A Position Paper Managing Youth Screen Time versus Physical Activity

Encouraging Active Living in a Technological Focussed Generation

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Abstract: Childhood obesity is becoming increasingly prolific and problematic. Contributors to childhood obesity include decreased levels of physical activity and increased sedentary behaviour. Screen-based entertainment may be an important factor in the development of childhood obesity as children and adolescents prefer to spend time using electronic devices than exercising. While it is difficult to encourage children to cease playing video games, it is possible to change these passive screens to active ones. Information and Communication Technologies (ICTs) have been utilized by academics and researchers to promote levels of physical activity among young people. This position paper is part of our continuous research into the use of technology in the facilitation and motivation of children to be more physically active. This paper presents the "MySteps" framework that has been developed to manage youth screen time and exercise performance statistics. By developing technology-based solutions, we intend to increase children and adolescents awareness of their levels of physical activity and screen time. Consequently, self-monitoring and management of screen time and physical activity levels may lead to more active living beginning at an early age and continuing in life.

1 INTRODUCTION

Levels of childhood obesity have been steadily increasing over recent decades (Childhood Obesity, 2014; De Onis et al., 2010; Patricia and Anderson, 2006). The percentage of obese children in the United States has increased from 7% in 1980 to 18% in 2012 (Childhood Obesity, 2014). Although the most recent literature on childhood obesity in the United States shows that there was no significant change in the prevalence of obesity between 2003-2004 and 2011-2012, the overall number of children considered obese remains elevated (Ogden et al., 2014). Worldwide, the prevalence of overweight and obese children has increased from 4.2% in 1990 to 6.7% in 2010. It is estimated that the prevalence will reach 9.1% by 2020 (De Onis et al., 2010). These predictions suggest the need for urgent and effective interventions to combat the issue of childhood obesity (De Onis et al., 2010). Obese children are more likely to become obese adults and therefore children should be specifically targeted, as the benefits of preventing childhood obesity will flow on into adulthood (Whitaker et al., 1998; Dietz, 1997; Whitaker et al., 1997). Obese youth are more likely to have health problems such as cardiovascular disease, diabetes and cancer. Childhood obesity is also associated with social and psychological problems such as depression and low self-esteem (Childhood Obesity, 2014; Daniels et al., 2005). The cluster of associated medical conditions emphasise the need for the development of effective interventions.

Researchers and health professionals alike are alarmed by the wide spread nature of childhood obesity and its associated health problems and have strived to elucidate causes and contributing factors. Energy intake relative to energy expenditure, genetics, physical activity and sedentary behaviour have all be identified as potential causes (Patricia and Anderson, 2006). Lower levels of physical activity and higher rates of television viewing are two additional important determinants (Janseen et al., 2005). The integration of technology into our lifestyles and decreased supervision of children by parents who work full time are two factors that may also contribute to decreased levels of physical activity and increased sedentary behaviour in children and adolescents (Patricia and Anderson, 2006).

The literature has demonstrated a strong association between time spent in front of screens,

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especially watching television, and the prevalence of obesity (Patricia and Anderson, 2006; Janseen et al., 2005; Dietz and Gortmaker, 1985). In one study, with each additional hour of television viewed, the prevalence of obesity increased by 2% (Dietz and Gortmaker, 1985). Computers, mobile phones, video game consoles and handheld Internet devices are becoming increasing popular entertaining appliance for children and adolescents. Television stations and video games specifically developed for youth have become a major source of enjoyment. With so much content now available in a variety of media, it is not surprising that children spend a large proportion of their leisure time using electronic entertainment devices (Roberts and Foehr, 2008). Screen time should be considered an important contributing factor to the increased numbers of obese children (Patricia and Anderson, 2006).

Moreover, researchers have demonstrated an inverse relationship between physical activity level and body fat, particularly in males (Westerterp and Goran, 1997) aged between 6 and 9 years (Ball et al., 2001). This may contribute to the development of childhood obesity (Ball et al., 2001). Therefore, an important key in the management, prevention and treatment of obesity in children and adolescents may lie in increasing their levels of physical activity (Daniels et al., 2005).

Increasing physical activity and decreasing sedentary behaviour has social, emotional and intellectual implications (Make your move, 2014). For example, it reduces anti-social behaviour, assists in the development of physical skills, and improves self-esteem and confidence (Make your move, 2014). Regular physical activity is also linked to improved health outcomes and motor skills (Reilly et al., 2006) and reduced risk of many diseases (Warburton et al., 2006; Make your move, 2014). It contributes to the prevention of several chronic diseases as the risk of the developing these conditions begins in childhood (Warburtonet al., 2006).

