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Evaluation of parental attitudes on the use and effect of technology on physical activity levels in children aged 7 to 11 - A knowledge elicitation study

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ABSTRACT

Aim: The aim of this study was to evaluate parental attitudes to the use and effects of technology on physical activity levels of children aged 7 to 11.
Methods: A web-based questionnaire was completed by parents of 7–11 year-old children who had access to technological devices. Pearson's chi-square test was used to determine if there were differences based on child's gender or parental occupation. Themes were identified and evaluated using content analysis.
Results: There were 197 respondents providing information on 231 children. Children commonly had access to at least 3 devices at home. 53.3% of respondents did not feel that technology use had an impact on the physical activity of their children compared to 46.8% who thought it had a negative effect. There were no difference based on child's gender or parent occupation.
Conclusions: Most parents do not believe that technology use negatively impacts upon their child's physical activity and suggest that enjoyment of physical activity and setting access rules account for this. However, a substantial number believe it has a negative impact and suggest less access to technology would result in an increase to activity levels. Technological interventions that include restrictive mediation approaches and strategies to enhance physical literacy may be beneficial.

1. Introduction

The department of Health and Social Care (Department of Health and Social Care, 2019) define physical activity as bodily movement produced by skeletal muscles that requires energy expenditure. It can take many forms, occurs in many, and has many purposes including daily activity, recreation and sport. Current guidelines recommended that children and young people participate in at least 60 minutes of physical activity a day (Department of Health and Social CareHealth Do, 2019). However Only 48.7% of children in England (Sport England, 2019a), 38% in Scotland (Bardsley et al., 2018), 51% in wales (The National Assembly for Wales, 2019) and 11.9% in Northern Ireland (Northern Ireland Statistics and Research Agency, 2018) met these recommendations. This problem is not restricted to the UK, as low levels of physical activity has been shown to be a global crisis which will likely continue to worsen (Guthold et al., 2018), driven by widening income inequality (Tomkinson et al., 2019). As a result, it is possible that the current generation of children may have a higher risk of developing non-communicable diseases that significantly impact on quality of life and risks premature death (Nechuta et al., 2015).

Currently, there is no consensus on the most effective way to increase childhood physical activity, despite a significant amount of published research. Research has shown that technology can reduce the impact of some key barriers to accessing healthcare (Jansen-Kosterink et al., 2016). A review of the use of technological interventions to improve physical activity suggested they offer 12–25% greater improvement in physical activity levels compared to non-technology interventions in adults; there were no difference between interactive, non-interactive or self-monitoring technologies (Hakala et al., 2016). This may provide an opportunity to draw on technological solutions in future behaviour change interventions to improve childhood physical activity, however, this has not yet been widely studied.

There is disagreement in the literature on whether technology acts as a barrier (Hesketh et al., 2017) or a facilitator (Brockman et al., 2011) to

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physical activity due to concerns about possible effects on children's brains, bodies and their socio-emotional, cognitive and physical development (Alghamdi, 2016) . Mobile applications have been shown to improve motivation to be active, enjoyment and increase number of daily steps and energy expenditure (Ennis, 2013; Epstein et al., 2007; Lyons et al., 2011; Murphy et al., 2009; Ni Mhurchu et al., 2008). However, it is also linked to increased sedentary behaviour, high body mass, poor sleep quality and relationships with family and friends (Fuller et al., 2017; Marsh et al., 2013; Stiglic & Viner, 2019). Parents play a crucial role as gatekeeper to accessing technology and development of digital literacy (Dias et al., 2016). Parents will have their own unique view of the benefits and potential harmful consequences of technology use in childhood, dependent on their own personal use, experience, knowledge, and competence. This will likely inform the availability of technology in their children's lives and the limits, supervision and guidance in place.

Due to the influential role parents play, it is essential that parents' perceptions of the effect of technology use on childhood physical activity levels are considered, and factors that facilitate or diminish physical activity levels are identified. Identification of these factors may have the potential to further our understanding of physical activity behaviours in primary school children and could inform the development of new technological approaches to increase engagement in physical activity, mitigate the negative effects of technology use and inform future policy. The aim of this study is therefore to evaluate parental attitudes to technology use and its effects on physical activity levels on children aged 7 to 11.

