



**Children's mental health and recreation: limited evidence
for associations with screen use**

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3 **Children's mental health and recreation: Limited evidence for associations with screen**
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30 **Running head:** Children's mental health, screens and recreation.
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Abstract

Aim: This study examined the direct and indirect associations between childhood psychopathology symptoms, screen use, media multitasking and participation in non-digital recreation.

Methods: Psychopathology symptoms, media use, media multitasking, participation in sports, social clubs and reading/games were reported by 520 parents about their 3-11-year-old children. The data were analysed using structural equation modelling.

Results: There were bi-directional negative associations between sports participation and emotional problems ($\beta = -.16, p < .001$ and $\beta = -.15, p < .001$); ADHD symptoms were associated with reduced reading/games ($\beta = -.14, p = .004$). A bi-directional positive association was found between media use and conduct problems ($\beta = .10, p = .015$ and $\beta = .14, p = .015$). Increased media multitasking was indirectly associated with elevated symptoms of ADHD via a reduction in reading/games ($\beta = .10, p = .026$). However, there was no evidence that screen use mediated the associations between psychopathology symptoms and non-digital recreation.

Conclusion: Depending on the specific psychological difficulties, children are either less likely to participate in non-digital recreation or are more likely to use screen media or multitask with media. Interventions for children, who experience emotional or behavioural difficulties, are needed to improve participation in non-digital recreation.

Abbreviations:

ADHD: Attention-deficit/hyperactivity disorder; **CFI:** Comparative Fit Index; **RMSEA:** Root Mean Square Error of Approximation

Key Notes:

- Excessive screen use in childhood has been linked to an unhealthy lifestyle marked by a reduction in physical, social and educational recreation, which in turn, may lead to poor mental health.
- We examined the associations between screen use, non-digital recreation and childhood psychopathology symptoms.
- Psychological difficulties were linked with either reduced non-digital recreation or with increased screen use, but there was little evidence that screen use reduced participation in healthy recreation.

Introduction

It is estimated that over 240 million children and adolescents meet diagnostic criteria for a mental health disorder, giving a worldwide prevalence of 13.4%¹. Moreover, nearly half of adolescents present with subthreshold symptoms², which over time may progress to full-blown psychiatric disorder³. These sobering statistics, in conjunction with the substantial negative societal and economic impact of mental disorders on the affected youth and their families, highlight the importance of identifying factors that may support children's wellbeing and reduce the likelihood of a disorder.

In Western countries, children spend nearly half their waking hours in recreational activities⁴. These activities substantially vary in their physical, cognitive and motivational demands⁵, and so may have a differential impact on children's mental health. One activity attracting interest from researchers, public health experts and agencies in this regard is screen use, such as, watching television, using computers or interactive digital devices. Excessive screen use may *directly* increase mental health problems. Primary school age children and

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2
3 young adolescents, who spend more time with screen media, report feeling less happy and
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5 experience more behavioural and emotional difficulties^{6,7}, elevated symptoms of anxiety,
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7 depression and conduct problems^{8,9}. Moreover, meta-analysis findings suggest that
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9 symptoms of attention deficit hyperactivity disorder (ADHD) are significantly, though
10
11 weakly, linked to increased screen use¹⁰. The association between screen use and poorer
12
13 mental health may also be *indirect*. Excessive screen use has been linked to an unhealthy
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15 lifestyle marked by a reduced physical⁶, social¹¹ and educational recreation. In turn, an
16
17 unhealthy lifestyle may lead to more mental health problems.
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22 Children's general level of physical activity is another well-established correlate of
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24 mental health. Longitudinal research has shown that adolescents, who were physically active
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26 in late childhood, sought the help of mental health professionals less frequently compared
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28 with their less active peers¹². One type of physical activity, which appears to be most clearly
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30 linked to positive mental health outcomes, is childhood sports participation. Older children,
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32 who participated in organised sports, reported overall better health-related quality of life,
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34 which included measures of one's physical, mental and emotional well-being¹³. Importantly,
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36 research has identified childhood sports participation as a protective factor against developing
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38 mental health problems¹⁴, including lowering the risk of anxiety¹⁵, depression¹⁶ and ADHD
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Although childhood emotional and behavioural problems are *associated* with more
screen use and less healthy lifestyle, the mechanisms driving these associations remain
unclear. It is possible that screen use reduces the behaviours associated with a healthy
lifestyle and impacts upon mental health, for instance, via displacement⁶. Screen use may
take up the time that could be spent on physical or social activities, in consequence, reducing
the opportunities for experiencing physiological benefits or developing skills that promote
good mental health. Alternatively, recreational preferences may be driven by pre-existing

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3 mental health problems. For instance, because of the documented deficits in social
4 functioning¹⁸, children with emotional and behavioural difficulties may prefer solitary
5 activities, such as using screens, and use these to replace socially-demanding interests.
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10 Additionally, *the way* in which children use screen media, may also shape these
11 associations. In recent years, easy access to a wide range of screen devices has given rise to a
12 new type of behaviour – media multitasking – which involves parallel use of several forms of
13 media, including screens¹⁹. Some children may develop a strong preference for screen media
14 because it facilitates multitasking in a way that other activities do not. Children with
15 emotional and behavioural problems often experience motivational and cognitive
16 difficulties²⁰. In consequence, they may find pursuing a single activity, which requires
17 focused effort and delayed rewards (e.g., sports or reading), more challenging and less
18 enjoyable, than engaging with parallel activities offering the instant gratification afforded by
19 media multitasking.
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34 Considering that much of the previous research in the field has focused on older
35 children and adolescents, the aim of the present study is to examine the associations between
36 behavioural and emotional disorders symptoms, media use and three common types of non-
37 digital recreation (sports, non-sports social clubs and reading/games) in 3-11-year-old
38 children. Two specific models, with different direct and mediated associations, were tested
39 (see Figures 1 and 2). We hypothesised: a negative association between symptoms of
40 psychopathology (especially ADHD and emotional problems) and participation in non-digital
41 recreation; a negative association between screen time and non-digital recreation; and a
42 positive association between these psychopathologies and screen time. As the effects of
43 media multitasking are currently poorly understood, our investigation of this variable was
44 exploratory. Recognising the limitations of our cross-sectional data, we take the first step to
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3 test our hypothesized links between psychopathology, screen use and non-digital recreation
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5 using structural equation modelling.
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8 **Method**

9 *Participants*

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14 The project received ethical approval from The University of Essex Research Ethics
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16 Committee. Participants were identified through nine primary schools and eight preschools
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18 based in urban and semi-rural locations in Essex, England. Based on the postcodes,
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20 participating schools and preschools covered an area of diverse socio-economic status,
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22 ranging from being in the 10% most deprived to 10% least deprived ([http://imd-by-
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60](http://imd-by-postcode.opendatacommunities.org/imd/2015)).

Packs containing information about the study and a survey were circulated to all parents, who had children registered in these institutions (~ 3,900 packs). There was no restriction regarding how many children from each family could participate. Parents of 564 children consented and returned questionnaires (~ 14%); 19.4% of the forms came from the schools located in the areas that are among 10% most deprived in England (original circulation – 20.4% of all forms), 42.3% from the schools located in areas of average deprivation (original circulation – 45.4% of all forms) and 38.3% from the schools located in 20% least deprived areas (original circulation – 34.2% of all forms). Responses regarding 2-year-olds (outside of pre-specified inclusion criteria, n = 5) and surveys with missing data (n = 39) were removed. The lack of information about child's age and parental mental health accounted for most of the missing data (59% and 28%, respectively). The final sample included 520 children aged 3-11 (see Table 1).

