

## PEER REVIEW HISTORY

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## ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	High-dose electronic media use in five-year-olds and its association with their psychosocial symptoms – a cohort study
<b>AUTHORS</b>	Niiranen, Janette; Kiviruusu, Olli; Vornanen, Riitta; Saarenpää-Heikkilä, Outi; Paavonen, Juulia

## VERSION 1 – REVIEW

<b>REVIEWER</b>	Eduardo Valenciano-Mendoza IDIBELL (Spain)
<b>REVIEW RETURNED</b>	11-Aug-2020

<b>GENERAL COMMENTS</b>	<p>Abstract</p> <p>The abstract is well elaborated. However, I would suggest including additional keywords such as e-media, children's mental health and children's development</p> <p>Introduction</p> <p>The topic is well introduced and the scientific justification of the research well developed. However, concepts related to electronic media use (screen time, program viewing...) would need to be defined in order to facilitate reader's understanding of the different forms of e-media usage. I would also suggest differentiating pathological forms of e-media usage from healthier forms such as serious games, playing with peers (vs. playing alone)...</p> <p>In addition, I would suggest describing e-media over-usage in the framework of behavioral addictions.</p> <p>The main objective and hypotheses are well described.</p> <p>Methods</p> <p>In this section, I would recommend specifying why game-playing is only assessed at 5 years old (and not at 18 months-old given that certain forms of e-games are available for younger children). In my opinion, it remains unclear how children's psychological well-being is assessed at 18 months of age. As far as I understand, psychological well-being is only measure at five years and, therefore, it becomes difficult to know whether the e-media usage at 18 months of age is the cause of the current psychological symptoms of the children or the latter is the consequence of e-media usage at five years old. A clarification on this issue needs to be made.</p>
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	<p>When the authors describe the FTF and SDQ questionnaires, I would recommend justifying why certain domains and subscales of the questionnaires are not included.</p> <p>Finally, I could be of interest to know (if possible) whether a compensation to participate in this study was given and an possible explanation of the fact that parents with lower education are underrepresented in the sample.</p> <p>Results</p> <p>The information in this section is well described and structured.</p> <p>Discussion and limitations</p> <p>This section is well structured. The objective and the main results of the study are mentioned at the very beginning of the section which helps the reader to follow the reasoning of the text. I would recommend discussing with more details the results in terms of psychological symptoms in the light of previous studies: what explanations may authors give to account for the fact that elevated levels of total screen time were associated with attention and concentration difficulties, hyperactivity and impulsivity...?</p> <p>In the subsection related to the limitations of the study, I would suggest clearly differentiating the strengths of the study from the limitations. An extra limitation that could be included is that psychological symptoms at 18 months of age are not assessed.</p>
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<b>REVIEWER</b>	Ortal Slobodin Ben-Gurion University, Israel
<b>REVIEW RETURNED</b>	02-Oct-2020

