Abstract

Primary school students spend the majority of the day sitting at school. Prolonged sitting is associated with endless negative health outcomes. However the data is primarily focused around adults with little data on the implications on childhood health outcomes. A replacement in school furniture through the implementation of standing desks has the potential to reduce sitting time amongst other benefits. This paper firstly provides an overview of the negative outcomes sitting is having on primary school students. The paper will also look into the main benefits standing desks are having on primary school students and the current barriers and issues towards implementing standing desks into primary schools. A qualitative approach through interviews was used to gain knowledge and insight through expert experiences (n=2) from their own research and observations. Participants related prolonged sitting with poor orthopaedic health, academic achievement and neurocognitive development. There were also common themes with the main benefits standing desks provide primary school students. These included increased movement and weight-loss, improved academic achievement, classroom behaviour and a better potential of future orthopaedic health. Lastly participants stated some current barriers towards implementing standing desks. These consisted of funding, the ‘not have’ effect and the initial switch over period. The overall data suggests there is certain feasibility for the use of standing desks within primary school.

Key Words: Prolonged Sitting, Standing Desks, Sedentary, Health, Barriers, Movement, Students, Learning, Primary School.

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Introduction

Sitting is slowly killing you (Levine, 2014). The research is evident that humans should not be sitting for prolonged periods of time. Jensen (2000) states that the research to show this is not recent either. The human body was constructed for movement (Sandler and Vernikos, 1986). However we are consistently making a type one error of being in sedentary states for prolonged periods of time. Two major changes that have created this sedentary shift are the industrial revolution and the use of modern technology (Levine, 2014). Many of us sit at work/school and are also seated when using

technology such as mobile devices, playing video games consoles and watching television (Opsvik, 2009, Owen, Sparling, Healy, Dunstan and Matthews, 2010). A variety of studies discussed in the literature review indicate endless negative effects and impacts of prolonged sitting and sedentary behaviours. However many primary school students are being forced to sit at a desk for an average of four and a half hours of their school day (Rideout, Foehr and Roberts, 2010). Where only 7% of youths aged 6-19 years are attaining the physical activity guidelines set out by the World Health Organisation (WHO), there needs to be a change within schools to promote more active learning and less sedentary behaviours (Tremblay, LeBlanc, Saunders, Larouche, Colley, Goldfield and Gorber, 2011). Recently researchers have conducted a broad range of studies on the implementation of standing desks in both occupational and school settings. These studies are looking to provide evidence that standing desks can combat the negative effects of prolonged sitting and sedentary behaviours. The overall outcome is to provide enough evidence for schools and occupational work settings to recognise the error within their furniture ergonomics and switch to better alternatives.

With clear research stating the health risks from prolonged sitting and sedentary behaviours there needs to be an in depth review with alternative solutions provided to the widespread school community. In particular the review needs to include research specific towards primary school students (5-11 years) and how the standing desk could be a feasible solution.

The main purpose of this study is to investigate the negative impacts prolonged sitting and sedentary behaviours are having on primary school students and whether a standing desk is a feasible solution. The main outcomes of this study are to: Provide an in-depth review of why primary school children should not be in sedentary states for prolonged periods of time, propose evidence of an alternative solution (standing desk) to help combat prolonged periods of sedentary behaviour and lastly to indicate current issues and barriers of implementing standing desks in primary schools.

This study could contribute towards the current and future research on standing desks. It will also specifically benefit standing desk researches that are pinpointing their studies within primary school settings. One particular outcome from this study that could be most beneficial is the current barriers of implementing standing desks into primary schools.

Literature Review

Sitting

For thousands of years humans have led physically active lifestyles (Opsvik, 2009). The human body was constructed with the purpose of movement, in an upright position to carry out physically demanding duties such as walking, running and hunting in order for survival (Jensen, 2000, Levine, 2014). Sitting on the other hand is an unnatural position for the human body to be crammed into, especially for prolonged periods of time (Levine, 2014). Metabolic Equivalents (METS) outline the energy expenditure of activities (Owen,

Bauman and Brown, 2008). Sitting is between 1 and 1.5 Metabolic Equivalent (METS) within sedentary physiology (Gunn, Brooks, Withers, Gore, Owen, Booth and Bauman, 2002). Owen et al., (2008) suggests that sitting expends the equivalent amount of energy as sleeping. Therefore sitting is a non-active behaviour and can be detrimental to the body (Owen et al., 2008).

Levine (2014) states that prolonged sitting and other such sedentary behaviours (watching television, playing video games etc.) have endless negative impacts of ones physical, mental and social health. However research is suggesting that the average adult is spending between 50-70% of their waking hours in sedentary pursuits (Levine, 2014). Similarly children aged 3-5 years similarly spend half their waking hours in sedentary states (Colley, Garriguet, Adamo, Carson, Janssen, Timmons and Tremblay, 2013). Focusing on the primary school age range, children in the UK between the ages of 6 and 11 years spend on average approximately 6.1 hours of the time awake in sedentary pursuits (Pate, Mitchell, Byun and Dowda, 2011). In Canada and United States this number is increased to 8.6 and 6-8 hours respectively (Colley, Garriguet, Janssen, Craig, Clarke and Tremblay, 2011, Matthews, Chen, Freedson, Buchowski, Beech, Pate and Troiano, 2008). The research indicates similar amounts of time people are spent in sedentary behaviours/sitting worldwide. The research also suggests a worldwide terrifying and increasing figure of sedentary behaviours in the population over several decades (Owen et al., 2010). When research suggests for each hour spent in sedentary pursuits two hours of life is lost, there needs to be a

revolutionary change to support the bodies main function of movement (Levine, 2014).

Standing Desks

Winston Churchill, Charles Dickens, Thomas Jefferson and Leonardo Da Vinci. This list provides a handful of extremely gifted human beings within their occupations. Coincidently, all of the above utilised standing desks within their day-to-day lives. Maybe they knew something we are only starting to try and change now?

The standing desk allows an individual to adopt an upright position whilst working/learning. Standing desks have been a hot topic within the last few years with many researchers trying to provide supporting evidence that a switch over from more common seated desks should be made (Levine, 2014, Vernikos, 2011). However in spite of numerous studies demonstrating the positive impacts standing desks are having the switchover rate from seated desks has not been as successful within primary schools. When statements such as ‘sitting is the new smoking’ and ‘sitting is slowly killing us’ are being published, it is worrying that primary schools are not quickly converting to more ergonomic school furniture (Levine, 2014, Santovec, 2013).

The next section of the study will look into the main negative impacts prolonged sitting and sedentary behaviours are having on the human body, with some specific research towards primary school students. Integrated will be research to suggest how standing desks could resolve many of these

negative impacts and therefore provide as a feasible solution within primary schools.