Health institutions across the world have set physical activity recommendations for children and adolescents to be at least 60 minutes of moderate-to-vigorous physical activity per day (Australia's, 2014; Strong et al., 2005; Janssen, 2007). However, few young people meet this recommendation (Janssen, 2007). Physical activity levels drop between childhood and adolescence and continue to decrease with advancing age (Troiano et al., 2008). It has been reported that participation in physical activity has declined and sedentary behaviour has become more common especially among adolescents (Brodersen et al., 2008).

Factors that influence levels of physical activity and may prevent children and adolescents from exercising have been identified. These include, environmental barriers such as limited access to exercise facilities and recreational programs (Sallis et al., 2000), and neighbourhood safety (Molnar et al., 2004). Furthermore, children's motivation is an important determinant of their level of physical activity (Biddle and Goudas, 1996; Sallis, et al., 2000). Weightless may not be an appropriate motivator for young children to increase their level of physical activity. Young children need to enjoy physical activity in order to engage in it (Daniels et al., 2005). For example, one mechanism that has been suggested to motivate young children to be more physically active is sport competence and the encouragement of their desire to succeed (Biddle and Goudas, 1996). Increased participation in physical activity and decreased screen time should be the focus of research into the prevention and treatment of obesity and the promotion of health among children and adolescents (Janseen et al., 2005; Lou, 2014). Interventions should promote an active lifestyle and be designed to motivate children to keep fit and active.

Utilising Information and Communication Technologies (ICTs) in physical activity interventions has a positive effect on physical activity behaviour change in children and adolescents (Lau et al., 2011). ICT-based interventions apply techniques such as Internet or SMS as delivery modes. A major advantage of ICT-based interventions is that they are more readily accessible to a wider audience. Furthermore, these interventions can deliver video, audio and animation content to targeted groups based on their needs and preferences. Other advantages include feedback, automatic reminders and social support (Lau et al., 2011).

Children and adolescents enjoy using technology and digital devices. A survey of 1,100 parent-child pairs in 2004 showed that the vast majority of US teens used the Internet daily to play games, communicate with friends and seeking information. Some reported using the Internet to search for health, dieting or physical fitness information. Teens are also like to communicate with friends online and share links, photos and videos (Lenhart et al., 2005). Therefore it is expected that developing technology-based solutions for supporting regular participation in physical activity would have positive results.

Our research is designed to explore the best available technology-based solutions for physical activity promotion in children and adolescents. In this paper, we discuss the 'MySteps' solution, which was

developed with the aim of managing screen time and physical activity behaviour among children and adolescents. This technology-based solution may support the transition of youth behaviour away from sedentary lifestyle and towards an active lifestyle. 'MySteps' utilises activity-monitoring technology coupled with web-based feedback. Through this web application, users can login and monitor their screen time and physical activity performance statistics and compare these to recommended levels.

The remainder of the paper provides background information on the current levels of physical activity and sedentary behaviour among children and adolescents. The importance of technology-based intervention within this context has also been outlined. The following section details our proposed solution 'MySteps' and its contribution to the active living technology research domain. This paper concludes with our aims and plans to future improve our solution.

2 SCREEN TIME

Sedentary activity refers to activity that involves sitting or lying down (Make your move, 2014). "Screen time" activities are those done in front of a screen, such as watching TV, working on a computer, or playing video games (Kaneshiro, 2013). Screen time is a sedentary activity that requires a very little energy expenditure (Kaneshiro, 2013). Recreational screen time is defined as the time spent in front of screens for entertainment purposes and includes watching TV, playing video games and chatting with friends online (Recreational, 2013).

Spending numerous hours undertaking screen-based activities may contribute to, or increase the risk of, overweight and obesity in children and adolescents (Lou, 2014). Spending large amounts of time in front of screens reduces the amount of time children spend exercising and contributes to unhealthy eating habits such as snacking (Dietz and Gortmaker, 1985; Kaneshiro, 2013; Recreational, 2013). Screen based food advertisements also play a role in encouraging unhealthy eating habits (Dietz and Gortmaker, 1985; Kaneshiro, 2013; Recreational, 2013). Furthermore, spending excessive hours in front of screens may lead to sleep disturbance/ disorders (Switch Off, 2015), risk of attention problems, anxiety, and depression (Kaneshiro, 2013). Children and adolescents social skills may also be negatively affected by too many hours spent in front of screens (Switch Off, 2015).

