Original article

Estimating Whether Replacing Time in Active Outdoor Play and Sedentary Video Games With Active Video Games Influences Youth's Mental Health

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A B S T R A C T

Purpose: The primary objective was to use isotemporal substitution models to estimate whether replacing time spent in sedentary video games (SVGs) and active outdoor play (AOP) with active video games (AVGs) would be associated with changes in youth's mental health.
Methods: A representative sample of 20,122 Canadian youth in Grades 6–10 was studied. The exposure variables were average hours/day spent playing AVGs, SVGs, and AOP. The outcomes consisted of a negative and internalizing mental health indicator (emotional problems), a positive and internalizing mental health indicator (life satisfaction), and a positive and externalizing mental health indicator (prosocial behavior). Isotemporal substitution models estimated the extent to which replacing time spent in SVGs and AOP with an equivalent amount of time in AVGs had on the mental health indicators.
Results: Replacing 1 hour/day of SVGs with 1 hour/day of AVGs was associated with a 6% (95% confidence interval: 3%–9%) reduced probability of high emotional problems, a 4% (2%–7%) increased probability of high life satisfaction, and a 13% (9%–16%) increased probability of high prosocial behavior. Replacing 1 hour/day of AOP with 1 hour/day of AVGs was associated with a 7% (3%–11%) increased probability of high emotional problems, a 3% (1%–5%) reduced probability of high life satisfaction, and a 6% (2%–9%) reduced probability of high prosocial behavior.
Conclusions: Replacing SVGs with AVGs was associated with more preferable mental health indicators. Conversely, replacing AOP with AVGs was associated with more deleterious mental health indicators.

IMPLICATIONS AND CONTRIBUTION

This modeling study estimated that replacing sedentary video games with an equivalent amount of time playing active video games would be associated with more preferable mental health indicators. However, replacing active outdoor play with an equivalent amount of time playing active video games would be associated with less preferable mental health indicators.

Physical inactivity in children and youth is a public health issue. Surveillance data from 105 countries indicate that 80% of 13- to 15-year-olds do not accumulate the recommend 60 minutes of moderate-to-vigorous physical activity on a daily basis [1]. This statistic is troubling as regular physical activity benefits the physical and mental health of young people [2,3].

Active video games (AVGs), such as Wii Sports and Dance Dance Revolution, have been promoted as a strategy to increase physical activity among children and youth [4]. As summarized here, AVG research has largely focused on the potential for these games to increase energy expenditure and decrease body weight [5]. In controlled laboratory settings, energy expenditure rates are higher when people play AVGs than when they play

conventional sedentary video games (SVGs) [6,7], lower when they play AVGs than when they engage in structured exercise [6,7], and about the same when they play AVGs or participate in active outdoor play (AOP) [8]. Studies based on AVG interventions performed in natural settings have reported a decrease in weight in the absence of a change in physical activity [9], no change in weight despite an increase in physical activity [10], a decrease in both physical activity and weight [11], and no beneficial change in physical activity or weight [12]. The inconsistent and incongruent nature of these findings has led to divergent opinions as to whether AVGs are beneficial or harmful.

Although AVG research within the general population has focused on measures of energy expenditure and obesity [5], the physical activity and gaming aspects of AVGs may contribute to other health outcomes. In particular, physical activity positively influences several aspects of mental health [2,3] while excessive gaming negatively influences mental health [13,14]. A more holistic approach to the study of AVGs and health is warranted.

The time a young person spends playing AVGs replaces an equal amount of time they would have spent doing something else. Consequently, the influence of AVGs on health depends on the impact of the AVGs and the time-dependent activities they replace. Because AVGs are an unstructured activity that young people do in their free time, they likely replace other unstructured, free-time activities. Two alternative activities, which reflect the physical activity and gaming aspects of AVGs, are AOP and SVG. It would be useful to understand what impact time spent in AVGs has on mental health if it replaced an equal amount of time spent in AOP or SVG. Isotemporal substitution statistical modeling techniques, which have been introduced into the physical activity sciences [15,16], could be used to estimate if replacing other unstructured activities with AVGs is associated with mental health.

