

Television- and Screen-Based Activity and Mental Well-Being in Adults

Mark Hamer, PhD, Emmanuel Stamatakis, PhD, Gita D. Mishra, PhD

Background: Sedentary behavior is emerging as an independent risk factor for physical health, although there is no existing evidence regarding mental well-being.

Purpose: This study aimed to examine the association between recreational sedentary behavior (based on TV- and screen-based entertainment [TVSE] time) and mental health in a representative sample of adults.

Methods: Participants were 3920 men and women (mean age 51.0 ± 15.8 years) from the 2003 Scottish Health Survey. The General Health Questionnaire (GHQ-12) and the mental health component of the 12-Item Short-Form Survey Instrument (MCS-12) were administered to obtain information on current mental health. Self-reported TVSE time, physical activity, and physical function was also measured. Analyses were conducted in 2009.

Results: Approximately 25% of participants engaged in at least 4 hours/day of TVSE. In general linear models, TVSE time per week was independently associated with GHQ-12 score (higher scores represent worse mental health status) after adjustment for age, gender, physical activity, physical function, area deprivation level, smoking, alcohol, fruit and vegetable intake, and BMI. After full adjustment, participants in the group with the highest TVSE level (>4 hours/day) had an increase in GHQ-12 score of 0.28 (95% CI=0.05, 0.51) compared with participants in the group with the lowest TVSE level (≤ 2 hours/day). In stratified analyses, the association between TVSE time and GHQ-12 score persisted across all physical activity levels. Similar associations were observed using the MCS-12.

Conclusions: Sedentary behavior in leisure time is independently associated with poorer mental health scores in a representative population sample.

(Am J Prev Med 2010;38(4):375–380) © 2010 American Journal of Preventive Medicine

Introduction

There is extensive evidence linking physical activity with better mental health,^{1–6} and individuals with psychiatric illness are less likely to be physically active.⁷ Mental health, however, has gained little attention in relation to sedentary behavior. The current guidelines for physical activity and health⁸ do not explicitly provide recommendations on sedentary behavior, although emerging evidence^{9–13} has suggested that it is an independent risk factor for physical health. For example, in a representative sample of the Canadian

population,⁹ there was a dose–response relationship between sitting time and all-cause mortality, and numerous studies^{10–13} have demonstrated associations between sedentary behavior and metabolic risk factors. All of these associations persist after adjustments for physical activity, thus suggesting that sedentary behavior and physical activity are separate constructs and not functional opposites. Metabolic risk factors often coexist with poor mental health,^{14,15} and it is therefore possible that sedentary behavior is also a risk factor for psychological morbidity. We previously demonstrated¹⁶ an independent association between sedentary behavior during leisure time (indexed from TV- and screen-based entertainment [TVSE] time) and psychological health in young children; thus, the aim of the present study was to examine this association among adults. Because sedentary behavior may partly reflect physical dysfunction, which also correlates highly with mental health,¹⁷ physical function was considered as a potential confounder in all of the current analyses.

From the Department of Epidemiology and Public Health, University College London, United Kingdom

Address correspondence and reprint requests to: Mark Hamer, PhD, Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 6BT, United Kingdom. E-mail: m.hamer@ucl.ac.uk.

0749-3797/00/\$17.00

doi: 10.1016/j.amepre.2009.12.030

Methods

Study Design and Participants

The Scottish Health Survey (SHS)¹⁸ is a periodic survey (conducted typically every 3–5 years) that draws a nationally representative sample of the general population living in households. The sample was drawn using multistage stratified probability sampling with postcode sectors selected at the first stage and household addresses selected at the second stage. Stratification was based on geographic areas and not on individual characteristics of the population. The present analyses included data from 3920 adults (mean age = 51.0 ± 15.8 years) measured in the 2003 SHS. Seventy-seven percent of eligible households took part in the survey. Participants gave full informed consent to participate in the study and ethical approval was obtained from the London Research Ethics Council. Trained interviewers visited households and interviews were conducted using computer-assisted personal interviewing.

