An Online Questionnaire Investigating Children's Postures and Usage of Personal Electronic Devices

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ABSTRACT

There has been a rapid development of computer technology which has seen a large increase in adults using personal electronic devices (PEDs) including laptops, tablets, mobile phones and desktops both for work and in their personal lives. In a similar vein, children have also increased their use of technology. Despite this, to date, there has been little research exploring children's self-reported postures whilst using their PEDs. The aim of this study was to use an online questionnaire to explore the ergonomic positions adopted by children aged 7-17 when using PEDs. Participants were recruited via social media, schools and posters. N=413 were included in the final analysis. The results indicate that children are using more portable handheld devices, smartphones and tablets compared with static devices, such as desktop computers and laptops. Over 80% of the participants reported using their PEDs for homework. The most commonly adopted position when using a PED was sitting on the sofa. The results show that children are reporting adopting less or non-ergonomic positions when using PEDs, using them for long periods, and not taking regular breaks. These findings raise questions around the relationship between device usage and posture as well as how to support children's safe use of devices at home.

KEYWORDS

Children's Device Usage, Ergonomic, Mobile technologies

Introduction

There has been a rapid development of computer technology which has seen a large increase in adults using personal electronic devices (PEDs) (including desktop computers, laptops, game consoles, mobile phones, and tablets) for both for work and in their personal lives (Piranveyseh et al., 2016, Ardahan et al., 2016). There are a number of studies that have looked at how adults are using PEDs and which have compared sitting and standing postures when using PEDs (D'Anna et al., 2018; Lee, Lee, & Han, 2016; Yu, James, Edwards, & Snodgrass, 2018). The study by D'Anna et al. (2018) looked at head and neck positions when using a smartphone in both sitting and standing and showed that the increased flexion of the neck which may be a risk factor of using a smartphone similarly. A previous study by Lee, Lee, & Han (2016) reached the same conclusion. Lee et al. (2016) found when in sitting, using a tablet or laptop may increase neck flexion, potentially increasing postural strain, whereas, this was not the case when using a desktop. This is proposed to be due to the static position of the monitor. Yu et al. (2018) concluded that when using a tablet or laptop adjustments to postures should be considered. None of these studies examined multiple devices and multiple positions which PEDs can be used in, apart from sitting at a desk and standing.

In line with the increase in adult usage over the last decade, the use of PEDs; has also increased rapidly in both children and adolescents (Straker, Pollock, Zubrick, & Kurinczuk, 2006; Ofcom, 2016). Furthermore, there has been a notable growth in children using devices to go online. For example, in children aged 8-11 years old, there has been a rise in online usage in just one year (84% in 2017 to 93% in 2018) (Ofcom, 2017, 2019). It is hypothesised that this is due to the increase in the use of more mobile devices such as tablet and smartphones (ONS, 2018). The latest Ofcom (2019) online survey reported that 83% of 12-15 year olds own their own smartphones and 59% own their own tablet which is an increase of 18% compared with the Ofcom 2018 report. In children aged 8-11 years olds, 37% were reported to own a smartphone, a 5.6% increase from the previous year and 49% reported they own a tablet, which is unchanged from the previous report. Further to this 81% of 12-15 year olds reported playing videos games for over 11 hours per week and 99% going online for up to 12 hours per week, this includes (but not limited too) homework, gaming, and social media (Ofcom, 2019). Online gaming is becoming more popular; 59% of 5-15s now play games online, increasing from 53% since 2018 and 45% five years ago. This increase in 2019 was driven by both 8-11s (66% vs. 58% in 2018) and 12-15s (72% vs. 66% in 2018).

It is important to investigate whether there are any potential risk factors which could be associated with the reported increase in technology usage in children. It has been highlighted that children's usage of PEDs could be a potential risk factor on their musculoskeletal system and posture, however, it is unclear if there are any detrimental long-term effects to children health's (Binboğa, Elif, & Korhan, 2014). Studies conducted by Straker et al. (2008), Noack-Cooper et al. (2009) and Kelly et al. (2009) found an association between PEDs and poor sitting posture, both via a questionnaire and lab-based studies observing laptops and computers usage but not looking at more common portable devices which are more likely to be used by children today. Both Straker et al. (2008) and Howie et al. (2017) considered postural differences of participants when using technology. Straker et al. (2008) found that there was a higher muscle activity and asymmetry in the truck and shoulders occurred throughout tablet use relative to desktop usage. The change in posture was also implied in the findings of Howie et al. (2017) determined that there was a displayed greater mean head, trunk, and upper arm angles in children while using a tablet than while playing with toys or watching television. In general, the studies have relatively low subject numbers and do not look at a multiple of device usage therefore further research is needed in looking at children posture and thus ergonomics when using a variety of different PEDs.