Weight Gain and Obesity

Since 1980 the rate of overweight and obese people has risen from 857 million to over 2.1 billion (Wise, 2014). A study indicated a 28% increase from adults and a 47% increase in children occured (Ng, Fleming, Robinson, Thomson, Graetz, Margono, Mullany, Biryukov, Abbafati, Abera and Abraham, 2014). Within three decades the average weight of a child in the United States has increased by 5kg (Lobstein, Jackson-Leach, Moodie, Hall, Gortmaker, Swinburn, James, Wang and McPherson, 2015). Various studies also suggest that currently one third of children worldwide are classed obese or overweight (Lobstein et al., 2015, van Jaarsveld and Guildford, 2015). Recently obesity rates have plateaued in both the UK and US (van Jaarsveld and Gulliford, 2015, Ogden, Carroll, Kit and Flegal, 2014). Despite this there is instead an ascending trend from severe types of obesity such as 'morbidly obese' (Skinner and Skelton, 2014). One study predicts that 51% of the population could be classed as obese by 2030 (Finklestein, Khavjou, Thompson, Trogdon, Pan, Sherry and Dietz, 2012). The study suggests a 33% rise in obesity prevalence and a 130% increase in severe obesity prevalence could occur if solutions are not found (Finklestein et al., 2012).

Obesity is a direct cause from prolonged sedentary behaviours and lack of physical activity (Sandler and Vernikos, 1986, Vernikos, 2011, Levine and Yeager 2009). Research supports this by indicating a linear correlation

between sedentary behaviours during work and obesity levels (Kozey-Keadle, Libertine, Staudenmayer and Freedson, 2012, Choi, Schnall, Yang, Dobson, Landsbergis, Israel, Karasek, and Baker, 2010, Mummery, Schofield, Steele, Eakin, Brown, 2005). To compensate for the amount of time spent in sedentary pursuits many individuals complete 30 minutes to 1 hour of 'moderate to vigorous physical activity' (MVPA) each day. These are the recommended physical activity set out by the World Health Organisation. Controversially a study by Bauman, Allman-Farinelli, Huxley and James, 2008) suggest one hour of MVPA each day is not enough time to neutralise the other 50-70% of the time an individual is spending in sedentary pursuits. Katzmarzyk, Church, Craig and Bouchard (2009) indicate that even exceeding the recommendations for participation in MVPA will not counteract the effects of prolonged sitting throughout the rest of the day. When children are spending 50-70% of their day in sedentary pursuits is it any surprise why obesity numbers have increased drastically within the last three decades? (Colley et al., 2011, Matthews et al., 2008).

Over a 5-year period Canadian adults experienced a 0.13cm increase in waist circumference for every 15 minutes in a sedentary state (Saunders, Tremblay, Despres, Bouchard, Tremblay and Chaput, 2013). Similarly Australians who sat for more than 352 minutes whilst at work had a 6.1cm greater waist circumference than those who sat for less than 352 minutes (Ryde, Brown, Peeters, Gilson and Brown, 2013). The study also indicated a rise in body mass index (BMI) of 1.8 units when sitting for more than 352 minutes at work (Ryde et al., 2013). However, both of these studies have been conducted on

adults and not children within the primary school age range. One study though does show positive effects on BMI and waist circumference when decreasing sedentary behaviours in children with a mean age of 8.9 years (Robinson, 1999). There were also no significant changes in moderate to vigorous physical activity (MVPA) during this study (Robinson, 1999). Although this indicates sedentary behaviour was not replaced with MVPA it does suggest that a decrease in sedentary pursuits alone could help decrease body weight, BMI and waist circumference. Conversely the WHO only provides guidelines for MVPA recommendations and sedentary behaviour guidelines to improve health benefits (World Health Organisation, 2015). The organisation does not look upon lower physical activity (such as standing) to improve overall health. With research suggesting alternative solutions (standing desks and short physical activity breaks) that could combat the negative impacts of prolonged sedentary behaviour, government guidelines should begin to introduce recommendations on lower forms of physical activity in replacement of sedentary behaviours.

More recently reviews of literature from Liao, Liao, Durand and Dunton (2014) and Tremblay et al., (2011) indicate that sedentary behaviour interventions have had significant positive effects on BMI and weight loss. However Tremblay et al., (2011) states that most studies on the impacts of health from sedentary behaviour amongst children have been based around television time. Therefore this could limit the external validity when talking about other sedentary behaviours such as time spent sitting. Nevertheless the data

supports the use of interventions from sedentary behaviour to combat weight gain and obesity.

Numerous studies state an increase in energy expenditure when using a standing desk compared to seated desks (Blake, Benden and Wendel, 2012, Torbeyns, Bailey, Bos and Meeusen, 2014, Reiff, Marlatt and Dengel, 2012). However many of these studies have been carried out in occupational settings with adults. Conversely there has been an increase of recent studies suggesting an association with standing desks and greater energy expenditure within a school setting (Benden, Zhao, Jeffrey, Wendel and Blake, 2014, Benden, Pickens, Shipp, Perry and Schneider, 2013, Benden, Mancuso, Zhao and Pickens, 2011). Specifically the Benden et al., (2014) study stated when using a standing desk, a significant mean energy expenditure increase of 0.16kcal/min where $p<0.0001$ and 0.08kcal/min where $p=0.0092$ was recorded in autumn and spring semester respectively. Reiff, Marlatt and Dengel (2012) projected a student could expend 20,461 more calories over the course of one academic year by using a standing desk. The study also informed that this could lead to a weight loss of 5.85 pounds per year providing calorie intake is controlled (Reiff et al., 2012). However the participants of this study had an age of 22.8 ± 1.9 years and therefore might lack the carry over of energy expenditure when comparing it to primary school students. On the other hand it still provides hardback evidence that standing desks could be a feasible method to reduce a positive energy balance and therefore weight gain (Reiff et al., 2012).

Cardiovascular Disease

Cardiovascular disease (CVD) and cancer are the main causes of death worldwide (French, Vedhara, Kaptein and Weinman, 2010). Together they account towards 64 and 71% of male and female deaths respectively (French et al., 2010).

Numerous studies have indicated that sedentary behaviours including prolonged sitting could increase the chance of cardiovascular disease (Patel, Bernstein, Deka, Feigelson, Campbell, Gapstur and Thun, 2010, Katzmarzyk et al., 2009, Warren, Ekelund, Besson, Mezzani, Geladas and Vanhees, 2010, Chomistek, Manson, Stefanick, Lu, Sands-Lincoln, Going, Garcia, Allison, Sims, LaMonte, Johnson and Eaton, 2013). Specifically, a study based on Scottish men and women over 35 years indicated a 125% increase in CVD mortality risk when watching >4 hours of TV a day (Stamatakis, Davis, Stathi and Hamer, 2012). A study by Wijndaele, Brage, Besson, Khaw, Sharp, Luben, Bhaniani, Wareham and Ekelund (2011) suggests similar results where 13000 participants aged 45-79 years showed a 8% increase in CVD mortality per hour of TV time a day. It is important to recognise that both these studies are concentrated at the middle to older age population. Therefore it might not have the same effect when representing these statistics to the primary school age range. However these statistics are still important as a framework to go from, providing concerning evidential links between sedentary behaviour and CVD. More specifically a review of eleven studies based on children and adolescents associated sedentary behaviour with a greater risk of CVD (Tremblay et al., 2011). This study also suggests that

even though the risk of CVD in children is low, the younger generation are still putting themselves at risk of CVD occurring in the future (Tremblay et al., 2011).

