



# What mums think matters: A mediating model of maternal perceptions of the impact of screen time on preschoolers' actual screen time

Trina Hinkley<sup>a,\*</sup>, Valerie Carson<sup>b</sup>, Krystle Kalomakaefu<sup>a</sup>, Helen Brown<sup>a</sup>

<sup>a</sup> Deakin University, Institute for Physical Activity and Nutrition (IPAN), School of Exercise and Nutrition Sciences, Geelong, Victoria, Australia

<sup>b</sup> Faculty of Physical Education and Recreation, University of Alberta, Edmonton, Alberta, Canada

## ARTICLE INFO

### Article history:

Received 7 November 2016

Received in revised form 4 April 2017

Accepted 10 April 2017

Available online 25 April 2017

### Keywords:

Preschool

Screen time

Wellbeing

Parent

Perceptions

Mediation

## ABSTRACT

Screen time during the preschool years is detrimental to wellbeing. The impact of parental perceptions on preschoolers' screen time is unknown. This paper explores the association between maternal perceptions of the impact of screen time on their preschoolers' wellbeing with their child's screen time and the potential mediating role of their perception of the appropriate amount of screen time. In 2013–2014, mothers of 575 preschoolers (2–5 years; metropolitan Melbourne and online sources) reported: their perceptions of the impact of screen time on 11 aspects of wellbeing, conceptually grouped to physical, social and cognitive well-being; their perceptions of the appropriate amount of screen time for preschoolers; and their child's actual screen time. Regression analyses investigated associations between perceptions and children's screen time. Mediation by perception of the appropriate amount of screen time was examined using indirect effects. Mothers' perceptions of the impact of screen time on social and cognitive wellbeing had a significant indirect effect on children's actual screen time through mothers' perception of the appropriate amount of screen time for their child. Findings illustrate the potential impact of parents' perceptions on their children's behaviors. Although a significant indirect effect was identified, direction of causality cannot be implied. Further exploration of the direction of association to determine causality, and interventions targeting parental perceptions, are warranted.

© 2017 Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

The preschool years (ages two–five years) are a critical period for the development of health behaviors, such as regular physical activity and minimal sedentary behavior (Leblanc et al., 2012). A predominant form of sedentary behavior in this age group is screen time, which includes use of television, DVD/video, computer, electronic games and portable smart media devices. Recent systematic reviews have reported adverse health outcomes associated with total volume of screen time across a variety of physical, cognitive, and psychosocial indicators (Leblanc et al., 2012; Carson et al., 2015; Hinkley et al., 2014a). For example, a higher duration of screen time has been associated with poorer weight status, blood pressure, bone mineral content and social competence, and increased behavioral problems (Leblanc et al., 2012; Carson et al., 2015; Hinkley et al., 2014a). Evidence also shows that screen time behaviors formed during the preschool years are stable and track into late childhood (Jones et al., 2013).

Given the adverse health indicators and stability of screen time, there are recommendations to limit screen time during early childhood (Department of Health, 2014; American Academy of Pediatrics Committee on Public Education, 2001; Tremblay et al., 2012). Nonetheless, the majority of preschoolers still exceed recommended levels (Hinkley et al., 2012a; Colley et al., 2013). Therefore, it is important to identify factors associated with preschoolers' screen time to inform the development of behavior reduction strategies. Parents play a major role in children's socialization and development and exert the most influence over their preschoolers' behavior (Davison et al., 2011). Particular attention to parents' beliefs, practices and behaviors, and how those might influence their child's behaviors, is warranted. A recent systematic review specifically integrated findings from studies reporting associations of parental influences with preschoolers' screen time and found inconclusive evidence supporting associations across five studies (Xu et al., 2015). None of the studies included perception of different aspects of children's health/development. Such exploration is necessary to adequately identify potential causal pathways as associations may vary for different outcomes.

Evidence of significant links between parental perceptions of the benefits of physical activity for their child and children's physical activity, suggest exploration of parental beliefs on the potential impacts of screen time on their child may be valuable (Dempsey et al., 1993;

\* Corresponding author at: Deakin University, Institute for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences (B), 221 Burwood Hwy, Burwood, Victoria 3125, Australia.

E-mail address: [trina.hinkley@deakin.edu.au](mailto:trina.hinkley@deakin.edu.au) (T. Hinkley).

Kimiecik and Horn, 1998; Kimiecik et al., 1996). The Health Belief Model (Rosenstock, 1990; Strecher et al., 1997) proposes that individuals may alter health-related behaviors if they perceive a health-related risk. This model may be useful to explain how parents' perceptions of the potential risk from screen time for their preschoolers' health and development might subsequently impact children's actual screen time behaviors.

A potential pathway for this association may be through perceptions of the appropriate amount of screen time for children. For instance, if parents believe more strongly in the adverse effects of screen time, they may limit their child's screen time more than parents who do not hold the same belief. No studies have previously explored such associations. Additionally, previous studies have largely failed to explore any potential mediators of associations between parental practices or beliefs and children's screen time. Investigating potential mediators can help identify mechanisms and aids in future intervention development to direct behavior change strategies.

