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Original Research

Does adult recreational screen-time sedentary behavior have an effect on self-perceived health?

León-Gómez Brenda Biaani [a,*], Laia Palència [a,b,c], Anna Puig-Ribera [d], Xavier Bartoll [a,c], Katherine Pérez [a,b,c]

[a] Agència de Salut Pública de Barcelona (ASPB), Barcelona, Spain
[b] CIBER Epidemiología y Salud Pública (CIBERESP), Madrid, Spain
[c] Institut d'Investigació Biomédica (IIB Sant Pau), Barcelona, Spain
[d] Sport and Physical Activity Research Group and Centre for Health and Social Care Research, Department of Physical Activity and Sports Sciences, University of Vic, Central University of Catalonia, Vic, Barcelona, Spain

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ABSTRACT

Objectives: Sedentary behavior is a risk factor for comorbidities independently of physical activity. Some studies have reported screen time as an unhealthier form of sedentary behavior. This study assessed the association between recreational screen-time behavior and self-perceived health.
Study design: This is a cross-sectional study.
Methods: As part of the *Salut als Carrers Project,* in 2018 a survey was conducted in a representative sample (n = 795) of residents aged ≥ 18 years living in the borough of Horta, in Barcelona. The survey assessed self-perceived health, recreational screen-time behavior on working and non-working days (Marshall questionnaire), leisure time physical activity (International Physical Activity Questionnaire [IPAQ] long form), socioeconomic status, and age. We analyzed associations between self-perceived health and recreational screen-time sedentary behavior, with adjustment of robust Poisson models for social class, age, and leisure physical activity. All analyses were stratified by gender.
Results: A total of 82.7% of men and 82.5% of women reported sedentary behavior during recreational screen time of ≥3 h/day on working days, and 63.9% of men and 65.8% of women on non-working days. Spending ≥3 h/day sitting in front of a screen for leisure was associated with poor self-perceived health only on working days for men [PR = 1.87 (1.13–3.09)] but not for women [PR = 1.32 (0.82–2.11)] regardless of leisure physical activity, age, and social class.
Conclusions: In adults, sedentary behavior during recreational screen time on working days is adversely associated with perceived ill health in men, irrespective of leisure time physical activity. Public health interventions could benefit from promoting a reduction in leisure screen sitting time after working hours.

1. Introduction

Life today demands fewer physical challenges compared to previous generations. This change has a dual effect on human behavior: people's mobility is reduced and people are sitting for longer [1]. Human beings lead a much more sedentary life. This is associated with the fact that there are more physical places where people can sit: on transportation, at work, at home, in the car, and in the community [1]. Likewise, studies show that sedentary behavior is an independent risk factor for health, morbidity and mortality, regardless of daily levels of moderate and/or vigorous physical activity [2–5].

There are various theories on the causality of the effect of watching television on all-cause mortality. One explanation is that television-viewing typically occurs in the evenings [6], usually after dinner, and prolonged postprandial sedentary time could be particularly detrimental to glucose and lipid metabolism [7]. However, there are other explanations such as people interrupting their sitting time more frequently during work than while watching television, and that sedentary time promotes several risk factors (such as bad eating habits) [7]. Another explanation for the observed difference could be that television-viewing

* Corresponding author. Agència de Salut Pública de Barcelona, Barcelona, España Plaça Lesseps, 1, 08023, Barcelona, Spain.
E-mail address: bblego@gmail.com (L.-G. Brenda Biaani).

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may be accompanied by unhealthy behaviors such as snacking [8]. In addition, food advertising on television may have a detrimental effect on eating behavior [9]. Because most of the population is exposed to this lifestyle (sedentary behavior) no matter how tiny the possible risk of screen-time sedentary behavior, this is a public health problem about which little is known [10,11].

