

Risks of Improper Tablet Computer Usage in the Elderly

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Abstract: Tablet computer usage in elderly populations has been shown to have a multitude of benefits, including but not limited to applications in post-stroke rehabilitation, and reduction of the cognitive declines associated with ageing. Research on tablet related injuries caused by improper tablet usage in older generations is sparse compared to those of younger generations. Through a literary review, this paper explores the potential risks faced by elderly tablet users. It is found elderly tablet users are at higher risk of more severe Musculoskeletal Disorders possibly resulting in permanent pain, headaches, insomnia, and all health risks associated with insomnia, including depression, strokes, and dementia.

Introduction

The rise to popularity of tablet computers since the iPad's release in 2010 has resulted in a considerable amount of research being conducted on the health effects of such devices. The positive effects of tablet computer use cannot be understated, especially for older generations where a recent study has shown tablet use to potentially reduce or delay cognitive changes associated with ageing (Vaportzis, Martin and Gow, 2017). Tablet use has also shown cognitive improvements in patients with Mild Cognitive Impairment, which is associated with a high risk of dementia (Djabelkhir et al., 2017). However, a not insignificant number of studies have also highlighted the risks associated with improper tablet usage.

Improper tablet usage has been documented to cause a multitude of problems in people of all demographics. Injuries range from neck and upper extremity discomfort (Bair, Gama and Toberman, 2015), flexed and asymmetrical spinal postures (Straker et al., 2018), lower back pain (Shan et al., 2013), and headaches (Torsheim et al., 2010). Symptoms from improper tablet usage are much more prevalent in females compared to males (Lee et al., 2018).

Despite the proliferation of research into risks of injury due to improper tablet use, very little research has been conducted on the direct risks that incorrect tablet usage poses to elderly generations. The lack of coverage of this niche may be due to a number of reasons. The elderly have seen a much slower to uptake in the

adoption of newer technology (Ji et al., 2010), thus fewer are available to take part in large-scale studies. Understanding the risks posed by the incorrect use of tablet computers by an ever increasing number of elderly people users cannot be understated.

In this paper, we aim to highlight the risks faced by tablet users, especially the elderly, through a literature review of recent scientific writing. Specifically covering the topics of common tablet injuries, which demographics are most likely to suffer from tablet injuries, why the elderly are more at risk, and what can be done to mitigate tablet related injuries in the elderly.

Common Tablet Injuries

Musculoskeletal Disorder

Musculoskeletal disorders (MSDs) are soft-tissue injuries caused by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions (Cdc.gov, 2018). MSDs are the most common form of ailment caused by improper tablet usage. MSDs can affect muscles, nerves, tendons, joint and cartilage in upper and lower limbs, neck and lower back contributing to a wide range of issues.

The most sensationalised tablet related injury fits within the MSD classification, "iPad Neck", sometimes referred to as "iHunch". iPad neck refers to a spinal problem of an excessively kyphotic thoracic spine resulting in neck pain and cervicogenic headache, similar to Dowager's hump as seen in Fig. 1. The forward sitting head posture and forward poking chin

can result in a compressive load on the cervical facet joints predisposed to acute joint locking episodes with pain and movement loss (Jackson, 2010). Researchers have found that bending the head at an angle of 60 degrees puts an extra 60 lbs (27kg) worth of pressure on the spine above the shoulders (Hansraj, 2014).



Fig. 1. A comparison of a natural head position at 0 degrees experiencing 10-12 lbs of pressure (left), and a head in a 60 degree forward position experiencing 60 lbs of pressure (right) (Hansraj, 2014).

In addition to iPad neck, the regularity of lower back pain is increasing. During the period of 2015 to 2016, reported rates of pain in the lower back increased from 28% to 45% in young adults. Users of tablet computers tend to slouch or use their tablet in unnatural positions for long periods of time (Lee et al., 2018). Tension built up when sat in unnatural positions is not limited to the back and has been linked to weight gain, constipation, heartburn, migraines, respiratory conditions (Lee et al., 2010).

MSD symptoms are present in 46% of college ages students, 33% reporting persistent neck pain (Kanchanomai et al., 2011). In the general population, the estimated 1-year incidence of neck pain from available studies ranges between 10.4% and 21.3% with a higher incidence noted in office and computer workers (Hoy et al., 2010).

