Preventive Medicine 81 (2015) 108–113

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

A prospective study of screen time in adolescence and depression symptoms in young adulthood

Anders Grøntved [a,b,*], John Singhammer [c], Karsten Froberg [a,b], Niels Christian Møller [a,b], An Pan [d], Karin A. Pfeiffer [e], Peter Lund Kristensen [a,b]

[a] Department of Sport Science and Clinical Biomechanics, Research Unit for Exercise Epidemiology, University of Southern Denmark, Denmark
[b] Centre of Research in Childhood Health, University of Southern Denmark, Denmark
[c] VIA University College, Århus, Denmark
[d] Department of Epidemiology and Biostatistics, MOE Key Lab of Environment and Health, School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei, China
[e] Department of Kinesiology, Michigan State University, East Lansing, MI, United States

ARTICLE INFO

Available online 21 August 2015

Keywords:
Depressive symptoms
Youth
Media
TV

ABSTRACT

Objectives. The purpose of this study was to examine the association between screen time in adolescence and depressive symptoms in young adulthood in a population-based cohort study of Danish adolescents.

Methods. Data were from a cohort of adolescents who were followed-up in young adulthood for a period of up to 12 years (1997–2010, mean 8.8 years, $n = 435$). Information on television viewing, computer use, total screen time and other determinants of depression were obtained in adolescence. Depressive symptoms were obtained in young adulthood using the Major Depression Inventory (MDI) and classified as mild, moderate or severe depression. Mixed regression models were used to examine the associations, with adjustment for major confounders.

Results. In multivariable adjusted analyses, each additional hour/day spent watching television or screen viewing in adolescence was associated with 1.36 (95% CI 0.73–1.98) and 1.05 (95% CI 0.50–1.60), respectively, greater MDI depression summary score in young adulthood ($p < 0.001$). In logistic regression models, each additional hour/day spent watching television or screen viewing was associated with 1.64 (95% CI 1.18–2.27) and 1.58 (95% CI 1.18–2.12), respectively, greater odds of prevalent depression in young adulthood, and dose–response relationships were indicated. Additional adjustment for either cardiorespiratory fitness or BMI did not materially change the results. No significant associations were observed between adolescent computer use and depressive symptoms in young adulthood.

Conclusions. Limiting screen time, particularly television viewing, during adolescence may be important for preventing depression in young adulthood.

Introduction

Screen use such as television (TV) viewing is highly popular and pervasive among young people. According to the most recent 2014 US Nielsen Company rating, adolescents 12–17 years old spend an average of 3 h and 53 min per day engaging in screen viewing behaviors, with traditional TV viewing at home as the predominant source (Nielsen Co., 2014). While several studies have reported that prolonged screen time in adolescence impairs cardiovascular health outcomes in later life (Grøntved et al., 2014; Hancox et al., 2004; van de Laar et al., 2014), evidence regarding its influence on other health outcomes such as mental health characteristics remains limited. Depression is a common mental health disorder among adolescents and young adults, with a population median age of onset at early to mid twenties (Kessler and Bromet, 2013), and it is a principal cause of disability adjusted life years lost among adolescents and young adults worldwide (World Health Organization, 2014; Gore et al., 2011).

The underlying processes through which screen time could be involved in the development of depression are likely to be complex and multidimensional. Excessive screen time may lead to withdrawal from interpersonal relationships, and media content could shape people's behavior and mood and lead to negative comparison of oneself with others, that in turn could cause depressive symptoms (Kraut et al., 1998; Lewinsohn et al., 1998). Furthermore, obesity, lack of engagement in physical activity, and poor sleep quality and quantity are other plausible mechanisms that could link screen time with depression (Baglioni et al., 2011; Luppino et al., 2010; Aberg et al., 2012).A number of cross-sectional studies have reported the association of screen time with