The general and standardized terminology of sedentary behavior defines this behavior as any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture [5,12]. Sedentary behavior can involve a variety of behaviors such as reading, writing, and screen watching. Thus, sedentary screen time behavior refers to the time spent on screen-based behaviours [5,13]. Furthermore, recreational screen-time sedentary behavior is defined as the time spent using a screen-based device (e.g., smartphone, tablet, computer, television) while being sedentary in contexts that are not related to school or work [5,14]. Regardless of high levels of moderate-vigorous physical activity, sedentary behavior during television-viewing time is an independent risk factor for ill health, morbidity, and mortality [2–4]. The evidence relating television screen-based behavior to health risk has recently been described, and relates to certain types of cancer [15] and the risk of type 2 diabetes and cardiovascular diseases [16]. In addition to the above, sedentary behavior In front of any type of screen (not only television-viewing) time has also recently been associated with mortality, independently of physical activity levels [17–19]. However, there is little information on how this variable may impact other health indicators in the population, such as self-perceived health, which are important to determine population health. The self-perceived health scale is a robust predictor of mortality, correlates strongly with other objective health indicators [20], [–] [22] and is a valid health indicator used worldwide. Due to the generalization of screen-watching across the general population, it is becoming a significant public health issue. Determining the association between self-perceived health and screen-based behaviors is becoming more important for the evaluation of population health.

Despite the emergence of the risks of sedentary behaviors for the global city-dwelling population, there have been no reports of the prevalence of recreational screen-time sedentary behavior among adults, although some studies have been performed in children and teenagers. Evidence has focused on studying the relationship between sedentary screen behavior and physical risk factors (e.g. cardio metabolic risks) [2–4,15–19]. Furthermore, the association between recreational screen-time sedentary behavior and self-rated health has not been established. While it is well known that self-rated health shows gender differences, there is no information on gender differences in recreational screen-time sedentary behavior. This study aimed to explore the associations between self-reported recreational screen-time sedentary behavior and self-rated health in a representative neighborhood adult (≥18 years) population by gender.

2. Methods

2.1. Study design, study population and information sources

This cross-sectional study used the *"Salut als Carrers"* [23] household health survey as the data source. *"Salut als Carrers"* is a project aiming to evaluate the effects on health of urban regeneration such as superblocks [24,25]. This survey was used to conduct the baseline assessment in *Horta,* a neighborhood in Barcelona. The survey was performed in a representative sample of non-institutionalized residents. We consider as residents all persons with more than 6 months of residence in the neighborhood. This was regardless of whether they were renting, had a mortgage or owned their home. For their selection it was essential that they were over 18 years old. In this study, we included only residents aged ≥18 to ≤64 years, with a sample size of 795 individuals (397 women). The survey has a section on socio-demographic variables, health, individual health determinants (which includes the physical activity and sedentary behavior part) and contextual health determinants. From each of these sections we obtained the variables to be worked on. The fieldwork to collect the information was done from May to September of 2018. The survey used a random nominal sample of the population according to age and gender quotas (200 individuals in each quota) with substitution.

2.2. Variables

Our dependent variable was self-rated health [26,27]. A five-level item question asked about self-rated health: "In general, how would you rate your health today?" with the possible choices being 1) "very good", 2) "good", 3) "moderate", 4) "bad", or 5) "very bad". Self-rated health was dichotomized and coded as "0" ("very good", "good" or "moderate"), and coded as "1" ("poor" or "very poor"). The main independent variable, recreational screen-time sedentary behavior, was based on the Marshall questionnaire [28]. Recreational screen-time sedentary behavior was measured in minutes/day on the last working and non-working day before the survey. For the analysis, it was categorized as <3 h and ≥3 h based on the results of the Ekelund meta-analysis [2]. That study showed an increasing risk (although not in all groups) of all-cause mortality from 3 h or more of sedentary behavior watching television. The adjustment variables were leisure-time moderate and vigorous physical activity, social class, and age. Moderate and vigorous physical activity METs (Metabolic Equivalents) per week were obtained from the long-form International Physical Activity Questionnaire (IPAQ) scale in leisure time [29–31]. METs from leisure-time moderate and vigorous physical activity were dichotomized according to respondents' physical activity levels per week as leisure-time inactivity (0 METs spent on leisure-time moderate and vigorous physical activity) or leisure time activity (1 or more METs spent on leisure-time moderate and vigorous physical activity). Social class was assessed using the Spanish Society of Epidemiology classification based on current or last occupation [32,33]. We used data on the interviewee's current or last occupation or, if he or she had never worked, the occupation of another member of the household working at the time of the interview; the responses were classified as non-manual class and manual class.