Therefore, the aims of this study are to: 1) explore perceptions of the potential impact of screen time on preschool children's health; and 2) determine if an association between perceptions of the potential impacts of screen time with preschool children's screen time is mediated by perceptions of the appropriate amount of screen time.

## 2. Methods

The 'Mums, Dads and Kids activity and screen time study' (MDK) is a cross-sectional study investigating various aspects of preschool children's (2–5 years, not yet in formal schooling) physical activity and screen time behaviors. Participant recruitment and data collection occurred between September 2013 and March 2014. The study received ethical approval from Deakin University, Faculty of Health, Human Ethics Advisory Group (HEAG-H 138-2012) and the Victorian Department of Education and Early Childhood Development. Participants were recruited from six randomly selected local government areas (LGAs) within metropolitan Melbourne. LGAs were divided into socioeconomic quintiles based on the Australian Bureau of Statistics Socioeconomic Index for Areas Index of Advantage and Disadvantage (Australian Bureau of Statistics, 2011). Two LGAs from each of high-, medium- and low-socioeconomic position areas were randomly selected. In total, 408 facilities were identified; 191 were contacted. Fifty nine preschools/childcare centers (30.9%) and 81 other facilities (e.g. swim schools; 42.4%) distributed information to their families. Online advertising was simultaneously undertaken through blogs and Facebook pages related to parenting, child education and family-lifestyle. In total, 30 Facebook profile administrators and 36 blog authors were contacted; 15 Facebook profile administrators (50%) and 10 blogs (27.8%) agreed to post information.

Potential participants were directed to a website with information about MDK where they provided their consent and completed a short screening survey to ensure they met the inclusion criteria: parent/care-giver to at least one child aged 2–5 years who had not yet commenced formal schooling. If more than one child met these criteria within a family, parents were directed to complete the survey for the child with the next birthday.

In total, 1238 parents completed the screening survey; 958 were eligible. Eligible families were provided with links to male and female versions of the survey and asked to complete the one relevant to them and forward the other to their partner/spouse. Only data from the mothers' survey are included in this study as there were an insufficient number of completed fathers' surveys to undertake these analyses. In total, 679 participants commenced the mother's survey. Of those, 24 were excluded (duplicate identification number ( $n = 8$ ); child age outside age range ( $n = 13$ ); self-report as being male ( $n = 1$ ); and maternal date of birth invalid ( $n = 2$ )). Where age/date of birth was invalid, contact with participants to clarify was attempted and data were only removed if clarification could not be achieved. Therefore, 655 cases were

available for inclusion. Of those, 80 cases had missing data on the variables of interest. Analyses were undertaken on data from 575 families: 311 boys (54%) and 264 girls.

### 2.1. Measures and data management

#### 2.1.1. Dependent variable

Mothers reported their child's usual weekday and weekend day TV/DVD/video viewing and computer/electronic game/hand held device use in 30 min increments from 0 to 12 or more hours. Data were converted to continuous variables using the mid-point: 1–30 min = 15 min; 31–60 min = 45 min, etc., consistent with previous studies where data were collected in a similar format (Cespedes et al., 2014; Hinkley et al., 2014b; Loprinzi and Davis, 2016; Fletcher et al., 2014; Wijtzes et al., 2013). Data from each of the variables were combined and weighted for week (multiplied by five) and weekend (multiplied by two) days and divided by seven to represent average daily screen time. As young children typically spend about 13 h awake each day, data were truncated at 12 h/day (Hinkley et al., 2012b). Test-retest reliability of this variable has previously been shown to be acceptable (ICC = 0.68, 95% CI 0.52, 0.83) (Hinkley et al., 2012c).

#### 2.1.2. Independent variables

Mothers reported their perceptions of the impact of more screen time on 11 aspects of their child's health and development using a three point scale: positive influence (−1), no influence (0), or negative influence (1). Responses for individual variables were summed to form conceptually-similar constructs for the purposes of analyses where higher scores represented greater perception of negative influence. Those constructs were: physical wellbeing (heart health, muscle and bone health, maintaining a healthy weight, motor skill development); cognitive wellbeing (academic achievement, cognitive development and functioning, ability to concentrate, language development); and social wellbeing (school readiness, social competence, self-esteem). Internal reliability was shown to be high for each of the constructs: Cronbach's  $\alpha = 0.88, 0.90$  and  $0.72$ , respectively. Each of the 11 individual items was assessed for test-retest reliability in a sub-sample using Kappa and percent agreement. Items were considered reliable if  $\kappa \geq 0.6$  and/or agreement  $\geq 60\%$  (Sim and Wright, 2000) all items met these criteria (see Table 2).

#### 2.1.3. Mediator variable

Mothers reported what they believed to be the ideal daily amount of screen time on a four point scale: none, less than 1 h, less than 2 h or any amount is ok. Data were dichotomized in accordance with international recommendations: 1 h or less and more than 1 h. This item had acceptable test-retest reliability ( $\kappa = 0.57$ , % agreement = 76.6%).