Sedentary behaviours and physical inactivity have been linked towards high blood pressure, decreased vessel diameter and decreased blood flow (Hamburg et al., 2007, Wijndaele et al., 2011, Lee and Wong, 2015). The studies ranged across all age ranges including children, teenagers and adults. A systematic review from Lee and Wong (2015) indicated that 18 of the 31 papers reviews showed no association with time spent in sedentary behaviours and blood pressure. However a meta-analysis of 28 papers indicated every hour of sedentary behaviour was associated with an increase of 0.06 mmHg and 0.20 mmHg of systolic and diastolic blood pressure respectively (Lee and Wong, 2015). The study concluded by indicating an odds ratio (OR) of 1.02 for having high blood pressure with every hour spent in sedentary pursuits per day, where $p=0.02$ and $OR > 1$ signifying a higher odds of outcome (Lee and Wong, 2015, Szumilas, 2010).

High levels of triglycerides, low levels of high-density lipoproteins (HDL) and high levels of low-density lipoproteins are all associated with unhealthy cholesterol and a greater risk of cardiovascular disease (Moyad and Lee, 2014). A study by Hamburg, McMackin, Huang, Shenouda, Widlansky, Schulz, Gokce, Ruderman, Keaney and Vita (2007) stated that physical inactivity lead to an increase in total cholesterol (TC) and triglycerides. Similarly a study showed parallel results suggesting prolonged inactivity led to a decrease in (HDL) cholesterol and an increase in triglycerides (Healy, Matthews, Dunstan, Winkler and Owen, 2011).

Lipoprotein lipase (LPL) is an enzyme with a main function of breaking down fat in the bloodstream to form triglycerides that then can be used for energy or be stored in fatty tissue (Mead, Irvine and Ramji, 2002). Sedentary behaviours such as prolonged sitting have the ability to shut off or hinder LPL activity (Hamilton, Hamilton and Zderic, 2004). A study on rats suggests similar impacts by indicating triglyceride uptake in oxidative muscles were significantly lower in sedentary rats in comparison to the controlled physically active rats (Bey and Hamilton, 2003).

Breaks from sedentary behaviour were associated with higher HDL and a decrease in triglycerides (Cooper, Sebire, Montgomery, Peters, Sharp, Jackson, Fitzsimons, Dayan and Andrews, 2011, Healy et al., 2011). A study conducted by Howard, Fraser, Sethi, Cerin, Hamilton, Owen, Dunstan and Kingwell (2013) also indicated decreases in blood viscosity and increases in blood flow when participants took breaks from sedentary states and completed light intensity activities. Although these studies were not using a standing desk, it suggests not being in sedentary pursuits such as sitting has a positive impact on the cardiovascular system. Examples of these cardiovascular benefits are: enhanced capillary blood flow to tissues, improved oxygen delivery to muscle tissues and improved blood circulation (Rhoades and Bell, 2013, Slonim and Pollock, 2006). As standing is physically demanding it provides evidence that there could be links between the use of a standing desk and the benefits already mentioned in comparison to sitting. On the other hand, a study has shown significant effects on the increase of HDL cholesterol (0.06mmol/L) and a decrease of triglycerides (11%) when replacing 2 hours of sitting time with standing (Healy, Winkler, Owen,

Anuradha and Dunstan 2015). Although the participants within this study were not specifically aged towards primary school students (mean age of 57.9 years), it still provides evidence of the positive benefits standing could have in comparison to sitting. Similarly a study by Alkhajah, Reeves, Eakin, Winkler, Owen and Healy (2012) stated a significant increase in HDL cholesterol with an average increase of 0.26mmol/L when sitting was almost completely replaced with standing over a 3-month period.

Although not all the research resulted in significant findings, there is evidence to suggest replacing sedentary pursuits with standing could have benefits on the cardiovascular system. There are still gaps within the research around this topic area, specifically towards the primary school age range (5-11). Therefore future research needs to investigate into the cardiovascular benefits standing has on children in comparison to sitting.

Cancer and Diabetes

Research has been inconsistent with the relationship between sedentary behaviours and cancer mortality (Kim, Wilkens, Park, Goodman, Monroe and Kolonel, 2013). Three particular studies found no association between sedentary behaviours and cancer mortality (Katzmarzyk et al., 2009, Dunstan, Barr, Healy, Salmon, Shaw, Balkau, B., Magliano, Cameron, Zimmet, and Owen, 2010, Wijndaele, Brage, Besson, Khaw, Sharp, Luben, Wareham and Ekelund, 2010). On the other hand a couple of larger scale studies suggest a possible relationship between sedentary behaviour and cancer mortality (Matthews, George, Moore, Bowles, Blair, Park, Troiano, Hollenbeck and Schatzkin, 2012, Suzuki, 2007). Specifically Suzuki (2007) indicated men who spent >4 hours watching television (sedentary behaviour) in comparison to

men who spent <2 hours watching television had a hazard ratio (HR) of 1.26 from cancer of all sites (1.26 times more frequently compared to the control population). Likewise women who spent >4 hours watching television had an increased risk of death from liver cancer with a HR of 2.38 (Suzuki, 2007).

Between 2001 and 2009 type 2 diabetes (T2D) has increased amongst youths aged 0-19 years by 30.5% (Dabelea et al., 2014). Research implies sedentary behaviours that involves sitting such as watching television (a sedentary behaviour consisting of sitting) could be associated to an increase risk of T2D. A review of 794 577 participants over 18 studies by Wilmot, Edwardson, Achana, Davies, Gorely, Gray, Khunti, Yates and Biddle (2012) reported significant associations between sedentary behaviours and a greater risk of developing T2D. Similarly, Hu, Li, Colditz, Willet and Manson (2003) reported a 70% increased risk of developing T2D when spending >40 hours a week watching television in comparison to watching <1 hour per week. Likewise men who watched television >40 hours a week in comparison to <1 hour per week significantly increased their relative risk factor of developing T2D by 2.3 (Hu, Leitzmann, Stampfer, Colditz, Willet and Rimm, 2001). However most of these studies were not conducted around the primary school age range. Therefore results could differ in children in comparison to adults. It is also important to mention that many studies did not find any significant association with sedentary behaviour and T2D risk (Solomon and Thyfault, 2013). On the other hand, when studies indicate an increased risk of developing T2D by 20% when being in sedentary states for >2 hours a day, it creates concern for the younger generations health (Grøntved, 2011).

An increase in sedentary pursuits can have effects on insulin sensitivity (Dunstan, Kingwell, Larsen, Healy, Cerin, Hamilton, Shaw, Bertovic, Zimmet, Salmon and Owen, 2012). “Insulin sensitivity is the degree to which a given plasma insulin stimulates an increase in the rate of uptake of glucose from the blood” (Wolever, 2006, pp.43). If an individual’s insulin sensitivity is low, they are prone to being diabetic. Studies have reported that prolonged sedentary behaviours could be associated with lower insulin sensitivity (Dunstan et al., 2012, Hamburg et al., 2007). Similarly a study conducted by Yates, Khunti, Wilmot, Brady, Webb, Srinivasan, Henson, Talbot and Davies (2012) stated lower insulin sensitivity from prolonged sitting. However the results reported significant effects in females but not males (Yates et al., 2012). In corresponding fashion insulin factors due to prolonged sitting are inconsistent within their findings. Future research needs to provide consistent results to create externally valid data. Nevertheless the current data should not be ruled out as a major concern within this topic area.