The association between some specific screen based activities and increased levels of adiposity has been investigated (Robinson, 1999). Reducing television, video and video game use does not significantly affect levels of physical activity (Robinson, 1999). However, it may be a promising method to help prevent childhood obesity as reducing screen time has been shown to affect BMI, triceps skinfold thickness, waist circumference and waist-to-hip ratio (Robinson, 1999). Considering these implications, a screen time limit has been set for children and adolescents. The current guidelines suggest a maximum of two hours a day for children aged between 5 and 18 years (Make your move, 2014; Recreational, 2013; Switch Off, 2015).

The literature demonstrates a high prevalence sedentary behaviour attributable to screen based activities among children and adolescents (Lou, 2014; Rideout et al., 2010). Children and adolescent spend an average of 8 hours per day engaged in sedentary behaviours and screen time (Lou, 2014; Wilson, 2012). This trend is likely to increase as technology advances. Compared to 2003, in 2007, there were fewer children complying with the recommended screen time (Sisson et al., 2011). There were a number of important findings from a 2010 study on the quantity and nature of media used by young Americans (Rideout et al., 2010). Firstly, between 2004 and 2009, the amount of time young people spent using media increased from an average of 6 hours and 21 minutes to 7 hours and 38 minutes per day (Rideout et al., 2010). Secondly this study revealed that the average time spent using computers, playing video games, watching TV and listening to music and audio increased during this period whereas the use of printed materials such as books declined (Rideout et al., 2010). Thirdly this study found that the advent of mobile media has facilitates the use of media and expanded the number of hours children and adolescents spend using media. Between 2004 and 2009, the percentage of young people who owned a mobile phone increased from 39% to 66%. In addition, the percentage of young people who own other portable devices such as iPods increased from 18% to 76% in the same time period (Rideout et al., 2010). Lastly, the number of homes with Internet access expanded from 74% to 84% between 2004 and 2009 (Rideout et al., 2010).

Social networking and video sites like YouTube constitute the majority of the home Internet use. Australian health statistics reveal that in 2011-12; children and adolescents spent greater than two hours per day in front of screens, levels of physical activity decreased and screen-based activity increased as age

increased (Australian Health, 2013). Additionally, it has been found that children whose parents and caregivers limit media use or set media-related rules spend less time in front of screens (Lou, 2014; Rideout et al., 2010).

3 PHYSICAL ACTIVITY

Physical activity refers to any activity that requires physical movement and that results in an increased respiratory and heat rate (Make your move, 2014). Examples include running, playing sports and swimming. Moderate intensity physical activity refers to physical exertion that does not result in breathlessness, for example fast walking or bike riding (Make your move, 2014). Vigorous physical activity refers to activities that require a higher level of physical effort and result in breathlessness, such as running (Make your move, 2014).

Children and adolescents are encouraged to participate in 60 minutes of moderate to vigorous physical activity daily (Make your move, 2014). These 60 minutes can be accumulated throughout the day (Make your move, 2014). Rather than measure physical activity in minutes, the criterion-referenced standards for physical activity measure physical activity in steps per day using a pedometer. The median optimal number of steps per day for children aged between 6 and 12 years is 12,000 for girls and 15,000 for boys. It is estimated that this is equivalent to approximately 120 minutes of physical activity per day for girls and 150 minutes per day for boys (Tudor-Locke et al., 2004).

There have been a number of attempts to assess the level and patterns of physical activity in children and adolescents using objective measurements (Riddoch et al., 2004; Troiano et al., 2008). However, the lack of a validated tool that captures the multitude of types of physical activity in children is a limitation of research in this area (Riddoch et al., 2004). There are many types of physical activity tracking tools, however, these vary in their mechanisms of measurement and accuracy. There is a need for an accurate device that is able to collect information about children's activity levels. Such a device would assist with assessing whether children meet the recommended levels of physical activity. This information along with information about what influences and motivates children and adolescents to be physically active would assist with the development of a suitable invention to promote sustained adherence to physically active behaviour (Riddoch et al., 2004).

The level of physical activity in children and adolescents is a topic of interest among researchers. It has been reported that boys are more physically active than girls (Riddoch et al., 2004; Troiano et al., 2008; Brodersen et al., 2008; Salliset al., 2000) and that younger children are more physically active and spend more time engaged in moderate intensity physical activity than adolescences (Riddoch et al., 2004; Troiano et al., 2008). The 2003-2004 National Health and Nutritional Examination Survey conducted in the United States reported that 42% of children met the recommended level of physical activity compared to 8% of adolescents (Troiano et al., 2008). Contrastingly, a European study reported that a large majority of young children met the recommended level of physical activity (Riddoch et al., 2004). However, in support of the US study, the European study found that few adolescents met the criteria recommended for physical activity (Riddoch et al., 2004).