#### 2.1.4. Covariates

Mothers reported their family demographic characteristics including their child's date of birth (from which child age was calculated) and sex. Mothers reported their own participation in screen time in the same manner they reported their child's screen time (see dependent variable above) and their highest level of education. Mothers' screen time data were managed in the same way as child screen time data to create an average daily screen time variable and truncated at 15 h as values greater than that were considered improbable. Mother's education level was used to determine family socioeconomic position (SEP; low SEP: year 10 or less; mid-SEP: year 12, diploma, trade; high SEP: university or higher qualification). These variables were chosen as covariates based on previous studies showing that child behaviors vary by age (Carson et al., 2014a), and parental education (Carson and Janssen, 2012; Wijtzes et al., 2012), and are likely to be associated with their parents' behaviors (Xu et al., 2015; Carson and Janssen, 2012). Further, health literacy may be associated with education level (Chen et al., 2014). Additionally, characteristics of child socialization by parents have been shown to vary

by child sex, suggesting that parents may expect and therefore guide their children into different behaviors (Langlois and Downs, 1980).

2.2. Data analyses

Descriptive statistics were used to describe family demographic variables and mothers' perceptions. The total (*c* path), direct (*c'* path) and indirect effects (*a* & *b* paths) of mothers' perceptions of the impact of screen time on their child's outcomes were estimated using Stata's `binary_mediation` command to account for the binary mediating variable. This command runs separate regression models for the *c*, *c'*, *a* & *b*, and combined *ab* paths (see Fig. 1). Separate analyses were undertaken for each of the three independent variables. The total effect represents the association of the mothers' perceptions of the impact of screen time with the child's screen time without adjusting for the mediating variable. The direct effect represents the effect of mothers' perceptions on children's screen time after adjusting for the mediating variable. The indirect effect represents the effect of mothers' perceptions of the outcomes of screen time on child screen time that occurs through the mediator. All indirect effects were estimated using a bootstrap sampling procedure with 1000 resamples, recommended as a valid and powerful method for testing intervening variable effects (Hayes, 2009). This procedure calculates point estimates and bias corrected 95% confidence intervals based on the product of coefficients estimated in the regression models for each resample. Where 0 falls outside the 95% confidence intervals, an indirect effect is evident (Hayes, 2009). Logistic and linear regression models were used to examine the effect of the independent variables on the mediator and of the mediator on the outcome variable, respectively.

3. Results

3.1. Descriptive results

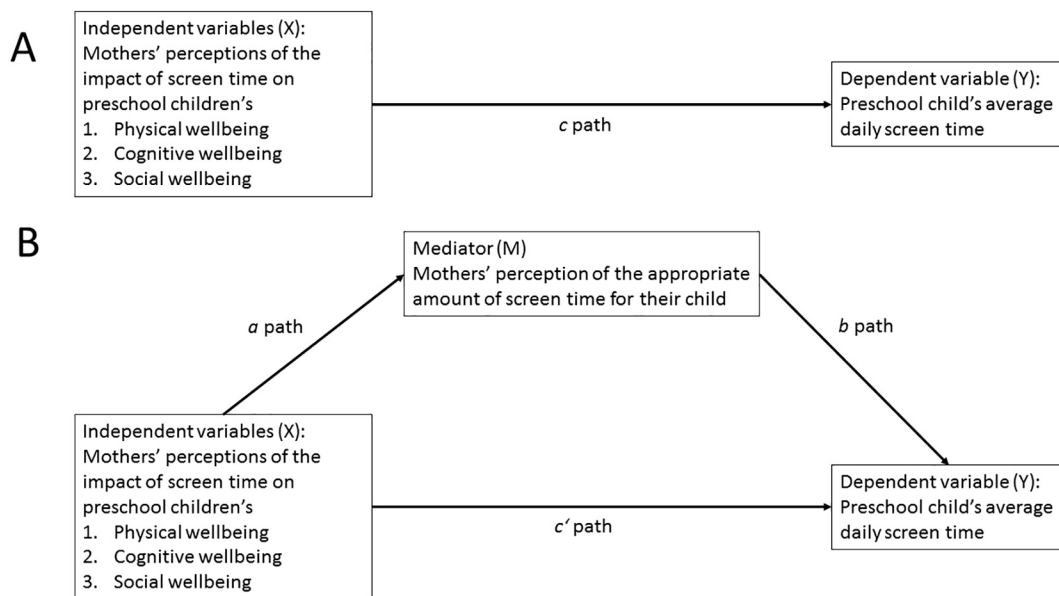
Table 1 reports demographic characteristics of participant mothers and children. Mothers were a mean age of 36.9 (95% CI 36.5, 37.3) years, 95% had partners, 74.5% were of high SEP and 94.4% lived in Australia. Mothers participated in 3.8 (95% CI 3.5, 4.0) h/day of screen time; 67.1% believed that ≤ 1 h/day was an appropriate amount of screen time for their child. Children were 3.8 (95% CI 3.7, 3.9) years of age and spent