Regular exercise could decrease the risk of cancer (Lemanne, Cassileth and Gubili, 2013). A systematic review of studies indicates mixed results with the association of physical activity and lower risk of developing cancer (Gonçalves, Florêncio, de Atayde Silva, Cobucci, Giraldo and Cote, 2014). However no research supports the association of standing time and a decreased risk of developing cancer. Regular interruptions from sitting (every 30 minutes) indicated lower levels of postprandial glucose and insulin (Peddie, Bone, Rehrer, Skeaff, Gray and Perry, 2013, Dunstan et al., 2012). Bell, Hammer, Batty, Singh-Manoux, Sabia and Kivimaki (2014) also reported from a study of 4000 civil servants, sitting <12 hours a week decreased the

risk of developing diabetes by 75%. The research is not definitive or broad enough to conclude whether standing desks could be significant towards preventing cancer and diabetes. Further research needs to be conducted to provide evidence that there could be significant links. However the research could suggest that learning within the classroom should be an active process. Preparing lessons where children have to regularly move around the classroom could be beneficial in conjunction with the research previously mentioned.

Orthopedic Problems

Levine (2014) states prolonged sitting has a direct towards back and neck pain. Current research supports this by indicating a positive relationship between prolonged sitting and back and neck pain (Gupta, Christiansen, Hallman, Korshoj, Carneiro and Holtermann, 2015, Stamatakis, Chau, Pedisic, Bauman, Macniven, Coombs and Hamer, 2013). However it is important to recognise that both of these studies participants were adults (18-65 years and 40+ years respectively). On the other hand there have been a handful of studies that associate back and neck pain with prolonged sitting in children. A review of literature by Grimes and Legg (2004) suggest children associated static sitting and computer use with neck and back pain and muscular tension (predominantly neck and shoulder). Trevelyan and Legg (2010) also reported 58% of children associated prolonged sitting with spinal back pain with lower back pain being the most severe and long lasting pain. Saarni, Nygård, Kaukiainen and Rimpelä (2007) suggest 70% of adolescent students sat with their necks flexed or rotated and 56% sat with their backs

flexed. Similarly a study on university students indicated lumber spine stiffness increased after only one hour of sitting in males and varied over 2 hours in females (Beach, Parkinson, Stothart and Callaghan, 2005). However the study was only conducted on 12 university students and therefore could lack conclusive results. Nevertheless it provides evidence that a high percentage of students across a wide variety of age ranges are sitting in poor positions and could have a negative impact on back/neck pain and muscular tension. Osteoporosis might also have an association with prolonged sitting. A study reported sitting time had negative impacts on bone mineral density (Chaston, Mandrichenko, Helbostadt and Skeleton, 2014). However there is not sufficient research to suggest evident links within this topic area.

Interrupting sitting time every 30 minutes has shown significant decreases in back discomfort (Thorp, Kingwell, Owen and Dunstan, 2014). Although this does not incorporate standing desks, it provides evidence that short periods of standing could decrease back pain. Therefore this could suggest standing for prolonged periods might prevent back pain in the first place. On the other hand a couple of studies believe standing desks could potentially lower the risk of back pain that is caused by improper seating positions from rigid school furniture (Wingrat and Exner, 2005, Benden et al., 2013). Specifically Benden et al., (2013) conducted a study on 42 elementary students. Two classrooms had standing desks and two classrooms had seated desks. Students who sat indicated higher discomfort in all areas of the body in comparison to standing desk students (Benden et al., 2013). Additionally students using standing desks were in preferred back positions whereas seated students typically

were in non-preferred back positions (Benden et al., 2013). A study by Carden, Clercq, Bourdeaudhuij and Breithecker (2004) also observed appropriate back postures whilst standing, improved seated posture, less neck rotation and almost no trunk flexion >45°. These students were in a "moving school" where sitting periods are shorter, lessons are planned to encourage activity for students and pupils sit in dynamic positions (back and neck straight) (Carden et al., 2004). In conclusion, standing desks could help promote more appropriate back positions during long periods of classroom lessons and decrease students back and neck discomfort.

Mental Health and Behaviour

A review of 14 studies indicated a relationship between sedentary behaviour with depression and low self-esteem (Tremblay et al., 2011). Another study by Hamer and Stamatakis (2014) conducted a 2 year follow up report where ≥6 in comparison to <2 hours spent in sedentary behaviours was associated with a higher risk of depression. In conjunction research from Liu, Wu and Yao (2015) indicated >2 hours in sedentary pursuits compared to <2 hours significantly increased the risk of depression among children and adolescents. Similarly research seems to indicate every hour spent in sedentary pursuits increases the risk of lower self-esteem (Russ, Larson, Franke and Halfon, 2009). An increase in television time (a sitting behaviour) has also displayed lower self-esteem in male children and increased aggression in female children (Neumark-Sztainer, Goeden, Story and Wall, 2004, Dominick, 1984). However it is important to state that the review from Tremblay et al., (2011) indicated that a handful of studies did not find any 'significant' findings in their

research. Nevertheless the review concluded that the studies that examined self-esteem had a moderate quality of reporting (Tremblay et al., 2011). In addition to this obesity has direct links towards both depression and self-esteem (Preiss, Brennan and Clarke, 2013, Williams and Frühbeck, 2009). Although the association between obesity and self-esteem is relatively weak during childhood, this increases when moving into adolescence and even more so into adulthood (Williams and Frühbeck, 2009). On the other hand research from Chastin, Mandrichenko, Helbostadt and Skelton (2014) suggests depression could decrease an individual's motivation to be active and engage in daily tasks. If children lose the motivation to complete daily activities at school this could hinder their learning, create behaviour problems (discussed later) and effect their participation in physical activity (Chastin et al., 2014). Therefore there are suggestions of the short and long-term impacts prolonged sitting could have from self-esteem and depression. Short-term effects link to global lower self-esteem and depression of which ones learning could be hindered, where more long-term effects could be the result of an increase in weight gain.

Research by Morris and Johnson (2010) indicate a relationship between sedentary behaviours and participation in delinquency in youth (bad/risky behaviour). Specifically youths who spent their sedentary pursuits playing video games or in front of a computer screen were more likely to partake in delinquency. The research also suggests that prolonged sedentary behaviours could be associated with symptoms/diagnosis of 'attention deficit/ hyperactivity disorder' (ADHD) (Morris and Johnson, 2010). ADHD can also

be related to poor behaviour through factors such as attention span and personal strain (Morris and Johnson, 2010). A book published by Kindlon, Thompson and Barker (1999) called ‘Raising Cain’ also believe that sedentary behaviours at school are having detrimental effects on children’s physical development, test scores and behavioural problems. Kindlon et al., (1999) suggest that boys especially are coming off worse compared to girls because of their shorter attention span and higher activity levels. However children are not provided enough opportunities to move within physical education or classroom based activities (Kindlon et al., 1999). This coincides where some schools do not regularly teach physical education (Tremblay et al., 2011). With the combination of children sitting for prolonged periods and little PA at school, drastic alterations are needed to change the way schools create an engaging and active environment for students. This could be done through the structure of lessons, the amount of physical education/play time given or creating an environment where sitting is reduced through standing desks.