<b>GENERAL COMMENTS</b>	<p>Thank you for the opportunity to review this paper. This is a large-scale study (N=699) that investigated the cross-sectional and longitudinal association between pre-schoolers' electronic media (e-media) usage and their psychosocial well-being.</p> <p>Abstract</p> <p>I am not sure that this study addressed accumulative effects of screen media, so I would avoid such a conclusive remark.</p> <p>Introduction</p> <p>1. The authors should address the bidirectional link between screen time and children's behavioral problems. While increased screen time might lead to socio- developmental problems, children with such problems are also more prone to use screen media excessively.</p> <p>Please see:</p> <p>Chonchaiya W, Nuntnarumit P, Pruksananonda C. Comparison of television viewing between children with autism spectrum disorder and controls. <i>Acta Paediatr.</i> 2011; 100: 1033-1037.</p> <p>Mazurek MO, Wenstrup C. Television, video game and social media use among children with ASD and typically developing siblings. <i>Autism Dev Disord.</i> 2013; 43: 1258-1271.</p> <p>Jones RA, Downing K, Rinehart NJ, et al. Physical activity, sedentary behavior and 13their correlates in children with Autism Spectrum Disorder: A systematic review. <i>PLoS ONE</i> .2017; 12: e0172482.</p>
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	<p>Thompson DA, Christakis D. The association between television viewing and irregular sleep schedules among children less than 3 years of age. <i>Pediatrics</i>. 2005; 116: 851-856.</p> <p>2. It might be a good idea to add several explanations for the link between screen time and child's development. This issue is shortly presented in the discussion, but I suggest to elaborate it and present it earlier.</p> <p>Please see for example:  Varni JW, Magnus B, Stucky BD et al. Psychometric properties of the PROMIS (R) pediatric scales: precision, stability, and comparison of different scoring and administration options. <i>Qual Life Resour</i>.2014; 23: 1233–1243.  Immordino-Yang MH, McColl A, Damasio H, et al. Neural correlates of admiration and compassion. <i>Proc Natl Acad Sci</i> .2009; 106: 8021–8026.  Heffler KF, Oestreicher LM. Causation model of autism: Audiovisual brain specialization in infancy competes with social brain networks. <i>Med Hypotheses</i>.2016; 91: 114-122.  Slobodin O, Heffler KF, Davidovitch M. Screen Media and Autism Spectrum Disorder: A Systematic Literature Review. <i>J Dev Behav Pediatr</i>. 2019 May;40(4):303-311. doi: 10.1097/DBP.0000000000000654. PMID: 30908423.</p> <p>Discussion</p> <p>1. Page 9, line 19- the word “feasible”- should be “possible”?</p> <p>2. Page9, Line 20- the increased use of media with child' age is an important finding and therefore should be further explained. It is not clear, for example, what do the authors mean by “personality traits”? Is there evidence for an association between certain personality traits and screen time? if so, please cite relevant research.</p> <p>3. Page 10, line 16- The authors state that “the reported exposures are very much in line with previous studies and therefore this seems to have a negligible influence on the findings”. It is not clear whether results of the current study were compared with studies that measured screen time using objective measures. It is difficult to assume that parental report of screen time is an objective measure, as it may be prone to recall error and bias, in particular social desirability. Since there is a lack of research validating measures of self-reported and parent-reported screen time among children and adolescents, their validity remains unclear. This should be addressed in the limitation section.</p>
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## VERSION 1 – AUTHOR RESPONSE

Reviewer #1

### The abstract

1. The abstract is well elaborated. However, I would suggest including additional keywords such as e-media, children's mental health and children's development.

Thank you for this comment. We have now added these keywords to the abstract according to your suggestion.

## The introduction

2. The topic is well introduced and the scientific justification of the research well developed. However, concepts related to electronic media use (screen time, program viewing...) would need to be defined in order to facilitate reader's understanding of the different forms of e-media usage. I would also suggest differentiating pathological forms of e-media usage from healthier forms such as serious games, playing with peers (vs. playing alone)...

These are very good suggestions, thank you. We have added definitions of the terms related to electronic media use (screen time and program viewing) (please see page 1, lines 17-18). We have also differentiated pathological forms of e-media usage from the healthier ones (page 1, lines 18-24).

3. In addition, I would suggest describing e-media over-usage in the framework of behavioral addictions.

Thank you for this comment. We have added an explanation of how e-media over-usage can be related to behavioral addictions (please see page 1, lines 31-35).

4. The main objective and hypotheses are well described.

Thank you.

## Methods

5. In this section, I would recommend specifying why game-playing is only assessed at 5 years old (and not at 18 months-old given that certain forms of e-games are available for younger children).

Thank you for the comment. It is true that nowadays, preschool aged children very often use iPads for game-playing. However, the use of iPads among the youngest children has become more popular only after our 18-month follow-up data had been collected which took place in 2013-2014. At that time iPads (or tablets) were not that common (see Rideout, 2017), at least not in Finland and among the youngest children. Therefore, unfortunately there were no questions about use of e-games in our survey at the age 18 months. We have added a short explanation of this to our manuscript (please see page 3, lines 34-35).