2. Methods

2.1. Study design

This was a knowledge elicitation study carried out using a web-based questionnaire, developed by the authors and evaluated for face validity prior to dissemination. (Appendix 1). It was developed iteratively following discussions and piloting within the research team. Participants were recruited through social media platforms and professional group mailing lists over a four-week period, from January to February 2020. Participants were invited to complete the questionnaire if they were the parent or guardian of one or more children aged between 7 and 11 years who had access to technological devices.

2.2. Data analysis

Responses from the questionnaire were downloaded from Google Forms into a spreadsheet and uploaded to SPSS Statistics for Windows (IBM Corp. Released 2016. Version 24.0. Armonk, NY: IBM Corp) which was used to conduct quantatitative analysis of the results. Descriptive statistics were presented, and Pearson's chi-square tests were used to determine if there were differences in responses based on child's gender or parent occupation. Content analysis was used to analyse open ended questions and identify themes which were then analysed in greater detail to identify trends or patterns as per Hsieh and Shannon (Hsieh & Shannon, 2005). Codes and subsequent themes were generated by a single researcher (RB) and were then discussed and verified with other members of the researcher team (MM,FP) and independently verified (AP) who was not involved in the prior processes. There were no disagreements on analysis of the results.

3. Results

3.1. General demographics

There were 197 respondents (n = 168 mothers, n = 20 fathers, n = 8 guardians, n = 1 missing, mean age 40.7 ± 7.9). 130 worked in professional occupations, defined as an occupation which required higher education and/or specialist training and a high degree of knowledge and expertise in the specific field and 45 individuals who worked in manual occupations, defined as an occupation that did not require higher education or specialist training and 20 were unemployed. Most respondents were from the United Kingdom (n = 191, 97%), the remaining were based in mainland Europe (n = 5, 3%). Respondents provided information on 231 children (n = 111 female, n = 117 male, n = 3 missing label of gender) between the ages of 7–11. Most had one child between the ages of 7–11 years (n = 164), some had two (n = 32) and one had three children in this age bracket. An overview of children's ages has been presented in Table 1.

3.2. Access to technology

The most common device used by children was television (n = 196, 84.8%. 95%CI 80.2 to 89.4) followed by tablets (n = 137, 59.3%. 95%CI 53 to 65.6), smart phones (n = 129, 55.8%. 95%CI 49.4 to 62.2) and video games consoles (n = 120, 52%. 95%CI 45.5 to 58.3). Less common were desktop computers (n = 33, 14.3%. 95%CI 9.8 to 18.8), electronic readers (n = 16, 6.9%. 95%CI 3.6 to 10.2), iPods (n = 2, 0.9%. 95%CI -0.3 to 1) and action cameras (n = 1, 0.4%. 95%CI -0.4 to 1.2). The modal number of devices they had access to was three (n = 59, 25.5%. 95%CI 19.9 to 31.1), closely followed by 4 (n = 49, 21.2%. 95%CI 15.9 to 26.5), 3 and 5 devices (n = 38, 16.5%. 95%CI 11.7 to 21.3) 6 (n = 20, 8.7%. 95%CI 5.1 to 12.3), 1 (n = 13, 5.6%. 95% CI2.6 to 8.6), 7 (n = 7, 3%. 95%CI 0.8 to 5.2), 9 (n = 5, 2.2%. 95%CI 0.3 to 4.1) and 8 (n = 2, 0.9%. 95%CI -0.3 to 2.1). There were no differences in the number of devices children had access to based on parental occupation ($\chi^2(8)$ = 7.88, p = 0.45, by child's gender (χ^2 (8) = 11.62, p = 0.16) or by perceived physical activity level (χ^2= (32) 41.87, p = 0.11).

3.3. Perception of time spent physically active each day

Time spent physically active has been presented in Fig. 1. Most children (n = 135, 58.4%. 95%CI 52.0 to 64.8) were active for less than 5 hours a week with the remaining (n = 96, 41.5%. 95%CI 35.2 to 48) active for more than 5 hours.