Despite increases in usage and hypothesised changes in body posture whilst using PEDs, there is a lack of evidence of children using a wide variety of PEDs and the positions they are using them in. This paper is part of a larger study which is aimed at exploring PED usage patterns and musculoskeletal pain. However, in this paper, we report on the results of an online questionnaire which was designed to explore the ergonomic positions adopted by children aged 7-17 when using personal electronic devices.

Methods

This study consisted of an online questionnaire exploring the PED usage of children, aged 7-17 years old; the type of device used, how and where they are using the devices, how long they are on a device, and what they are doing when on a device.

Ethical approval for this study was granted by the School of Health and Society Research Panel at the University of Salford, UK (Reference: HSR1819-028)

The Questionnaire Design

There is currently a lack of validated questionnaires which explore these topics with 7-17 years olds, therefore a combination of existing questionnaires and new questions were utilised and developed. The validated questionnaires used were the computer usage questionnaire (Smith, 2007) and the teen Nordic questionnaire (TNMQ-S) (Legault, Cantin & Descarreaux, 2014).

The Nordic questionnaire is a standardised questionnaire allowing comparison of general musculoskeletal complaints, shoulder, neck and low back pain and the impact of these complaints on daily and working life (Kuorinka et al. 1987). The questionnaire was developed as a research tool for use in adults and not children but not for clinical diagnoses and (Palmer et al., 1999). Legault et al. (2014) developed the Teen Nordic questionnaire (TNMQ-S); which when tested suggests that this questionnaire results, when selfadministered to adolescents of 10 to 19 years of age, are reliable. The TNMQ-S was originally written in French, the questionnaire was translated into English for this study (Tsang et al., 2017). The computer usage questionnaire (CUQ), was developed by Smith (2007) to explore how children were being exposed to computers, the positions in which they were using them and if they reported taking a regular break when on the device. To further explore this topic the researcher added an additional section to the online questionnaire. These questions were included to gather information on PED usage (in the home and at school, and what they are using them for, how long they are using them for), the position the child is normally using PEDs (sat on the sofa, lying down, kneeling etc e.g. "What position are you in when using your personal electronic device?") to allow a better understanding of ergonomics when using PEDs and preventative measures the participants may be taking i.e. taking regular breaks.

Questionnaire Validation Study

In order to ensure whether the new questionnaire was suitable for use and showed good levels of usability, a test-retest validation study was conducted (Christodoulo et al., 2015). This study was guided by the work of Peat (2001) who developed nine steps to help improve the internal validity of a questionnaire by testing it on the target audience. A convenience sample of schools was used to recruit participants. The questionnaire was piloted using a small sample (n=60 at time point one, and n=51 at time point two (28% attrition) of mixed gender children from one primary and one secondary school (aged between 7-15 years old)). From the findings of the validation study the wording of n=51 questions required changing (e.g. male and female was changed to boy and girl to support the understanding of the younger participants). No other changes were made, and the length of time it took to complete the questionnaire was seen as acceptable to those who took part.

Participants recruitment

The study consisted of a purposive and opportunistic sample recruited via schools and social media over six months in 2019. Participants were recruited via four different routes:

- Schools an email was sent to primary/secondary schools and colleges to recruit 7-17 years old's,
- Social media due to the age restrictions on social media platforms (Facebook, Twitter and Instagram) where users need to be 13 years or older, this form of recruitment targeted 13-17 years old and parents of children above the ages of 7,
- Posters around the University of Salford targeting parents of 7 17 years old's,
- Cardinus Risk Management Ltd networks targeting parents of 7 17 years old's.

Recruitment methods were designed to be age-appropriate and in line with any relevant regulation (e.g. for social media platforms). Consent was obtained digitally at the start of the questionnaire from the participant and the participants, who also had to indicate that their parent/guardian had consented to them participating in the study. To support the informed consent for children of different ages and ability, an animated video was developed for the participants to watch covering the information included in the participation information sheet. Previous research has found that videos are more acceptable than the written versions of information sheets for children (Harris & Porcellato, 2018). Each question also had an audio option.