Over a 7-week period of using standing desks participants reported positive changes in depression and overall mood states including energy levels, productivity and decreased stress (Pronk, Katz, Lowry and Payfer, 2012). Coincidentally when participants resorted back to seated desks it generated a negative, reversible effect on depression and overall mood (Pronkz et al., 2012). Similarly another study indicated reduced dullness and drowsiness when standing whilst working (Hasegawa, Inoue, Tsutuse and Kumashiro, 2001). On the other hand a one study suggests there was no change in mood state (Husemann, Von Mach, Borsotto, Zepf and Scharnbacher, 2009). The

research is inconsistent with its findings. However, the research is significant enough with more recent studies indicating an association between standing and improved mood states to not overlook the potential benefits of a standing desk.

Although not related in comparison to mental health issues such as depression and self-esteem, there are numerous studies that show positive associations between standing desks and energy levels, fatigue and focus. Dutta, Koepp, Stovitz, Levine and Pereira (2014) reported improvements in perceived energy levels, relaxation and calmness when using standing desks over a 4-week period. This could be beneficial within a classroom due to research claiming improved energy levels could be associated with an increase in task motivation and performance (Boksem, Meijman and Lorist, 2006). Complementing this standing desks show positive signs on productivity through quality of work within a classroom setting (Katz, Mulder and Pronk, 2015). Dornhecker, Benden, Blake, Zhao and Wendel (2015) also indicated improvements in children's academic engagement over the fall and spring term within elementary school. On the other hand a review of studies shows no correlation between standing desks and productivity (MacEwan, MacDonald and Burr, 2015). Although this does not show a clear positive association, it does imply that standing desks can be implemented without the risk of losing productivity or task performance. This is important in a primary school where teachers are given a set curriculum to teach within a certain period of time. It provides feasibility that standing desks could be used in

schools to positively benefit students in numerous ways already mentioned but without hindering the student or teachers learning/teaching.

Numerous studies are beginning to suggest that the implementation of standing desks could have a positive impact on student's behaviour. Benden, Blake, Wendel and Huber (2011) presented over a period of 10 days (in fall and spring) improvements in student behaviour. Furthermore, 70% of parents agreed that behaviour had positively improved within class (Benden et al., 2011). One teacher also stated the standing desks were academically beneficial for an individual with ADHD through improvements in attention span and focus (Benden et al., 2011). A more recent study complements this by indicating behaviour improved in all students within the intervention group (Katz, Mulder and Pronk, 2015). In comparison student's behaviour either remained the same or was worse when using seated desks (Katz et al., 2015). The research is showing beneficial links between standing desks and improved behaviour. The reason behind this could be when standing students are more engaged due to higher muscle and neurocognitive activation (Mehta, Shortz and Benden, 2015). Cognitive function improves when regional cerebral blood flow is increased (Pereira, Green, Nandi and Aziz, 2007). This links back to research suggesting blood flow increases during standing (Wijndaele et al., 2011, Lee and Wong, 2015). Therefore when cognitive function is improved students are more engaged (through greater attention spans and focus) within a lesson (Mehta et al., 2015). In conclusion this could be the connection leading to improved classroom behaviour when using a standing desk.

Current research is indicating endless positive benefits standing desks provide in comparison to sitting. The majority of studies within the last decade have mainly been conducted within an occupational setting. Although more recent studies are beginning to conduct research specifically on school students, there is still currently inadequate evidence to provide schools with clear reasoning to implement standing desks. There are three main gaps in the current literature. First, the research lacks consistent findings of improvements in behaviour, academic engagement, achievement and orthopedic benefits within school students. Second, there is little to no long-term research on the benefits of standing desks for school students. Finally, there is an absence of information towards the current barriers of implementing standing desks within schools. However it is important to recognise that standing desks have only just begun to be properly considered within schools. Therefore only now is research starting to grow with evidence of numerous benefits standing desks are providing students. Without any doubt in the next five to ten years the research will produce extensive and clear evidence to provide schools with strong reasoning to implement standing desks with their classrooms.

Methodology

Research Paradigm

The study was carried out in an Interpretivist tradition using a constructivism viewpoint where knowledge was constructed through the implementation of

qualitative research to create social interactions and discussions of experiences.

An Interpretivist paradigm was used in this study to provide knowledge through social interactions where human views and experiences are discovered (O'Hara, Wainwright and Kay, 2011). This corresponds with the study using an ontological constructivist view where knowledge is relativist and occurs through the constructions of people's interactions, ideas and beliefs (Thomas, 2009). A subjective epistemological standpoint was adopted as knowledge was seen through social values using qualitative data collection methods (Glynn and Woodside, 2009) The study therefore used qualitative data as it supports and links to the idea of knowledge being socially constructed through the use of descriptions, interactions and experiences (Dodd and Epstein, 2012).

Design Frame

The study used a phenomenological design frame. This method was appropriate for the study as phenomenological research looks upon detailed stories from individuals' experiences of the certain topic area (Jones, 2015). These experiences are constructed through qualitative methods to interpret results (Jones, 2015). Both phenomenological research and qualitative methods relate back to the research paradigms because both heavily rely on the interpretation of subjective data (Creswell, 2012). Therefore it was an appropriate framework to use within the study. This design frame was appropriate to use for the aims of the study as it provided in-depth knowledge

from expert experiences. Buckley and Delicath (2013) support this by stating phenomenology studies carefully chose individuals to explore their lived experiences of a phenomenon. Through the story telling and descriptive nature of a phenomenological design frame it provided rich, in-depth material that was relative towards the main outcomes of the study (Creswell, 2012). It gave the study an appropriate method of analysis by putting the experiences into common themes for evaluation. This allowed the data to be analysed through qualitative methods. Therefore the design was appropriate to use through its relation to an Interpretivist paradigm as this paradigm typically consists of qualitative research and analysis (Thomas, 2009).

Participants

Participants were initially recruited through an invitation via email. Upon an email back participants were then provided with information sheets and consent forms. A purposeful sample was used to focus on a particular group of people to provide in-depth insights where the most can be learned about a topic area (Merriam and Tisdell, 2015). The criteria for a successful candidate were a postgraduate whom has carried out research within the chosen topic area or is part of an organisation that is heavily involved around the topic area (standing desks within primary schools). By successfully being part of the criteria list participants were seen as significantly appropriate for the study.

Seven participants fitted the criteria and were sent an initial invitation email. Two participants replied and partook in the study. A brief description is provided of each participant below. Participants were coded to ensure ethical

considerations had been attained. Each participant was given a pseudonym in replacement of his or her name.

P.1. A female who is a co-founder of an organisation in United States of America (USA) providing education and funding of standing desks within primary schools. She has currently donated standing desks within a classroom at an elementary school for research and to kick start a standing classroom culture.

P.2. A male with a ‘Doctor of Philosophy’ (PhD) with interests in obesity and obesity solutions. Within the last decade this participant has carried out and lead numerous studies focusing on both the negative impacts of prolonged sitting and the use of standing desks in both occupational and school settings.

Data Collection

Data was collected through the qualitative means of interviews. The study used qualitative data collection methods because an Interpretivist paradigm was implemented through a constructivism viewpoint. Thomas (2009) supports this by stating an Interpretivist paradigm seeks information through qualitative data collection such as descriptions, analysis and interactions. Specifically phenomenological interviews were used to produce detailed stories of experiences where the interviewer allowed the interviewee to expand on their stories providing richer and more detailed data for analysis (Creswell, 2012). One-to-one interviews were adopted as phenomenological interviews are predominantly carried out this way but also help to provide

more in-depth experiences from each interviewee (Jones, 2015, Creswell, 2012).