Lee et al. (2018) conducted a cross-sectional survey of 412 people within a university population. Lee et al (2018) found that men and women experience musculoskeletal symptoms differently. Women experience musculoskeletal pain primarily in the regions of their upper backs and shoulders whereas men

primarily experience pain around the head region as shown in Fig. 2.

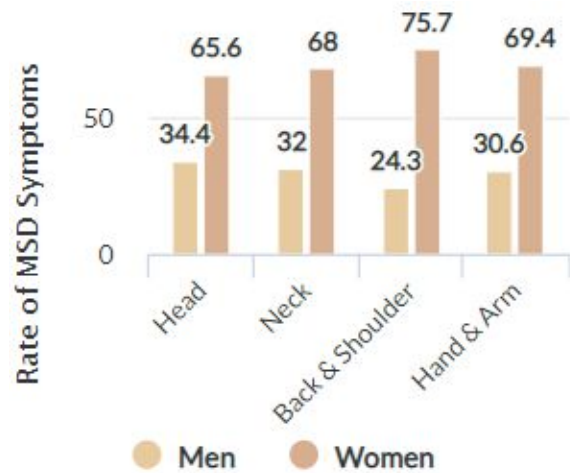


Fig. 2. Most common regions of Musculoskeletal pain (Lee et al. 2018).

Lee et al. (2018) discovered rates of MSDs vary depending on length of time using the tablet, ranging from 62.8% of participants showing symptoms when using their tablet less than 3 hours daily to 75.8% of participants showing symptoms when using their tablet for more than 6 hours daily, as shown in Fig 3. Posture when using the tablet device also affects rates of MSDs, 78.8% of participants reported symptoms when lying on their side, 76% reported symptoms when sitting on the floor, and 67.7% reported symptoms while seated on a couch or on a chair as shown in Fig. 4. The largest difference in rates of MSDs symptoms came from sitting posture, using a tablet with no back support resulted in 78.8% of participants reporting symptoms of MSDs compared to only 65.5% of participants that used a tablet stand as seen in Fig. 5.

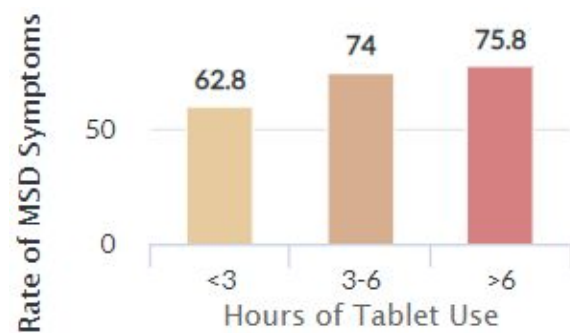


Fig. 3. Rates of musculoskeletal pain with increasing tablet usage time. (Lee et al. 2018).

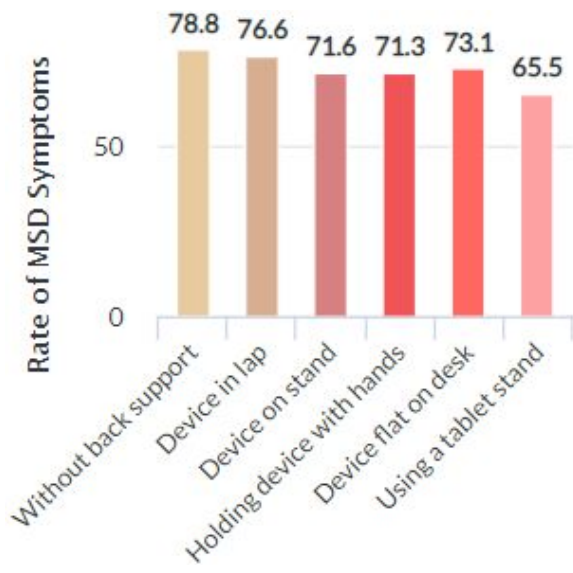


Fig. 4. Rates of musculoskeletal pain with various sitting positions. (Lee et al. 2018).