* Corresponding author at: Department of Sports Science and Clinical Biomechanics, Research Unit for Exercise Epidemiology, Centre of Research in Childhood Health, University of Southern Denmark, Campusvej 55, 5230 Odense M, Denmark.
E-mail address: agroentved@health.sdu.dk (A. Grøntved).

http://dx.doi.org/10.1016/j.ypmed.2015.08.009
0091-7435/

symptoms of depression in young people (Kim et al., 2010; Hong et al., 2009; Casiano et al., 2012). However, the relationship between depression and excessive screen time is likely to be bidirectional (Hume et al., 2011), indicating that it is critical to use prospective data to limit the possibility of reverse causation bias. We are aware of two previous prospective studies that have examined the relationship of screen use with later depression in young people (Hume et al., 2011; Primack et al., 2009), but the results have been mixed. Additional prospective studies on the topic are warranted to clarify the relationship. In this study our aim was to examine the association of screen time in adolescence with symptoms of depression in young adulthood in a population-based sample of Danish adolescents followed for up to 12 years.

Methods

Study design and sampling of participants

The data used for this study are based on the Danish cohorts of the European Youth Heart Study (EYHS). EYHS is an ongoing, international, population-based prospective observational multicenter study. A description of the sampling procedure and the general description of the EYHS can be found elsewhere (Riddoch et al., 2005). Random samples of 658 and 771 15-year-old adolescents were invited to participate in 1997–1998 and 2003–2004, respectively, of whom 429 (65%) and 444 (58%) agreed to take part (the source population was all adolescents attending school in the Municipality of Odense, the third largest municipality in Denmark). Follow-up visits were conducted in 2009–2010 where all originally invited participants were re-invited, and 650 (45%) participated in the follow-up visits. The eligible cohort for the current analyses consisted of 435 individuals who had complete data for all exposure and outcome variables (242 individuals with 6-year follow-up and 193 individuals with 12-year follow-up). Ninety-six percent of the population at baseline was white (Caucasian). The local scientific ethics committee approved the study, and all participants (and their parents when participants were 15 years of age) gave informed consent to participate.

Assessment of symptoms of depression

During the follow-up visits in 2009–2010, symptoms of depression were assessed using the Major Depression Inventory (MDI) scale (Bech et al., 2001). The MDI scale consists of 10 ICD-10 symptoms of depression which are nearly identical to the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV) major depression symptoms (the low self-esteem symptom is incorporated in the symptom of guilt in the DSM-IV). The 10 symptoms are based on 12 items on a six-point Likert scale (0 to 5), and each individual item measures how much time the symptoms have been present during the past 14 days. Zero on the scale indicates that the symptom has not been present at all and five that the symptom has been present all of the time. Examples of items on the scale include: “Have you felt lacking in energy and strength” (item 2), "Have you felt that life wasn't worth living" (item 6), "Have you had trouble sleeping at night" (item 9). We scored and classified individuals with any significant depressive symptoms including mild, moderate or severe depression defined as MDI ≥20. The MDI scale has been reported to have a high degree of agreement with the Schedules for Clinical Assessment in Neuropsychiatry tool (sensitivity 0.86 and specificity 0.86 for classification of moderate to severe depression) and the Hamilton Depression Scale ($r = 0.86$) (Bech et al., 2001; Olsen et al., 2003). Because of the sample size we were unable to further sub-divide participants into mild, moderate, and severe depression for analyses. However, for descriptive purpose we also reported prevalence according to DSM-IV major depression and ICD-10 mild, moderate or severe depression (Table 2). We also used the MDI scale as a summary score indicating the severity of depression, which includes values from 0 to 50 with 50 representing extreme depression. We did not administer the MDI tool nor did we specifically ask the participants or their parents about history of depression at baseline when they were 15 years old. However, we asked the parents to provide information on the participants' history of long-term illnesses. Of the participants eligible for the current analyses, the parents of one female participant reported a history of depression in adolescence, and we excluded this individual from the analysis.

