Osong Public Health and Research Perspectives

Journal homepage: http://www.kcdcphrp.org

Original Article

Joint Association of Screen Time and Physical Activity with Obesity: Findings from the Korea Media Panel Study

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Article history:

Received: April 30, 2018
Revised: July 25, 2018
Accepted: July 26, 2018

Keywords:

Korea media panel study, obesity, physical activity, screen time

ABSTRACT

Objectives: There is evidence to suggest that sedentary behavior is associated with a higher risk of metabolic disease. The aim of this study was to investigate cross-sectional joint associations of physical activity (PA) and screen time (ST), with the risk of obesity in Korean adults.

Methods: The Korea Media Panel Study consisted of a household interview and a self-administered diary survey on media usage over 3 days. ST (hours/day) was defined as the reported daily average hours spent watching television, computing (i.e., desktop, notebook, netbook, tablets), smartphone and video game console use. Cross-sectional associations of obesity (BMI ≥ 25 kg/m^2) and the amount of daily ST and PA were examined by logistic regression models adjusting for other possible confounders including alcohol consumption, smoking, depressive symptoms and demographic information. There were 7,808 participants included in the analyses.

Results: Increased ST was significantly associated with the risk of obesity (controlling for other possible confounders), but PA level was not found to be significantly linked. Participants who engaged in screen time > 6 hours per day had a higher incidence of obesity.

Conclusion: This study provides evidence of the association between ST and the increased incidence of obesity measured by BMI, independent of PA amongst Korean adults.

https://doi.org/10.24171/j.phrp.2018.9.4.10
pISSN 2210-9099 eISSN 2233-6052

Introduction

Cumulative evidence suggests that sedentary behavior is associated with a higher risk of metabolic disease and mortality [1–11]. Sedentary behavior is characterized by energy expenditure whilst awake in a sitting or reclining posture [12]. Among many sedentary behaviors, watching television remains the major contributor, associated with obesity in adults [4,7,10,13]. Therefore, screen time including television viewing, is used as a surrogate measure of sedentary behavior. Several studies have investigated the relationship between sedentary behavior or screen time, and health risks amongst children and adolescents [14–22]. It has been hypothesized that increased screen time leads to a poor health status due to reduced physical activity [6]. Furthermore, the amount of time engaged in watching television has been associated with an increased risk of cardiovascular disease mortality in Australian adults [8].

Although many previous studies have used passive media use as a proxy for sedentary time [13,14], many others distinguish between sedentary time or sitting time, and screen time due to the nature of related behaviors. A recent study has shown that a high level of physical activity decreases the risk of death or poor health outcomes, resulting from a longer sitting time. However, a poorer health outcome resulting from a high level of screen time was not alleviated by high levels of physical activity [15]. In other words, among sedentary behaviors,

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television watching may have additional health risks compared with other activities that involve sitting. For example, television viewing may lead to different dietary habits and involve longer, focused periods of inactivity, causing various cardio-metabolic health risks.

The introduction of smart devices such as smart phones and tablets make our lives convenient. In Korea, smartphone use has increased exponentially. Korea has high internet accessibility and fast broadband speeds, nearly 96% of fixed subscribers access the internet with speeds exceeding 50 Mbps [16]. The social impact of connectivity and media usage has many advantages in daily life. For instance, relationships with others may have improved through social network services, and it has become easy to acquire information and be up-to-date with current news from online newspapers. However, there is a lack of domestic empirical studies on the adverse mental and physical effects of excessive media use in the Korean population. In Korea, the prevalence of obesity has been steadily increasing whilst physical activity participation rates have been decreasing in the past decade [17,18]. In addition, there has been a dramatic increase in the prevalence of severe and extreme obesity in the Korean population [19]. The aim of this study was to investigate the association between physical activity and screen time with the risk of obesity in a sample of the Korean population.