3.4. Perceptions of effect of technology on children

Over half (53.25% n = 123, 95%CI 46.8 to 59.6) of respondents did not feel that technology use had an impact on the amount of physical activity their children achieved compared to 46.67% (n = 108, 95%CI 40.4 to 53.2) who thought it negatively affected the amount. There were no differences in child's gender (χ^2 (1) = 0.16, p = 0.2)or parent occupation (χ^2 (1) = 0.07, p = 0.1) (Table 2).

Approximately half (51.52%) of the parents felt their children were likely (n = 86) or very likely (n = 33) to choose using their technology devices over being physically active. There was no difference in the number of children likely to choose technology over being physically active based on child's gender χ^2 (4) 4.9, p = 0.3) or parent occupation χ^2 (1) 1.20, p = 0.27 (Table 2).

Just below half (45.9%; n = 106) of respondents thought that their children would be more active if they had less access to technology compared to 29% (n = 67) who did not and 25.1% (n = 58) who were

Table 1
Overview of children ages.

Age	Frequency	Percentage (%)
7	48	20.8
8	40	17.3
9	30	13.0
10	43	18.6
11	53	22.9
Missing	17	7.4
Total	231	100

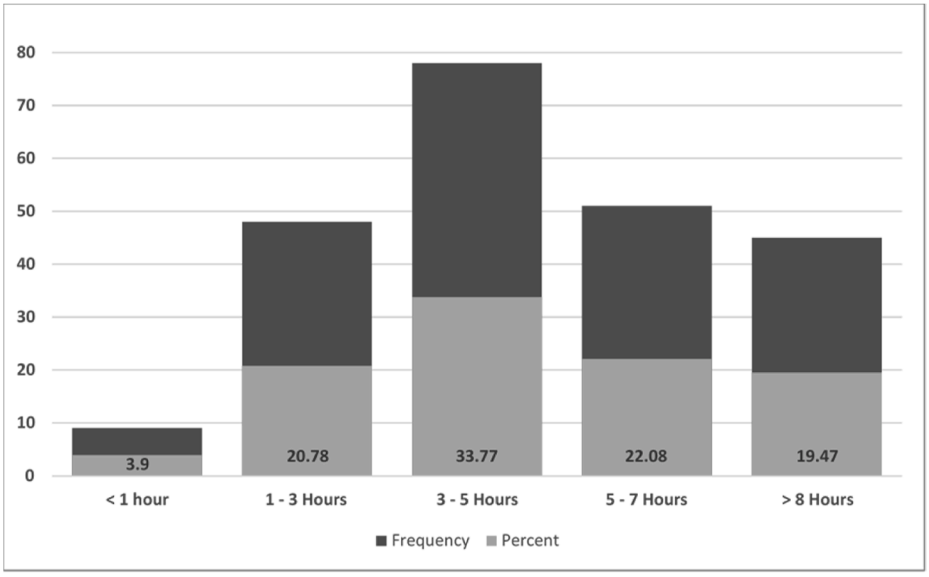

Fig. 1. Parent/Guardian perception of time spent active every week.

Table 2
Differences between child gender and parent occupations on parent perceptions of effects of technology on physical activity.

Does access to technology reduce amount of physical activity your child does?						
	Yes	No				Significance
Female	52 (57.3)	55 (49.7)				0.2
Male	69 (63.7)	50 (55.3)				
Manual	35 (41.4)	42 (35.6)				0.1
Professional	88 (81.6)	64 (70.4)				
How likely is your child to choose technology over being physically active?						
	Never	Very Unlikely	Unlikely	Likely	Very Likely	
Female	4 (4.3)	12 (13.7)	31 (34.6)	45 (39.3)	15 (15.2)	0.3
Male	5 (4.7)	17 (15.3)	42 (38.4)	38 (43.7)	17 (16.8)	
Manual	0 (3)	6 (9.8)	25 (24.9)	30 (28.2)	16 (11.1)	0.27
Professional	9 (6)	23 (19.2)	49 (49.1)	54 (55.8)	17 (21.9)	
Would your child be more active if they had less access to technology?						
	No	Maybe	Yes			
Female	27 (26.5)	24 (30.8)	56 (49.7)			0.94
Male	38 (34.2)	32 (29.5)	49 (55.3)			
Manual	16 (22.2)	22 (19.5)	39 (35.3)			0.15
Professional	50 (43.8)	36 (38.5)	66 (69.7)			

Analysis as per Pearson's Chi Square. Data shown as count (expected count). * indicates significance less than 0.05.

unsure. There were no differences on this based on child's gender χ^2 (2) 0.12 p = 0.94, or by parental occupation type χ^2 (1) 1.48, p = 0.15 (Table 2).