[Table 1 here]

Measures

Behavioural and emotional symptoms

Symptoms of ADHD, conduct problems and emotional problems were measured with the parent report on the respective subscales of the Strengths and Difficulties Questionnaire²¹.

Non-digital recreation

The frequency of children's participation in three types of non-digital recreation outside of school was measured: sports activities (e.g., swimming, football, dancing, etc.), non-sports activities (e.g., music groups, scouts, art, other social groups) and reading and games at home. Parents made responses on a scale ranging from 'None' = 1 to 'More than 3 times a week' = 4.

Digital media use and media multitasking

Parents reported on the amount of time children spent daily on six popular media activities: watching television, listening to music, using a smartphone, using a tablet, using a computer, playing game consoles and reading. Responses ranged from 'None', to 'More than 4 hours'. Average daily media use was calculated by taking the mid-point of each response option (min = 0 increasing in steps of 0.5h to max =4). These scores were used to derive an amount of time spent daily using *each* medium, the total amount of time spent daily using *all* media and the total amount of time spent each day using *digital media only* (reading excluded).

An adapted media multitasking questionnaire¹⁹ was used to quantify children's multitasking with media. Participants were asked: "When [name of media activity] how often does your child engage simultaneously with the following activities" and were presented with a table showing whether, while engaged in this primary media activity, children simultaneously engaged in either of the other six activities. Responses were made on a four-

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3 point scale ranging from ‘Never’ to ‘Most of the time’ and were subsequently assigned values
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5 of 0, 0.33, 0.67 and 1. These responses were then summed for each activity. The following
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7 formula was used to calculate the multitasking index ¹⁹ where h_i was an amount of time spent
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9 daily using each medium, h_{total} quantified the total amount of time spent daily using all media
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11 and m_i , quantified additional media used while engaged with the primary medium.
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$$\sum_{i=1}^6 \frac{m_i \times h_i}{h_{total}}$$

21 *Control variables*

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23 Child’s age, gender, ethnicity and parental education were included as covariates.
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25 Considering that children’s mental health symptoms are linked to more challenging family
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27 circumstances²², we also included measures of parental mental health and child-parent
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29 conflict. Parental mental health was measured with Mental Health Inventory MHI-5; ²³. The
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31 scale was reliable, Cronbach $\alpha=.82$. Child-parent conflict was measured with the conflict
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33 subscale of the Child-Parent Relationship Sale ²⁴. The scale was reliable, Cronbach $\alpha= .88$.
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36 *Statistical analyses*

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39 First, we calculated Pearson (for continuous variables) and biserial (for dichotomous
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41 variable, gender) correlation coefficients to examine the associations between childhood
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43 behavioural and emotional symptoms, digital media use, indices of non-digital recreation and
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45 control variables. Second, structural equation modelling was conducted using maximum
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47 likelihood estimation to test our hypotheses. In model 1, we modelled simultaneous direct
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49 paths from media use and media multitasking to emotional, ADHD and conduct symptoms.
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51 Bootstrapping based on 1000 samples was used to assess bias-corrected indirect effects of both
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53 media use variables on children’s emotional, ADHD and conduct symptoms via sports, non-
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55 sports and reading/games.
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3 In model 2, simultaneous direct paths from emotional problems, conduct problems
4 and ADHD symptoms were modelled to sports, non-sports and reading/games. Bootstrapping
5 was used to assess bias-corrected indirect effects of child mental health symptoms on non-
6 digital recreation via digital media use. Control variables were included in the models only
7 when they correlated with either the predictor or the outcome variable. Fit of the model was
8 assessed by applying the 'rules of thumb', which indicate a good fit ²⁵ to the comparative fit
9 index (CFI > 0.95) and the root mean square error of approximation (RMSEA < 0.06).
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21 **Results**

22 *Correlations*

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24 Means, standard deviations (SD) and correlations between the variables included in
25 the model are shown in Table 2. Emotional symptoms correlated negatively with with sports
26 ($r = -.16, p < .001$), ADHD symptoms correlated negatively with non-sports ($r = -.09, p =$
27 $.047$) and reading/games ($r = -.16, p < .001$) and conduct problems correlated negatively with
28 sports ($r = -.10, p = .024$) and non-sports ($r = -.10, p = .018$). Digital media use and media
29 multitasking correlated negatively with reading/games ($r = -.15, p = .001$ and $r = -.19, p <$
30 $.001$, respectively). There were no other significant associations between media use, media
31 multitasking and non-digital recreation. There were, however, significant correlations
32 between children's mental health and media use. Specifically, screen use was positively
33 correlated with emotional symptoms ($r = .11, p = .014$), ADHD symptoms ($r = .11, p = .013$).
34 and conduct problems ($r = .10, p = .022$). Media multitasking was positively correlated with
35 emotional symptoms ($r = .11, p = .009$).
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53 **[Table 2 here]**

54 *Structural equation modelling*

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3 *Model 1: digital media use and media multitasking to psychopathology symptoms via non-*
4 *digital recreation*
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6 Results of the structural equation modelling are shown in Figure 1. Model 1 achieved a good
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8 fit: CFI=.98, RMSEA=.04, $\chi^2(22) = 42.5$, $p = .005$. There was a weak positive direct
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10 association between digital media use and conduct problems ($\beta = .10$, $p = .015$) indicating
11
12 that children who spent more time using digital media had elevated symptoms of conduct
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14 disorder. There was also a direct negative association between sports participation and
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16 emotional symptoms ($\beta = -.16$, $p < .001$) indicating that children who participated in sports
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18 activities more frequently were less likely to experience emotional difficulties. Finally, the
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20 analysis of indirect effects estimated with bootstrapping showed that media multitasking was
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22 associated with less reading/games at home, which, in turn, was associated with elevated
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24 symptoms of ADHD ($\beta = .10$, $p = .026$). There were no other significant direct or indirect
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26 associations.
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32 **[Figure 1 here]**
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36 *Model 2: psychopathology symptoms to non-digital recreation via digital media use and*
37 *media multitasking.*
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41 Results of the structural equation modelling are shown in Figure 2. Model 2 achieved
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43 a good fit: CFI=.98, RMSEA=.04, $\chi^2(23) = 41.4$, $p = .011$. Increased emotional symptoms
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45 were directly associated with reduced sports participation ($\beta = -.15$, $p < .001$). Increased
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47 ADHD symptoms were directly associated with reduced reading/games at home ($\beta = -.14$, p
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49 $= .004$). Further, conduct problems were positively associated with the amount of digital
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51 media use ($\beta = .14$, $p = .015$) and media multitasking was negatively associated with
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53 reading/games at home ($\beta = -.14$, $p = .003$). There were no other significant direct or indirect
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55 associations.
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59 **[Figure 2 here]**
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6 In addition, the following associations pertaining to the demographic variables, which
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8 were included in both models but omitted from the figures, were significant: male gender was
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10 associated with increased ADHD symptoms ($\beta = .22, p < .001$) and less reading/games at
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12 home ($\beta = -.10, p = .028$). Older age was associated with increased emotional problems ($\beta =$
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14 $.12, p = .005$) but lower ADHD and conduct symptoms ($\beta = -.13, p = .002$ and $\beta = -.13,$
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16 $p < .001$, respectively). It was also associated with an increase in use of digital media and
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18 media multitasking ($\beta = .27, p < .001$ and $\beta = .16, p < .001$, respectively), more sports ($\beta = .30,$
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20 $p < .001$) and non-sports participation ($\beta = .14, p = .003$). Higher parental education was
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22 associated with lower ADHD and conduct symptoms ($\beta = -.10, p = .017$ and $\beta = -.11, p =$
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24 $.002$, respectively), increased sports ($\beta = .10, p = .023$) and non-sports participation ($\beta = .10, p$
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26 $= .023$) and with more reading/games ($\beta = .13, p = .003$). Being in ethnic minority was
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28 associated with more digital media use and more multitasking ($\beta = .16, p < .001, \beta = .14, p =$
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30 $.002$, respectively). Increased level of child-parent conflict was associated with elevated
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32 emotional ($\beta = .23, p < .001$), ADHD ($\beta = .36, p < .001$) and conduct symptoms ($\beta = .61, p <$
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34 $.001$). Finally, poorer parental mental health was associated with child's elevated emotional
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36 ($\beta = .22, p < .001$) and ADHD symptoms ($\beta = .10, p = .011$), reduced sports ($\beta = -.13,$
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38 $p = .003$) and non-sports participation ($\beta = -.11, p = .021$).
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47 Discussion