2.3. Analysis

All analyses were stratified by sex and the sample was weighted by using the sample design. We calculated the distribution (number and percentages) of all dependent and independent variables in men and women. To analyze the relationship between self-reported health and recreational screen-time sedentary behavior on working and non-working days, Poisson regression models with robust variance were adjusted by moderate and vigorous physical activity, social status, and age. These variables were first added to the models separately and were then sequentially introduced to detect which variable explained the change in the screen-time coefficient, if any (first age, then age plus occupation, and finally age plus occupation plus physical activity). To control for reverse causation, people who reported risk of poor mental health and mobility problems were excluded from the analyses. People classified as having a mobility problem were those who reported that they had not left home because of a mobility problem in the last week. All prevalence ratios were calculated using STATA 15 [34].

3. Results

Table 1 shows weighted general distributions of the variables of interest separately for women (percentages are among women) and men (percentages are among men). The percentage of people aged 18–44 years was 55.6% in men and 53.7% in women. Manual workers accounted for 53.1% of men and 64.2% of women. A total of 13.6% of men and 17.3% of women in the neighborhood of Horta perceived their health as poor. The prevalence of high (≥3 h) recreational screen-time

Table 1
Weighted descriptive of the distribution of the variables across men and women of the Horta neighborhood in 2018.

	Men		Women	
	N	Percent	N	Percent
Sedentary behavior on working day				
Higher levels	329	82.7	327	82.5
Lower levels	69	17.3	68	17.0
Missing	–	–	2	0.5
Total	398	100	397	100
Sedentary behavior on non-working day				
Higher levels	254	63.9	261	65.8
Lower levels	144	36.1	134	33.7
missing	–	–	2	0.5
Total	398	100	397	100
Age (years)				
18–44	221	55.6	213	53.7
45–64	177	44.4	184	46.3
Total	398	100	397	100
Occupation				
Manual	212	53.1	255	64.2
Non-Manual	179	44.9	129	32.5
missing	8	2.0	13	3.3
Total	398	100	397	100
Leisure-time Physical Activity				
No physical activity	224	56.3	191	48.1
Physical activity	174	43.7	206	51.9
Total	398	100	397	100
Self-rated health				
Good	344	86.4	328	82.7
Poor	54	13.6	69	17.3
Total	398	100	397	100

Note.
Physical activity (moderate and vigorous physical activity in leisure time).
Sedentary behavior(recreational screen time behavior; lower levels <3 h; higher levels≥3 h).
Working day (Monday to Friday).
Non-working day (Saturday or Sunday).

sedentary behavior on working days was 82.7% in men and 82.5% in women. Moreover, the prevalence of high (≥3 h) recreational screen-time sedentary behavior on non-working days was 63.9% in men and 65.8% in women. A total of 56.3% of and 48.1% of women were not physically active in leisure time.