A study of British children indicated remarkable reductions in physical activity and increases in sedentary, especially among adolescents (Brodersen et al., 2008). Another study reported that only 7% of Canadian children met the daily physical activity recommendations (Wilson, 2012). In a 2011-12 Australian Health Survey of physical activity, only one-third of children, and one in ten young people undertook the recommended 60 minutes of physical activity every day (Research, 2014). On average, children and adolescents spend one and a half hours per day physically active (Australian Health, 2013). One study that measured physically activity in steps per day using a pedometer reported that children recorded an average of 9,140 Steps/day (Australian Health, 2013). Younger children were most likely to achieve the goal of 12,000 steps per day whereas only 7% of children aged 15 to 17 years did so (Australian Health, 2013).

4 A TECHNOLOGY BASED SOLUTION FOR PARITY

In response to the increased incidence of obesity in children and adolescents, many interventions and treatment programs have been developed with the aim of combatting this problem (Epstein et al., 1994; Reilly et al., 2006; Epstein et al., 1998). These interventions have different focuses including diet and exercise, surgical and drug treatments, behaviour change, self-monitoring, and managing screen time and physical activity levels (Shapiro et al., 2008;

Robinson, 1999; Epstein et al., 1998). Several new technologies have been developed and existing technologies exploited for this purpose. For example, Short Message Service (SMS) has been proposed as a method of monitoring children and adolescents' screen time and physical activity behaviour (Shapiro et al., 2008). Results showed that children and adolescents seems to be more affected by technology-based programs compared to other traditional paper-based methods of self-monitoring. Using electronic-based programs might be more suitable and provide adherence and acceptability in self-monitoring and behavioural change among young generation (Shapiro et al., 2008).

The literature supports the use of Information and Communication Technologies in physical activity interventions as a number of positive effects have been documented for children and adolescents (Lau et al., 2011). Electronic tools are useful in increasing individuals' awareness and enhancing their adherence to self-monitoring because of their ability to provide immediate feedback (Bartlett et al., 2002). A survey of a US sample of 1100 parent-child pairs found that 84% of teens owned at least one personal media device: a desktop or laptop computer, mobile phone or Personal Digital Assistant (Lenhart et al., 2005). While personal technological devices are widespread in their use, it remains to be determined which device/s hold the most promise for motivating children and adolescents to adhere to a more physically active lifestyle. It is important that such devices are designed to engage young people, monitor activity accurately and support active lifestyles.

A number of factors that positively affect behavioural change, increase awareness of physical activity and enhance adherence to self-monitoring have been identified, for example home-based tailored interactive programs targeted at children (Bartlett et al., 2002; Shapiro et al., 2008). Additionally, technology that provides immediate feedback and facilitates self-monitoring (Shapiro et al., 2008) as well as provides visual presentation of activity level such as charts (Bartlett et al., 2002) has been recommended. Studies have demonstrated a strong relationship between parental support and family inclusion, in the form of verbal encouragement or direct assistance, and increased childhood physical activity levels (Sallis et al., 2000; Bartlett et al., 2002; Epstein et al., 1994).

There are a number of important design considerations in developing technologies that encourage physical activity. Firstly, this technology should give users appropriate credit for their physical activity. There is a problem with currently available activity tracking technologies in that they do not record all types of physical activity. Therefore, designers should consider the most common physical activities undertaken by their targeted users (Consolvo et al., 2006). Secondly, technology should allow users to access information regarding their past and current physical activity levels with respect to their goals. Thirdly, technology should include features, such as the ability to share data with friends, which support socializing and communication and which may enhance motivation. Additionally, in developing technology that encourages physical activity, designers should be aware of the practical constraints of users' lifestyles. Finally, the technology should provide reasonable goals that encourage a sustainable increase in physical activity (Consolvo et al., 2006).

A number of similar technology-based projects have been developed with the aim of encouraging and motivating physical activity in specific groups including children, adults (Consolvo et al., 2006) and seniors (Bickmore et al., 2005). An example is 'Houston', a prototype mobile phone application that requires its user to wear a pedometer to count their daily steps and then share these step counts with friends. This system has been developed with the aim of encouraging physical activity. Feedback gathered regarding this application reported that it motivated participants to plan increased levels of physical activity (Consolvo et al., 2006).