6. In my opinion, it remains unclear how children's psychological well-being is assessed at 18 months of age. As far as I understand, psychological well-being is only measured at five years and, therefore, it becomes difficult to know whether the e-media usage at 18 months of age is the cause of the current psychological symptoms of the children or the latter is the consequence of e-media usage at five years old. A clarification on this issue needs to be made.

Thank you for this comment. As the reviewer correctly pointed out, we have evaluated children's psychosocial symptoms only at 5 years of age. At 18 month time point, we had questions related to health, development and electronic media use. Unfortunately we did not include psychosocial symptom scales at this time point as we wanted to avoid too long questionnaires per time point to keep response rate high.

The aim of our analysis was first to evaluate prospective associations between e-media use at 18 months and psychosocial symptoms at 5 years (upper part of table 3).

Second, we analyzed cross-sectional associations between e-media use at 5 years of age and psychosocial symptoms at 5 years of age (lower part of table 3 and table 4). In the latter analyses, we included e-media use at 18 months as an adjusting factor.

We acknowledge that based on the design of the study, the available measures, and analyses conducted, it is not possible to evaluate whether the e-media usage at 18 months of age is the cause of the current psychological symptoms of the children or the latter is the consequence of e-media usage at five years old.

We have now clarified the measures available at 18 months (page 3, lines 34-35) and 5 years (page 4, lines 8-10), and also revised the description of our analytical strategy in the statistical analyses section of the manuscript (please see page 4 lines 43-44, and page 5, lines 1-2).

We have also added that psychosocial symptoms were not measured at 18 months in the limitation section of the study (page 8, lines 7-8).

7. When the authors describe the FTF and SDQ questionnaires, I would recommend justifying why certain domains and subscales of the questionnaires are not included.

Thank you for this important comment. We included in the analysis those subscales of SDQ and FTF questionnaires that we considered to be the most relevant relative to our research questions. We aimed to study how electronic media use is related to children's psychosocial symptoms at 5 years. By psychosocial symptoms we mean emotional and behavioral symptoms and inattention. Therefore, we did not include those scales in the FTF and SDQ that we not directly related to the aims of our study (e.g., motor functions, perception, and memory in FTF).

We have now clarified our concept of psychosocial symptoms in the introduction (page 2, lines 26-27) and also provided an explanation for selecting subscales of FTF and SDQ in the method section (please see page 4, lines 8-10).

8. Finally, I could be of interest to know (if possible) whether a compensation to participate in this study was given and a possible explanation of the fact that parents with lower education are underrepresented in the sample.

Thank you for this comment. Participation of the study was voluntary, and the families received no compensation for the participation. We have added this information in the methods section (please see page 3, lines 1-2).

Regarding the fact that parents with lower education are underrepresented in our study is likely due to the common finding that drop-out rates typically are higher among lower socioeconomic group (see e.g. Perez, 2007). We have included this explanation in the limitations section (page 8, lines 7-9).

## Results

9. The information in this section is well described and structured.

Thank you.

## Discussion

10. This section is well structured. The objective and the main results of the study are mentioned at the very beginning of the section which helps the reader to follow the reasoning of the text. I would recommend discussing with more details the results in terms of psychological symptoms in the light of previous studies: what explanations may authors give to account for the fact that elevated levels of total screen time were associated with attention and concentration difficulties, hyperactivity and impulsivity...?

Thank you for your valuable comment. We have now modified the discussion section to take these points into account. Specifically, we have now discussed with more details the results on the relationship between elevated levels of screen time and attention difficulties, hyperactivity and impulsivity (p. 6, lines 38-43). We now provide explanations of the factors that might explain the association between high screen time and ADHD. For example Nikkelen & Walkenburger (2014) have stated that screen time may hinder the availability for activities that are considered to better stimulate cognitive abilities and longer attention span. Moreover, the displacement theory suggests that television's harmful effects operate by displacing developmentally appropriate media material with an attention-grabbing stimulus with a lack of developmental value (Zimmerman and Christakis, 2007; see also Lissak, 2018). Hopefully, this reasonably enlightens the issue.

