater impact on weight status, and more independent research focus on these specific media devices is necessary.

It remains important that the measure of duration be considered on all screen devices as total screen time,[25] and to also separate this duration spent on mobiles screen devices, as being more the norm for acceptable or utilized devices. Only a few studies have systematically reported a relationship between obesity and smartphones/tablets, despite the evidence that childhood obesity is linked to excessive TV viewing, equating to five or more hours per day.[26] We have shown that increased duration of time that children spend in front of mobile screen devices, including TV, increase the risk of obesity. Importantly, we demonstrated that the duration of time regarding mobile screen devices encourages a significantly higher risk of obesity. Parents

may be strongly advised to limit their children's time on mobile screen devices. Therefore, it is important to provide alternative activities for their children, for example free time to play, exercise, and organize sporting games. This is critical considering the increased prevalence of childhood obesity and associated health concerns potentially due to the increased trend in the use of mobile screen devices in school-aged children. The easy availability of marketing and applications that target this segment of the population should be properly managed. The relationship between mobile screen devices use and youth obesity warrants further investigation.

A paucity of research is shown regarding the access or ownership of children's mobile screen devices.[3] Our research findings show obese children, particularly obese boys, owned more smartphones than their normal weight peers. This appears to suggest that obese boys are using mobile screen devices more often on weekdays and weekends. As well, tablets were the devices most owned among children in both groups and genders. Boys tend to own more game consoles than girls. This finding was not surprising, given that boys tend to play more video games than girls.[27] Knowing the relationship between the ownership of these devices among children and their using time, will help target valid intervention strategies to minimize the time spent using devices by these vulnerable groups.

Our results revealed for the boys' group, there was a direct association between screen time and obesity. Conversely, in girls a weak association emerged. The interaction between screen watching time and gender, however, yielded no statistical significance. However, it still shows a significant differentiation between the normal weight and obese groups. A significant association between BMI and girls watching TV has been reported,[28] but our current study elicited no difference among girls in all screen devices viewing. A difference was detected among the boys as evident in other devices.

Interestingly, Saudi girls in this current study in both groups seem to spend the same amount of time using all screen devices. This can be fairly explained in that Saudi girls, due to the country's conservative social traditions and culture, in most cases have fewer opportunities when compared to boys to engage in leisure time physical activity. Socio-culturally, most Saudi families do not encourage girls to participate in leisure time physical activities or pursuits.[29] Accordingly, they spend more of their time at home watching and using electronic/digital screens. Higher use of screen time among girls compared to boys was reported among Canadian[30] and Greek youth.[31] As well, research done in five European countries has established that girls, unlike boys, spend most of their time in sedentary lifestyles.[32] These findings are similar to those found in our analysis. Therefore, the study provides good insights into the existence of gender differences.

Study limitations. Despite the data in this study being largely self-reported, which can lead to recall and social desirability bias, most of the questions used to collect the sedentary data did originate from previously validated measures. Furthermore, data on child sedentary behaviours were collected from parents, which is suggested for children less than 12 years of age.[33] Prompt cards were employed to help their understanding of the questions and improve response accuracy.

A strength of the current study was the ability to recruit children from Saudi Arabia only. However, it will be interesting if another study is conducted that is able to comment on this type of current study population compared to other communities in Saudi Arabia and of the same age group.

While eating during watching screens is seen as the mechanism that triggers this increasing obesity onset among children, yet the current study did not investigate this issue. Instead, it focused only on obtaining and documenting differences in screen watching habits between obese and normal weight children. The effects of eating while watching screen is an important topic of academic debate and research, but it widely explored in other academic health research studies.

Our study does not include an investigation regarding the influences of how long participants engaged in physical activities, which is published elsewhere.[34] Despite this, it does support the notion that increased sedentary behaviors are related to BMI more than physical activities for this pre-adolescent age group.[35] Consequently, the important role of each factor (physical activity vs sedentary behaviors) require to recognized, thus emphasizing the need to investigate these links separately.[36] Previous research studies indicate that sedentary and physical activity behaviors should be deemed distinct constructs, that is, evaluations in one field should not necessarily be applied as markers of the other.[37] Our current understanding of what predicts sedentary lifestyles in children still remains some way behind that concerning physical activities,[38] so the current study's data and analysis make an important contribution to the relevant evidence base.

In conclusion, during weekdays, computer and internet use, electronic games, mobile screen devices may lead to unhealthy weight gain among children.

During weekends, only smartphones and tablet devices were used, and this contributed to obesity. Although computer and internet use on weekends highlighted the differences, the association was borderline and not significant among the genders. Generally, watching TV does not explain much of the variation in children's body weight. More attention should be given to the use of smartphones and tablet devices especially among children.

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