Table 2 shows the crude and adjusted prevalence ratio (PR) of the association between self-rated health and recreational screen-time sedentary behavior on working days among women and men. A statistically significant crude association was observed between self-rated health and recreational screen-time sedentary behavior, age, and moderate and vigorous physical activity among men and women. Socioeconomic status was statistically significantly associated only in women [PR = 1.57, 95%CI= (1.02–2.43)], and was almost significantly associated in men [PR = 1.52 95%CI= (0.93–2.46)]. The association between self-rated health and recreational screen-time sedentary behavior [PR = 2.90 95%CI= (1.81–4.66)] was statistically significant after adjustment by age [PR = 2.21 95%CI= (1.35–3.61)], socioeconomic status [PR = 2.07 95%CI= (1.23–3.46)], and moderate and vigorous physical activity in men [PR 1.87 (1.13–3.09)]. Thus, men with higher recreational screen-time sedentary behavior (≥3 h/day) in Horta were 87% more likely to self-report poor health than those who sat less, independently of adjustment variables. In women, the association between self-rated health and recreational screen-time sedentary behavior [PR = 1.84 95%CI= (1.16–2.90)] was almost statistically significant after adjustment by age [PR = 1.57 95%CI= (0.99–2.49)], and was not significant after adjustment by socioeconomic status [PR = 1.38 95%CI= (0.86–2.23)] and moderate and vigorous physical activity [PR 1.32 95% CI= (0.82–2.11)].

Table 3 shows the crude and adjusted prevalence ratio (PR) of the association between self-rated health and recreational screen-time sedentary behavior on non-working days among women and men. There was a statistically significant crude association between self-rated health and all variables of interest (recreational screen-time sedentary behavior only in men, socioeconomic status only in women and age and moderate and vigorous physical activity both sexes) among men and women. The association between self-rated health and recreational screen-time sedentary behavior [PR = 1.77 95%CI=(1.10–2.87)] was not statistically significant after adjustment by age [PR = 1.54 95% CI=(0.96–2.47)], socioeconomic status [PR = 1.44 95%CI=(0.89–2.34)] and moderate and vigorous physical activity [PR = 1.33 (0.83–2.13)] in men. In women, the association between self-rated health and recreational screen-time sedentary behavior [PR = 1.37 95%CI= (0.89–2.12)] was not statistically significant alone or after adjustment by age [PR =

Table 2
Crude and adjusted associations between recreational screen time sedentary behavior and self-rated health on working days.

		Self-rated health Crude[a]				Model 1[b]				Model 2[c]				Model 3[d]			
		PR	CI inf	CI sup	P	PR	CI inf	CI sup	P	PR	CI inf	CI sup	P	PR	CI inf	CI sup	P
Men	Lower SB	1	1	1		1	1	1		1	1	1		1	1	1	
	Higher SB	2.90	1.81	4.66	0.00	2.21	1.35	3.61	0.00	2.07	1.23	3.46	0.01	1.87	1.13	3.09	0.01
	Age 18–44 years	1	1	1		1	1	1		1	1	1		1	1	1	
	Age 45–64 years	3.83	2.09	7.02	0.00	3.30	1.76	6.17	0.00	3.27	1.76	6.09	0.00	2.92	1.54	5.54	0.00
	Manual	1	1	1						1	1	1		1	1	1	
	Non-Manual	1.52	0.93	2.46	0.09	–	–	–	–	1.44	0.89	2.33	0.14	1.34	0.82	2.19	0.24
	PA	1	1	1										1	1	1	
	No PA	2.70	1.60	4.53	0.00	–	–	–	–	–	–	–	–	1.91	1.11	3.29	0.02
Women	Lower SB	1	1	1		1	1	1		1	1	1		1	1	1	
	Higher SB	1.84	1.16	2.90	0.01	1.57	0.99	2.49	0.06	1.38	0.86	2.23	0.19	1.32	0.82	2.11	0.25
	Age 18–44 years	1	1	1		1	1	1		1	1	1		1	1	1	
	Age 45–64 years	1.97	1.25	3.12	0.00	1.77	1.11	2.83	0.02	2.00	1.23	3.24	0.01	1.96	1.21	3.18	0.01
	Manual	1	1	1						1	1	1		1	1	1	
	Non-Manual	1.57	1.02	2.43	0.04	–	–	–	–	1.56	1.00	2.43	0.05	1.42	0.90	2.24	0.13
	PA	1	1	1										1	1	1	
	No PA	1.89	1.19	3.01	0.01	–	–	–	–	–	–	–	–	1.70	1.04	2.76	0.03