Mental Health

Current mental health was assessed from the 12-item version of the General Health Questionnaire (GHQ-12), which is a measure of psychological distress devised for population studies. The questionnaire inquires about general level of happiness, experience of depressive and anxiety symptoms, and sleep disturbance during the past 4 weeks. Interpretation of the answers is based on a 4-point response scale scored using a bimodal method (symptom present: *not at all* = 0, *same as usual* = 0, *more than usual* = 1, and *much more than usual* = 1). The GHQ-12 is a highly validated instrument and has been strongly associated¹⁹ with various psychological disorders, such as depression and anxiety. Participants were also administered the 12-Item Short-Form Survey Instrument (SF-12), which measures eight attributes of functional health status and has demonstrated²⁰ strong validity and reliability. The mental health component of the SF-12 (MCS-12) was employed as a second measure of mental health.

Sedentary Behavior and Physical Activity and Function

As an indicator of sedentary behavior in leisure time, participants reported the total time spent in TVSE during each weekday and each weekend day, which was used to calculate their total weekly TVSE time. Physical activity interviews inquired about participation in the 4 weeks prior to the interview. Frequency of participation (for at least 30 minutes per occasion) was assessed across three domains of activity: leisure-time sports (e.g., cycling, swimming, running, aerobics, dancing, and ball sports such as football and tennis); walking for any purpose; and domestic physical activity (e.g., heavy housework, home improvement activities, manual and gardening work). The self-report questions were

validated²¹ through objective physical activity assessment on 106 adults from the general population (45 men) using accelerometer devices that were worn for 2 nonconsecutive weeks over a period of 1 month. Physical function was assessed from the SF-12 by using the Physical Component Summary Score (PCS-12), in which the scores range from 0 to 100, with lower scores representing poorer physical function.

Demographics

Interviewers measured height and weight for the calculation of BMI and asked demographic and other health-related questions such as smoking, alcohol intake, and daily intake of fruit and vegetables. The Scottish Index of Multiple Deprivation was assessed from 31 indicators in six individual domains, including employment, current income, housing, health, education, and skills and training, and is highly validated.²²

Statistical Analysis

The TVSE variable was categorized into four groups comprising ≤2 hours/day, 2–3 hours/day, 3–4 hours/day, and >4 hours/day, and ANOVA was employed to test for differences in variables among the TVSE groups. Associations between the GHQ-12 and MCS-12 scores and TVSE were examined using general linear models. Several models were fitted, which included (1) basic adjustments for age and gender (Model 1); (2) further adjustments for moderate to vigorous physical activity (frequency per week of activities that last for 30 minutes or more; <1, 1–4, or ≥5 times) and physical function score split into tertiles (Model 2); and (3) a fully adjusted model with further adjustments for deprivation index quintile; smoking (never, previous, <20 cigarettes per day, or ≥20 cigarettes per day); frequency of alcohol intake (daily, 3–6 days per week, 1–2 days per week, every 1–3 months, 1–2 days per year, or never or ex-drinker); daily intake of fruit and vegetables (none, 1–4 servings per day, or ≥5 servings per day); and BMI (Model 3). This modeling strategy allowed us to control for potential confounding. In additional analyses, logistic regression was performed to examine the association between TVSE categories and psychological distress using an established cut point (GHQ-12 score ≥4) to define distress.¹⁹ Differences in the results according to physical activity, physical function, smoking status, and obesity level were assessed using stratified analyses. All analyses were conducted using SPSS, version 14.