3.4.1. *Parental mediation of technology use*

Analysis of those who reported that they did not believe that access to technology negatively affected the amount of physical activity their children performed suggested that this was in part due to parental mediation, setting rules of access and time limits to use based on 36 comments. This is highlighted best by the following quote:

> "The variety of devices and their availability is very easily accessible today, 24 hours a day in fact. This can be habit forming as (sic) addictive. However as long as sensible time limits are in place and other activities are actively encouraged, their enjoyment of technology is not necessarily unbeneficial (respondent #64)"

&

> "We limit his technology use already, but he is always attempting and asking to get back to a screen in the time when he isn't supposed to be using one … If we take him out and away from screens eg camping or to parties he happily engages in physical activity with other kids, and loves doing sport at school, but at home, the temptation of the screen is always there distracting him (respondent #137)"

Parents who felt that reducing access to technology would lead to an increase in the amount of physical activity completed by their children, suggest this is primarily due to the removal of alternatives to physical activity based on 92 comments. Comments included:

> "Without doubt. If you remove technology from the equation then the main options open to the child revert back to those activities offered to children several decades ago (playing outdoors, hide/seek, cycling to meet friends, football with friends etc …)." (Respondent #138)

&

> "Fewer alternatives to physical activity would help participation in exercise." (Respondent #180)

3.4.2. Intrinsic motivation determines physical activity and technology use

Parents who did not believe that access to technology negatively affected the amount of physical activity their children performed reported that this was due to a perception or a reassurance that their children enjoying being physical activity over using technology (n = 19 comments). This is best encapsulated by the following quote:

> "He is a very active boy, who given the choice would prefer to be running around with a football rather than sitting down. Respondent #181)"
>
> &
>
> "My daughter is very active she does not like sitting around." (respondent #192)

Those who thought that access to technology had a negative effect on the amount of physical activity their children performed suggest that this was likely due to children placing a higher value on time spent with technology over physical activity (n = 92 comments). This is best demonstrated by the following comment:

> "… He doesn't really play independently (not involving a screen) and when his ROBLOX time ends often tries to sneak off and watch YouTube videos of other people playing the same game on his phone!" (Respondent #142)
>
> &
>
> "My child is less motivated to leave the home/go outside and play when watching videos/playing games etc." (Respondent #166)

4. Discussion

4.1. Study aims

The aim of this study was to evaluate parental attitudes to the use and effects of technology on physical activity levels of primary school children. We were able to attract responses from a considerable sample of parents in the UK exploring their children's access to technology, physical activity level and the potential effect of technology use on this. Results demonstrate children regularly access a variety of technological devices on a daily basis. Over half (53.3%) of parents did not feel that technology use had an impact on the amount of physical activity their children, compared to 46.8% of parents who thought it negatively affected the amount of physical activity. There were no differences based on the child's gender or occupation of the parents.

A small majority of parents perceive that their child completes less than 5 hours of physical activity a week, supporting the need for behaviour change interventions aiming to promoting childhood physical activity. Being physically active is positively associated with living a happier, healthier, longer life due to improvements in physical health, mental wellbeing, personal and social development (National Institute for Health and Research, 2019). It has been shown to reduce the risk of developing chronic health conditions such as cardiovascular disease, cancer, dementia, diabetes, anxiety and depression and low back pain (Wen et al., 2011) and is thought to lead to an increase in life expectancy of up to 6.9 years in comparison to those who are physically inactive (Reimers et al., 2012). Due to the link between child and adulthood physical activity levels, it is possible that the current generation of increasingly sedentary children will experience a higher risk of developing non-communicable diseases that significantly impact on quality of life than their predecessors (Nechuta et al., 2015; Telama, 2009). Socially responsible development requires that designers take account of the potential ethical and social consequences of their products and take steps to mitigate these concerns (Nwagbara & Reid, 2013; Guadamillas-Gómez & Donate-Manzanares, 2011). Those who develop emergent technologies need to take into consideration these concerns as they could act as a key barrier to uptake and successful implementation of their applications.