Note: CI (Confidence Interval) Inf (Inferior) Sup (Superior) PA (moderate and vigorous physical activity in leisure time) SB (recreational screen time behavio r)Working day (Monday to Friday) Non-working day (Saturday or Sunday).
[a] Independent Models: separate crude models.
[b] Model 1 = self-rated health + recreational screen time sedentary behavior + Age.
[c] Model 2 = self-rated health + recreational screen time sedentary behavior + Age + Occupation.
[d] Model 3 = self-rated health + recreational screen time sedentary behavior + Age + Occupation + moderate and vigorous physical activity in leisure time.

Table 3
Crude and adjusted associations between recreational screen time sedentary behavior and self-rated health on non-working days.

		Self-rated health Crude[a]				Model 1[b]				Model 2[c]				Model 3[d]			
		PR	CI inf	CI sup	P	PR	CI inf	CI sup	P	PR	CI inf	CI sup	P	PR	CI inf	CI sup	P
Men	Lower SB	1	1	1		1	1	1		1	1	1		1	1	1	
	Higher SB	1.77	1.1	2.87	0.02	1.54	0.96	2.47	0.08	1.44	0.89	2.34	0.14	1.33	0.83	2.13	0.24
	Age 18-44	1	1	1		1	1	1		1	1	1		1	1	1	
	Age 45-64	3.83	2.09	7.02	0	3.65	1.98	6.72	0	3.62	1.98	6.62	0	3.18	1.7	5.95	0
	Manual	1	1	1						1	1	1		1	1	1	
	Non Manual	1.52	0.93	2.46	0.09	–	–	–	–	1.52	0.94	2.45	0.08	1.41	0.87	2.29	0.16
	PA	1	1	1										1	1	1	
	No PA	2.7	1.6	4.53	0	–	–	–	–	–	–	–	–	2	1.17	3.43	0.01
Women	Lower SB	1	1	1		1	1	1		1	1	1		1	1	1	
	Higher SB	1.37	0.89	2.12	0.15	1.31	0.85	2.02	0.22	1.24	0.8	1.93	0.33	1.2	0.78	1.86	0.41
	Age 18-44	1	1	1		1	1	1		1	1	1		1	1	1	
	Age 45-64	1.97	1.25	3.12	0	1.9	1.2	3	0.01	2.1	1.3	3.39	0	2.05	1.28	3.3	0
	Manual	1	1	1						1	1	1		1	1	1	
	Non Manual	1.57	1.02	2.43	0.04	–	–	–	–	1.6	1.03	2.47	0.04	1.45	0.92	2.28	0.11
	PA	1	1	1										1	1	1	
	No PA	1.89	1.19	3.01	0.01	–	–	–	–	–	–	–	–	1.71	1.05	2.78	0.03

Note: CI (Confidence Interval) Inf (Inferior) Sup (Superior) PA (moderate and vigorous physical activity in leisure time) SB (recreational screen time behavio r)Working day (Monday to Friday) Non-working day (Saturday or Sunday).

[a] Independent Models: separate crude models.

[b] Model 1 = self-rated health + recreational screen time sedentary behavior + Age.

[c] Model 2 = self-rated health + recreational screen time sedentary behavior + Age + Occupation.

[d] Model 3 = self-rated health + recreational screen time sedentary behavior + Age + Occupation + moderate and vigorous physical activity in leisure time.

1.31 95%CI= (0.85–2.02)], socioeconomic status [PR = 1.24 95%CI= (0.80–1.93)], and moderate and vigorous physical activity [PR = 1.20 95%CI= (0.78–1.86)]. There seems not to be a difference in the effects of socioeconomic factors between men and women. Additionally, Fig. 1 shows how, with adjustment by age (model 1), the association was specially attenuated. In addition, age was the variable that most explained the change in the coefficient (except in non-working women).

