Movement, posture and muscle activity in young children using tablet computers

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1. Mobile touch screen device use by children is an emerging ergonomics issue

Mobile touch screen devices (MTSD), such as tablet computers and smart phones, are rapidly becoming accessible to children. Over 90\% of Australians aged 18-34 years (common age for parents of young children) were using a MTSD to access the internet in 2014,\textsuperscript{1} suggesting most young children have access to these devices in families. Recent USA data show access to MTSD in families with 0-8 year old children rose rapidly from 52\% in 2011 to 75\% in 2013.\textsuperscript{2} Preliminary data from Australia show that in 2014, 63.7\% of 0-5 year old children had used a tablet computer and 45.6\% had used a mobile phone. Notably, 48\% had used a tablet computer for more than 30 minutes on weekdays and 24\% for more than 30 minutes on weekends.

This growing MTSD use has likely musculoskeletal implications for children as previous generations of technology have been shown to have musculoskeletal implications. In 2000, we published a study on computer use and musculoskeletal symptoms in school children, and found that 60\% of children reported discomfort using laptops.\textsuperscript{3} The development of computer-related discomfort/soreness is thought to be due to awkward, sustained postures and greater, sustained muscle activity.\textsuperscript{4} Given the observable awkward postures and durations of MTSD use, discomfort in the neck and back in particular are likely, as shown in a survey of adolescents,\textsuperscript{5} although this may be offset by the mobility of MTSD which may increase variation in postures.

The mean task postures and muscle activity during computer use are thought to be important in musculoskeletal symptom development\textsuperscript{6} and the earliest research on the ergonomics of children using computers found poor postures and raised muscle activity levels during desktop computer use.\textsuperscript{7} The variation of task postures and muscle activity during computer use is also thought to be important in musculoskeletal symptom development\textsuperscript{8} and we have shown increased monotony of posture and muscle activity during desktop computer use in laboratory studies and in all-day field measurement studies.\textsuperscript{9} Our early research on laptop computers showed increased neck flexion and cervical erector spinae and upper trapezius activity with laptop use compared with desktop computer use.\textsuperscript{10} The majority of research to date has been on desktop and laptop computers and not on the new generation of MTSD, despite their growing use. In 2008, we published the first (and to date only) study examining the posture and muscle activity of children using tablet computers (stylus input, at a desk).\textsuperscript{11} We found less neutral spinal postures and higher activity in upper trapezius and cervical erector spine muscles during tablet use by 5-6 year old children, suggesting an increased risk of musculoskeletal symptoms. As yet there are no studies reporting on the postures and the muscle activities of children using current touch screen tablets – which are likely different from those we studied in 2008 – either sitting at a desk or any other common position of use.

1.1 Study aim

Given the indications of rapidly rising MTSD use by children and the potential for early increases in risk of musculoskeletal symptoms, this study aimed to compare the arm movement, upper limb and trunk posture and neck/shoulder muscle activity of young children using a tablet computer with other typical childhood tasks of playing with toys and watching television.

2. Methods

2.1 Design and participants

This study was a within subject, randomized trial approved by Curtin University Human Research Ethics Committee with written informed consent obtained from all parents. Five children aged between 3 and 5 years [height mean 104.5 ±3.8°cm and mass mean 18.5 ±2.6°kg] completed three conditions (15 minutes each) in a balanced, randomized order; 1) playing with traditional age appropriate toys to simulate free play environment (e.g. drawing/crafts, trains, toy cars), 2) playing with iPad2 (Apple, Cupertino, USA) with a range of age appropriate apps and 3) viewing television with a range of age appropriate programs.
2.2 Dependent variables

Dependent variables included mean and variation in dominant arm hand movement (ActiGraph GT3X+), wrist, thorax and head posture (Vicon motion analysis; Oxford metrics, Oxford, UK) and upper trapezius muscle activity (Delsys wireless EMG system, Delsys inc. Natick, USA).

3. Results

Preliminary results suggest there was more hand movement during tablet play than during television viewing, but less than during toy play (Fig. 1a). However repetitive wrist movements were observed during tablet play (Fig. 1b) (note: absolute degrees are offset to allow simultaneous display of 3 conditions).

There was greater mean and variation (error bars) in upper trapezius muscle activity during tablet play than television viewing, although less than when playing with traditional toys (Fig. 2a). The mean neck flexion during tablet play was greater than the other conditions (Fig. 2b). The thorax was also more flexed during tablet play (20.0° ±10.2) than when playing with toys (11.7° ±15.2) or watching television (13.3° ±2.5).

Figure 1 Dominant wrist movement of 3-5 year olds watching TV, using a tablet computer and playing with toys.

Figure 2a) Dominant hand upper trapezius mean (error bars are variability) muscle activity (mV) and b) mean (error bars are variability) global head position (°, normalised to head position during TV condition) of 3-5 year olds watching TV, using a tablet computer and playing with toys.
4. Conclusion

Tablet computer use by young children is typified by less movement, muscle activity and poor spinal posture than toy play and some repetitive wrist movements; all of which may increase the risk of musculoskeletal symptom development.

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References