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The Prospective Association Between Electronic Device Use Before Bedtime and Academic Attainment in Adolescents

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A B S T R A C T

Purpose: To examine longitudinal associations between five commonly used technology devices prior to bedtime and real-life academic outcomes in adolescents.

Methods: A total of 853 adolescents were recruited to a three-year prospective cohort study, with annual assessments. Academic grades/levels for three core subjects (English, Mathematics, and Science) were extracted from school records, and standardized (z-scores) were derived at the end of each academic year. A validated questionnaire was used to determine the frequency of using five types of technology (television viewing, video gaming, mobile telephone use, listening to music, and social networking) before bedtime.

Results: After adjustment, English attainment was the subject most affected by prebedtime technology use, where three of five technologies assessed were negatively and prospectively associated (social networking [$\beta = -.07$ and $p = .024$], video gaming [$\beta = -.10$ and $p = .008$], and mobile telephone [$\beta = -.07$ and $p = .017$]). Social networking ($\beta = -.07$ and $p = .042$), television viewing ($\beta = -.08$ and $p = .044$), and mobile telephones ($\beta = -.07$ and $p = .031$) were associated with significant impairment in English for girls whereas attainment in boys was most impaired by video gaming ($\beta = -.12$ and $p = .014$).

Conclusions: The use of electronic devices by adolescents before bedtime may reduce their academic attainment, but apart from video gaming for boys, the negative impact of near bedtime technology use on academic performance is small.

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IMPLICATIONS AND CONTRIBUTION

Several concerns have been raised regarding the health and performance implications of increasing technology use by adolescents, particularly near bedtime. This prospective study observed that technology use near bedtime (particularly social networking by girls and video gaming by boys) was associated with reduced academic performance, but the effect was small.

Electronic media device availability, accessibility, and utilization have precipitously increased among adolescents [1]. Frequent exposure to different types of electronic media devices has been linked to multiple adverse outcomes including poor sleep [2], higher body mass index (BMI) [3], reduced daytime

functioning [4], decreased working memory in video gamers [5], and increased alcohol and tobacco use in adolescents [1]. A birth cohort study found that excessive television viewing during adolescence was the strongest predictor of subjective report of leaving school without academic qualifications [6]. Recent studies have also shown deleterious effects of technology use upon academic performance [7,8]. The majority of studies, however, have not focused on frequency of prebedtime use of technology. In contrast to the many studies that have documented undesirable effects of different types of technology use, beneficial outcomes have also been reported. For example,

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previous studies have documented that video gaming can improve problem-solving abilities [9], visual-spatial skills [9], and reaction times [10]. Another study found a positive association between the duration of home internet use and performance on standardized reading tests as well as grade point average in adolescents from low-income families [11]. More recently, another group demonstrated that Facebook users (≥ 1 year) scored higher on assessments of verbal ability, spelling, and working memory compared to less frequent users [12]. These more recent studies suggest that device type as well as the content exposure are likely to be important for educational-related outcomes, as reflected in a recent systematic review of prospective studies [13]. Indeed, there is increasing interest in internet-based interventions to enhance knowledge and educational outcomes surrounding health-related behaviors [14] as well as for reducing suicidal ideation and depressive symptoms among adolescents [15].

Little is known about the prospective effects of bedtime use of technologies on academic outcomes in adolescents [16]. Contemporary adolescents now have access to a diverse range of portable devices and engaging in technology-based activities prebedtime is widespread. Sleep, as well as hours spent undertaking homework may be mediators of the relationship between technology use and academic performance. Interestingly, gender differences between technology use by type (girls engage more with mobile phones whereas boys tend to interact with video games) [11,17] as well as performance outcomes in core academic subjects [18] have been documented [19]. However, some have relied on subjective academic outcomes [20,21], while others have investigated the contribution of a combination of lifestyle behaviors to abilities of preadolescents in reading, writing, and mathematics [22] yet none have focused on the effects of prebedtime technology use upon academic attainment in core subjects. Given the documented technology type preference observed by gender this warrants investigation of the potential prospective effects of technology type on academic attainment according to gender.

To date, there are very few studies that have investigated the prospective associations between frequency of bedtime use for a range of specific technologies and objective academic attainment in the three core academic subjects (English, Mathematics, and Science). Furthermore, there are no studies of this type that have examined potential gender differences in relation to academic-related outcomes. Sleep as well as time spent undertaking homework, are potential mediators of the relationship between technology use and academic attainment, but these have scarcely been examined. The objectives of our study were three-fold. First, we sought to examine the potential associations between near bedtime use of five different technology types and real-life academic attainment outcomes in a large adolescent cohort. Second, we assessed potential gender differences in these relationships. Third, we investigated the possibility of sleep and hours spent undertaking homework in a typical week as potential mediators of the relationship between technology use and academic attainment. We hypothesized that: (1) there would be a negative effect of electronic device use before bedtime upon objective academic attainment; (2) gender differences would be observed for these associations; and (3) sleep and/or hours spent completing homework in a typical week would mediate the relationship between technology use and academic performance.

Methods

Nine secondary schools in the Midlands region of England (UK) were approached for participation in the Midlands Adolescent Schools Sleep Education Study. Schools were selected to ensure different school types within different areas were included, which served as a proxy of socio-economic status. Eight schools agreed to participate in the three-year cohort study. Parents/guardians of all students registered in year 7/8 (age 11–13 years) of each participating school were sent a letter outlining the study and requesting consent during the first term of academic year 2011/2012. Parental response rate was 80% and a total of 892 adolescents were eligible to participate. These students were approached for study participation. Other study criteria were that: (1) the student provided assent; (2) they were not taking sleep medication (prescribed/over the counter); (3) they did not have a physician diagnosed sleep disorder; and (4) they had not travelled to a different time zone four weeks prior to providing data at the time points assessed. Baseline data were collected during academic year 2011/2012 where 853 adolescents participated, and data collection for the same measures was repeated during the same term for a further two years (2012/2013 and 2013/2014). The study received ethical approval from the University of Birmingham Research Ethics Committee (ERN_08-437).

Academic attainment

The primary outcome measure, academic attainment, was objectively determined at the end of each academic year from school records for English, Mathematics, and Science for each student. Given that the methods of assessment differ according to school type as well as year group, we generated an academic attainment z-score for each year of study and for each participating school. Science at baseline was assessed in all schools except for one. Complete data on Science attainment were obtained for all schools at the last two time points. Mathematics and English were assessed in all schools at all three time points.

Technology use

Participants were asked to estimate the frequency of multiple types of technology use from a questionnaire [23]. Specifically, participants stated the frequency of using the following technologies on weekdays 2 hours before bedtime: television viewing, video gaming, mobile phones, computer/laptop use for social networking, and listening to music. Response options for each technology were “never,” “sometimes,” “usually,” and “always” (coded 0–3) with one response permitted for each technology. Participants completed this questionnaire online in a classroom setting with instructions by a trained researcher. The online questionnaire was completed under exam-like conditions to minimize peer influence on reporting outcomes to reduce potential biases.

Other measures

A number of demographic data were collected: age (years), gender, and school type (independent/public). At each assessment, height (to the nearest .5 cm) and weight (to the nearest .1 kg) were obtained to derive BMI (kg/m^2). Given that our group previously demonstrated a negative linear relationship between obesity and academic outcomes, this was considered to be an important confounder of the relationship under investigation [3]. The online questionnaire also required participants to complete the Cleveland

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