This study had two objectives. The first was to examine the association between AVGs and mental health indicators among youth in Grades 6–10. The second was to use isotemporal substation models to estimate whether replacing time spent in AOP and SVGs with AVGs would be association with changes in youth's mental health.

Methods

Study sample and design

This article is based on the 2014 Canadian Health Behaviour in School-aged Children (HBSC) study [17,18]. A total of 349 schools were selected using a weighted probability technique that ensured proportional representation based on geography, language, religion, and community size. The target population was Grade 6–10 students who were approximately 11–15 years old. Seventy-seven percent of those selected participated. Participation involved completing a confidential questionnaire in the classroom. Consent was obtained from students, parents/guardians, and school boards. Ethics approval was obtained from the General Research Ethics Board of Queen's University (file #6010236).

Of the original sample of 30,117 participants, 3,896 were excluded because they did not respond to one or more AVG, SVG, or AOP questions. An additional 3,509 participants were excluded because they were missing data on one or more of the mental health indicators. Finally, 2,590 participants were excluded because they were missing data on one or more of the

covariates. This left a final sample of 20,122 participants. There were no differences in age (14.2 vs. 14.0 years), immigration status (80% vs. 79% Canadian born), household structure (80% vs. 78% dual parent household), or perceived family wealth (56% vs. 55% perceived wealth as high) in the included and excluded participants. However, there were slight differences in gender (47% vs. 53% boys) and ethnicity (77% vs. 73% white). As the objectives of the present study were etiologic in nature, the exclusion of 9,995 participants would only bias the findings if the association between AVGs, SVGs, and AOP with mental health differed in participants who were included or excluded.

All the HBSC questionnaire items are continuously developed, validated, and pilot tested by the HBSC international network and in Canada by the Canadian HBSC investigators [17,18]. While the findings of these validity and pilot studies are typically not published, to comply with the international HBSC protocol, the items must demonstrate good psychometric properties and be well understood by youth.

Active video games, sedentary video games, and active outdoor play exposures

The following questions assessed AVGs, SVGs, and AOP use: (1) "How many hours a day, in your free time, do you usually spend playing moving or fitness video games such as Wii Fitness, Dance Central, or Sports Champions on Wii, Xbox Kinect, or PlayStation Moves?" (2) "How many hours a day, in your free time, do you usually spend playing games on a computer, games console, tablet (like iPad), smartphone or other electronic device (not including moving or fitness games)?" and (3) "How many hours a day, in your free time, do you usually spend playing outdoors outside of school hours?" Participants indicated how much time they spent in each activity during weekdays and the weekend with the following response options: "None at all," "About half an hour a day," "About 1 hour," "About 2 hours," "About 3 hours," "About 4 hours," "About 5 hours," "About 6 hours," or "About 7 or more hours a day." The average number of hours/day they engaged in each activity and all three activities combined was estimated.

Mental health indicators

Mental health includes negative and positive aspects that can be internalized or externalized [18,19]. Therefore, this study included a negative and internalizing mental health indicator (emotional problems), a positive and internalizing mental health indicator (life satisfaction), and a positive and externalizing mental health indicator (prosocial behaviors).

Emotional problems. Based on the underlying theory and on factor and reliability analyses, an emotional problems score with a reliability of .84 was constructed using responses to nine questions [18]. The first three questions asked participants the frequency they "felt low (depressed)," "felt nervous," and "had difficulties in getting to sleep" with five response options ranging from "rarely or never" to "about every day." The next question asked "In the last week have you felt sad" with five response options ranging from "never" to "always." The remaining five questions asked participants if they "have trouble making decisions," "often wish I were someone else," "often feel helpless," "often feel left out of things," and "often feel lonely" with five response options ranging from "strongly disagree" to