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49 In this cross-sectional study, we proposed two models to test hypotheses about the
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51 associations between symptoms of psychopathology, digital media use and non-digital
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53 recreation in children aged 3-11 years. In Model 1, we tested the direct paths from screen use
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55 and media multitasking to psychopathology symptoms via non-digital recreation. In Model 2,
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3 the direction of the paths was altered: psychopathology symptoms to non-digital recreation
4 via media use and media multitasking.
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8 The results of Model 1 and 2 partially support our predictions of direct associations
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10 between childhood psychopathology and non-digital recreation with bi-directional negative
11 associations between emotional problems and participation in sports. This fits with previous
12 longitudinal findings showing positive links between children's sports participation and
13 subsequent mental health¹⁴. It is also consistent with the proposal that elevated levels of
14 emotional symptoms may lead to decreased sports participation, which, in turn, reduces
15 children's opportunities for experiences that could improve symptoms; for example, fostering
16 new social relations, learning to deal with disappointments or developing resilience²⁶.
17 Perhaps missing out on these positive and enriching experiences exacerbates emotional
18 problems and, in consequence, increases risk of a subsequent mental disorder.
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31 The results of both models also showed that elevated symptoms of ADHD were linked
32 to a reduction in reading and games. While our study does not provide information about the
33 mechanisms that underpin this association, it is plausible that children with higher levels of
34 ADHD symptoms avoid reading and games because they often experience literacy
35 difficulties²⁷. The lack of pleasure derived from these activities could also play a role –
36 previous research demonstrated that children diagnosed with ADHD enjoyed reading and
37 being read to less than control children²⁸.
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47 In contrast, there was no support for the hypothesis that the associations between
48 psychopathology symptoms and non-digital recreation were mediated by screen use. There
49 was, however, evidence that conduct problems were directly linked with increased screen
50 use. These results tie with the qualitative literature, which reports that parents often use
51 digital media as 'electronic babysitters'²⁹. Perhaps when confronted with difficult to manage
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3 behaviours, parents reach to digital media more to find respite from the demands of parenting
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5 children with conduct problems.
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8 The exploratory analysis of media multitasking returned two findings of note. Model 1,
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10 showed that increased media multitasking was indirectly associated with elevated symptoms
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12 of ADHD via a reduction in reading and games. Model 2 showed that media multitasking was
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14 associated with less reading and games at home. Media multitasking is a relatively new type
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16 of behaviour, which is a poorly understood in terms of the potential consequences for
17
18 children's development and learning. Future research should aim to establish whether media
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20 multitasking provides children with the same developmental opportunities as more traditional
21
22 non-digital recreation.
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26 Of note are also the results pertaining to two parental variables, which were included as
27
28 covariates in the analysis. Consistent with previous research⁵, children of parents with higher
29
30 education participated more in all forms of non-digital recreation. Importantly, poorer
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32 parental mental health was associated with reduced sports and non-sports participation but
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34 not with reading and games at home. It might be that parents, who experience more
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36 psychological difficulties, lack energy, commitment or financial means to take their children
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38 to activities outside of home. However, they still may be able to encourage or help children
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40 with activities at home.
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44 Although both models revealed significant associations between childhood emotional
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46 and behavioural problems, digital and non-digital recreation, these relationships were small in
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48 magnitude. This fits with the overall pattern of findings reported in the previous literature
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50 investigating the correlates of screen media use³⁰. However, it is important to note the young
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52 age of participants in the present study and the cross-sectional design of the study. Older
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54 children and adolescents, who have access to a wider range of screen media and more control
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56 over the use of their free time, may choose to spend more time using screen media or
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3 multitasking. Moreover, as the demands on children's free time increase (e.g., doing
4 homework or revising for exams), the displacement effects on other non-digital recreation
5 may become more apparent. Similarly, as children get older, psychological problems may
6 become more severe. Indeed, adolescence is the crucial period for onset of many mental
7 disorders. Therefore, further research should include longitudinal investigation of changes in
8 both children's recreation and mental health across childhood and adolescence. Finally, the
9 generalisibility of our findings may be limited by a relatively high non-response rate and a
10 lack of ethnic diversity of the sample. Though, these limitations were somewhat moderated
11 by including participants representing a wide range of socio-economic backgrounds.
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24 **Conclusions**

25
26 The present results show that psychological and behavioural difficulties may be linked
27 to children's recreation in very specific ways. While emotional symptoms are associated with
28 reduced sports participation, symptoms of ADHD are linked to less reading and games at
29 home. In contrast, conduct problems are associated with increased media use. Importantly,
30 there was no evidence that children displaced social and educational recreation with screen
31 use. Therefore, simply adhering to paediatric recommendations regarding limiting media use
32 is unlikely to result in improved participation in other non-digital recreation by those children
33 who experience emotional or behavioural difficulties. Further research should explore other
34 barriers to participating in sports, social and educational recreation, as these may represent an
35 important intervention target for improving children's mental health.
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Table 1. Characteristics of the child and parent sample.

	%	N
Gender of child		
Male	50.2	261

Female	49.8	259
Age of child		
3-5-year-old	35.4	184
6-8-year-old	37.9	197
9-11-year-old	26.7	139
Ethnic group of child		
White	88.1	458
Other	11.9	62
Gender of parent		
Male	7.3	38
Female	92.7	482
Highest level of parent's education		
No exams taken	2.7	14
GCSE	18.1	94
A-levels	12.5	65
Vocational qualifications (i.e., NVQ, BTEC)	33.2	173
Undergraduate degree	16	83
Postgraduate degree	13.8	72
Undisclosed	3.7	19

Table 2. Means (SD) and cross-sectional correlations between non-digital recreation, childhood behaviour and emotional symptoms, digital media use and multitasking, and control variables.