**Table 1**  
Descriptive characteristics of mothers and children.

Participants characteristics	Mean (95% CI) or %
<i>Parent characteristics</i>	
Age (years; mean (95% CI))	36.9 (36.5, 37.3)
Marital status – married/de facto (% yes)	95.0
Country of residence – Australia (% yes)	94.4
Education level (%)	
<Year 12	3.1
Year 12, trade, certificate, apprenticeship, diploma	21.9
University degree of higher	74.5
Employment status (%)	
<10 h/week	42.1
10–20 h/week	20.4
20–30 h/week	18.6
30–40 h/week	10.8
40–50 h/week	6.1
>50 h/week	2.1
Disability/poor health (%)	5.6
What proportion of the time are you primary carer?	
<25%	0.5
25–50%	4.0
50–75%	17.9
>75%	77.6
The amount of screen time that's appropriate – 1 h or less (% yes)	67.1
Parent average daily screen time (h/day)	3.8 (3.5, 4.0)
<i>Child characteristics</i>	
Sex (% male)	54.1
Age (years)	3.8 (3.7, 3.9)
Time in childcare (h/week)	16.4 (15.4, 17.4)
Time spent sleeping (h/day)	11.4 (11.3, 11.5)
Disability (% yes)	8.6
Child outdoor play time (h/day)	3.1 (2.9, 3.2)
Child average daily screen time (h/day)	2.0 (1.9, 2.2)

Study undertaken in Melbourne, Australia; 2013–2014.

2.0 (95% CI 1.9, 2.2) h/day in screen time. Participants indicated that they became aware of the study through the following sources (total reports exceed sample size as some participants reported more than one source): preschool/childcare: 114; child activity group (e.g. swim class): 19; online blog: 85; Facebook: 233; twitter: 3; friend: 44; and other (including those who could not remember): 92.



**Fig. 1.** Mediating pathways of maternal perceptions on preschoolers' screen time. (A) Direct association of maternal perception of the impact of screen time on children's wellbeing with children's screen time. (B) Association of mothers' perceptions of the impact of screen time on preschoolers' wellbeing and actual screen time mediated by mothers' perceptions of appropriate screen time levels.

Table 2 reports details of mothers' beliefs about the impact of screen time on wellbeing outcomes. More than 75% of mothers believed that screen time had an adverse effect on each of the constructs of children's physical wellbeing measured, with a mean score of 3.2 (95% CI 3.0, 3.3; range – 4 to 4, higher scores indicating stronger belief in adverse impact) on the total scale. For cognitive wellbeing, between 37% and 51% of mothers believed screen time was detrimental to children's development (mean 0.3, 95% CI 0.0, 0.5; range – 4 to 4). Between 36% and 74% of mothers believed screen time was detrimental to aspects of children's social wellbeing (mean 1.1, 95% CI 1.0, 1.3; range – 3 to 3).

### 3.2. Total effects

Table 3 presents details of total, direct, and indirect effects and *a* and *b* pathways. A significant total effect (adjusting for confounders but not mediator) was observed for cognitive wellbeing such that for each additional unit of mothers' perceptions of the adverse impact of screen time on cognitive wellbeing, children spent 6 min/day less in screen time. No significant total effects were seen for mothers' perceptions of the impact of screen time on children's physical or social wellbeing on children's actual screen time.

### 3.3. Direct effects

No significant direct effects were evident in any of the models between mothers' perceptions of the impact of screen time on children's physical, cognitive or social wellbeing with children's screen time after adjusting for the mediator and confounders.

### 3.4. Association between the independent variables and the mediator

After adjusting for confounders there were significant inverse associations between mothers' perceptions of the adverse effects of screen time on children's cognitive and social wellbeing and mothers' perceptions of the appropriate amount of screen time. Mothers were 16% and 23% less likely to believe more than 1 h of screen time per day was appropriate for their child with every unit increase in their belief that screen time had a detrimental effect on their child's cognitive and social wellbeing, respectively. There was no association between mothers' beliefs about the impact of screen time on their child's physical wellbeing

and their perceptions of the appropriate amount of screen time for their child.

### 3.5. Association between the mediating variable and the dependent variable

After adjusting for confounders and the respective independent variables, there were significant associations between the mediator (mothers' perceptions of the appropriate amount of screen time) and their child's screen time. Mothers who believed that more than 1 h/day of screen time was appropriate for their child had children who spent 45 min (physical wellbeing), 43 min (cognitive wellbeing), and 44 min (social wellbeing) more in screen time than mothers who believed that 1 h or less was appropriate for their child.

### 3.6. Indirect effects

Mothers' perceptions of the impact of screen time on social and cognitive wellbeing had a significant indirect effect on children's actual screen time through mothers' perception of the appropriate amount of screen time for their child. Estimates of the indirect effects are interpreted with respect to the unit of metric of the independent and dependent variables, independently of the metric of the mediating variable (Hayes, 2009). In these analyses, for every unit increase in mothers' perception of the adverse impact of screen time on children's cognitive and social wellbeing, the point estimates were –0.06 and –0.05, respectively. That is, children's screen time decreases by 0.06 and 0.05 units (h/day; 3.6 and 3.0 min/day, respectively) indirectly through mothers' perceptions of the appropriate amount of screen time for every unit increase in their perceptions of the adverse impact of screen time on cognitive and social wellbeing, respectively. For example, children of parents who believed that screen time had an adverse impact on all of the individual outcomes in the cognitive wellbeing construct spent 14.4 min (0.06 \* 60 \* 4) less per day in screen time than children of parents who believed that screen time had no influence on any of the cognitive wellbeing outcomes. There was no evidence of an indirect effect in the model containing mothers' perceptions of the impact of screen time on children's physical wellbeing.