4.2. Access to technology

Most children have access to a least 3 devices, most commonly using television, iPads and smartphone. Our results are consistent with recent reports on children's digital literacy and technology use smartphones (Ofcom, 2019; Organisation for Economic Co-operation and Development, 2019). This supports the view that technology is widely available and used by children, and that technology-based health interventions to promote childhood physical activity is feasible. Further research is required at an individual device level to analyse the variety of hardware and software combinations, and supported applications, identifying those which have potential to encourage healthy behaviours. This may provide the foundations for developing technological approaches to enhance childhood health and wellbeing. An example of emergent technologies that could facilitate this is the use of smart speakers/virtual assistants. This study showed that 34% of children had access to a smart speaker in the home. This is likely to increase in the future as a recent Deloitte report suggested that smart speakers are currently the fastest growing connected device category worldwide and with production costs dropping, their appeal will likely increase (Deloitte, 2019). As families become more comfortable having these integrated virtual assistants in their home, this creates an opportunity for those developing telemedicine solutions to offer customisable and interactive physical activity promotion that can be aimed at the family or individual children.

4.3. Lessons from parents not concerned with Children's technology use

53.25% of parents were not concerned that technology use was negatively impacting their child's physical activity level. These parents frequently reported the importance of parental mediation of their children's technology use. This involves applying co-use, supervision, negotiation, restriction, and monitoring to facilitate, teach and act as a gatekeeper in its use (Nikken & Jansz, 2014; Nikken & Schols, 2015). Reports of restrictive mediation were common in this cohort, many commenting on setting access rules, time limits, and ensuring technology use was balanced with physical activity. This is thought to be common when parents consider that unchecked use could lead to negative behavioural effects (Nikken & Jansz, 2006).

Some parents who report their children's physical activity is not affected by technology use suggest that intrinsic enjoyment of physical activity and sport is crucial. Respondents reported numerous instances of more active children enjoying and independently choosing to play sport, dance, swim or play outdoors over their technological devices. This is in keeping with recent literature which suggests children with higher physical literacy are more likely to meet recommended activity levels (National Institute for Health and Research, 2019). Physical literacy consists of enjoyment, confidence, competence, understanding and knowledge of physical activity. Children who understand why activity is important, enjoy it, have sufficient knowledge and are confident do more than twice the amount of physical activity than those who do not (Sport England, 2019b). As a result, developing approaches to improve physical literacy using technology offers potential to improve children's physical activity levels.

4.4. Parental concerns relating to the effect of technology on physical activity levels

Responses received in this study highlight that a significant number of parents of children (46.67%) are concerned that technology use is having a negative impact on the amount of physical activity completed by children and that less access to technology would lead to significant improvement in activity levels. Comments suggested that this concern

rises from a widely reported belief that children enjoy technology use so much that they are increasingly likely to select interaction with technology than participating in physical activity or sport. It is also possible that some parents are less willing, able to, or confident in, mediating their child's technology use. It is not known why some parents are able to effectively mediate their child's use and others are not from our results; further evaluation of this is necessitated.

Our findings suggest there is a need to support parents in mediating time spent using technology and to incorporate appropriate health promotion strategies to improve physical literacy within their technologies. Failure to do so, could be counterproductive in terms of physical activity promotion. The potential negative effects of technology use on physical activity could be mediated with pre-set access rules, time limits within applications, offer rewards/bonuses related to completed or supplement content with health promotion messages.