The interviews adopted a semi-structured approach. Semi-structured interviews were used to gain an understanding of lived experiences of experts that have either conducted research on standing desks or are heavily involved with standing desks within their day-to-day lives (Gill, Stewart, Treasure and Chadwick, 2008). One of the main benefits of using semi-structured interviews was that it allowed the interviewee to expand on questions in more depth providing greater knowledge to the interviewer (Currie, 2005). With only two interviews it was important that the depth and extent of knowledge provided was adequate to produce valid responses and results. Spalding (2005) complements this by stating interviewing a small amount of experts is sufficient if time is an issue. On the other hand it is important to consider in semi-structured interviews that although there are chances for the interviewee to expand on questions they might not be in a talkative mood (Myers, 2013). Therefore the interviewer could end up with insufficient data for analysis (Myers, 2013). The study took this into consideration by contacting experts in the field for interviews. Interviewing people with a passion and extensive knowledge within a topic area helped to eliminate the interviewee from saying little. Semi-structured interviews can also provide unanticipated answers due to the flexibility of its structure (Flin, O'Connor and Crichton, 2013). This could either be beneficial by providing unbiased answers by looking at both advantages and disadvantages of a topic or provide information that might normally be overlooked but offer valuable data for analysis (Fline et al., 2013)

However it could also hinder the study through irrelevant information for data analysis (Flin et al., 2013). Overall the benefits outweighed the potential disadvantages and therefore provide a suitable method of data collection.

Semi structured interviews relies on creating a number of themes to base questions around in the interview (Recker, 2011). These themes were based around the three main outcomes of the study and therefore relate back to the aims of the study. By creating themes instead of questions it gives more flexibility for the interviewee to express their experiences (Blackwell, Hammond, Fife-Schaw and Smith, 2006). In turn this could help produce more rich and in-depth data given by the interviewee instead of just answering questions that only offer a direct answer. However a more flexible structure could become time costly when analysing the data from either the interviewee going on irrelevant tangents or taking more time because of in-depth answers (Myers, 2013). Conversely the study only carried out two interviews and therefore improved the time efficiency of data collection and analysis. Nevertheless it was an important factor to consider as seven email invitations were initially sent.

Both interviewees were situated abroad (outside of United Kingdom). Therefore face-to-face interviews were impossible to conduct. Instead interviews were carried out via Skype phone call. Both interviewees were situated seven hours behind Greenwich Mean Time (GMT) and were conducted at 4pm and 10:30pm GMT time. Although this could be seen as a lot of effort to interview via telephone, the level of expertise and in-depth data

that was gathered more than outweighed the perceived disadvantage (Ehlers and Pawlowski, 2006).

Data Analysis

Interviews lasted between thirty and forty-five minutes and were transcribed verbatim. A thematic analysis was implemented when analysing interviews. One main advantage of using a thematic analysis is that it summarises key ideas from extensive amounts of data (Sparks and Smith, 2013). A thematic analysis also revolves around the social interpretation of qualitative data and therefore is an appropriate data analysis method for the studies research paradigm (Sparks and Smith, 2013). The study followed the analysis process of Miles and Huberman's (1994) coding system whereby data was put into themes. This analytical process is widely seen as a valid qualitative analysis method for coding data (Kotzab and Westhaus, 2005, Miles, Huberman and Saldana, 2013). One of the main advantages from coding the data into themes was that it provided the researcher with similar themes from different interviews (Miles et al., 2013). This can help towards producing more valid conclusions and improving the overall accuracy of the study (Miles et al., 2013). Raw data from interview transcripts were coded with relevant quotes being highlighted. Highlighted quotes and codes were then put into 'first order themes' based around the main outcomes of the study (Biddle, Hanrahan and Sellers, 2001). The process was then repeated with first order themes being divided into second order themes where appropriate. Second order themes consisted of similar groups that were recognised within first order themes (Biddle et al., 2001). This resulted in common associations being formatted

from both interviews, expressing similar conclusions on the impacts of sitting, the benefits of standing desks and the current barriers and issues to implementing standing desks in primary schools.

From the data analysis one participant gave information from the interview that they wanted to be kept confidential. Therefore this data was blacked out in the transcripts and was not used in the data analysis.

Ethical Considerations

The study adhered to St Mary's University's ethical guidelines through the British Education Research Association (BERA). Abiding to research ethics is important to produce un-biased results, improve the avoidance of error, prevent the fabrication of results and to improve the overall quality of the research (Resnik, 2011). Participants were under no obligation to partake in the research. All participants were required to complete a consent form that was provided with an information sheet. The information sheet gave participants an exact outline and procedure of their role within the study. Providing these documents ensured that participants had complete knowledge of their participation within the study, ensured that all information they provided were confidential and therefore felt no pressure to partake in the study (Miller, Mauthner, Birch and Jessop, 2012). Participants also had the right to withdraw from the study at any point, including after being interviewed. This could have been done by signing the withdrawal form that was situated at the bottom of their original consent form. Participant's names or personal information were not referenced within the research. Instead pseudonyms

replaced any personal information to ensure privacy and confidentiality. All data from the data collection and analysis were saved onto a password-protected file. Therefore only the researcher or participant (on request) could access the data.

Results and Discussion

From the analysis three themes (general dimensions) emerged which were relative to the three aims of the study. The emerging themes were: Negative impacts of sitting on primary school students (Appendix 7), Benefits of standing desks for primary school students (Appendix 8) and Current barriers and issues towards implementing standing desks in primary schools (Appendix 9). First order themes were developed from the general dimensions with further second order themes to appropriately support.

The aims of this study looked into three main areas. Firstly the study looked to provide an in-depth review of why primary school children should not be in sedentary states for prolonged periods of time. The second aim attempted to propose evidence of alternative solutions to help combat prolonged periods of sedentary behaviour. Lastly the study also proposed to research into current barriers of implementing standing desks in primary schools. The three general dimensions from the data analysis were highlighted as relevant to each aim respectively.

Negative impacts of sitting on primary school students

The interviews presented several impacts prolonged sitting is having on primary school students. To begin with there was a clear understanding that prolonged sitting was having a multitude of negative impacts on primary school students orthopaedic health specifically spinal position, hip range and dysfunctional movement patterns.

"Erm it's really impossible to organize your spine and your trunk in a seated position and so you know you see, I mean literally go into any primary school classroom and you see people just hanging on their tissues in their C-spine position and kids are looking for stability in all sorts of different ways in that seated position." (P.1. Line 47-51).

"90% of the kindergarteners just run perfectly naturally you know, they sprint out the playground on the forefoot, their running technique is immaculate, um and then by the first grade about half the kids have converted into heel striking which is a dysfunctional movement pattern." (P.1. Line 21-24).

"But what we observed in kids in our own elementary school was that already by second, third, fourth, fifth grade that children are already um missing erm key hip extension. Basically their hips have become so tight from the sitting load that they can't fully extend their hips anymore…" (P.1. Line 8-11).

