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Original article

Tracking and Predictors of Screen Time From Early Adolescence to Early Adulthood: A 10-Year Follow-up Study

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A B S T R A C T

Purpose: To examine tracking of weekday and weekend screen time (ST; i.e., television [TV] and computer [PC] time) from early adolescence to early adulthood and to identify social ecological predictors of weekday and weekend ST among boys and girls separately.
Methods: Data were retrieved from elementary schools (n = 59) in Flanders (Belgium). At baseline, 1,957 children (age, 9.9 ± .43 years) and one of the parents filled out a questionnaire on sedentary behavior and individual, social, and environmental variables. After a 10-year follow-up period, six hundred fifty-five 20-year-olds (age, 19.9 ± .43 years) filled out an adapted questionnaire on sedentary behavior, of which 593 contained full data at baseline and follow-up. Multiple regressions were performed to examine predictors (baseline) of ST (follow-up), and logistic regressions were used to analyze tracking of ST.
Results: For boys, a consistent positive predictor of weekday and weekend TV and PC time at follow-up was ST at baseline ($p < .01$). For girls, drinking more soda at baseline predicted more weekday and weekend TV and PC time at follow-up ($p \leq .02$). Some other individual variables also predicted ST in both boys and girls. Tracking was only found among boys; those exceeding the ST guideline at baseline were three to five times more likely to exceed this guideline at follow-up ($p \leq .001$). Tracking was not present among girls.
Conclusions: To minimize TV and PC time during early adulthood, interventions for adolescent boys should focus on minimizing ST. For girls, focus should be on healthy eating. However, more research is warranted to confirm these conclusions.

IMPLICATIONS AND CONTRIBUTION

Few studies have investigated longitudinal predictors and tracking of screen-related behaviors using follow-up periods beyond 5 years. The present study identified tracking of screen time for boys over a 10-year follow-up period. Among girls, an unhealthy eating behavior during early adolescence predicted more screen time during early adulthood.

The *Sedentary Behaviour Research Network* updated the definition of sedentary behavior (SB) as any waking activity characterized by an energy expenditure of ≤1.5 metabolic equivalents performed in a sitting/reclining posture [1]. There is increasing evidence that SB, independent of physical activity (PA), is associated with negative health outcomes, even in adolescence [2]. In adolescents, high levels of SB (mostly measured via television [TV] time) are associated with unfavorable body composition, lower levels of physical fitness, lowered scores for self-esteem and prosocial behavior, and decreased academic achievement [2].

Conflicts of Interest: None.

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Several studies have found high levels of screen time (ST, which includes TV and computer [PC] time) in adolescents [3–6]. On the basis of the current Canadian SB guideline for youth (also adopted in Flanders), ST should be limited to no more than 2 hours/day [7,8]. However, self-reported data of a longitudinal study on SB in 11-year-olds showed that 63% of boys and 50% of girls watched TV at least 2 hours/day and 60% of boys and 32% of girls played video games at least 1 hour/day [6]. Furthermore, 9- to 17-year-olds spent between 132 and 248 minutes/day in ST activities [3–5]. Some studies also showed that ST levels are higher during weekends [4,9] and that boys had a higher level of ST than girls [4,6,10].

Still, information on how ST changes over time is needed. It was found that watching TV is a relatively stable behavior, which in other words "*tracks*" over time [11]. However, tracking may weaken (decline in tracking coefficient over years) after approximately 4 years of follow-up [11,12], but to our knowledge, only five studies investigated tracking of watching TV beyond 5 years in youth [6,11–15]. More information needs to be gathered to explore if SB remains stable over long periods [11]. Studying tracking of ST during transition to adulthood (starting at the age of 10 years) is of interest because in this period, more changes in lifestyle will arise because of the transition from secondary school to higher education/professional life. Biddle et al. [11] concluded that little evidence existed for tracking differences between boys and girls; however, a study showed higher tracking for video gaming among girls than among boys [6]. More research is needed to conclude if gender differences exist in tracking studies, so that possibly high-risk subpopulations can be identified.