**Table 2**  
Maternal report of their perception of the impact of screen time on child outcomes.

Construct	Variable	% reporting ST has a positive influence on this outcome	% reporting ST has no influence on this outcome	% reporting ST has a negative influence on this outcome	Internal reliability	Scale scores (mean, 95% CI; range) <sup>a</sup>
Physical wellbeing	Heart health	0.9	20.7	78.5	$\kappa = 0.44$ (78.9%)	3.2 (3.0, 3.3; – 4, 4)
	Muscle and bone health	0.9	16.2	82.9	$\kappa = 0.50$ (80.8%)	
	Maintaining a healthy weight	1.6	15.3	83.1	$\kappa = 0.66$ (86.5%)	
	Fundamental movement skills	2.6	19.0	78.5	$\kappa = 0.34$ (71.2%)	
Cognitive wellbeing	Academic achievement	34.1	26.2	39.7	$\kappa = 0.56$ (71.2%)	0.3 (0.0, 0.5; – 4, 4)
	Cognitive development	36.9	23.3	39.8	$\kappa = 0.65$ (78.9%)	
	Ability to concentrate	27.8	21.9	50.3	$\kappa = 0.67$ (78.9%)	
	Language development	39.1	23.6	37.2	$\kappa = 0.61$ (76.9%)	
Social wellbeing	School readiness	28.6	34.5	36.9	$\kappa = 0.49$ (67.3%)	1.1 (1.0, 1.3; – 3, 3)
	Social competence	2.9	21.0	73.1	$\kappa = 0.44$ (69.2%)	
	Self-esteem	7.8	46.0	43.2	$\kappa = 0.59$ (76.9%)	

<sup>a</sup> Higher scores reflect perceptions of more negative influences; study undertaken in Melbourne, Australia; 2013–2014.

**Table 3**

Total, direct, and indirect effects, *a* and *b* pathways, of the effect of mothers' perceptions of the impact of screen time on preschoolers' wellbeing, mediated through mothers' perceptions of the appropriate amount of screen time ( $\beta$ , 95% CI).

Independent variable	<i>c</i> path (total effect)	<i>c'</i> (direct effects)	Mediated effect <i>ab</i> (indirect effect)	<i>a</i> path (OR, 95% CI)	<i>b</i> path
Physical wellbeing	0.03 (−0.04, 0.11)	0.02 (−0.06, 0.10)	−0.01 (−0.04, 0.01)	0.93 (0.83, 1.05)	0.75 (0.51, 0.99)*
Cognitive wellbeing	−0.10 (−0.18, −0.02)**	−0.05 (−0.12, 0.03)	−0.06 (−0.09, −0.03)**	0.84 (0.79, 0.90)*	0.71 (0.46, 0.96)*
Social wellbeing	−0.07 (−0.14, 0.01)	−0.03 (−0.09, 0.04)	−0.05 (−0.08, −0.02)**	0.77 (0.69, 0.86)*	0.73 (0.48, 0.98)*

All paths were adjusted for: child sex, SEP, maternal screen time, child age. Study undertaken in Melbourne, Australia; 2013–2014.

\*  $p < 0.001$ .

\*\*  $p < 0.05$ .

#### 4. Discussion

This study examined whether the association of mothers' perceptions of the impact of screen time on constructs of wellbeing with children's screen time was mediated by their perceptions of the appropriate amount of screen time. Results indicate significant mediating effects in the models containing perceptions of cognitive and social wellbeing despite mothers reporting higher levels of perceived adverse outcomes on children's physical wellbeing. These findings suggest that greater concern about adverse impacts of screen time on cognitive and social wellbeing may be more persuasive in supporting behavior change than concerns about adverse impacts on physical wellbeing.

Increasing evidence suggests that screen time may be detrimental to physical, cognitive and psychosocial wellbeing (Leblanc et al., 2012; Carson et al., 2015; Hinkley et al., 2014a). Nonetheless, qualitative research has found that parents perceive screen time as beneficial to skill, language and vocabulary development (Hesketh et al., 2013; De Decker et al., 2012), children's reaction times, developing computer and communication skills (De Decker et al., 2012) and supporting literacy development (Neumann, 2014). This study found the majority of mothers believed screen time was detrimental to aspects of children's physical wellbeing. However,  $\geq 50\%$  of the mothers in this study reported that they believed that screen time was not harmful to children's cognitive and social wellbeing outcomes. These findings suggest that educating mothers about the detrimental impacts of screen time on children's cognitive and social wellbeing may be necessary, particularly as parents value social and cognitive wellbeing highly in this age group (Carson et al., 2014b). Additionally, as the mediating models in which cognitive and social wellbeing were the independent variables found significant mediating effects on children's screen time, targeting those perceptions in interventions may serve to support lower levels of preschoolers' screen time. This study did not collect data on screen time content, nor were mothers requested to consider a particular type of content when reporting their perception of screen time impact. Therefore, it is possible that associations may vary if mothers had been directed to consider specific content (e.g. violent vs. educational). Future research may wish to explore such nuances.