Results

TV- and screen-based entertainment time was normally distributed, and approximately 25% of the sample reported more than 4 hours of TVSE per day. The overall health profile of the sample was poor: 66% were classified

Table 1. Characteristics of the sample with reference to TVSE time in adults ($n=3920$), % unless otherwise noted

| Variable | TVSE (hours/day) | | | | p-trend |
|---|------------------|---------------------|---------------------|-----------------|---------|
| | ≤2.0 (n=1194) | >2.0–3.0 (n=995) | >3.0–4.0 (n=753) | >4.0 (n=978) | |
| Age (years) | 49.3±15.3 | 49.6±15.3 | 51.9±15.8 | 54.0±16.4 | <0.001 |
| Gender (men) | 40.5 | 45.8 | 46.5 | 49.2 | 0.001 |
| Deprivation (top quintile) | 8.5 | 11.1 | 14.7 | 23.3 | <0.001 |
| Physical function (PCS-12 score; M±SD) ^a | 50.6±9.6 | 50.5±9.1 | 48.4±10.3 | 45.1±12.0 | <0.001 |
| Mental function (MCS-12 score; M±SD) ^a | 52.3±8.3 | 52.6±8.0 | 52.5±8.3 | 50.3±10.2 | <0.001 |
| Psychological distress (GHQ-12 score≥4) | 13.1 | 10.9 | 12.6 | 19.9 | <0.001 |
| Physical activity (meeting guideline) ^b | 38.4 | 33.0 | 26.4 | 21.7 | <0.001 |
| Smokers | 19.0 | 20.0 | 25.0 | 32.4 | <0.001 |
| Alcohol intake | | | | | |
| Daily | 13.7 | 12.3 | 12.7 | 13.7 | <0.001 |
| Never | 9.7 | 6.6 | 9.2 | 9.7 | |
| Fruit and vegetable intake (≥5 servings/day) | 30.6 | 28.5 | 20.1 | 15.8 | <0.001 |
| BMI (kg/m ² ; M±SD) | 26.8±4.6 | 27.5±4.8 | 28.0±5.2 | 28.5±5.9 | <0.001 |
| Overweight/obese | 60.1 | 67.4 | 71.6 | 71.3 | <0.001 |

^aPCS-12 and MCS-12 scores range from 0 to 100, with lower scores representing poorer physical/mental function.

^bPhysical activity guidelines refer to five or more 30-minute sessions of moderate to vigorous physical activity per week.

GHQ-12, General Health Questionnaire; MCS, mental health component of the 12-Item Short-Form Survey Instrument; PCS, Physical Component Summary Score; TVSE, TV- and screen-based entertainment

as overweight or obese based on BMI measures, 75.6% did not adhere to five or more daily servings of fruit and vegetables, and 23.6% were current smokers. Participants reporting high TVSE levels were older, had higher levels of deprivation, poorer physical function, lower physical activity levels, higher BMI, and lower levels of consumption of fruit and vegetables, and they were more likely to be smokers (Table 1).

There was a positive association between TVSE level and GHQ-12 score but an inverse association between physical activity level and physical function with GHQ-12 (Table 2). The association with TVSE was substantially attenuated after adjustment for physical function and physical activity level, although it remained significant for the highest level of TVSE. After full adjustment, participants in the group with the highest TVSE level had an increase in GHQ-12 score of 0.28 (95% CI=0.05, 0.51) compared with participants in the group with the lowest level. As expected, the association became

even stronger when TVSE time was modeled as a continuous variable ($p<0.001$).

In logistic regression analyses, participants in the group with the highest TVSE level had greater risk of psychological distress (defined as GHQ-12≥4) compared with those in the group with the lowest level (age- and gender-adjusted OR=1.79, 95% CI=1.42, 2.26). This association, however, was attenuated considerably after further adjustments (fully adjusted OR=1.19, 95% CI=0.92, 1.53). An examination was also made of the association between TVSE level and the mental health component of the SF-12 (MCS-12), which produced associations that were similar to those observed with the GHQ-12 score. For example, after full adjustments,

participants in the group with the highest TVSE level had a difference in MCS-12 score of 1.54 (95% CI= -2.31, -0.77) compared with participants in the group with the lowest level.

In stratified analyses, the association between TVSE and GHQ-12 score persisted across all physical activity categories (Figure 1), smoking status, and obesity category. The association was weaker and nonsignificant among participants with higher levels of physical function compared to those with lower levels of function.