Previous research supports the data suggesting hip extension and functional movement patterns are detrimentally affected by prolonged sitting (Rosengart,

2014). The data also exposed a major concern on the increase in injuries occurring that could be a result of prolonged sitting. One interviewee stated:

"…our big local hospital, they apparently have a 24 hour operating room going for kids who have torn their ACL's, and that is a ginormous increase historically in terms of kids having orthopaedic dysfunction…" (P.1. Line 97-99).

The data suggests a positive correlation between the amounts of time children spend in sedentary behaviours and increased orthopaedic problems and injury. Specifically a child's spinal position when going into adulthood was of major concern. One participant commented on the orthopaedic problems within their own adult physical therapy clinic:

"…*theres a new diagnosis called 'text-neck' where you know where people have spent so much time sitting in a what we call a 'C-Spine' position. Erm and you know their head we call it forward head on neck but you know if your head is you know forward on your neck it can be upwards of 60 pounds of additional pressure on your cervical spine."* (P.1. Line 33-37).

The data suggests if children spend prolonged periods of time in a cramped up, C-Spine position through prolonged sitting there is a probability of several negative downstream effects both as a child, but more importantly later on in adulthood. This observation from the interviewee complements the current research suggesting an increase in back pain resulting from prolonged sitting

(Beach et al., 2005, Levine, 2014). Overall it provides a major concern for children and their future orthopaedic health. It is also a major concern for health organisations due to the rapid increase of children going to hospital because of injuries caused by dysfunctional movements as a result of prolonged sitting.

Neurocognitive development also emerged as a common theme. When discussing this theme participants stated:

"…the idea that you know both adults and children alike you know, literally their brain turns off when they're sitting, they're not as functional erm cognitively is well known…" (P.1. Line 74-76)

"…there is a reasonably neurological hypothesis where by we know the brain development is influenced by the erm exposures a person or mammal is subjected to. For example cats bought up in the dark have underdeveloped visual cortex's and children bought up in the absence of movement as you can imagine are going to have underdeveloped neurological systems for promoting, enjoying and perpetuating movement." (P.2. Line 50-55)

Previous research supports the data suggesting links between increased sedentary time and poor neurocognitive function (Levine, 2014). Participants also mentioned the downstream impacts of hindered brain and neurological function. One participant indicated when going into a high school:

"*I went in there and they all had standard desks and there were literally kids flopped over the desks with beanie caps on pulled down over their eyes asleep. So in other words the paradigm that seated children are more attentive is quite possibly false"* (P.2. Line 144-147).

Consequently there is a possibility that children's short attention spans could be a cause from hindered neurological function. One interviewee stated:

"…the research on the brain and neuroscientists knowing that your brain doesn't, is not working, is not firing when you're sitting down is well known…" (P.1. Line 67-69).

A relationship between brain systems shutting off and poor attention spans seems somewhat closely linked when putting the two into perspective. This corresponds with the previous research by Kindlon et al., (1999) that suggests a lack of movement during school is resulting in poor attention spans and consequently leading pupils to partake in more delinquent behaviour.

Educational attainment was briefly mentioned as another negative impact from a lack of movement. Participant P.2 who has conducted extensive research within this area stated:

"Similarly in schools the number one outcome has to be educational attainment. So that to me is the biggest issue related to children sitting, mainly that If children were not sitting the data suggests their educational attainment

would improve significantly and both in the UK and the USA we are looking to be at a competitive advantage from school age onwards and therefore this is relevant." (P.2. Line 39-44)

Research from Clark, Sugiyami, Healy, Salmon, Dunstan, Shaw, Zimmet and Owen (2010) supports the suggestion of a possible relationship between sedentary behaviours and hindered educational attainment. It seems obvious that if the data indicates sitting switches the brain off and leads to poor neurocognitive function, academic attainment would be hindered. However previous research is currently inadequate to show significant results (Hinckson et al., 2015). Nevertheless the data provides some insight into the negative impacts a sitting classroom could have on a child's attainment in comparison to a more engaged, actively structured classroom.

Benefits of standing desks for primary school students

Participants presented personal experiences through their own research and observed a range of benefits that standing desks present to primary school students. Both participants indicated the increase in movement alone that a standing desk provides results in various positive impacts on children. From the interview participants said:

"…just the plain fact of standing versus sitting is beneficial. Erm because the kids can be constantly in motion and changing position…" (P.1. Line 185-186).

"…kids move an awful lot more if given the permission to move whether that's through furniture or through the structure of the lessons themselves. And the data I've seen is actually quite impressive where by children are once giving this permission and once they're given the facility to do it, they actually move about twice as much as they do prior to them interventions." (P.2. Line 105-110).

The data corresponds with previous research suggesting that standing kids move more (Lanningham-Foster, Foster, McCrady, Manohar, Jensen, Mitre, Hill and Levine, 2008). More movement subsequently leads to numerous positive health impacts including increased energy expenditure and improved mood states (Benden et al., 2014, Pronk et al., 2012). There were also some school specific impacts that were expressed in the data. Participant P.1 indicated a key feature of any standing desk for children should incorporate a fidget bar:

"And that's that little moving bar underneath the desk and erm you know again, it creates an non-disruptive way for kids to be pretty much be moving all day long when they're standing…" (P.1. Line 231-233).

Similarly participant P.2 stated, *"children have pent up energy, that pent up energy needs to be dissipated in some shape or form*" (P.2. Line 92-93) and the wiggle bar as P.2 named it, *"literally gives a permission, a physical and environmental permission for the child to move*" (P.2 Line 95-96).

The fidget/wiggle bar should be a vital aspect of any standing desk, especially if being implemented into primary schools as it promotes the student to constantly move. The downstream of positive benefits of this constant movement were also specified from both participants. In particular weight loss was a common theme. Participant P.2 stated:

"Children lose weight particularly if they are over weight and children feel fitter and stronger." (P.2. Line 124-125).

This also coincides with numerous studies that indicate significant increases in energy expenditure when using a standing desk in comparison to sitting (Blake et al., 2012, Torbeyns et al., 2014 and Reiff et al., 2012). Increased movement in the classroom was also mentioned to have benefits on classroom behaviour:

"We've had some parents of kids who had historical behaviour problems say that they're trips to the principle have decreased so I think engagement, better behaviour…" (P.1. Line 242-244).

"…last of all kids who are for example quite inattentive through being over active or fidgety or sometimes a little erm pugnacious or rambunctious in this classroom are much better behaved." (P.2. Line 127-130).

An interesting concept, whereby more movement by children actually creates a more attentive, well behaved classroom. It is easy to assume that more

movement could create a more chaotic classroom and do more harm than good. However the fidget bar provides a non-disruptive moving feature and that is the important concept to understand. Because the teacher cannot see pupils constantly moving their foot under the table it creates a more effective and positive classroom environment for both students and teachers. Previous research also complements this with many studies finding improvements in student behaviour from increased movement and using standing desks, even if classroom behaviour was not the primary focus of the study (Katz et al., 2015, Benden et al., 2011).

When comparing sitting to standing desks participant P.1 stated improvements of primary school student's spinal positions when using standing desks:

"…it's better for them orthopedically because they're no longer in this C-spine shape, I mean I would love it for you to see our kids in our school because you just see them with these perfect little positions, their feet are straight, there spines are organized…" (P.1. Line 199-202).