11. In the subsection related to the limitations of the study, I would suggest clearly differentiating the strengths of the study from the limitations. An extra limitation that could be included is that psychological symptoms at 18 months of age are not assessed.

Thank you for this valuable comment. We have now differentiated the strengths and limitations of the study more clearly in the text and added this limitation according to your suggestion (please see page 7, lines 43-44 and page 8, lines 1-9).

## Reviewer #2

1. I am not sure that this study addressed accumulative effects of screen media, so I would avoid such a conclusive remark.

Thank you for this notion. We have removed that remark from the text and displaced it with a description of how these risk factors "seem to be significant" in the long term (please see abstract section of the text).

2. The authors should address the bidirectional link between screen time and children's behavioral problems. While increased screen time might lead to socio- developmental problems, children with such problems are also more prone to use screen media excessively.  
Please see:

Chonchaiya W, Nuntnarumit P, Pruksananonda C. Comparison of television viewing between children with autism spectrum disorder and controls. *Acta Paediatr.* 2011; 100: 1033-1037.

Mazurek MO, Wenstrup C. Television, video game and social media use among children with ASD and typically developing siblings. *Autism Dev Disord.* 2013; 43: 1258-1271.  
 Jones RA, Downing K, Rinehart NJ, et al. Physical activity, sedentary behavior and 13their correlates in children with Autism Spectrum Disorder: A systematic review. *PLoS ONE.* 2017; 12: e0172482.  
 Thompson DA, Christakis D. The association between television viewing and irregular sleep schedules among children less than 3 years of age. *Pediatrics.* 2005; 116: 851-856.

Thank you for this comment. We totally agree that children with socio-developmental problems might also be more prone to use screen media excessively. We have now clarified (and also with the help of the suggested references) the introduction part to emphasize the bidirectional association between screen time and children's psychosocial problems (p. 2, lines 2-3).

3. It might be a good idea to add several explanations for the link between screen time and child's development. This issue is shortly presented in the discussion, but I suggest elaborating it and presenting it earlier.

Please see for example:

Varni JW, Magnus B, Stucky BD et al. Psychometric properties of the PROMIS (R) pediatric scales: precision, stability, and comparison of different scoring and administration options. *Qual Life Resour.* 2014; 23: 1233–1243.  
 Immordino-Yang MH, McColl A, Damasio H, et al. Neural correlates of admiration and compassion. *Proc Natl Acad Sci.* 2009; 106: 8021–8026.  
 Heffler KF, Oestreicher LM. Causation model of autism: Audiovisual brain specialization in infancy competes with social brain networks. *Med Hypotheses.* 2016; 91: 114-122.  
 Slobodin O, Heffler KF, Davidovitch M. Screen Media and Autism Spectrum Disorder: A Systematic Literature Review. *J Dev Behav Pediatr.* 2019 May;40(4):303-311. doi: 10.1097/DBP.0000000000000654. PMID: 30908423.

Thank you for this your valuable suggestion and the interesting references. We have now elaborated more and added explanations for the link between screen time and child's development and also benefited from the suggested references (please see page 1, lines 26-35).

4. Page 9, line 19- the word "feasible" - should be "possible"?

Thank you for the comment. We have changed the word "*feasible*" to "*possible*" (see page 7, line 7).

5. Page 9, Line 20: the increased use of media with child' age is an important finding and therefore should be further explained. It is not clear, for example, what do the authors mean by "personality traits"? Is there evidence for an association between certain personality traits and screen time? If so, please cite relevant research.

We appreciate this relevant comment. This sentence was indeed unclear. We have now revised the text to clarify that certain inherited temperamental traits, such as



persistence and introversion might be associated with increased screen time at preschool age (Allen, 2015). Please see changes at page 7, lines 8-9.