Variable	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sports	2.5 (1.0)	-												
2. Non-sports	1.5 (0.8)	.19**	-											
3. Reading/Games	3.6 (0.7)	.02	.12**	-										
4. Emotional problems	2.0 (2.0)	-.16**	.00	-.02	-									
5. Conduct problems	1.5 (1.6)	-.10*	-.10*	-.06	.22**	-								
6. ADHD symptoms	3.6 (2.5)	-.07	-.09*	-.16**	.19**	.46**	-							
7. Digital media use	3.7 (2.0)	-.04	-.04	-.15**	.11*	.10*	.11*	-						
8. Media multitasking	0.4 (0.4)	-.05	-.08	-.19**	.11**	.07	.06	.45**	-					
9. Age	6.7 (2.3)	.25**	.13**	-.10*	.10*	-.18**	-.12**	.25**	.16**	-				
10. Male gender	-	.07	-.01	-.07	-.05	.07	.22**	.05	-.05	-.06	-			
11. Ethnicity (other)	-	-.06	-.02	-.06	.03	.01	.01	.16**	.14**	.06	-.04	-		
12. Parent mental health problems	2.2 (0.8)	-.15**	-.10*	-.05	.30**	.23**	.20**	.07	.10*	.03	.02	.01	-	
13. Parent-child conflict	1.7 (0.7)	-.03	-.04	-.08	.28**	.63**	.40**	.06	.05	-.05	.02	.04	.27**	-
14. Parental education	-	.09*	.09*	.13**	-.02	-.06	-.05	-.03	-.07	-.02	.11*	.05	.12**	.05

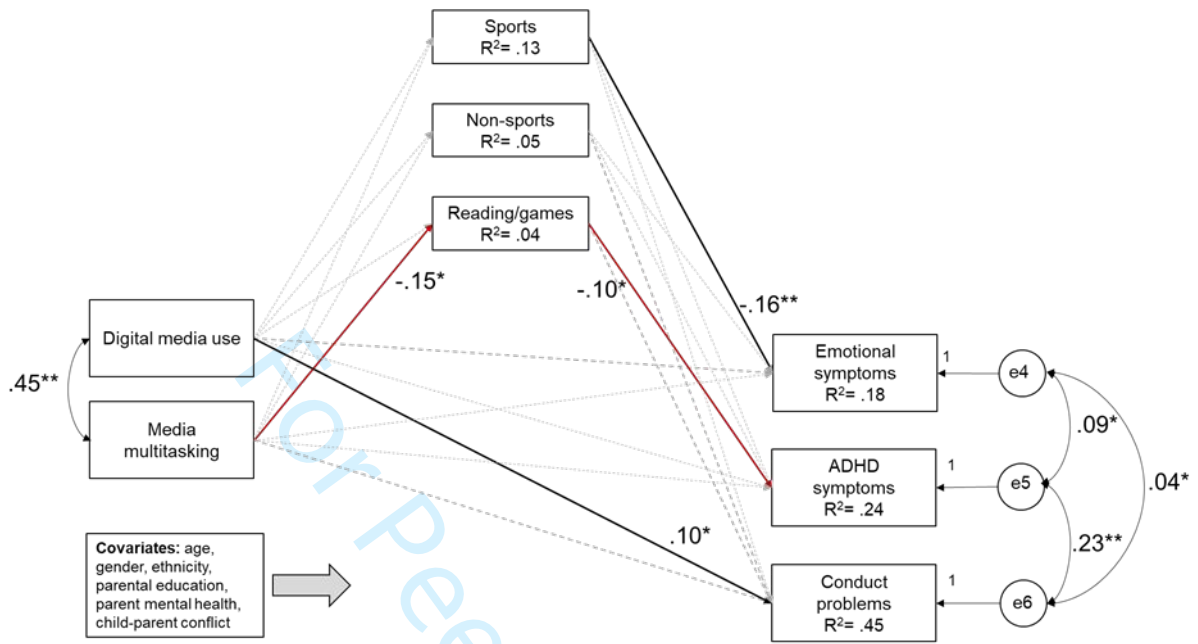
Figure 1. Digital media to psychopathology symptoms via non-digital recreation. Path coefficients expressed as standardised values (* $p < .05$, ** $p < .001$). Black lines: direct

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3 significant associations; red lines: indirect significant associations. Dashed lines: non-
4 significant paths. Uncorrelated residual errors of non-digital recreation variables (e1, e2, e3)
5 are omitted from the figure for visual simplicity.
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9 **Figure 2.** Structural equation model for the associations between childhood behavioural and
10 emotional symptoms and non-digital recreation mediated by digital media use. Path
11 coefficients are expressed as standardised values (asterisks denote: * $p < .05$, ** $p < .001$). Black
12 solid lines represent direct significant associations. Dashed grey lines represent non-
13 significant paths.
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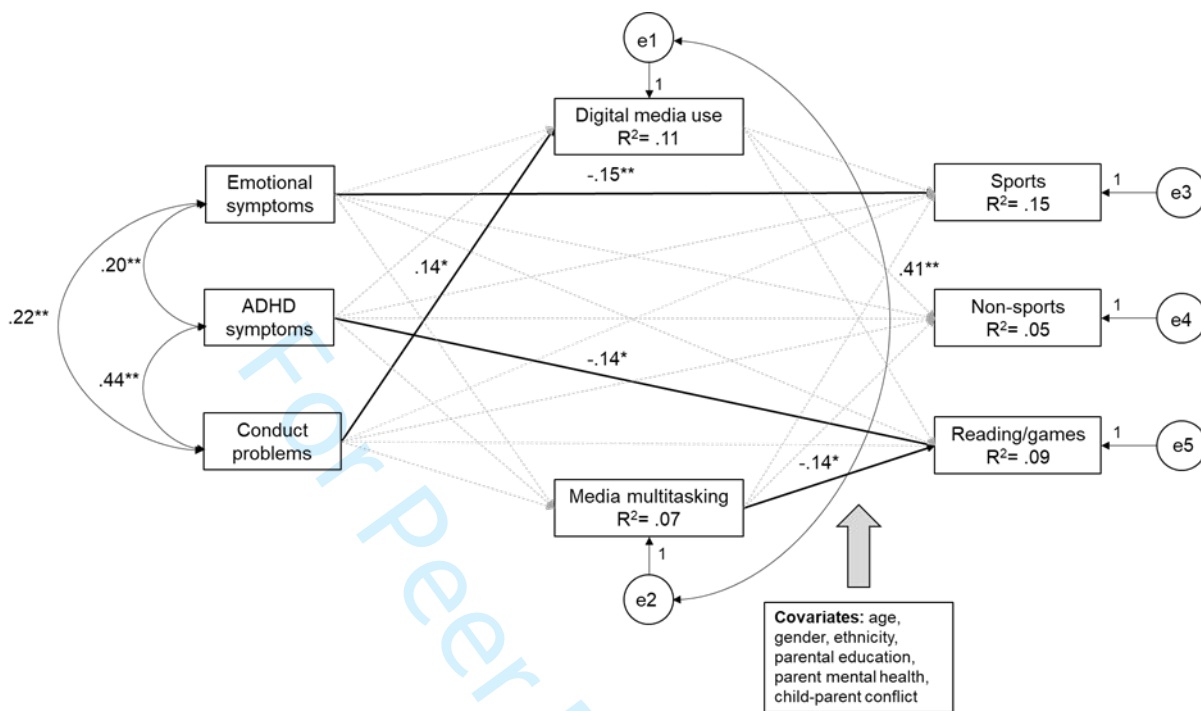
For Peer Review Only