There are no comparable studies against which to directly evaluate the findings from this study. Previous studies have reported that parents' perception that 'TV helps' is associated with increased screen time in preschoolers (Barr-Anderson et al., 2011; Hinkley et al., 2013), while parental perception that 'TV hurts' has been associated with lower levels of screen time in one study (Vandewater et al., 2005) and not associated with screen time in another (Vandewater et al., 2007). Such associations need to be examined within the context of use of rules limiting screen time and parenting style (Xu et al., 2015). Such constructs may indeed help explain reported associations. However, this study suggests that maternal perceptions of the appropriate amount of screen time for preschoolers may mediate the association between perceptions of the impact of screen time and preschoolers' actual screen time. Future studies may wish to examine these associations with the additional mediators of parenting style and use of rules limiting screen time to further explore potential causal pathways.

Previous research suggests that when parents of preschoolers are advised of screen time recommendations, they perceive the

recommendation of 1 h or less per day as appropriate (Carson et al., 2014b; Bentley et al., 2015). Nonetheless, they report multiple barriers to reducing children's screen time (Carson et al., 2014b; Bentley et al., 2015), and there exists a lack of awareness of the screen time recommendations themselves (Bentley et al., 2015). Raising awareness of the recommended level of screen time, the detrimental impact of screen time, particularly on cognitive and social wellbeing, and providing advice on potential strategies to minimize screen time, may be warranted and necessary as intervention strategies to reduce preschoolers' screen time.

It was beyond the scope of this study to explore the practices in which mothers engage to actually limit their child's screen time. Improving parenting practices, parental self-efficacy or changing parenting style (Xu et al., 2015), limiting screen time (Downing et al., 2015), and ensuring children do not have screen devices in their bedrooms (Tandon et al., 2014), have been shown to be associated with lower levels of preschoolers' screen time. It is likely that mothers who perceive more detrimental cognitive and social wellbeing outcomes from screen time are more likely to engage in these types of parenting practices or other practices yet to be identified, which may also limit preschoolers' screen time. However, such associations remain to be explored.

Although a number of interventions have previously been trialed to decrease preschoolers' screen time, none have targeted perceptions of the impact of screen time nor of the appropriate amount of screen time (Schmidt et al., 2012). Given the apparent lack of awareness by mothers of the detrimental impacts of screen time on cognitive and social wellbeing in this study, targeting these perceptions in future interventions and public health programs is warranted. Additionally, as mothers' perceptions of the appropriate amount of screen time is associated with their children's actual screen time in this study, and the low levels of awareness of screen time recommendations in previous studies (Bentley et al., 2015), promoting the screen time recommendations, and benefits of complying with those recommendations, may be an effective intervention and public health promotion strategy.

Strengths and limitations of this study must be acknowledged. This is a cross-sectional study and causation cannot be implied; nor can the findings exclude other causal pathways, which may explain children's screen time. For instance, consistent with the principles of cognitive dissonance, it is possible that the amount of screen time children engage in may influence maternal perceptions of both an appropriate amount of screen time and reported perceptions of the impact of screen time on well-being (Aronson et al., 2007). However, the large sample size allowed contemporary mediating models to be explored. Data were parent proxy-reported and are therefore subject to social desirability and other biases. Consequently, the true strength of reported associations may be over- or under-estimated. However, all items included in this study had good internal and/or test-retest reliability. Coefficients of association were generally small yet the potential cumulative impact of such associations on children's overall behaviors (up to 15 min/day per association) may carry important public health implications for the general population. Given the sample size and recruitment methods, these findings are unlikely to be representative of all families with preschool children. However, a range of families, who reported diverse responses on included variables, participated in the study.

Therefore these data provide valuable insight into parent perceptions of preschool children's screen time.

## 5. Conclusions

Findings from this study highlight the impact of parents' perceptions on their children's behaviors. Given the increasing prevalence, stability, and adverse health and developmental outcomes associated with screen time, these findings provide previously unidentified intervention targets to help decrease preschoolers' screen time. Further exploration of the direction of association to determine causality, and interventions targeting parental perceptions, are warranted.

## Conflict of interest

The authors report no conflicts.

## Statement of financial support

TH is supported by a National Health and Medical Research Council Early Career Fellowship (APP1070571). VC is supported by a Canadian Institutes of Health Research (CIHR) New Investigator Salary Award. The study was funded by the School of Exercise and Nutrition Sciences, Deakin University. Deakin University had no role in the study design; collection, analysis or interpretation of data; writing the report; or the decision to submit the report for publication.

## Acknowledgments

We thank Jennifer McCann for providing extraordinary research and administrative support throughout recruitment and data collection and management for this project.