6. Page 10, line 16- The authors state that “the reported exposures are very much in line with previous studies and therefore this seems to have a negligible influence on the findings”. It is not clear whether results of the current study were compared with studies that measured screen time using objective measures. It is difficult to assume that parental report of screen time is an objective measure, as it may be prone to recall error and bias, in particular social desirability. Since there is a lack of research validating measures of self-reported and parent-reported screen time among children and adolescents, their validity remains unclear. This should be addressed in the limitation section.

Thank you for your comment, we understand it. However, in this section, we intended to explain that our results regarding electronic media exposure were very well in line with those that have been based on parent-report diaries (Määttä et al., 2017). Based on the results of that study (that was collected approximately the same time), children’s average screen time was 111.0 minutes (Määttä et al., 2017), whereas in our study it was 114.1 minutes. Both studies are based on large population based samples concerning the same age groups and respective geographic areas. Therefore, we consider that the parent reported average estimates on electronic media usage appear to be relatively reliable. We have now clarified this in the limitations and also acknowledged the need to validate parent reports against more objective measures in future studies (please see page 8, lines 12-16).

## VERSION 2 – REVIEW

<b>REVIEWER</b>	Eduardo Valenciano-Mendoza Bellvitge University Hospital-IDIBELL
<b>REVIEW RETURNED</b>	04-Dec-2020

<b>GENERAL COMMENTS</b>	<p>First of all, I would like to thank the authors for considering my suggestions. In a second review of the paper, I would like to consider the following points:</p> <p><b>Abstract</b></p> <p>The authors have included relevant keywords as I suggested.</p> <p><b>Introduction</b></p> <p>The authors have addressed the three aspects I mentioned in my first review. As indicated, key concepts related to electronic media use have been adequately defined and new and appropriate references have been added. In addition, a differentiation between pathological and healthier forms of e-media usage has been made which gives a more comprehensive view of this matter. Finally, the new explanation of how e-media over-usage might be related to behavioral addictions is clear and references are appropriate.</p> <p><b>Methods</b></p> <p>A brief but clear justification of why game-playing is not assessed at 18 months-old has been made. The rest of my previous suggestions (to specify why certain domains and subscales of FTF</p>
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	<p>and SDQ questionnaires are not included, whether participants received any kind of compensation and an explanation of the fact that parents with lower education are underrepresented in the sample) have been included in the new version of the manuscript. Relevant references have been added.</p> <p>Discussion</p> <p>An interesting discussion has been included regarding the association between total screen time and attention/concentration difficulties, hyperactivity and impulsivity. The new references support these explanations in a convenient way.</p> <p>Finally, as I suggested, the section devoted to the strengths and limitations has been re-organized giving now greater clarity to the text.</p> <p>Thank you very much for considering my suggestions to improve this interesting work.</p>
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<b>REVIEWER</b>	Ortal Slobodin Ben-Gurion University of the Negev
<b>REVIEW RETURNED</b>	01-Dec-2020

<b>GENERAL COMMENTS</b>	<p>Thank you for addressing my previous comments. I have some minor comments that might help the authors to refine their paper.</p> <ol style="list-style-type: none"> <li>1. In the abstract- I would avoid the word "cause" in regard to the effects of screen media.</li> <li>2. In the method section, it is not clear whether both parents were assessed. If so, were their scores calculated in any manner?</li> <li>3. In reporting statistics, for instance (OR 1.88, p=0.03), please add "=" and italicize the "P".</li> <li>4. In the sentence "temperamental traits of a child, such as persistence and introversion", I would replace the word "temperamental" with "personality".</li> <li>5. The terms "psychological symptoms" and "psychosocial symptoms" are used interchangeably. Please be consistent.</li> <li>6. The term "play a lesser role" is not accurate. Please rewrite.</li> <li>7. The limitation section should systematically address the problems of parental report of child's screen time.</li> </ol>
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## VERSION 2 – AUTHOR RESPONSE

### Responses to the comments by Reviewer: 2

Thank you for addressing my previous comments. I have some minor comments that might help the authors to refine their paper.

1. In the abstract- I would avoid the word “cause” in regard to the effects of screen media.

Answer: Thank you for this comment. We have now corrected this accordingly. The new term: “are related to” is used (see the abstract part of the text).