FIGURE 1



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FIGURE 2



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3 **Children's mental health and recreation: Limited evidence for associations with screen**
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5 **use**
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11 **Abstract**
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14 **Aim:** This study examined the direct and indirect associations between childhood
15 psychopathology symptoms, screen use, media multitasking and participation in non-digital
16 recreation.
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21 **Methods:** Psychopathology symptoms, media use, media multitasking, participation in
22 sports, social clubs and reading/games were reported by 520 parents about their 3-11-year-old
23 children. The data were analysed using structural equation modelling.
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29 **Results:** There were bi-directional negative associations between sports participation and
30 emotional problems ($\beta = -.16, p < .001$ and $\beta = -.15, p < .001$); ADHD symptoms were
31 associated with reduced reading/games ($\beta = -.14, p = .004$). A bi-directional positive
32 association was found between media use and conduct problems ($\beta = .10, p = .015$ and $\beta =$
33 $.14, p = .015$). Increased media multitasking was indirectly associated with elevated
34 symptoms of ADHD via a reduction in reading/games ($\beta = .10, p = .026$). However, there was
35 no evidence that screen use mediated the associations between psychopathology symptoms
36 and non-digital recreation.
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48 **Conclusion:** Depending on the specific psychological difficulties, children are either less
49 likely to participate in non-digital recreation or are more likely to use screen media or
50 multitask with media. Interventions for children, who experience emotional or behavioural
51 difficulties, are needed to improve participation in non-digital recreation.
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3 **Abbreviations:**
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6 **ADHD:** Attention-deficit/hyperactivity disorder; **CFI:** Comparative Fit Index; **RMSEA:**

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8 **Root Mean Square Error of Approximation**
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Key Notes:

- Excessive screen use in childhood has been linked to an unhealthy lifestyle marked by a reduction in physical, social and educational recreation, which in turn, may lead to poor mental health.
- We examined the associations between screen use, non-digital recreation and childhood psychopathology symptoms.
- Psychological difficulties were linked with either reduced non-digital recreation or with increased screen use, but there was little evidence that screen use reduced participation in healthy recreation.

Introduction

It is estimated that over 240 million children and adolescents meet diagnostic criteria for a mental health disorder, giving a worldwide prevalence of 13.4%¹. Moreover, nearly half of adolescents present with subthreshold symptoms², which over time may progress to full-blown psychiatric disorder³. These sobering statistics, in conjunction with the substantial negative societal and economic impact of mental disorders on the affected youth and their families, highlight the importance of identifying factors that may support children's wellbeing and reduce the likelihood of a disorder.

In Western countries, children spend nearly half their waking hours in recreational activities⁴. These activities substantially vary in their physical, cognitive and motivational demands⁵, and so may have a differential impact on children's mental health. One activity attracting interest from researchers, public health experts and agencies in this regard is screen use, such as, watching television, using computers or interactive digital devices. Excessive screen use may *directly* increase mental health problems. Primary school age children and

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2
3 young adolescents, who spend more time with screen media, report feeling less happy and
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5 experience more behavioural and emotional difficulties^{6,7}, elevated symptoms of anxiety,
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7 depression and conduct problems^{8,9}. Moreover, meta-analysis findings suggest that
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9 symptoms of attention-deficit/hyperactivity disorder (ADHD) are significantly, though
10
11 weakly, linked to increased screen use¹⁰. The association between screen use and poorer
12
13 mental health may also be *indirect*. Excessive screen use has been linked to an unhealthy
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15 lifestyle marked by a reduced physical⁶, social¹¹ and educational recreation. In turn, an
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17 unhealthy lifestyle may lead to more mental health problems.
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22 Children's general level of physical activity is another well-established correlate of
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24 mental health. Longitudinal research has shown that adolescents, who were physically active
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26 in late childhood, sought the help of mental health professionals less frequently compared
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28 with their less active peers¹². One type of physical activity, which appears to be most clearly
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30 linked to positive mental health outcomes, is childhood sports participation. Older children,
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32 who participated in organised sports, reported overall better health-related quality of life,
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34 which included measures of one's physical, mental and emotional well-being¹³. Importantly,
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36 research has identified childhood sports participation as a protective factor against developing
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38 mental health problems¹⁴, including lowering the risk of anxiety¹⁵, depression¹⁶ and ADHD
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Although childhood emotional and behavioural problems are *associated* with more
screen use and less healthy lifestyle, the mechanisms driving these associations remain
unclear. It is possible that screen use reduces the behaviours associated with a healthy
lifestyle and impacts upon mental health, for instance, via displacement⁶. Screen use may
take up the time that could be spent on physical or social activities, in consequence, reducing
the opportunities for experiencing physiological benefits or developing skills that promote
good mental health. Alternatively, recreational preferences may be driven by pre-existing

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3 mental health problems. For instance, because of the documented deficits in social
4 functioning¹⁸, children with emotional and behavioural difficulties may prefer solitary
5 activities, such as using screens, and use these to replace socially-demanding interests.
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10 Additionally, *the way* in which children use screen media, may also shape these
11 associations. In recent years, easy access to a wide range of screen devices has given rise to a
12 new type of behaviour – media multitasking – which involves parallel use of several forms of
13 media, including screens¹⁹. Some children may develop a strong preference for screen media
14 because it facilitates multitasking in a way that other activities do not. Children with
15 emotional and behavioural problems often experience motivational and cognitive
16 difficulties²⁰. In consequence, they may find pursuing a single activity, which requires
17 focused effort and delayed rewards (e.g., sports or reading), more challenging and less
18 enjoyable, than engaging with parallel activities offering the instant gratification afforded by
19 media multitasking.
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34 Considering that much of the previous research in the field has focused on older
35 children and adolescents, the aim of the present study is to examine the associations between
36 behavioural and emotional disorders symptoms, media use and three common types of non-
37 digital recreation (sports, non-sports social clubs and reading/games) in 3-11-year-old
38 children. Two specific models, with different direct and mediated associations, were tested
39 (see Figures 1 and 2). We hypothesised: a negative association between symptoms of
40 psychopathology (especially ADHD and emotional problems) and participation in non-digital
41 recreation; a negative association between screen time and non-digital recreation; and a
42 positive association between these psychopathologies and screen time. As the effects of
43 media multitasking are currently poorly understood, our investigation of this variable was
44 exploratory. Recognising the limitations of our cross-sectional data, we take the first step to
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3 test our hypothesized links between psychopathology, screen use and non-digital recreation
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5 using structural equation modelling.
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8 **Method**

9 *Participants*

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14 The project received ethical approval from The University of Essex Research Ethics
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16 Committee. Participants were identified through nine primary schools and eight preschools
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18 based in urban and semi-rural locations in Essex, England. Based on the postcodes,
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20 participating schools and preschools covered an area of diverse socio-economic status,
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22 ranging from being in the 10% most deprived to 10% least deprived ([http://imd-by-
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60](http://imd-by-postcode.opendatacommunities.org/imd/2015)).

Packs containing information about the study and a survey were circulated to all
parents, who had children registered in these institutions (~ 3,900 packs). There was no
restriction regarding how many children from each family could participate. Parents of 564
children consented and returned questionnaires (~ 14%); 19.4% of the forms came from the
schools located in the areas that are among 10% most deprived in England (original
circulation – 20.4% of all forms), 42.3% from the schools located in areas of average
deprivation (original circulation – 45.4% of all forms) and 38.3% from the schools located in
20% least deprived areas (original circulation – 34.2% of all forms). Responses regarding 2-
year-olds (outside of pre-specified inclusion criteria, n = 5) and surveys with missing data (n
= 39) were removed. The lack of information about child's age and parental mental health
accounted for most of the missing data (59% and 28%, respectively). The final sample
included 520 children aged 3-11 (see Table 1).