Discussion

We found an independent association between leisure-time sedentary behavior (indexed by TVSE time) and lower scores on two measures of mental health. Importantly, this finding was independent of potential confounders such as physical activity level and physical func-

Table 2. Association of TVSE time, physical activity, physical function, and GHQ-12 score ($n=3920$), β (95% CI) unless otherwise noted

| Variable | GHQ-12 (M \pm SD) | Model 1 | Model 2 | Model 3 |
|---|---------------------|----------------------|----------------------|----------------------|
| TVSE group (hours/day) | | | | |
| Low (≤ 2.0) | 1.25 \pm 2.62 | ref | ref | ref |
| Medium (>2.0 – 3.0) | 1.05 \pm 2.31 | –0.18 (–0.41, 0.05) | –0.21 (–0.43, 0.01) | –0.21 (–0.43, 0.01) |
| High (>3.0 – 4.0) | 1.27 \pm 2.56 | 0.07 (–0.19, 0.32) | –0.11 (–0.35, 0.13) | –0.15 (–0.39, 0.09) |
| Very high (≥ 4.0) | 1.98 \pm 3.36 | 0.80 (0.57, 1.03) | 0.36 (0.14, 0.59) | 0.28 (0.05, 0.51) |
| p -trend | | <0.001 | <0.001 | <0.001 |
| Physical activity level (frequency/week) | | | | |
| Low (<1 /week) | 1.92 \pm 3.23 | ref | ref | ref |
| Medium (1–4/week) | 1.23 \pm 2.60 | –0.77 (–0.98, –0.56) | –0.42 (–0.63, –0.22) | –0.41 (–0.61, –0.21) |
| High (≥ 5 /week) | 0.99 \pm 2.30 | –1.03 (–1.25, –0.80) | –0.61 (–0.83, –0.39) | –0.60 (–0.82, –0.38) |
| p -trend | | <0.001 | <0.001 | <0.001 |
| Physical function (PCS-12 score) | | | | |
| Low (<48.5) | 2.45 \pm 3.53 | ref | ref | ref |
| Medium (48.5–55) | 0.72 \pm 1.91 | –1.91 (–2.12, –1.70) | –1.74 (–1.95, –1.53) | –1.66 (–1.87, –1.44) |
| High (>55) | 1.06 \pm 2.35 | –1.64 (–1.85, –1.42) | –1.41 (–1.63, –1.19) | –1.27 (–1.50, –1.04) |
| p -trend | | <0.001 | <0.001 | <0.001 |

Note: The β values represent mean differences in GHQ-12 scores compared with the reference group. Model 1 adjusted for age and gender; Model 2 had mutual adjustments for physical activity, physical function, and TVSE; Model 3 had further adjustment for deprivation index quintile, smoking (never, previous, <20 cigarettes per day, or ≥ 20 cigarettes per day); frequency of alcohol intake (daily/3–6 times per week, 1–2 times per week, every 1–3 months, 1–2 times per year, never, or ex-drinker); BMI; and daily fruit and vegetable intake (none, 1–4 servings, or ≥ 5 servings).

GHQ-12, General Health Questionnaire; PCS, Physical Component Summary Score; TVSE, TV- and screen-based entertainment

tion. We are unaware of any previous work that has examined the association between sedentary behavior in leisure time and mental health in adults. A recent study²³ found a longitudinal association between TV viewing and development of depressive symptoms over a 7-year period between adolescence and early adulthood. However, that study did not adjust for physical activity, so the independence of this relationship remains to be established. Interestingly, other recreational sedentary activities such as video cassettes, computer games, or radio were not associated with incident depression, which suggests that the association may be partly explained by exposure to particular media.

The association between TVSE time and GHQ-12 score was substantially attenuated after adjustment for physical function, suggesting a complex relationship among physical limitations, recreational sedentary behavior, and mental health, which requires further work to tease apart. It should also be noted that the association between TVSE and GHQ-12 score was observed only in the group with the highest TVSE exposure level and not

in the low- to moderate-exposure groups (approximately up to 4 hours/day). In a recent study,²⁴ there was an association between participation in enjoyable leisure-time activities and higher levels of positive psychological state. Thus, if participants perceive TVSE as a pleasurable activity, this may partly explain the current findings, although further work is needed to address this issue.