Assessment of screen time in adolescence and young adulthood

TV and computer use during leisure time was obtained by self-report using a computer-based questionnaire as previously described (Grøntved et al., 2014). Participants answered each question individually, and the computers were placed in a quiet area in the clinical testing facility. A researcher was present in the case of any questions. At baseline the participants answered two questions about the amount of time viewing TV (the number of hours per day spent viewing TV before and after school with response categories: none, <1, 1–2, 2–3, >3). For these categories we assigned the mid-point of each viewing interval and assumed that the categories ‘<1’ and ‘>3’ had the same amplitude (>0–1 and 3–4 h per day respectively). A summary variable of daily TV viewing time was then constructed based on the two derived times (hours/day). Daily leisure time spent using a computer was asked in one question (number of hours per day spent playing computer games with response categories none, <1, 1–2, >2) and was derived similar to the TV viewing variable. At the follow-up visits, participants were also asked about their daily time spent viewing TV and using a computer. At both time-points, a total screen time variable (hours/day) was created by summarizing TV viewing time and computer use. These screen time questions are fairly comparable with the HELENA sedentary behavior questionnaire, which has moderate to high reliability in European adolescents (test–retest reliability coefficient 0.68–0.82) (Rey-López et al., 2012).

Assessment of other covariates in adolescence

Body height and weight were assessed using standard anthropometric procedures by trained research staff, and body mass index (BMI) was calculated. Parental educational level was obtained by parental self-report and defined according to the International Standard Classification of Education (ISCED) (UNESCO 1997) and was divided into basic education (basic), secondary or post-secondary education (secondary), and tertiary education (higher). The ethnicity of the adolescent and the parental marital status were obtained by parental self-report. Alcohol intake and smoking status were obtained by self-report using a computer-based questionnaire. Alcohol intake (beer, wine, spirits, alcoholic lemonade) was asked in a sequence of questions that were subsequently re-coded to form a nominal scale variable: never tasted alcohol or only tasted alcohol at celebrations, occasionally (≤1 serving per month), weekly or daily. Smoking status was asked in a single question with the following response options (I don't smoke, I sometimes smoke, I smoke every day). Cardiorespiratory fitness was assessed during a progressive maximal ergometer bicycle test as previously described (Riddoch et al., 2005). Heart rate (HR) was recorded every 5 s throughout the test using an HR monitor (Polar Vantage, Finland). Criteria for a maximal effort were HR of 185 beats per minute or greater and a subjective judgment by the observer that the participant could no longer continue, even after encouragement. Maximal power output normalized to body weight (max watts/kg) was used as a measure of cardiorespiratory fitness, and this measure was highly correlated with VO_2-max assessed directly ($r > 0.90$, $p < 0.001$) (Anderssen et al., 2007).

Statistical analysis

The associations of screen time in adolescence with symptoms of depression (MDI summary score) in young adulthood were examined using a mixed linear regression model with screen time as a continuous variable. Initially, we adjusted the models for age at baseline, follow-up time, and sex (as fixed effects), and the school was treated as a random effect. Subsequently we conducted multivariable adjusted analyses including the original variables plus parental educational level, marital status, smoking status, and alcohol intake in adolescence as these were identified as possible confounding factors. Furthermore, we additionally and separately adjusted for cardiorespiratory fitness and BMI in adolescence, since these may be putative intermediates of the association or alternatively confounding factors of the relationship. Although we *a priori* identified ethnicity as a confounding variable, it was not considered in the analyses because 96% of the study population was white. We also examined the possibility that the associations of screen time with depression were different between boys and girls as previously suggested (Primack et al., 2009) by including an interaction term and main effects of sex and screen time. Standard linear regression diagnostics were examined, including examining the linearity and normality of residuals, and these evaluations revealed no indication of violation of assumptions.

We then analyzed the association of screen time in adolescence with the odds of any significant depression (MDI score ≥ 20) in young adulthood using