## References

- American Academy of Pediatrics Committee on Public Education, 2001n. Children, adolescents, and television. *Pediatr.* 107 (2), 423–426.
- Aronson, E., Wilson, T., Akert, R., Fehr, B., 2007. *Social Psychology*. third ed. Pearson Prentice Hall, Toronto.
- Australian Bureau of Statistics, 2011. *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA) 2033.0.55.001*. Australian Bureau of Statistics, Canberra.
- Barr-Anderson, D.J., Fulkerson, J.A., Smyth, M., et al., 2011. Associations of American Indian children's screen-time behavior with parental television behavior, parental perceptions of children's screen time, and media-related resources in the home. *Prev. Chronic Dis.* 8 (5), A105.
- Bentley, G.F., Jago, R., Turner, K.M., 2015. Mothers' perceptions of the UK physical activity and sedentary behaviour guidelines for the early years (Start Active, Stay Active): a qualitative study. *BMJ Open* 5 (9):e008383. <http://dx.doi.org/10.1136/bmjopen-2015-008383>.
- Carson, V., Janssen, I., 2012. Associations between factors within the home setting and screen time among children aged 0–5 years: a cross-sectional study. *BMC Public Health* 12, 539.
- Carson, V., Rosu, A., Janssen, I., 2014a. A cross-sectional study of the environment, physical activity, and screen time among young children and their parents. *BMC Public Health* 14 (1):61. <http://dx.doi.org/10.1186/1471-2458-14-61>.
- Carson, V., Clark, M., Berry, T., Holt, N.L., Latimer-Cheung, A.E., 2014b. A qualitative examination of the perceptions of parents on the Canadian Sedentary Behaviour Guidelines for the early years. *Int. J. Behav. Nutr. Phys. Act.* 11 (1). <http://dx.doi.org/10.1186/1479-5868-11-65>.
- Carson, V., Kuzik, N., Hunter, S., et al., 2015. Systematic review of sedentary behavior and cognitive development in early childhood. *Prev. Med.* 78:115–122. <http://dx.doi.org/10.1016/j.ypmed.2015.07.016>.
- Cespedes, E.M., Gillman, M.W., Kleinman, K., et al., 2014. Television viewing, bedroom television, and sleep duration from infancy to mid-childhood. *Pediatr.* 133 (5): e1163–e1171. <http://dx.doi.org/10.1542/peds.2013-3998>.
- Chen, G.D., Huang, C.N., Yang, Y.S., Lew-Ting, C.Y., 2014. Patient perception of understanding health education and instructions has moderating effect on glycemic control. *BMC Public Health* 14:683. <http://dx.doi.org/10.1186/1471-2458-14-683>.
- Colley, R.C., Garriguet, D., Adamo, K.B., et al., 2013. Physical activity and sedentary behavior during the early years in Canada: a cross-sectional study. *Int. J. Behav. Nutr. Phys. Act.* 10:54. <http://dx.doi.org/10.1186/1479-5868-10-54>.
- Davison, K.K., Lawson, H.A., Coatsworth, J.D., 2011. The Family-Centered Action Model of Intervention Layout and Implementation (FAMILI): the example of childhood obesity. *Health Promot. Pract.* <http://dx.doi.org/10.1177/1524839910377966>.
- De Decker, E., De Craemer, M., De Bourdeaudhuij, I., et al., 2012. Influencing factors of screen time in preschool children: an exploration of parents' perceptions through focus groups in six European countries. *Obes. Rev.* 13 (Suppl. 1):75–84. <http://dx.doi.org/10.1111/j.1467-789X.2011.00961.x>.
- Dempsey, J., Kimiecik, J., Horn, T., 1993. Parental influence on children's moderate to vigorous physical activity participation: an expectancy-value approach. *Pediatr. Exerc. Sci.* 5 (2), 151–167.
- Department of Health, 2014. *National Physical Activity Recommendations for Children 0–5 Years*. Department of Health, Canberra, ACT.
- Downing, K.L., Hinkley, T., Hesketh, K.D., 2015. Associations of parental rules and socioeconomic position with preschool children's sedentary behaviour and screen time. *J Phys Act Health* 12:515–521. <http://dx.doi.org/10.1123/jpah.2013-0427>.
- Fletcher, E.N., Whitaker, R.C., Marino, A.J., Anderson, S.E., 2014. Screen time at home and school among low-income children attending head start. *Child Indicators Res.* 7 (2): 421–436. <http://dx.doi.org/10.1007/s12187-013-9212-8>.
- Hayes, A.F., 2009. Beyond Baron and Kenny: statistical mediation analysis in the new millennium. *Commun. Monogr.* 76 (4):408–420. <http://dx.doi.org/10.1080/03637750903310360>.
- Hesketh, K.D., Campbell, K.J., Hinkley, T., 2013. Children's physical activity and screen time: qualitative comparison of views of parents of infants and preschool children. *Int. J. Behav. Nutr. Phys. Act.* 9, 152.
- Hinkley, T., Salmon, J., Okely, A.D., Crawford, D., Hesketh, K., 2012a. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med. Sci. Sports Exerc.* 44 (3):458–465. <http://dx.doi.org/10.1249/MSS.0b013e318233763b>.
- Hinkley, T., Salmon, J., Okely, A.D., Hesketh, K., Crawford, D., 2012b. Correlates of preschool children's physical activity. *Am. J. Prev. Med.* 43 (2), 159–167.