Materials and Methods

1. Data

This was a cross-sectional, secondary data analyses of the 2014 Korea Media Panel Study (KMPS) that was conducted on 10,464 panel members aged 6 years and older [20]. The KMPS is an ongoing panel study that uses a complex, multistage probability design to obtain a representative sample of the non-institutionalized Korean population. The survey consists of a household interview and a self-administered diary survey on media usage over 3 days. The KMPS also includes a special section of questionnaires each year. In 2014, health behavior-related questionnaires included a Korean version of the International Physical Activity Questionnaire-Short Form (IPAQ-SF). Since the IPAQ-SF was been developed and tested for use in adults aged 19 to 69 years, IPAQ-SF and other health behavior related questionnaires were administered only to respondents aged > 13 years. Therefore, this study includes respondents aged 19 to 69 years; a total of 7,808 records were analyzed.

2. Screen time

Screen time (hours/day) was defined as the reported average daily hours of watching television, use of a computer (i.e., desktop, notebook, netbook, tablets), smartphone, or video game console. The average daily screen time was categorized into 4 groups based on the distribution of the average daily screen time (< 2, ≥ 2 to < 4, ≥ 4 to < 6, and ≥ 6 hours/day) to stabilize regression estimates. Similar categorizations of average daily screen time have been used in previous studies [9,21,22].

3. Physical activity

Self-reported physical activity was collected using the IPAQ-SF that was developed by a group of public health and physical activity researchers from multiple countries to assess physical activity for population-based surveillance [23]. The validity and reliability of the Korean version has been previously demonstrated [24]. Participants in the 2014 KMPS were required to indicate the number of days spent participating in exercise; vigorous, and moderate physical activity, and walking for at least 10 minutes at a time per week. Although the IPAQ-SF guidelines suggests categorizing into 3 groups, the participants in this current study were categorized into 2 groups (inactive or active) for the ease of interpretation. The active group consisted of the participants who took part in vigorous or moderate physical activity for at least 1 day per week, and the inactive group included those participants who exercised less than the active group i.e. who walked for at least 10 minutes per week.

4. Outcome- Incidence of obesity

Body mass index (BMI) was assessed using self-reported height and weight, which was used to calculate BMI (kg/m^2). Based on the guidelines from the "Korean society for the study of obesity" [25], participants with a BMI ≥ 25 were classified as obese.

5. Covariates

Questionnaires on health behavior and socioeconomic status were self-administered. Questionnaire items that were included as covariates in the statistical analysis included, "How often do you consume alcohol per week?" (never, at least once a week, or daily), "What are your smoking habits?" (currently smoking, previously a smoker, or non-smoker) and "In the last 12 months, have you ever felt sad or hopeless daily for more than 2 weeks, such that it stopped your daily routine?" Pre-tax monthly average income (including interest) and any other incomes, were used as a measure of socioeconomic status.

6. Statistical analysis

The mean and standard deviations were presented for quantitative variables. Percentages for qualitative and

quantitative variables were categorized into groups. To evaluate correlations between the incidence of obesity and the study variables, chi-square analysis was conducted for each covariate.

For incidence of obesity, multiple logistic regression analyses were conducted to evaluate the association between screen time and physical activity and the odds of obesity at a 95% confidence interval were presented.

In the models, low screen time (< 2 hours per day) and being physically active were considered as the reference groups that affect obesity. The models were adjusted for age, gender, income, smoking, alcohol consumption, and depressive symptoms. Survey weights were used in each analysis to adjust sampling biases. All statistical analyses were carried out using Statistical Analysis Software (Version 9.4, SAS Institute Inc, Cary, NC). The level of statistical significance was set at $p \leq 0.05$.

Results

The descriptive statistics of the study population are summarized in Table 1. Of the total study population (N = 7,808), 49.28% were women, 15% were obese (BMI ≥ 25), 20% reported a high level of screen time (> 6 hours per day), and 46.90% reported not participating in any physical activity. The mean age of the current study participants was approximately 43 years, and there was a significant

Table 1. Descriptive statistics of participant characteristics (n = 7,808)*.