4. Discussion

In this study, we found an association between recreational screen-time sedentary behavior and self-rated health on working days among men and women and on non-working days among men. After adjustment by age, socioeconomic status and physical activity only the association among men on working days remained significant. In addition, we found a higher prevalence of 3 h or more of recreational screen time per day in a sedentary posture on working than on non-working days at the neighborhood level. This pattern seemed to be present in men and women.

There is growing evidence that sedentary behavior may be a distinct risk factor, independently of physical activity, for multiple adverse health outcomes in adults [4]. However, as far as we know, this is the first study to explore the association between self-reported recreational screen-time sedentary behavior and self-rated health in adults. We found a significant and independent positive association between recreational screen-time sedentary behavior and self-rated health in men on working days. These results support the results of a meta-analysis showing an association between mortality and television-watching sedentary behavior independently of physical activity [35]. This study also supports the association between general sedentary behavior and self-rated health that was found in other population, ages, and contexts [19,36–38]. In this regard, this study adds fundamental information about how a general epidemiological measure such as self-related health is associated with recreational screen-time sedentary behavior in the adult population. Targeting this behavior may provide an alternative approach to improving population health (men on working days). Likewise, studying the associations between these behaviors and extensively used health measures could help to improve population health surveillance. Thus, self-perceived health is also a widely used and accepted valid measure associated with morbidity and mortality [39]. It is therefore important to assess the association between self-perceived health status and recreational screen-time sedentary behavior across the general adult population. Additionally, researchers have previously reported that the combination of no physical activity and high screen-time showed the greatest negative impact on health-related quality of life [40]. Our study shows how recreational screen-time sedentary behavior could be a risk factor for poor self-perceived health. Furthermore, recreational

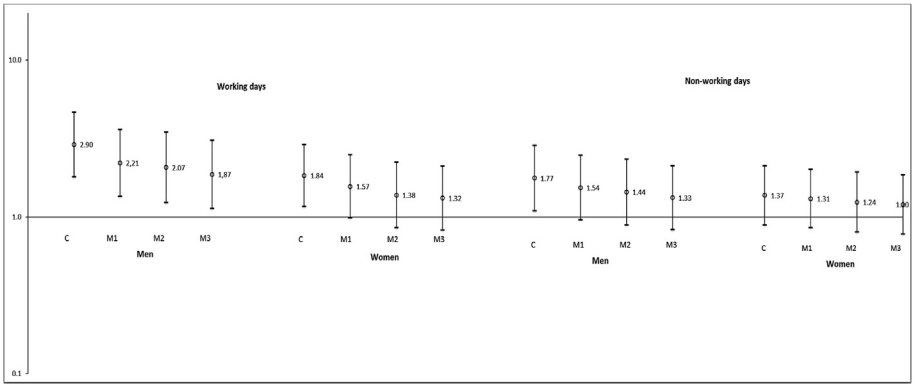

Fig. 1. Crude and adjusted associations between recreational screen time sedentary behavior and self-rated health in working and non-working days among men and women
Working day (Monday to Friday)
Non-working day (Saturday or Sunday)
C Independent Models: separate crude models
M1 Model 1 = self-rated health + recreational screen time sedentary behavior + Age |
M2 Model 2 = self-rated health + recreational screen time sedentary behavior + Age + Occupation
M3 Model 3 = self-rated health + recreational screen time sedentary behavior + Age + Occupation + moderate and vigorous physical activity in leisure time.

screen-time sedentary behavior as a risk factor contributes to self-perceived health [41].

In addition to the association between recreational screen-time sedentary behavior with self-perceived health, we found gender differences in the distribution of this association. Although an association was found in both men and women, significance disappeared in women after adjustment for age and socioeconomic position. Nevertheless, there remained a risk of almost 1.4, and, because significance depends on sample size, among other factors, we cannot exclude the possibility that there is still an association [42].