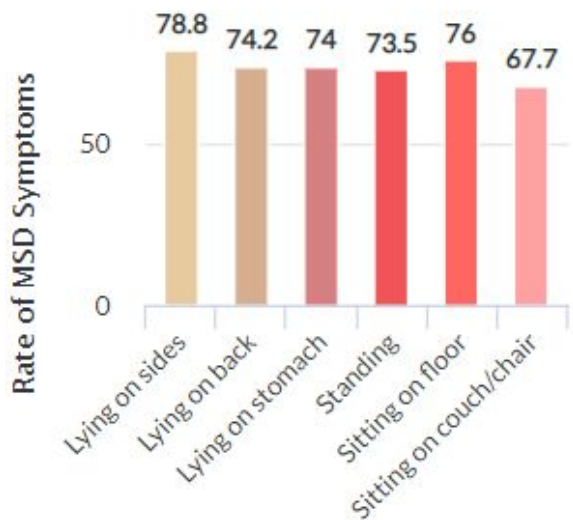


Fig. 5. Rates of musculoskeletal pain with various sitting postures. (Lee et al. 2018).

Women appear to be the primary victims of MSDs caused by tablet usage. As seen in Fig. 6., 70.1% of women that took part in the survey conducted by Lee et al (2018) reported symptoms of MSDs, where only 29.9% of men reported symptoms. The risk factor was also reported to be higher in women than men with 72.8% of women at risk and only 59.8% of men. These gendered findings by Lee et al (2018) are not the first, a study published by Shan et al (2013) of high school students in

China showed girls are especially susceptible to specific musculoskeletal disorders. The likelihood of women and girls developing neck pain is especially serious as women and girls are less likely to recover from neck pain (Skillgate et al., 2012).

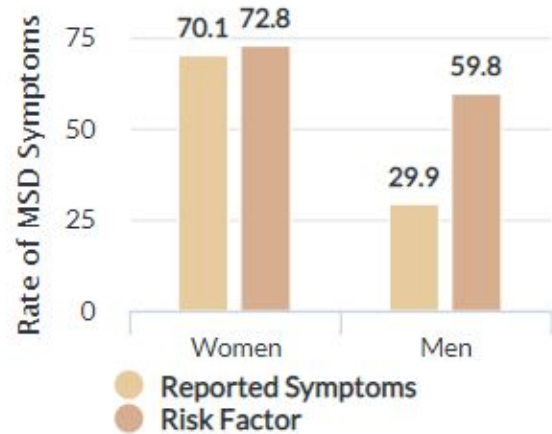


Fig. 6. Rates of musculoskeletal disorder symptoms and the risk factor for each gender. (Lee et al. 2018).

To explain the difference in rates of MSDs, Lee et al (2018) state “Gender differences in anthropometry and biomechanics may explain the disparity in neck and shoulder musculoskeletal symptoms”. Women, when using a tablet computer, have significantly higher normalised keyboard actuation force than men and tend to have higher muscle activities with less neutral shoulder positions. The unnatural shoulder positions and high normalised keyboard forces are due to shoulder width and arm length being significantly negatively correlated with normalised typing forces (Won et al., 2009). When holding the tablet women are also at a disadvantage due to their generally lower muscle strength and smaller body size (Lee et al., 2018). Even though tablet computers are excessively heavy, a tablet’s weight becomes significant when held for an increased period of time.

Tendonitis

Tendonitis is the inflammation of a tendon, generally occurring when a person overuses a tendon. Classically plaguing athletes, examples of widely known Tendonitis

injuries include Tennis Elbow or Cricketers Shoulder (Ranson and Gregory, 2008). With the rise of mobile phones and tablet computers, there has been a rise in Cellphone Thumb and Cellphone Elbow (Karim, 2005), both occurring when a mobile phone or tablet is used in an unnatural position for extended periods of time.

Tendonitis is closely linked to Repetitive Strain Injury (RSI), which affects over 1 in 5 adults (Gisselman et al., 2016). An increase of Carpal Tunnel Syndrome (CTS) reports in 2012 was linked to use of iPads, two years after the iPad's initial release. Researchers have suggested that the increase in CTS reports may be due to excessive usage of fingers to type and holding the device for extended periods of time, damaging the wrist (Hsiao and Cho, 2012).

Headaches

A headache is the symptom of pain anywhere in the region of the head or neck. The most common types of headaches are migraines (sharp or throbbing pains), tension headaches and cluster headaches (The International Classification of Headache Disorders, 2013). Headaches have been attributed to computer use, computer gaming, TV viewing and tablet usage. Rates of headaches due to such activities are rampant; a study of adolescents across 6 countries showed 15-31% of males and 26-44% of females experience recurrent headaches (Torsheim et al., 2010).