Variables	Male	Female	Total
Age (y; mean ± SD)	42.27 ± 14.86	42.99 ± 13.67	42.62 ± 14.24
19-35	33.01	31.24	32.14
36-50	35.64	35.66	35.65
> 50	31.35	33.10	32.21
Female	-	-	49.28
Screen time (h/d)			
< 2	19.61	13.32	16.51
2-4	37.96	36.86	37.42
4-6	23.82	28.22	25.99
> 6	18.60	21.60	20.08
Physical activity			
Inactive	40.99	47.01	46.90
Active	59.01	52.99	53.10
Smoking habit			
Previously	17.21	0.81	9.13
Currently	40.83	0.95	21.17
Never	41.96	98.24	69.69
Alcohol consumption			
None	21.64	68.79	44.88
≥ wk	77.46	31.19	54.66
Daily	0.89	0.03	0.47
Depressive symptoms (Yes)	4.19	4.72	4.45
BMI (kg/m2; mean ± SD)	23.48 ± 2.30	22.03 ± 2.43	22.76 ± 2.49
Underweight (< 18.5)	0.77	4.86	2.78
Normal (≤ 18.5 to < 25)	79.11	85.57	82.30
Obese (25 ≥)	20.12	9.57	14.92

* Presented as percentages unless otherwise stated.
BMI = body mass index.

Table 2. Prevalence of obesity in participant population.

Variables	Obesity (%)		
	Male	Female	Total
Age (y)			
< 35	15.57	2.95	9.52
36-50	22.60	8.89	15.84
> 50	22.10	16.55	19.29
Screen time (h/d)			
< 2	17.76	6.87	13.43
2-4	20.12	8.18	14.32
4-6	18.66	10.27	14.17
> 6	24.49	12.68	18.23
Physical activity			
Inactive	17.69	10.58	15.97
Active	21.82	8.43	13.73
Smoking habit			
Previously	23.72	12.94	23.25
Currently	21.42	11.26	21.20
Never	17.38	9.52	11.92
Alcohol consumption			
None	17.50	11.20	12.74
≥1/ wk	20.98	5.97	16.76
Daily	9.66	0.00	9.39
Depressive symptoms			
Yes	33.24	13.10	22.71
No	19.55	9.39	14.56

relationship between the prevalence of obesity and the age group. Other covariates showed significant associations with the prevalence of obesity such as gender, screen time, physical activity, smoking habits, alcohol consumption and depressive symptoms. Female participants reported more screen time, and less physical activity, compared to males. The distribution of smoking habits was significantly different among males and females; more females had never smoked and more than half of males (58.04%) were either current or previous smokers. Regarding alcohol consumption, there was a significant difference between genders, as males were more likely drink at least once a week, compared to females.

The prevalence of obesity, was twice as likely in males than females. Obesity in females was over twice as likely in older females (age > 50 years) than younger females. Physically inactive females were more likely to be obese, whereas physically active males were more likely to be obese. Approximately 70% of the participants reported that they had never smoked and showed the lowest prevalence of obesity, compared to current and previous smokers. Although the proportion of subjects with depressive symptoms was less than 5%, participants of either gender with depressive symptoms were more likely to be obese in both genders (Table 2).

Table 3. Multiple logistic regression analysis to determine the relationship between obesity, screen time and physical activity (*N*=7,808).

Screen time/ physical activity	Model 1* OR (95% CI)	Model 2† OR (95% CI)
Screen time		
< 2 h/d	Reference	Reference
2-4 h/d	1.06 (0.83, 1.36)	1.04 (0.81, 1.34)
4-6 h/d	1.07 (0.83, 1.39)	1.06 (0.81, 1.37)
> 6 h/d	1.48 (1.13, 1.95)	1.42 (1.08, 1.86)
p trend	0.008	0.023
Physical activity		
Active	0.93 (0.79, 1.09)	0.93 (0.79, 1.09)
p	0.341	0.370

*Model 1 adjusted for age and gender.
†Model 2 adjusted for age, gender, income, alcohol consumption, smoking, and depressive symptoms.
CI = confidence interval; OR = odds ratio.

Multiple logistic regression models were applied to explore joint associations of screen time and physical activity with the risk of obesity. In models adjusting for age, gender, income, alcohol consumption, smoking, and depressive symptoms, a significant association was found between obesity and spending > 6 hours per day on screen time, compared to participants who spent < 2 hours per day. However, no significant associations were found between physical activity and the incidence of obesity (Table 3).