[Table 1 here]

Measures

Behavioural and emotional symptoms

Symptoms of ADHD, conduct problems and emotional problems were measured with the parent report on the respective subscales of the Strengths and Difficulties Questionnaire²¹.

Non-digital recreation

The frequency of children's participation in three types of non-digital recreation outside of school was measured: sports activities (e.g., swimming, football, dancing, etc.), non-sports activities (e.g., music groups, scouts, art, other social groups) and reading and games at home. Parents made responses on a scale ranging from 'None' = 1 to 'More than 3 times a week' = 4.

Digital media use and media multitasking

Parents reported on the amount of time children spent daily on six popular media activities: watching television, listening to music, using a smartphone, using a tablet, using a computer, playing game consoles and reading. Responses ranged from 'None', to 'More than 4 hours'. Average daily media use was calculated by taking the mid-point of each response option (min = 0 increasing in steps of 0.5h to max =4). These scores were used to derive an amount of time spent daily using *each* medium, the total amount of time spent daily using *all* media and the total amount of time spent each day using *digital media only* (reading excluded).

An adapted media multitasking questionnaire¹⁹ was used to quantify children's multitasking with media. Participants were asked: "When [name of media activity] how often does your child engage simultaneously with the following activities" and were presented with a table showing whether, while engaged in this primary media activity, children simultaneously engaged in either of the other six activities. Responses were made on a four-

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3 point scale ranging from ‘Never’ to ‘Most of the time’ and were subsequently assigned values
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5 of 0, 0.33, 0.67 and 1. These responses were then summed for each activity. The following
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7 formula was used to calculate the multitasking index ¹⁹ where h_i was an amount of time spent
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9 daily using each medium, h_{total} quantified the total amount of time spent daily using all media
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11 and m_i , quantified additional media used while engaged with the primary medium.
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$$\sum_{i=1}^6 \frac{m_i \times h_i}{h_{total}}$$

21 *Control variables*

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23 Child’s age, gender, ethnicity and parental education were included as covariates.
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25 Considering that children’s mental health symptoms are linked to more challenging family
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27 circumstances²², we also included measures of parental mental health and child-parent
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29 conflict. Parental mental health was measured with Mental Health Inventory MHI-5; ²³. The
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31 scale was reliable, Cronbach $\alpha=.82$. Child-parent conflict was measured with the conflict
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33 subscale of the Child-Parent Relationship Sale ²⁴. The scale was reliable, Cronbach $\alpha= .88$.
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36 *Statistical analyses*

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39 First, we calculated Pearson (for continuous variables) and biserial (for dichotomous
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41 variable, gender) correlation coefficients to examine the associations between childhood
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43 behavioural and emotional symptoms, digital media use, indices of non-digital recreation and
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45 control variables. Second, structural equation modelling was conducted using maximum
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47 likelihood estimation to test our hypotheses. In model 1, we modelled simultaneous direct
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49 paths from media use and media multitasking to emotional, ADHD and conduct symptoms.
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51 **Boostrapping based on 1000 samples** was used to asses bias-corrected indirect effects of both
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53 media use variables on children’s emotional, ADHD and conduct symptoms via sports, non-
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55 sports and reading/games.
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3 In model 2, simultaneous direct paths from emotional problems, conduct problems
4 and ADHD symptoms were modelled to sports, non-sports and reading/games. Bootstrapping
5 was used to assess bias-corrected indirect effects of child mental health symptoms on non-
6 digital recreation via digital media use. Control variables were included in the models only
7 when they correlated with either the predictor or the outcome variable. Fit of the model was
8 assessed by applying the 'rules of thumb', which indicate a good fit ²⁵ to the comparative fit
9 index (CFI > 0.95) and the root mean square error of approximation (RMSEA < 0.06).
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22 **Results**

23 *Correlations*

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25 Means, standard deviations (SD) and correlations between the variables included in
26 the model are shown in Table 2. Emotional symptoms correlated negatively with with sports
27 (r = -.16, p < .001), ADHD symptoms correlated negatively with non-sports (r = -.09, p =
28 .047) and reading/games (r = -.16, p < .001) and conduct problems correlated negatively with
29 sports (r = -.10, p = .024) and non-sports (r = -.10, p = .018). Digital media use and media
30 multitasking correlated negatively with reading/games (r = -.15, p = .001 and r = -.19, p <
31 .001, respectively). There were no other significant associations between media use, media
32 multitasking and non-digital recreation. There were, however, significant correlations
33 between children's mental health and media use. Specifically, screen use was positively
34 correlated with emotional symptoms (r = .11, p = .014), ADHD symptoms (r = .11, p = .013).
35 and conduct problems (r = .10, p = .022). Media multitasking was positively correlated with
36 emotional symptoms (r = .11, p = .009).
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53 **[Table 2 here]**

54 *Structural equation modelling*

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3 *Model 1: digital media use and media multitasking to psychopathology symptoms via non-*
4 *digital recreation*
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6 Results of the structural equation modelling are shown in Figure 1. Model 1 achieved a good
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8 fit: CFI=.98, RMSEA=.04, $\chi^2(22) = 42.5$, $p = .005$. There was a weak positive direct
9
10 association between digital media use and conduct problems ($\beta = .10$, $p = .015$) indicating
11
12 that children who spent more time using digital media had elevated symptoms of conduct
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14 disorder. There was also a direct negative association between sports participation and
15
16 emotional symptoms ($\beta = -.16$, $p < .001$) indicating that children who participated in sports
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18 activities more frequently were less likely to experience emotional difficulties. Finally, the
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20 analysis of indirect effects estimated with bootstrapping showed that media multitasking was
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22 associated with less reading/games at home, which, in turn, was associated with elevated
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24 symptoms of ADHD ($\beta = .10$, $p = .026$). There were no other significant direct or indirect
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26 associations.
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32 **[Figure 1 here]**
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36 *Model 2: psychopathology symptoms to non-digital recreation via digital media use and*
37 *media multitasking.*
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40 Results of the structural equation modelling are shown in Figure 2. Model 2 achieved
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42 a good fit: CFI=.98, RMSEA=.04, $\chi^2(23) = 41.4$, $p = .011$. Increased emotional symptoms
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44 were directly associated with reduced sports participation ($\beta = -.15$, $p < .001$). Increased
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46 ADHD symptoms were directly associated with reduced reading/games at home ($\beta = -.14$, p
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48 $= .004$). Further, conduct problems were positively associated with the amount of digital
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50 media use ($\beta = .14$, $p = .015$) and media multitasking was negatively associated with
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52 reading/games at home ($\beta = -.14$, $p = .003$). There were no other significant direct or indirect
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54 associations.
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59 **[Figure 2 here]**
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6 In addition, the following associations pertaining to the demographic variables, which
7 were included in both models but omitted from the figures, were significant: male gender was
8 associated with increased ADHD symptoms ($\beta = .22, p < .001$) and less reading/games at
9 home ($\beta = -.10, p = .028$). Older age was associated with increased emotional problems ($\beta =$
10 $.12, p = .005$) but lower ADHD and conduct symptoms ($\beta = -.13, p = .002$ and $\beta = -.13,$
11 $p < .001$, respectively). It was also associated with an increase in use of digital media and
12 media multitasking ($\beta = .27, p < .001$ and $\beta = .16, p < .001$, respectively), more sports ($\beta = .30,$
13 $p < .001$) and non-sports participation ($\beta = .14, p = .003$). Higher parental education was
14 associated with lower ADHD and conduct symptoms ($\beta = -.10, p = .017$ and $\beta = -.11, p =$
15 $.002$, respectively), increased sports ($\beta = .10, p = .023$) and non-sports participation ($\beta = .10, p$
16 $= .023$) and with more reading/games ($\beta = .13, p = .003$). Being in ethnic minority was
17 associated with more digital media use and more multitasking ($\beta = .16, p < .001, \beta = .14, p =$
18 $.002$, respectively). Increased level of child-parent conflict was associated with elevated
19 emotional ($\beta = .23, p < .001$), ADHD ($\beta = .36, p < .001$) and conduct symptoms ($\beta = .61, p <$
20 $.001$). Finally, poorer parental mental health was associated with child's elevated emotional
21 ($\beta = .22, p < .001$) and ADHD symptoms ($\beta = .10, p = .011$), reduced sports ($\beta = -.13,$
22 $p = .003$) and non-sports participation ($\beta = -.11, p = .021$).
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47 Discussion