- Hinkley, T., Salmon, J., Okely, A.D., Crawford, D., Hesketh, K., 2012c. The HAPPY Study: development and reliability of a parent survey to assess correlates of preschool children's physical activity. *J. Sci. Med. Sport* 15 (5):407–417. <http://dx.doi.org/10.1016/j.jsams.2011.12.009>.
- Hinkley, T., Salmon, J., Okely, A.D., Crawford, D., 2013. The correlates of preschoolers' compliance with screen recommendations exist across multiple domains. *Prev. Med.* 57 (3):212–219. <http://dx.doi.org/10.1016/j.ypmed.2013.05.020>.
- Hinkley, T., Teychenne, M., Downing, K.L., et al., 2014a. Early childhood physical activity, sedentary behaviors and psychosocial well-being: a systematic review. *Prev. Med.* 62:182–192. <http://dx.doi.org/10.1016/j.ypmed.2014.02.007>.
- Hinkley, T., Verbestel, V., Ahrens, W., et al., 2014b. Early childhood electronic media use as a predictor of poorer well-being a prospective cohort study. *JAMA Pediatr.* 168 (5):485–492. <http://dx.doi.org/10.1001/jamapediatrics.2014.94>.
- Jones, R.A., Hinkley, T., Okely, A.D., Salmon, J., 2013. Tracking physical activity and sedentary behavior in childhood: a systematic review. *Am. J. Prev. Med.* 44 (6):651–658. <http://dx.doi.org/10.1016/j.amepre.2013.03.001>.
- Kimiecik, J.C., Horn, T.S., 1998. Parental beliefs and children's moderate-to-vigorous physical activity. *Res. Q. Exerc. Sport* 69 (2), 163.
- Kimiecik, J.C., Horn, T.S., Shurin, C.S., 1996. Relationships among children's beliefs, perceptions of their parents' beliefs, and their moderate-to-vigorous physical activity. *Res. Q. Exerc. Sport* 67 (3), 324.
- Langlois, J.H., Downs, A.C., 1980. Mothers, fathers, and peers as socialization agents of sex-typed play behaviors in young children. *Child Dev.* 51, 1237–1247.
- Leblanc, A.G., Spence, J.C., Carson, V., et al., 2012. Systematic review of sedentary behaviour and health indicators in the early years (aged 0–4 years). *Appl. Physiol. Nutr. Metab.* 37 (4):753–772. <http://dx.doi.org/10.1139/h2012-063>.
- Loprinzi, P.D., Davis, R.E., 2016. Secular trends in parent-reported television viewing among children in the United States, 2001–2012. *Child Care Health Dev.* 42 (2): 288–291. <http://dx.doi.org/10.1111/cch.12304>.
- Neumann, M.M., 2014. An examination of touch screen tablets and emergent literacy in Australian pre-school children. *Aust. J. Educ.* 58 (2):109–122. <http://dx.doi.org/10.1177/0004944114523368>.
- Rosenstock, I.M., 1990. *The health belief model: explaining health behavior through expectancies*. In: Glanz, K., Lewis, F.M., Rimer, B.K. (Eds.), *Health Behavior and Health Education: Theory, Research, and Practice*. Jossey-Bass, San Francisco, CA, US, pp. 39–62.
- Schmidt, M.E., Haines, J., O'Brien, A., et al., 2012. Systematic review of effective strategies for reducing screen time among young children. *Obesity (Silver Spring)* 20 (7): 1338–1354. <http://dx.doi.org/10.1038/oby.2011.348>.
- Sim, J., Wright, C., 2000. *Research in Health Care: Concepts, Designs and Methods*. Stanley Thornes (Publishers) Ltd., Cheltenham, Victoria.
- Strecher, V.J., Champion, V.L., Rosenstock, I.M., 1997. *The Health Belief Model and Health Behavior*. Plenum Press, New York, NY, US.
- Tandon, P., Grow, H.M., Couch, S., et al., 2014. Physical and social home environment in relation to children's overall and home-based physical activity and sedentary time. *Prev. Med.* 66:39–44. <http://dx.doi.org/10.1016/j.ypmed.2014.05.019>.
- Tremblay, M.S., Leblanc, A.G., Carson, V., et al., 2012. Canadian sedentary behaviour guidelines for the early years (aged 0–4 years). *Appl. Physiol. Nutr. Metab.* 37 (2):370–380. <http://dx.doi.org/10.1139/h2012-019>.
- Vandewater, E.A., Park, S.-E., Huang, X., Wartella, E.A., 2005. "No—you can't watch that": parental rules and young children's media use. *Am. Behav. Sci.* 48 (5):608–623. <http://dx.doi.org/10.1177/0002764204271497>.

- Vandewater, E.A., Rideout, V.J., Wartella, E.A., et al., 2007. Digital childhood: electronic media and technology use among infants, toddlers, and preschoolers. *Pediatrics* 119, e1006–e1015.
- Wijtzes, A.I., Jansen, W., Kamphuis, C.B.M., et al., 2012. Increased risk of exceeding entertainment-media guidelines in preschool children from low socioeconomic background: the Generation R Study. *Prev. Med.* 55 (4):325–329. <http://dx.doi.org/10.1016/j.jpmed.2012.07.023>.
- Wijtzes, A.I., Jansen, W., Jaddoe, V.W., et al., 2013. Ethnic background and television viewing time among 4-year-old preschool children: the generation R study. *J. Dev. Behav. Pediatr.* 34 (2):63–71. <http://dx.doi.org/10.1097/DBP.0b013e31827b163a>.
- Xu, H., Wen, L.M., Rissel, C., 2015. Associations of parental influences with physical activity and screen time among young children: a systematic review. *J. Obes.* 2015: 546925. <http://dx.doi.org/10.1155/2015/546925>.