Discussion

This is the first study to investigate the association between screen time and the incidence of obesity in Korean adults. The major finding of this study was the significant association between the incidence of obesity and screen time in the Korean population. Although this association was slightly reduced after controlling for health-related covariates, participants spending screen time > 6 hours per day was associated

with approximately 1.42 times the increased risk of obesity, independently of physical activity, when compared to spending screen time < 2 hours per day. This finding is consistent with those of previous studies in adolescents and adults, further confirming the independent role of screen time as a risk factor for obesity when controlling for physical activity level [15,26,27]. When screen time was categorized into groups, prolonged screen time > 6 hours per day was found to be significantly associated with the risk of obesity.

There are 2 plausible explanations for the mechanisms by which excessive screen time may lead to obesity, involving low energy expenditure, or high energy intake as a result of eating during extended sedentary screen time periods have been suggested. Some have argued that time spent watching television reduces time spent in physical activity [6]. However, the current findings did not support the notion of reduced physical activity due to excessive screen time, as no significant relationship was found between obesity and physical activity when screen time and other health related covariates were controlled for. No significant relationship was found between screen time and the level of physical activity in the additional analyses in this study. Similarly, as indicated by Boone et al. [26], increases in screen time may also increase the risk of obesity, although increases in physical activity level in our study did not. There is growing evidence regarding the independent nature of the relationship between physical activity and sedentary, screen watching behavior [28]. Although results may vary with age, some studies have demonstrated successful interventions entailing replacement of television viewing with physical activity in older adults (≥ 60 years) [29,30].

Taken together, this study supports the idea of reducing screen time and increasing physical activity to improve health outcomes. Physiological mechanisms have been suggested to explain the association between sedentary behavior and obesity. It was suggested that prolonged sitting time impairs lipoprotein lipase activity, which affected lipid and glucose metabolism in skeletal muscle. The detrimental changes on lipid and glucose metabolism due to prolonged sitting time cannot be reversed or prevented by increased physical activity [31–33]. Not only does screen time involve prolonged sitting, but it also influences consumption of high fat food [34]. Among women, it was found that those who spent more time watching television, were more likely to consume food like red meat, snacks, refined grains and sweets [10]. In relation to this, Korean adolescents have been shown to consume more unhealthy foods that may leads to cardiovascular diseases whilst watching television [35]. Although KMPS data did not record participants' food consumption habits while watching television, it was suspected that excessive screen time may trigger high calorie intake in the Korean population. In support of this notion, Lee at el [35] showed that unhealthy dietary patterns were associated with excessive screen time among Korean adolescents.

The strengths of the present analysis were the ability to perform multiple logistic regression analysis in a large Korean adult population (making this representative ethnically), and to determine the relative risks of the joint measures of obesity, physical activity and media consumption, which was possible as a result of recording a detailed diary log. However, the study does have some limitations. Firstly, the collected data for weight and height used in the calculation of BMI were not collected by trained professionals, but self-reported. It is well known that the self-reported anthropometric measures show bias [36] and that the calculated BMI derived from self-reported height and weight tends to be underestimated. Although the measurement bias in this regard was seemingly lower in the Asian population, it proved to be greater in obese participants. Secondly, although the IPAQ-SF is typically reported to overestimate the physical activity level [37], it is widely used because the solid and reliable measurement tools of physical activity are limited within the acceptable range of cost and feasibility [38]. Obesity is related to other health conditions such as heart disease, stroke, high blood pressure, and diabetes. The study population's health status was not known, so it was not possible to determine other health factors affecting obesity, as measured through the BMI. This was because the KMPS does not collect any detailed information on health conditions of each participant. Additionally, recent studies have reported the adverse effects of excessive screen time on mental health, which may also affect the incidence of obesity [22,39]. Therefore, the joint association of screen time and physical activity with obesity must be interpreted cautiously.

In summary, excessive screen time is associated with a higher BMI, as well as an increased risk of obesity independently of physical activity in the Korean population. This study supports increasing public awareness of the adverse effects of excessive screen time on obesity and the importance of maintaining a moderate amount of screen time.

Conflicts of Interest

There is no potential conflicts of interest.

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