At present, the field of sedentary behavior research is in its infancy and there is little experimental work to support the existing data from population studies. In a recent experimental study,²⁵ participants who withdrew from their habitual exercise for 2 weeks demonstrated a significant increase in negative mood and symptoms of fatigue, although it was not possible to interpret if these effects were caused by a reduction in exercise or through an increase in sedentary behavior. The experimental induction of 5 days of bed rest, which represents an extreme form of sedentary behavior, can have profound effects on various metabolic risk factors such as insulin resistance and vascular dysfunction.²⁶ Given that metabolic risk is associated with psychological factors,^{14,15} this may be a

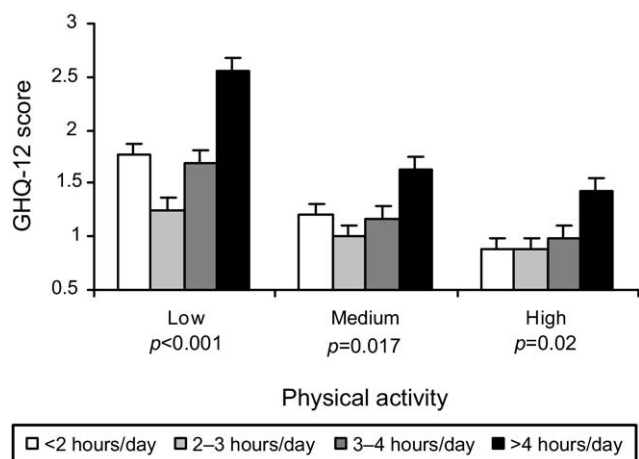


Figure 1. TV time and GHQ-12 stratified by moderate to vigorous physical activity level (low, <1 session per week; medium, 1–4 sessions per week; high, ≥ 5 sessions per week). Values are mean \pm SEM adjusted for age and gender.

GHQ-12, General Health Questionnaire

potential mechanism in explaining the link between sedentary behavior and mental health.

Another possibility is that excessive time spent in TVSE encourages social isolation and limits the development of social support networks, thereby reducing coping abilities and adversely affecting mental well-being. Excessive TVSE exposure often occurs before going to bed, which might disrupt sleep and contribute to cognitive and mental dysfunction.²⁷ Certain media content might also directly affect mental health.²⁸ The present results should, however, be interpreted with caution because of the cross-sectional nature of the data, which precludes any inference of causality. Indeed, the direction of the association also remains unclear because psychological distress might be the cause or a result of sedentary behavior.

The limitations of the present study should be recognized. TV- and screen-based entertainment time was used as a broader marker of leisure-time sedentary behavior, which has been employed previously²⁹ and is thought to be the most important indicator of nonoccupational sitting behavior. The validity of this measure, however, appears to be quite variable among studies, and the development of reliable and valid self-report instruments that cover the full range of leisure-time sedentary behavior is desirable. Notwithstanding, the current measure of TVSE time demonstrated convergent validity in view of the fact that it was associated with other variables such as physical function and BMI. It is possible that some of the observed associations between sedentary behavior and health outcomes are confounded by dietary intake, because TVSE has been associated³⁰ with increased consumption of fast

food and calorie-dense snacks. Although dietary intake data from the present study were quite crude, adjustment for basic indicators of healthy eating such as fruit and vegetable consumption did not appreciably alter the results. However, future studies should attempt to examine this issue in greater detail.

This is the first study, to our knowledge, to demonstrate an independent relationship between leisure-time sedentary behavior and mental health in a representative adult population. The present findings are consistent with emerging research that suggests sedentary behavior is an independent health risk.

The authors receive grant funding from the National Institute for Health Research, United Kingdom, and the Medical Research Council, United Kingdom. The Scottish Health Survey is funded by the Scottish Executive.

No financial disclosures were reported by the authors of this paper.

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