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49 In this cross-sectional study, we proposed two models to test hypotheses about the
50 associations between symptoms of psychopathology, digital media use and non-digital
51 recreation in children aged 3-11 years. In Model 1, we tested the direct paths from screen use
52 and media multitasking to psychopathology symptoms via non-digital recreation. In Model 2,
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3 the direction of the paths was altered: psychopathology symptoms to non-digital recreation
4 via media use and media multitasking.
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8 The results of Model 1 and 2 partially support our predictions of direct associations
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10 between childhood psychopathology and non-digital recreation with bi-directional negative
11 associations between emotional problems and participation in sports. This fits with previous
12 longitudinal findings showing positive links between children's sports participation and
13 subsequent mental health¹⁴. It is also consistent with the proposal that elevated levels of
14 emotional symptoms may lead to decreased sports participation, which, in turn, reduces
15 children's opportunities for experiences that could improve symptoms; for example, fostering
16 new social relations, learning to deal with disappointments or developing resilience²⁶.
17 Perhaps missing out on these positive and enriching experiences exacerbates emotional
18 problems and, in consequence, increases risk of a subsequent mental disorder.
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31 The results of both models also showed that elevated symptoms of ADHD were linked
32 to a reduction in reading and games. While our study does not provide information about the
33 mechanisms that underpin this association, it is plausible that children with higher levels of
34 ADHD symptoms avoid reading and games because they often experience literacy
35 difficulties²⁷. The lack of pleasure derived from these activities could also play a role –
36 previous research demonstrated that children diagnosed with ADHD enjoyed reading and
37 being read to less than control children²⁸.
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47 In contrast, there was no support for the hypothesis that the associations between
48 psychopathology symptoms and non-digital recreation were mediated by screen use. There
49 was, however, evidence that conduct problems were directly linked with increased screen
50 use. These results tie with the qualitative literature, which reports that parents often use
51 digital media as 'electronic babysitters'²⁹. Perhaps when confronted with difficult to manage
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3 behaviours, parents reach to digital media more to find respite from the demands of parenting
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5 children with conduct problems.
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8 The exploratory analysis of media multitasking returned two findings of note. Model 1,
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10 showed that increased media multitasking was indirectly associated with elevated symptoms
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12 of ADHD via a reduction in reading and games. Model 2 showed that media multitasking was
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14 associated with less reading and games at home. Media multitasking is a relatively new type
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16 of behaviour, which is a poorly understood in terms of the potential consequences for
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18 children's development and learning. Future research should aim to establish whether media
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20 multitasking provides children with the same developmental opportunities as more traditional
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22 non-digital recreation.
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26 Of note are also the results pertaining to two parental variables, which were included as
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28 covariates in the analysis. Consistent with previous research⁵, children of parents with higher
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30 education participated more in all forms of non-digital recreation. Importantly, poorer
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32 parental mental health was associated with reduced sports and non-sports participation but
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34 not with reading and games at home. It might be that parents, who experience more
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36 psychological difficulties, lack energy, commitment or financial means to take their children
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38 to activities outside of home. However, they still may be able to encourage or help children
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40 with activities at home.
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44 Although both models revealed significant associations between childhood emotional
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46 and behavioural problems, digital and non-digital recreation, these relationships were small in
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48 magnitude. This fits with the overall pattern of findings reported in the previous literature
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50 investigating the correlates of screen media use³⁰. However, it is important to note the young
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52 age of participants in the present study and the cross-sectional design of the study. Older
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54 children and adolescents, who have access to a wider range of screen media and more control
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56 over the use of their free time, may choose to spend more time using screen media or
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3 multitasking. Moreover, as the demands on children's free time increase (e.g., doing
4 homework or revising for exams), the displacement effects on other non-digital recreation
5 may become more apparent. Similarly, as children get older, psychological problems may
6 become more severe. Indeed, adolescence is the crucial period for onset of many mental
7 disorders. Therefore, further research should include longitudinal investigation of changes in
8 both children's recreation and mental health across childhood and adolescence. Finally, the
9 generalisibility of our findings may be limited by a relatively high non-response rate and a
10 lack of ethnic diversity of the sample. Though, these limitations were somewhat moderated
11 by including participants representing a wide range of socio-economic backgrounds.
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23 **Conclusions**

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26 The present results show that psychological and behavioural difficulties may be linked
27 to children's recreation in very specific ways. While emotional symptoms are associated with
28 reduced sports participation, symptoms of ADHD are linked to less reading and games at
29 home. In contrast, conduct problems are associated with increased media use. Importantly,
30 there was no evidence that children displaced social and educational recreation with screen
31 use. Therefore, simply adhering to paediatric recommendations regarding limiting media use
32 is unlikely to result in improved participation in other non-digital recreation by those children
33 who experience emotional or behavioural difficulties. Further research should explore other
34 barriers to participating in sports, social and educational recreation, as these may represent an
35 important intervention target for improving children's mental health.
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Table 1. Characteristics of the child and parent sample.

	%	N
Gender of child		
Male	50.2	261

Female	49.8	259
Age of child		
3-5-year-old	35.4	184
6-8-year-old	37.9	197
9-11-year-old	26.7	139
Ethnic group of child		
White	88.1	458
Other	11.9	62
Gender of parent		
Male	7.3	38
Female	92.7	482
Highest level of parent's education		
No exams taken	2.7	14
GCSE	18.1	94
A-levels	12.5	65
Vocational qualifications (i.e., NVQ, BTEC)	33.2	173
Undergraduate degree	16	83
Postgraduate degree	13.8	72
Undisclosed	3.7	19

Table 2. Means (SD) and cross-sectional correlations between non-digital recreation, childhood behaviour and emotional symptoms, digital media use and multitasking, and control variables.