Headaches that occur through tablet usage is due to a problem that is known as Computer Vision Syndrome or CVS, a phenomenon where the regularity of blinking reduces below the average rate (Han, 2015). CVS can lead to fatigue, blurred vision, eyestrain and subsequently headaches. Users have even reported dizziness and blurred vision after they have ceased use of their tablet computer.

Insomnia

Insomnia is a common sleep disorder resulting in difficulty falling asleep, staying asleep, or both; resulting in little or poor quality

sleep. Acute insomnia is common and is often brought on by stressful situations and only lasts days to weeks. Chronic insomnia lasts for months or longer and is commonly a side effect of another problem such as a medical condition. In 9 years from 2007 to 2016, rates of Chronic insomnia increased from 30% (Roth, 2007) to 33% (Bhaskar, Hemavathy and Prasad, 2016), affecting an additional 10 million people in the US alone.

Insomnia is often the result of the use of tablet computers at night. The light emitted from tablet computers in dark environments have been found to have an adverse effect on the quality and quantity of sleep due to an inhibited secretion of melatonins (Cain & Gradisar, 2010). A study in 2013 corroborated Cain & Gradisar's findings stating "The use of computer for watching television, movies, and TV series in bed was found to be positively related to the severity of insomnia symptoms." (Fossum et al., 2013).

Due to Insomnia's chronicity, the disorder has been associated with an immense degradation in an individual's quality of life. A survey of over 8,000 French respondents reported 1% of non-insomniacs and 8% of insomniacs had an industrial accident in the 12 months prior to the survey. Individuals reporting a current sleep problem were more likely to have decreased job performance and to have been absent from work in the last month due to health problems than those with a healthy sleep pattern (Kuppermann et al., 1995).

Tablet Computers and the Elderly

Tablet computers have been shown to have a multitude of benefits for the elderly. iPad usage has been successfully integrated into neuro-rehabilitation services aimed at reducing post-stroke impairments (Ameer and Ali, 2017). Engaging in cognitive stimulus activities, such as puzzle games on a tablet computer, have been found to be protective of age-related cognitive decline (Givon Schaham, Sternberg and Rand, 2018).

Tablet computer use comes at a greater risk with to the elderly. Hsiao and Cho (2012) conducted research where participants completed a series of tasks while being monitored with a three-dimensional motion capture system and an electromyographic analysis was used to obtain kinematic and kinetic data. After the tasks were completed the participants were questioned about possible MSD symptoms. For the majority of pain regions investigated the elderly participants reported high average pain scores and a higher percentage of prevalence of musculoskeletal symptoms than the younger participants.

Increased pain in elderly tablet users can be attributed to a number of factors. Older patients are more likely to have diminished cervical foramina spaces, nerve root irritation and impingement from tablet usage may trigger the aforementioned pain down the users' arms (Jackson, 2010). Elderly users have a greater amplitude of muscle activity in the forearm, and greater craniocervical angle and neck flexion resulting in a forward head posture. Consequently, putting the user at a higher risk for musculoskeletal disorders (Hsiao and Cho, 2012). Tablet weight-related troubles experienced by women are also experienced by the elderly as grip strength deteriorates over time declining 40% in an individual from 30 to 80 years old (Sato and Fukuba, 2000).

A portion of older adults suffer from a variety of vision impairments of various strengths, ranging from partial loss of vision through to complete blindness. Such impairments can result in harmful tablet use habits. For comfortable reading, the average 60-year-old requires three times more light than the average 20-year-old to see the same level of detail (Haigh, 1993). Elderly users also experience decreased contrast sensitivity and worsening light accommodation due to decreasing elasticity in the lens moving the average near point distance from 12.5cm to 50cm between the age range of 30 and 50 years respectively.

To circumvent such issues, increasing contrast, brightness, and moving the tablet

away from the user are common solutions. However, these solutions bring about an increased risk of some common tablet related injuries. Moving the tablet to the average near point for a 50-year-old would require the user to hold the tablet at arm's length, increasing the likelihood of musculoskeletal pain (assuming no tablet stand is in use). Increasing brightness runs the risk of increasing chances of headaches and insomnia if the tablet is used at nighttime. Insomnia in elderly women can be particularly devastating to an individual's wellbeing.