Following the basic model of planned promotion of population health, it is important to provide information on the determinants/predictors of the targeted behavior [16]. For one health-related behavior, PA, sufficient information on predictors is available; however, predictors of SB are likely to differ from those of PA [17]. A current gap in the literature is the noticeable absence of longitudinal determinants of SB as mostly correlates were investigated through cross-sectional studies [18]. Ecological models are used to explain SB and state that multiple levels of predictors influence the different contexts of SB (including ST) [19]. Predictors of SB can be classified on the basis of the following levels of the ecological model of SB: individual, social, organizational/community, environmental, and policy based [19]. The predictors included in the present study were based on previous findings on correlates of SB in youth and can be categorized as individual, social, and environmental factors [19]. Studies measuring predictors of SB in different subgroups (e.g., gender differences) are scarce but are needed to target interventions to the needs of specific subgroups [20].

As evidence is limited about longitudinal predictors of ST and tracking of this behavior over a longer period, more research is warranted. Therefore, the aims of this longitudinal study (10-year follow-up) were (1) to examine predictors (measured at the age of 10 years) of TV and PC time (measured at the age of 20 years) separately for boys and girls and for weekdays and weekends and (2) to analyze the tracking of ST (TV and PC time) from early adolescence (at the age of 10 years) to early adulthood (at the age of 20 years) separately for boys and girls and for weekdays and weekends.

Methods

Subjects and procedures

Data were retrieved from the longitudinal eating and activity study conducted from 2002 (baseline) to 2012 (follow-up) in Flanders (Belgium). At baseline, 100 randomly selected schools were contacted, whereas 59 schools agreed to participate. Students from the fifth grade of these 59 primary schools were invited to participate in the longitudinal study (n = 1,957). Children recruited were, on average, 9.9 years (±.43) old at baseline and 19.9 years (±.43) old at follow-up. The detailed methodology has been reported elsewhere [21]. In brief, at baseline, children were asked to complete a self-administered questionnaire in the classroom on SB and potential predictors. Before the study, informed consent forms were sent to the parents/main caregivers and 88.1% (n = 1,725) gave their permission for participation of their child (10-year-olds) at baseline. Also, one of the parents filled out a paper-and-pencil questionnaire about SB, demographics, and anthropometrics of their child (1,722 matched questionnaires from children and parents contained all the information) at baseline. Parents were free to choose who filled out the questionnaire. Data revealed that this was mostly done by the mother (83.1%). Ten years later, an invitation letter to fill out a Web-based questionnaire at home was sent to the persons who participated at baseline (if their address was available). At follow-up, informed consent forms were sent to the 20-year-olds. The persons without access to PC and/or Internet could ask for a paper version of this questionnaire. This resulted in six hundred fifty-five 20-year-olds (of the 1,722 matched questionnaires; response rate of 38%) who filled out a questionnaire adapted to their age and situation (e.g., no school-related questions) on SB at follow-up.

In the present study, a total of 593 respondents were included of which children/parent data at baseline and data from early adulthood at follow-up (53.6% girls) were complete. Drop-out analyses were executed to gather information about possible differences between the children who dropped out and the children who remained in the study. Children who dropped out were slightly older (9.95 ± .50 years vs. 9.90 ± .43 years; p = .001) and somewhat more boys (69.2% vs. 61.6%) dropped out of the study (p = .030). No differences were found for body mass index (BMI; p = .414) and nationality (p = .827). The study was approved by the Ghent University Ethics Committee.

Measures

Included measures in the present study were based on the three previously mentioned levels of a social ecological approach [19]. At the *individual level*, gender [18], BMI [10,18,22], ST behaviors [18], school break activities [23], PA [24], active transport to school [10], self-rated health, psychosocial variables [25], and nutrition variables [18,26] were included. At the *social level*, marital situation of parents [18], parental educational attainment [18,22], and frequency of family meals [27] were included and studied as possible predictors of ST. At the *environmental level*, information about outdoor playing opportunities was gathered [10,18].

An overview of the included measures (including scoring methods and descriptive statistics [% or mean ± SD] of the total sample) is reported in Table 1.

Baseline. At baseline, both the children (10-year-olds) and one of their parents filled out a questionnaire. The following variables were obtained through the baseline questionnaire of the children.

At the individual level of the ecological model, gender, nutritional habits, PA, self-rated health, and psychosocial variables were assessed. Variables assessing nutritional habits were as follows: number of days/week eating chips, fruits, cookies,