Variable	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sports	2.5 (1.0)	-												
2. Non-sports	1.5 (0.8)	.19**	-											
3. Reading/Games	3.6 (0.7)	.02	.12**	-										
4. Emotional problems	2.0 (2.0)	-.16**	.00	-.02	-									
5. Conduct problems	1.5 (1.6)	-.10*	-.10*	-.06	.22**	-								
6. ADHD symptoms	3.6 (2.5)	-.07	-.09*	-.16**	.19**	.46**	-							
7. Digital media use	3.7 (2.0)	-.04	-.04	-.15**	.11*	.10*	.11*	-						
8. Media multitasking	0.4 (0.4)	-.05	-.08	-.19**	.11**	.07	.06	.45**	-					
9. Age	6.7 (2.3)	.25**	.13**	-.10*	.10*	-.18**	-.12**	.25**	.16**	-				
10. Male gender	-	.07	-.01	-.07	-.05	.07	.22**	.05	-.05	-.06	-			
11. Ethnicity (other)	-	-.06	-.02	-.06	.03	.01	.01	.16**	.14**	.06	-.04	-		
12. Parent mental health problems	2.2 (0.8)	-.15**	-.10*	-.05	.30**	.23**	.20**	.07	.10*	.03	.02	.01	-	
13. Parent-child conflict	1.7 (0.7)	-.03	-.04	-.08	.28**	.63**	.40**	.06	.05	-.05	.02	.04	.27**	-
14. Parental education	-	.09*	.09*	.13**	-.02	-.06	-.05	-.03	-.07	-.02	.11*	.05	.12**	.05

Figure 1. Digital media to psychopathology symptoms via non-digital recreation. Path coefficients expressed as standardised values (*p<.05, **p<.001). Black lines: direct

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3 significant associations; red lines: indirect significant associations. Dashed lines: non-
4 significant paths. Uncorrelated residual errors of non-digital recreation variables (e1, e2, e3)
5 are omitted from the figure for visual simplicity.
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10 **Figure 2.** Structural equation model for the associations between childhood behavioural and
11 emotional symptoms and non-digital recreation mediated by digital media use. Path
12 coefficients are expressed as standardised values (asterisks denote: * $p < .05$, ** $p < .001$). Black
13 solid lines represent direct significant associations. Dashed grey lines represent non-
14 significant paths.
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FIGURE 1

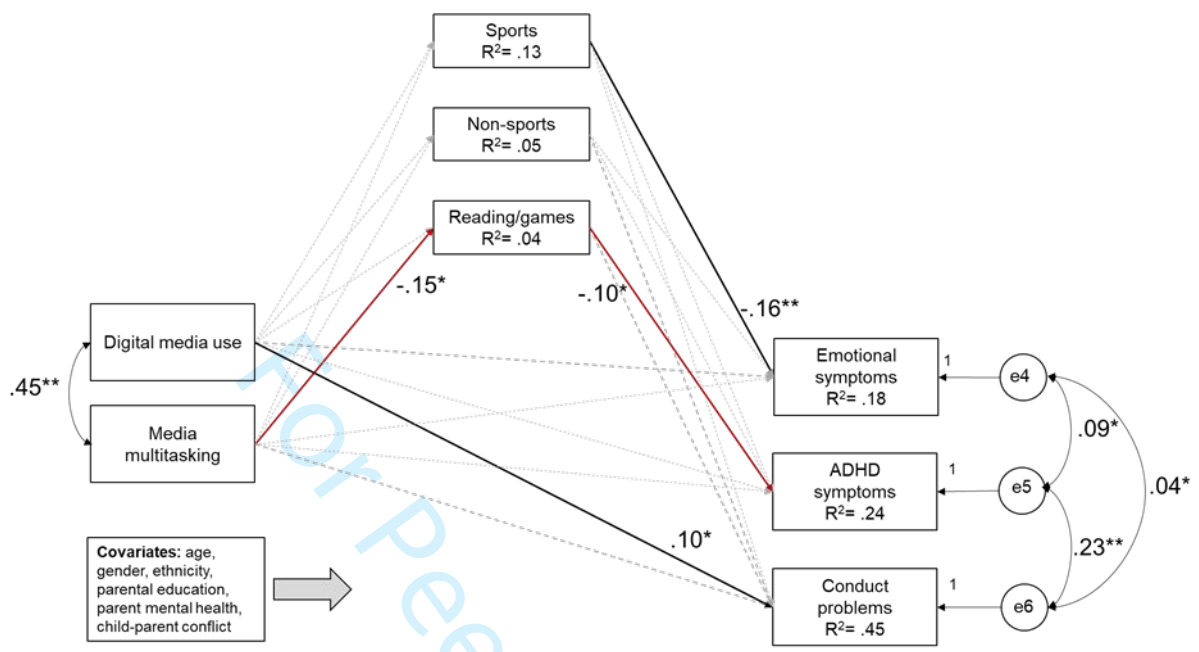
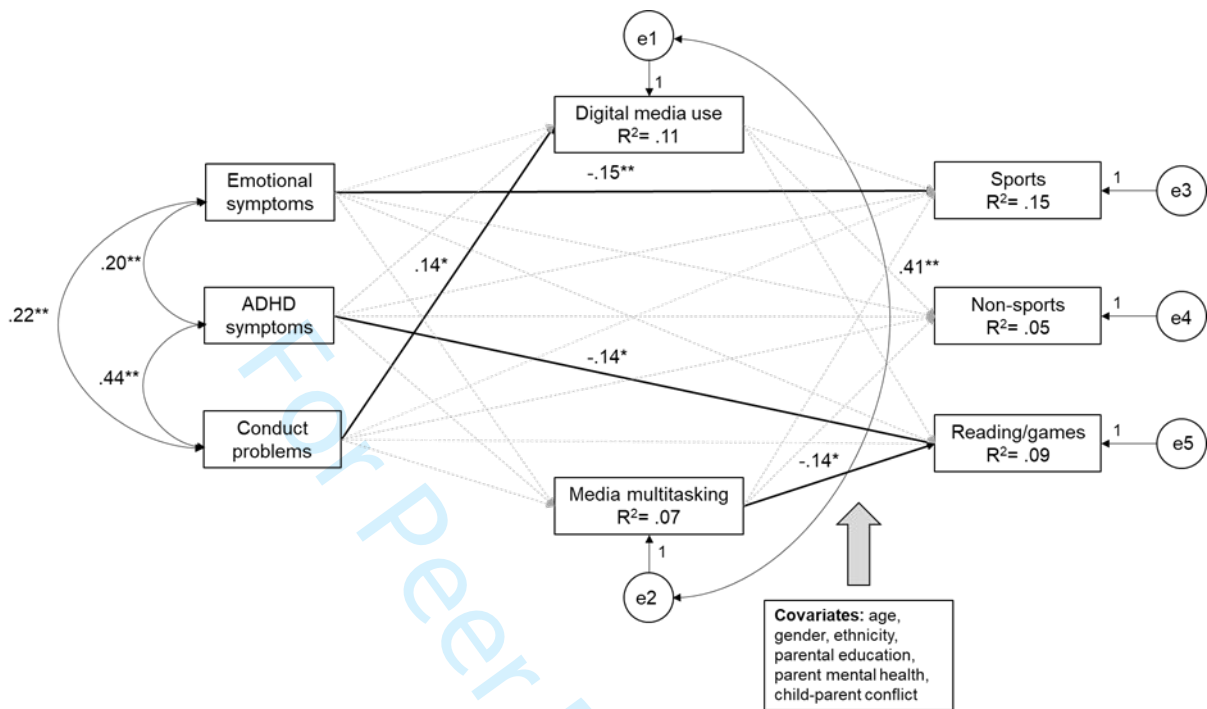


FIGURE 2



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5 authors and not necessarily those of the NHS, the NIHR or the Department of Health.
6

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