2. In the method section, it is not clear whether both parents were assessed. If so, were their scores calculated in any manner?

Answer: The questions regarding child were asked from both parents at five years and 73.4% the answers was filled by a mother alone, 1.0% by father alone and 25.5% by parents together. We have now added this information in the method section (p. 3, lines 13-15).

In the statistical models, we used maternal education as an adjusting factor. While both mothers’ and fathers’ education were assessed in the questionnaires, we preferred mother’s education, instead of father’s education, in order to maximize sample size (the number of missing answers was larger among the fathers). We have now clarified this in the method section (see page 4, line 35) and in the results section (tables 1, 3 and 4).

3. In reporting statistics, for instance (OR 1.88,  $p=0.03$ ), please add “=” and italicize the “P”.

Answer: Thank you for this comment, we have now revised this as suggested.

4. In the sentence “temperamental traits of a child, such as persistence and introversion”, I would replace the word “temperamental” with “personality”.

Answer: Thank you for the comment, we revised the text as suggested (p. 7, line 8).

5. The terms “psychological symptoms” and “psychosocial symptoms” are used interchangeably. Please be consistent.

Answer: Thank you for this comment; we have now checked the text for consistency and use only the term “psychosocial symptoms” (page 8, line 8).

6. The term “play a lesser role” is not accurate. Please rewrite.

Answer: Thank you for this comment. We have rewritten the sentence as follows: “while use of e-games was only associated with hyperactivity in the crude models” (page 8, line 25-26).

7. The limitation section should systematically address the problems of parental report of child's screen time.

Answer: Thank you for the suggestion. We have now revised this section in order to address this limitation in more systematic manner. The new version of the text can be found below.

*“The measurement of e-media use was based on parental questionnaires and not logs or objective or observational measures. Therefore the reported amounts of e-media use are prone to recall bias or social-desirability bias (over reporting or underreporting the actual usage). If this bias is randomly distributed among the children, it does not affect the findings. However, if it is related to exposure or outcome, it might have some effect on the findings. Thus, in future studies, parent reports of children's e-media use need to be validated with objective measures. However, of note is that in a previous study (14) conducted in Finland among a comparable age-group and using parental logs on child's e-media use, the reported daily total e-media exposure was 111 minutes, while in our study the respective figure was 114 minutes. This suggests that the reported exposures in our study could be relatively reliable.” (See page 8, line 8-18).*

## Responses to the comments by Reviewer: 1

Comments to the Author: First of all, I would like to thank the authors for considering my suggestions. In a second review of the paper, I would like to consider the following points:

Abstract: The authors have included relevant keywords as I suggested.

Answer: Thank you for your helpful suggestions.

Introduction: The authors have addressed the three aspects I mentioned in my first review. As indicated, key concepts related to electronic media use have been adequately defined and new and appropriate references have been added. In addition, a differentiation between pathological and healthier forms of e-media usage has been made which gives a more comprehensive view of this matter. Finally, the new explanation of how e-media over-usage might be related to behavioral addictions is clear and references are appropriate.

Answer: Thank you for this comment; we are pleased to hear that our revisions responded well to the requests.

Methods: A brief but clear justification of why game-playing is not assessed at 18 months-old has been made. The rest of my previous suggestions (to specify why certain domains and subscales of FTF and SDQ questionnaires are not included, whether participants received any kind of compensation and an explanation of the fact that parents with lower education are underrepresented in the sample) have been included in the new version of the manuscript. Relevant references have been added.

Answer: Thank you.

Discussion: An interesting discussion has been included regarding the association between total screen time and attention/concentration difficulties, hyperactivity and impulsivity. The new references support these explanations in a convenient way.

Answer: Thank you.

Finally, as I suggested, the section devoted to the strengths and limitations has been re-organized giving now greater clarity to the text. Thank you very much for considering my suggestions to improve this interesting work.

Answer: Thank you for your valuable comments to improve the manuscript.