In general, to our knowledge, there are no previous reports of gender differences between men and women in recreational screen-time sedentary behavior. Consequently, there is no established theory as to why these differences may occur, but we believe they may be multifactorial and that differences in the distribution of social determinants of health by gender may play an important role. This is because it is known that health determinants are distributed differently among men and women. In addition, these differences could be mediated by certain mechanisms, e.g., by leisure time related to exposure to sedentary behavior. The type of sedentary behavior may differ; for example women may interrupt sitting time more frequently, which has a proven health benefit [7], or may do other types of domestic work while sitting, such as sewing or ironing, which could also have a differential effect. Differences in the distribution of domestic work, with women having less free time at home, may also be related to greater continuous exposure time (without breaks) among men [7,43]. Likewise, biological causality could also be an issue to explore [44]. More research is needed to determine why sex differences exist. In future, research should study how the different components of recreational screen-time sedentary behavior (number of breaks, whether people accumulate sitting time at intervals of 5–10 min, more than 30 min, etc.) are related to self-perceived health. To do this, objective measures of sedentary behavior (*ActivPal*) would need to be used. Then, those differences are very important because and after this information we could consider that this could have implication on the distribution of chronic degenerative diseases. This could be part of a set of risks that have implication in sex and gender differences in leading causes of mortality such as heart disease, cancer, chronic obstructive pulmonary disease, cancer, etc [45].

A surprising result was the difference between working and non-work days. The prevalence of sedentary screen time was higher on working days than on non-working days. Moreover, associations with self-perceived health were stronger on working days. One explanation may lie in the lack of statistical power in this study. Another possibility is that most people have high exposure to sedentary behavior at work so that on weekdays they accumulate a greater number of hours per day while sitting. This total accumulation of hours of sedentary behavior on workdays could explain the differences in the strength of the association on workdays and non-working days. However, much more research is needed to determine the reason for these patterns.

This study has some limitations. The first is that the measurement of sedentary behavior was self-reported, which is not the gold standard for sedentary behavior measurement. However, examination of sedentary behavior at the neighborhood level required large-scale assessment, which was much more feasible by means of a survey and the scale used had been previously validated. The second is that the study sample is small, which affected the level of significance of some associations. In addition, an inverse association cannot be ruled out, although we tried to exclude people who self-reported a risk of mental ill health and some disability in the previous week and who could therefore spend more time sitting. Lastly, even though there may be multiple confounding factors, we consider that our analysis covers at least the main factors that may be in the chain of confusion, such as: physical activity, socioeconomic factors, employment, working days or not, and gender, and we exclude people who may have some basic pathology, to avoid reverse causation. However, we know that sedentary behavior is a very complex phenomenon so there may be multiple other factors both contextual and individual that affect the outcome of the study. Of note, the use of self-reporting also allowed identification of behaviors that took place while sitting. An example is screen time. This also allowed us to identify the prevalence of recreational screen-time sedentary behavior in a representative sample of the general population in a neighborhood of a large city. Lastly, this is the first study to estimate the association between perceived health and screen time.

5. Conclusion

This study indicates that during leisure time, not only should moderate or vigorous physical activity be promoted, but also interventions to reduce screen time. Public health programs should take these results into account when maximizing the effectiveness of the interventions to promote active lifestyles. It is important to identify and generate more information about this health risk at the population level as well as to identify interventions that help reduce sedentary behavior and the use of screens, especially in risk groups. Gender differences among recreational screen time sedentary behavior should be deeply studied. Identifying, understanding, and making visible gender differences in risk factors such as this are key to acting on differences in the distribution of mortality in chronic diseases. This is becoming increasingly relevant in a context where day-to-day sedentary behavior is part of our lives.

Ethics approval

The Clinical research ethical committee *IMIM Institut Hospital del Mar d'Investigacions Mèdiques* (reference 2018/7979/I) approved the "*Environmental, health effects and health inequalities of Superblocks in Barcelona*" ("*Salut als Carrers*" study protocol) which is what this study is framed in. All participants were in agreement and signed the informed consent to participate in "*Salut als Carrers*" project. All data was worked in an anonymized form.

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Declaration of competing interest

The authors of this paper do not declare any competing interests.

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