Participants were included if they were between the ages of 7 to 17, lived in the UK and if they completed and answered "yes" to all of the consent questions.

Once the questionnaire closed the data was downloaded and analysed using SPSS statistical software, SPSS version 21 for Windows (Inc, Chicago, IL), using logistic regression and correlation analysis.

Results

Overall, there were n=503 responses with n=413 meeting the inclusion criteria and being included in the analysis (loss of 17.89%). Participants were excluded if they answered no to any of the consent questions or did not meet the inclusion criteria outlined above. Within the sample, n=224 were females and n=189 were males; the mean age was 11.9; with a standard deviation of 3.3 years) who all lived in the UK. The age range of the participants was compatible with the percentage of the UK population for each age included in the study. (E.g. age 7 - % of those who took part 8.5%, UK population aged 7 =9.9% - age 15 - % of those who took part 10.1%, UK population aged 15 = 8.4%). Looking at the data related to the gender of those who responded, 54.2% were males (n=224) and 45.8% (n=189) were females.

For both genders there was a large percentage who reported they did not use a desktop computer (male= 34.38%, female= 36.73%); with games consoles being more widely used by males (90.18%) compared to females (55.11%). The results show that children are using more portable devices such as smartphones (n=328; 79.42%) and tablets (n=310; 75.06%), with tablets being the most commonly used across the age groups. This compared with lower rates of reported static devices usage, for desktop computers (n=196; 47.46%) and laptops (n=268; 64.89%). Within the sample, n=341 (82.57%) of the participants reported using their PEDs for homework, showing they play an important part of their education outside of school, as well as being used for leisure purposes.

Looking at primary and secondary school children, on average the primary children's (7 - 11 year olds) PED reported usage, on average, was 3.37 hours at school and 1.61 hours out of school and the secondary children (12-17 year old's) spend an average of 4.93 hours whilst at school on PED devices and 2.98 hours out of school. This shows a significant increase (p=0.002) in time using a device from primary school-aged children to secondary age children. This could be due to the potential access of children having devices and the freedom of them being able to use devices throughout the age groups.

Looking more in-depth at the difference between ages, for the youngest in the sample (n=39, 7 year olds), n=30 (76.9%) reported using a tablet daily (on a normal school day), with only n=7 (17.95%) using a smartphone, n=11 (28.21%) using a laptop and n=20 (51.28%) desktop. Showing that even with the younger age there is a high percentage using PEDs, and

this was reported to be often to allow them to do their homework (n=25 (64.1%) reported they used a PED to do homework). Looking at the participants aged 15 years old (n=35), thus still in full-time education (in the UK children must attend an educational setting until the end of year 11, (15 or 16 year olds) but after that point can start work or/and apprenticeship if not continuing full time education, therefore participants aged-16-17 who answered this questionnaire may not have been in education and not doing homework), n= 20 (57.14%) used a tablet daily, on a normal school day, n= 28 (80%) using a smartphone compared with n=17 (48.57%) for laptop and n=18 (51.42%) desktops. All participants in this age group reported doing homework on a PED.

In terms of the ergonomic findings and the positions the participant reported that they adopted when using the device, it was found, that this differed depending on the device and how static or portable it was. As can be seen in Table 1 it was more common for a casual position to be adopted when using portable devices, e.g. tablet and smartphone, with most doing so sitting on the sofa. In comparison if they reported using a static device e.g. laptop, they were found to report being more likely to sit in a more ergonomically advised position; at a desk with a chair.

Table 1: Positions participants adopted when using PEDs (all participants answered that they only sat at a desk when using a desktop computer, therefore desktop computer was not included in this table)

Position adopted	Laptop	Tablet	Smartphone
	(11-288)	(11-310)	(11-520)
Sitting at a desk	192 (67.13%)	56 (18.06%)	57 (17.38%)
Sitting on the sofa	115 (40.21%)	256 (82.58%)	283 (86.28%)
Lying prone on the floor	45 (15.73%)	140 (45.16%)	171 (52.13%)
Lying supine on the floor	35 (12.23%)	134 (43.23%)	193 (58.84%)
Sat on the floor	30 (10.49%)	68 (21.94%)	145 (44.21%)
In the car	5 (1.75%)	101 (32.58%)	189 (57.62%)

Children's smartphone usage showed the greater versatility of adapting different posture across the positions. Over 50% of children reported adapting their positions when using a smartphone, except when sitting at a desk or sitting on the floor, showing that the smartphone usage was more adaptive to different positions. The results also showed that n=155 (47.26%) of children used their smartphones when they were walking about.