Participant P.1 followed this by indicating:

"they're practicing better positions and postures all day as apposed to practicing crappy positions and postures, which we know will have a positive downstream effect on their lifetime orthopedics" (P.1. Line 261-263).

The interviewee suggested when students were standing there were no signs of any c-spine or forward shoulder position that were typically noticed when students were seated. The observations complement previous research that similarly found corrected posture was a result through the implementation of standing desks on high school students (Koskelo, Vuorikari and Hänninen, 2007). By putting students in an upright position they are able to constantly practice better positions whilst preventing the potential orthopaedic risks from a c-spine or tight hips. Both this study and the previous research similarly indicate the benefits of corrected posture that include improved future orthopaedic health together with alleviated neck, shoulder and back pain (Koskelo et al., 2007).

Lastly from the data participant P.2 has conducted and stated in the interview, there was a common theme between children being active in school and an increase in attainment grades:

"So what's very interesting is has now been a multitude of studies being conducted that demonstrate that if children are enabled, facilitated and encouraged to be active during school time their grades will actually improve somewhere in the sort of erm around ten percent…" (P.2. Line 31-34).

"The grades of children in our data sets improve when they're able to move more. And those improvements even start at pre school age and so 'moving children learn better' would be the erm nutshell summary of that." (P.2. Line 113-116).

“Children are more ready when they get home to do homework even at young ages.” (P.2. Line 122-123).

Interestingly the previous data is insufficient on significant increases in attainment grades when using a standing desk (Hinckson, Salmon, Benden, Clemes, Sudholz, Barber, Aminian and Ridgers, 2015). However the data provided in the interview by P.2 indicated children who are more active in school could achieve better grades. More importantly when the data sets are showing improvements of around a 10% increase, this could be extremely substantial evidence for the future implementation of ergonomic school furniture.

Current barriers and issues towards implementing standing desks in primary schools

The biggest barrier towards implementing standing desks that was presented in both interviews was the lack of funding:

“I think the biggest issue at least in the US is funding because we have way more interest in demand right now than we have money to fund.” (P.1. Line 387-388).

“The third barrier is the simple one which can be overcome in a few years of decent funding.” (P.2. Line 269-270).

The data confirms previous research indicating money being a big influencing factor towards the globalisation of standing desks in primary schools (Hinckson et al., 2015). Participant P.1 indicated the two main funding issues are firstly the amount of interest surpasses the funding possible to make it happen and secondly standing desks are too expensive in comparison to seated desks and chairs. Participant P.1 stated in the interview they have had meetings with the main standing desk companies and discussed with them:

"look until these things are $150, which is at least in the neighbourhood of a sitting desks and a chair this is going to be hard to really implement on a global scale" (P.1. Line 397-399).

Previous research supports this by indicating standing desks currently cost approximately 20% more than seated desks and chairs (Benden et al., 2011). Cost and funding is the one fundamental section that could ignite the future potential for standing desks to be globally implemented. The typical standing desk for children at this point in time is hard to acquire for under $250. When compared to seated desks this is ultimately the current major barrier towards implementing standing desks on a global scale.

In conjunction with funding one aspect that participant P.2 expressed as a barrier was the 'not have effect'. As discussed with funding many schools cannot currently afford standing desks. Similarly with the research P.2 has conducted, not being able to accommodate for all students in a school was sometimes the biggest challenge:

“And my answer would be is really the biggest negative effect is the ‘not have’ effect. Meaning you know for example we recently did a successful standing desks programme in a California school. All the kids loved it, the teachers loved it, parents loved it but the negative was the slue of “well how about our school? If they’re doing it then why can’t we?” (P.2. Line 157-161).

Although there has been no previous research corresponding with this, it provides an interesting insight into the process of how research should be carried out on standing desks and the strategic planning of implementing standing desks into schools. Participant P.2 provided future considerations on their own research:

“And so if I’m going to do a programme like this in a group of young primary school kids in the UK and you only have the money to do two classrooms out of six for the sake of argument you absolutely need to get buy in from everybody that that’s acceptable.” (P.2. Line 173-176).

“So that strategic planning is actually far more important than one thinks.” (P. 2. Line 179-180).

An interesting concept where success could actually be the downfall in implementing standing desks is the fact that other students, teachers and schools could become jealous that they are not being provided with these great opportunities. The overall data provides careful attention that is needed

when considering the implementation of standing desks. For example if only one classroom is being provided with standing desks either: make sure everyone has agreed that this is okay (this includes parents, students and teachers) or incorporate a classroom share where each class has an equal opportunity to use the standing desks.

Lastly the initial switch over period was seen as a current issue with standing desks. Participant P.1 gave examples from their own experience:

"…every so often there is a parent who where a kid would come home reporting they're tired and that is a point of concern to the parent…" (P.1. Line 276-277)

"…some kids it takes them 6 weeks to adjust or even up to 2 months but then after 2 months you know even the slothiest kids seem to adjust and opt for standing all day versus slouching around on a stool." (P.1. Line 285-287).

Similarly research by Salmon, Sudholz and Dunstan (2015) implied that over 50% of students who used standing desks for one term reported leg pain. However participant P.1 carried onto state that this should not be seen as a negative:

"…I mean I don't think being tired is a negative because I think what it shows is the sign that how far away from normal kids have gotten that they cant

stand for a short period of time, so to me its not a negative…" (P.1. Line 278-280).

The data provided interesting insight into how out of sync we are to being an active nation whereby currently standing and light activity is seen as a break from sitting. However ultimately the mindset should be the reverse of that. The data also suggests that there should be careful consideration of the adjustment period when switching from seated to standing desks. Hinckson et al., (2015) complements this by indicating an adjustment period is needed in order for muscles to be conditioned towards the new environment. Therefore it should be compulsory that all students and parents are notified of the initial tiredness/soreness that could occur before making the switchover to standing desks.

Conclusion

The main aim of the study was to provide insight into the feasibility of standing desks within primary schools. From the data there is certain feasibility that standing desks can be implemented into primary schools. The data complements previous research that states promising opportunities for standing desks in school settings (Hinckson et al., 2015). The data suggests sitting can have detrimental effects on a primary school student's orthopaedic health, neurocognitive development and academic attainment. Complementing this the main benefits standing desks provide were increased movement leading to weight loss, improved academic achievement and classroom behaviour and better orthopaedic health through the practice of

correct positions and posture. On the other hand the data provided current barriers and issues towards globally implementing standing desks in primary school. These consisted of funding, the ‘not have’ effect and the initial adjustment period.

Limitations and Future Research

While the interviews consisted of experts in the field providing detailed data, having more participants could have resulted in additional common themes or further supported the themes within this study. The time frame was a potential restriction towards not acquiring more participants. Although the data offered some clear understanding of the benefits standing desks provide primary school students there are still some key areas that research needs to focus on, mainly the long-term implications of standing desks. Previous studies provide numerous data on the short-term benefits. However there is a distinct lack of long-term outcome data to support the short-term benefits that could contribute towards the global implementation of standing desks in schools. Alongside this the data has provided a baseline of some key fundamental barriers hindering the implementation of standing desks in primary schools. However there now is an opportunity to further investigate the potential barriers standing desks might face when looking to be implemented on a global scale.

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