Parents have indicated that restrictive mediation was acceptable and can be successful in enabling access to technology, while reducing potential negative consequences of its use. This is consistent with previous research has also shown that children were likely to follow rules that constrain technology use (Hiniker et al., 2016). Parents, especially those who are less able to mediate their child's technology use, may benefit from interventions that empower, educate, and provide ongoing feedback on its implementation and use. Although some technologies include options to set time limits or access controls, it may not always be obvious or simple to do for those who are not technology savvy, simplifying this process would support these parents. Those developing physical activity interventions should engage with parents and children as end users, and conduct further research and testing on the acceptability, feasibility of, and most effective solutions for introducing restrictive mediation options within their technologies.

4.5. Limitations

Understanding the motivators, facilitators, and barriers to physical activity, especially in childhood, is a complex endeavour and technology use is one of several potential factors that need to be considered. Reducing access to, or mediating technology use may not necessarily lead to increased physical activity as children could choose to do other sedentary activities or hobbies. Those developing interventions to improve childhood physical activity also need to consider other physical, social, and economic factors that can impact on physical activity reported elsewhere in public health literature.

Although parent occupation was considered and this can give an insight into socioeconomic status of the respondents and children in this study, it is limited by lack of inclusion of more detailed socioeconomic data. Most respondents worked in professional occupations which could suggest the sample has a higher number of those from a medium to higher socioeconomic status. Also, as the questionnaire was only available online, it may have preferentially recruited respondents who regularly use and are comfortable with technology. Further research of a similar nature with a focus on inclusion of families from lower socioeconomic statuses, available in alternative formats, would be beneficial.

This questionnaire was conducted in January and February 2020, prior to the onset of COVID-19. Considering the use of technology for home schooling, increased time spent at home, closure of sports and physical activity facilities and challenges for parents balancing childcare and working from home, and possible toll lockdown had on mental health of the population, it is likely that children would have increased their technology use. Research to explore the impact of Covid-19 on children's physical activity and technology is required.

5. Conclusion

Findings from this study add to our understanding of the physical activity behaviours of primary school children in the UK, and could be used to increase engagement in physical activity using technology, mitigate the negative effects of technology use and inform future policy. It indicates that children regularly access a variety of technological devices on a daily basis. A majority of parents do not believe that technology use negatively impacts upon physical activity, suggesting that their child's enjoyment of physical activity and setting access rules and time limits account for this. However, a substantial number are concerned that children's affinity for, and high usage of technology is having a negative impact on their physical activity levels. These parents believe less access to technology would result in an increase to activity levels, often reporting their children gain greater enjoyment from technology use than from physical activity. Those that are developing interventions to improve childhood physical activity should be aware of the potential negative consequences of it use. They may also consider designing interventions that include strategies to include restrictive mediation approaches and enhance physical literacy.

Ethical Approval

Ethical approval for this study was granted by the School of Allied Health Professions Student's Ethics committe, Keele University.

Consent

The dataset used and analysed in this study is available upon request from the corresponding author.

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Author contribution

RB led in study conception, data collection and analysis and contributed to the writing of the manuscript. FP was involved in data analysis, drafting of the manuscript and carried out significant revisions. AP was involved in data analysis and interpretation, drafting of the manuscript, and carried out significant revisions. MM was involved in study conception, data analysis and drafting of the manuscript. All authors read and approved the final manuscript.

CRediT authorship contribution statement

Beech Robert: Conceptualization, Formal analysis, Writing – original draft, led in study conception, data collection and analysis and contributed to the writing of the manuscript. **Philp Fraser:** Writing – original draft, was involved in drafting of the manuscript and carried out significant revisions. **Pandyan Anand David:** Formal analysis, Writing – original draft, was involved in data analysis and interpretation, drafting of the manuscript, and carried out significant revisions. **McCluskey Michael:** Conceptualization, Formal analysis, Writing – original draft, was involved in study conception, data analysis and drafting of the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: In accordance with Elsevier policy and my ethical obligation as a researcher, I am reporting that Professor Anand Pandyan has received unrestricted educational support from Allergan and Biometrics Ltd., and Honorarium payments from Allergan, Biometrics Ltd, Ipsen, and Merz. These companies are unlikely to be affected by the research reported in the enclosed paper. I have disclosed those interests fully to Elsevier, and I have in place an approved plan for managing any potential conflicts

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Appendix A. Supplementary data

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