Despite reporting they were often using devices for long periods at a time, around a third of those who took part (n=121, 29.28%) reported not taking regular breaks of a few minutes at least once an hour. It was found that the lack of breaks, which can support recovery from poor posture, increased with age – with only n=7/39 (17.95%) of the 7 year olds reporting that they did not take regular breaks compared with n=15/29 (51.72%) of the 16 year olds.

Discussion

This online questionnaire is the first nationwide questionnaire to explore self-reported PEDs usage in UK children aged 7 -1 7 years. The findings have added to the current knowledge, providing new information on the usage of PEDS within UK children, what positions they are adopting whilst using these devices and behaviours whilst using devices such as length of time and number of breaks. Children are using more mobile PEDs, tablets and smartphones, compared to more static PEDs, laptops and desktops, which are more commonly used in the school (Ofcom, 2019). The results have shown that less than half of children aged 7-17 years

use a desktop, but over three-quarters use a tablet device. With over 80% of the participants reporting using PEDs for homework but under 50% report owning a desktop computer, it can be deduced that they are using a mobile device to complete homework.

The results show that children are using more portable handheld devices, smartphones and tablets, (tablets were the most commonly used across the age groups) compared with more static devices, such as desktop computers and laptops. When using portable PEDs, only a small number of participants sat at a desk, with the most commonly adopted position being sat on a sofa, lying prone or supine. These positions were adopted despite a high number of participants reporting that they completed homework on the PED. Overall, it can be seen that children are potentially adopting less or non-ergonomic positions when using PEDs, at times for long periods.

The results have shown that 7 year olds are more likely to take a break when using PEDS compared with 16 year olds. There could many potential reasons for this. The question on the questionnaire asked if they took breaks for a few minutes once an hour, but what was not determined is how long on average a 7 year old spends on a device at one time, on average a 7 year old has a concentration span approximate of up to 24 minutes (Eccles, 1999), therefore the likelihood of them needing to take regular breaks is higher than for a teenager. In this questionnaire, the 16 year olds reported the highest percentage of not taking frequent breaks when using their PEDS. The questionnaire was run from April-October 2019 which is over the exam period in the UK for 15-16 year olds, GCSE's in 2019 was 13/05/2019 - 21/06/2019 with an extended period of revision prior to this. Therefore, the change of this age group increasing their PED usage but decreasing their breaks could be down to exams pressure, similarly, this may translate to when they become adults experiencing pressure in the workplace (Hannan et al., 2005). As a result, education is important from an early age on the benefits of taking regular breaks, on both mental and physical wellbeing, when using PEDs (Holley, Wilson & Palermo, 2017).

Limitations

Although the questionnaire response rate was high there are some potential limitations around reporting. Within the questionnaire, there is likely to have been an element of over or underreporting. For example, the participants might have underestimated the amount of time they spent on a PED. There is a potential that the questionnaire has not reached all of the targeted population – online questionnaires require the participant to have access to a PED which has the internet. However, for this study we are only interested in participants who use PEDs and the likelihood of them having the internet is high, so this is predicted to be a relatively low limit to the study but still needs to be acknowledged as a limitation.

The questionnaire did not explore the exact position adopted by participants when they were sat on the sofa. As there are different positions which could be adopted, some have the potential to be more ergonomic than others, for example i.e. sitting upright with feet flat on the floor compared to side sitting with feet elevated. Given this limitation, further work could explore the positions adopted in different settings.

Conclusion

The outcomes of the questionnaire support the latest data which shows that children are frequently using PEDs, and there is a trend away from static systems (e.g. desktop computers). The results inform our current understanding of how children position themselves when they use PEDs, highlighting that children are using PEDs to do their homework but not sitting at a workstation, i.e. sitting at a desk. These findings raise questions

on the relationship between device usage, posture whilst using devices, and the risk factors for children related to these and future postural or musculoskeletal pain issues. It also leads to questions around how to support children to safely use devices at home when more learning and homework is digital, as children today have never known life without the internet. There is also a need to develop ways to make children and parents more aware of potential risk factors and ways to mitigate these. To support this more research is needed in this area, to determine the risk factors to children of children's posture when using PEDs.

Funding Acknowledgements

The PhD is co-funded by the University of Salford and Cardinus Risk Management Limited.

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