Sleep disorders in elderly women have been attributed to adverse mental health outcomes, including the risk of depressive symptoms, dementia, and cognitive decline. Sleep disorders have been associated with a 23% increase in hypertension risk, a 48% increase in coronary heart disease (Guo et al., 2013), and a 15% increase in strokes (Cappuccio et al., 2011). Disturbances in sleep and treatments for sleep contribute to other outcomes, such as falls, disability, and chronic pain (Stone and Xiao, 2018).

Injury Prevention for Elderly Users

Research conducted by Pattison & Stedmon (2006) found significant differences existed between young and old computer users. This is corroborated by Hsiao and Cho (2012) who state "A lot of older adults try to learn to use computers and might use different ways to perform a computer task compared to younger people". Understanding that elderly tablet users learn differently may be the first step to mitigating the injuries sustained by tablet usage.

Researchers Vaportzis, Giatsi Clausen and Gow (2017) interviewed older adults to gain their perceptions of tablet computers and barriers they face when interacting with them. The researchers found that most elderly are eager to adopt new technology and displayed a willingness to learn. However, a number of them took umbrage with the lack of instructions and guidance, noting that if there were any instructions they are too technical. Participants

who had family members or friends helping them learn noted that when they asked for assistance, the helper completed the job quickly instead of guiding them.

Being patient with elderly users when teaching them may be all it takes to allow them to become more proficient. As an example, an experienced user may use short, quick flicking gestures to quickly move a list. This motion tends not to be obvious to elderly tablet users. In an interview conducted by Harada et al. (2013) a participant commented: “the screen just ‘flew away’...”. Such sentiments are is corroborated by Vaportzis, Giatsi Clausen and Gow (2017) who states that tablets “require support to be introduced to older people in an appropriate manner, as older people may lack confidence when first using this technology.”. Harada et al. (2013) also states “As elderly people may be less reluctant to experiment, it may be good to show various alternative interaction approaches, preferably gradually and repeatedly, to accommodate for their slower learning pace.”

Musculoskeletal disorders caused by tablet usage may be prevented with a proper introduction to tablets also. Research conducted by Lee et al. (2018) demonstrated that use of a tablet stand and adequate seating can reduce rates of MSDs in people of all ages. Given the additional issues faced by the elderly in relation to MSDs highlighted by research conducted by Jackson (2010), and Hsiao and Cho (2012) correct posture can significantly reduce the likelihood and potency of MSDs in the elderly. Thus, teaching a novice elderly tablet user correct posture during tablet use is imperative.

Tablet manufacturers and accessory manufacturers can play a part in assisting elderly tablet users also. Pattison and Stedmon (2006) noted several key features that can reduce tablet related injuries in the elderly:

- Improve illumination and user interface options.
- Avoid using high-frequency audio feedback and keep auditory feedback as simple as possible.

- Couple auditory feedback with visual and tactile feedback
- Design casings that are easy to hold and include options for oversized keys (if applicable).
- Keep menu structures intuitive and consistent.
- Make user interfaces as simple as possible.

Many mainstream tablet computers do not include an adequate amount of these older user-friendly features and may be directly contributing to the pain suffered by elderly tablet users.

Conclusion

Given the rise in popularity of tablet computer devices, understanding the risks of improper use is essential. Many elderly users have demonstrated a keen willingness to learn how to use their tablets correctly due to all of the beneficial properties tablets computer possess but struggle to use them effectively due to various issues.

The investigation conducted in this paper has shown that elderly users are very likely to experience tablet related injuries, especially elderly women. Elderly users are more at risk of all forms of musculoskeletal disorders, headaches, insomnia, and all mental health-related issues along with it, including depression, strokes, dementia, cardiovascular disease, and cognitive decline. All of these risks are present despite the lack of research in the subject area.

For elderly users, who already may be in pain, it is doubly important to use their tablet correctly. As shown in this paper, consideration from manufacturers and some patient education could prevent the majority of potential injuries elderly tablet users face. Overcoming these hurdles could open up the elderly population to a new world of information and social contact currently muddled with frustration, anxiety and pain.

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