5 'MYSTEPS' ICT FRAMEWORK

5.1 Overview of the 'MySteps' Framework

The 'MySteps' solution is part of a larger body of research being conducted to address the ever-growing problem of childhood and adolescent obesity. Our proposed solution focuses on the contributing factors to the issue of increased screen time and decreased physical activity among youth. It is widely accepted that children and adolescents seek entertainment though information and communication technologies. On the basis of an extensive literature review and investigations, we believe that the trend toward an increasing number of overweight and obese children is likely to worsen in the short term.

Furthermore, we acknowledge that it is problematic to prevent children playing video games or spending significant time in front of screens. We,

therefore, feel that a more useful approach is to utilize the very same technologies they are already prolific in order to encourage a more balanced, active and healthy lifestyle. We aim to employ a technology-based solution to increase awareness of unhealthy behaviour and support youth behaviour to be more active. Hence, Managing Youth Screen Time and Exercise Performance Statistics (MySteps) provides an easy to access web-based application that integrates a physical exertion tracking device to review an individual's daily activity behaviour.

5.2 Prototype Design and Implementation

In our web-based platform, we have used the daily step count as a measure of physical activity. We focused on 'recreational screen time' – time that children and adolescents spend in front of screens for fun and entertainment purposes. Our system is composed of two parts: hardware (Fitbit device and a computer) and software ('MySteps' website).

For the hardware component we used a Fitbit tracking device. After extensive product testing and a review of the literature we selected the Fitbit Zip. The Fitbit Zip is a wearable device that can be clipped to pocket, belt, shoes or clothes. The Zip tacks steps taken, calories burned and distance travelled. For our solution we elected to use steps taken. This decision was based on extensive evidence in the literature regarding baseline recommended daily steps for youths (15000 for males and 12000 for females). A computer device, either a desktop or laptop computer with internet access, is necessary to use MySteps. This allows for physical activity and screen time data to be uploaded to the MySteps website.

For the software component, we developed the 'MySteps' website. Users have to register and create an account in order to manage and monitor their screen time and physical activity counts on the 'MySteps' website. Fitbit provides a free API, which we have integrated into the MySteps framework. On registering and logging into MySteps at any given time the user can authenticate with their Fitbit account and their real time exercise statistics are updated in the MySteps application. The screen time element needs to be self-regulated (parent participation is strongly encouraged for this component of the App) and entered manually directly into the MySteps App. This can be done at any time and any number of times during the day to provide a progressive cumulative total for each day. A history of past behaviour is recorded.

Based on screen time and physical activity data, a visual representation is provided. Each element is mapped individually and in combination with the second element against the recommended levels. The graphs are easy to interpret so a young user can view their performance and ideally adjust their behaviour for the remainder of the day to meet the recommended levels. Users are also able to monitor their behaviour over the preceding week. The final sentence of a caption must end with a period.

6 CONCLUSIONS AND FUTURE WORK

This paper provides information regarding the increased prevalence of childhood and adolescent obesity and the risk this poses for the future due to the associated health problems. It specifically highlights increasing sedentary behaviour and decreasing levels of physical activity among young people as major contributing factors to the development of obesity. Current data relating to levels of physical activity and amount of time children and adolescents spend using screen-based activities is provided. We suggest that technology may help alleviate the problem of obesity among young people. Information and Communication Technologies have been previously utilised for the promotion of physical activity among children and adolescents. We aim to integrate the best available technologies to keep children active. Our previous work in this area found that the use of active video games (Altamimi and Skinner, 2012; Altamimi et al., 2014a; Altamimi et al., 2014), activity monitoring technologies and a combination of both of these technologies facilitated an active lifestyle among children and adolescents (Altamimi and Skinner 2013a; Altamimi et al., 2013; Altamimi et al., 2014b; Altamimi and Skinner, 2013b). This paper presents our solution, 'MySteps', a website designed to manage youth screen time and daily step counts.

The usability of 'MySteps' has been tested by the authors who intend to publish the website and run a small pilot to test its effectiveness in reducing screen time and increasing physical activity among youths. If this pilot demonstrates favourable results, we plan to integrate more features such as a rewards based on the physical exertion. We suggest that the combination of 'MySteps' with exergaming technology would have a further advantage. It is expected that in-game reward and progress based on physical exertion would act as a motivator for greater

physical activity in children while simultaneously reducing sedentary time spent in front of screens.

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