

Direct Measurement of TV Viewing Time and Physical Activity in Children

A Pilot Study

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Abstract: The main aim of this study was to design an electronic device to objectively monitor Television (TV) viewing time in children. The second aim was to examine the relationship between TV viewing time and physical activate activity (PA). Seven children (mean \pm SD, age, 10.7 ± 2.1 years; body mass, 35.7 ± 17 kg; height, 137.4 ± 12.3 cm) participated in this study. TV viewing time was directly measured for two consecutive days by a novel wireless electronic device, using Radio-frequency identification (RFID) technology which was connected to a main electronic board that is designed to measure TV viewing time in minutes. PA was also measured, concurrently with TV viewing time measurement, by pedometers (Yamax Digiwalker SW-700) for 3 consecutive days. The preliminary results show that the average TV viewing time of children was 248 ± 188 min/day. Participants also recorded a mean of 10731 ± 3399 steps per day. The average TV viewing time was positively associated with the average steps in children, but not statistically significant ($r= 0.74$, $p= 0.056$). It is concluded that the current study produces a novel wireless electronic tool that can monitor TV viewing time in children. It is also concluded that high association between TV viewing time and PA was observed among children, although not statistically significant.

1 INTRODUCTION

It is well known that reduced physical activity (PA) is one of the leading causes of the increased prevalence of obesity among children and adults (Blair 1993; Hill and Peters, 1998). In addition to physical inactivity, sedentary behaviour is believed to be a separate entity that could play a role in the aetiology of type 2 diabetes mellitus (T2D). A number of researches have demonstrated that physical activity and sedentary behaviour are two independents entities (Taveras et al., 2007, Ekelund et al., 2006). Sedentary behaviour is shown to be related to adverse cardiometabolic risk profiles and premature mortality (Lollgen et al., 2009). Television (TV) viewing is the most predominant sedentary behaviour and has been used as a measure of sedentary behaviour. There is also an accumulating evidence to suggest that there are adverse associations between TV viewing time and a number of cardiovascular risk factors such as the metabolic syndrome and obesity, abnormal glucose

metabolism, and T2D (Hu et al., 2003; Dunstan et al., 2005; Dunstan et al., 2007; Wijndaele et al., 2009). TV viewing is usually assessed by using a questionnaire that has a single question about daily or weekly TV viewing. It is known that self-reported measures suffer from some amount of reporting error. Therefore, measurement error in TV viewing time may lead to weaken the observed findings from previous studies.

Few studies used an objective measurement to monitor TV viewing time, such as direct observation and videotaping (Anderson et al., 1985; McKenzie et al., 1992; Ferguson et al., 2006). Unfortunately, these later measurements of TV viewing time have shortcomings since they are invasive to the person's privacy and they may change an individual's behaviour. They are also considered as impractical when used in large-scale research studies. Therefore, there is a need for alternative objective measures to monitor TV viewing time. To the best of our knowledge, no studies have assessed TV viewing with an objective measure such as an electronic

device. Thus, the main aim of this study was to design an electronic device to objectively monitor TV viewing time in children. The secondary aim of this study was to compare TV viewing time measured by the new electronic device with PA assessed by pedometers.

2 METHODS

2.1 Participants

Seven children participated in this study. Body weight to the nearest 100 g and height to the nearest 1 cm were measured using a Seca digital scale and measuring rod for BMI (weight/stature²) calculations. Prior to enrolment in the study, all parents signed an informed consent.

2.2 Tools

2.2.1 Direct TV Time Measurement Tool

TV viewing time was directly measured for two consecutive days by a novel wireless electronic device, using Radio-frequency identification (RFID) technology which was connected to a main electronic board that is designed to measure TV viewing time in minutes. The electronic TV monitor is comprised of three elements: a tracking tag (a wrist watch), a reader, and main electronic board (Figure 1).

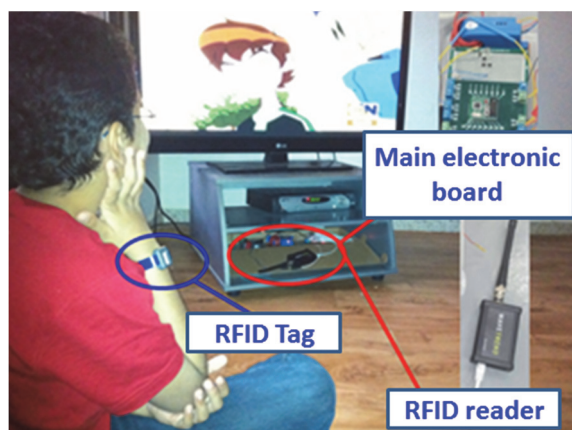


Figure 1: Description of the electronic TV monitor.

This electronic TV monitor uses RFID technology. RFID is a wireless and non-contact radio-frequency that transfers data automatically using identifying and tracking tag (i.e. RFID tag) that is placed to a child's wrist like a watch. The

RFID Reader is connected to a main electronic board which is designed to measure the TV viewing time in minutes when the RFID tag is detected by the RFID Reader and the TV is switched on. The main electronic board is composed with 24V Battery, ATmega8 microcontroller, Voltage Regulator, RS232 adapter, and RFID Reader to receive data from the RFID tag.

2.2.2 Pedometer

PA was also measured by pedometers (Yamax Digiwalker SW-700) for 3 consecutive days, concurrently with TV viewing time measurement. Participants were instructed to clip the pedometer to the waistband.

2.3 Statistical Analysis

Analyses were conducted using SPSS for Windows (Version 16). Data were expressed as mean values and standard deviations (SD). Pearson product-moment correlation coefficient was used to determine the correlation between PA measured by pedometers and directly measured TV viewing time. Statistical significance was accepted if $p < 0.05$.

3 RESULTS

Descriptive characteristics of all participants are shown in Table 1. The preliminary results show that the average TV viewing time of children was 248 ± 188 min per day. Participants also recorded a mean of 10731 ± 3399 steps per day. The result of this study also show that the average TV viewing time was positively associated with the average steps in children, but not statistically significant ($r = 0.74$, $p = 0.056$).

Table 1: Participants' characteristics.

Variables	Results
Age (years)	10.7 ± 2.1
Body weight (kg)	35.7 ± 17.1
Height (cm)	137.4 ± 12.3
BMI (kg/m ²)	18.1 ± 5.7

4 DISCUSSION

TV viewing has been previously identified as a primary sedentary pursuit, and is associated to a number of cardiovascular risk factors such as the metabolic syndrome and obesity, abnormal glucose

metabolism, and T2D (Hu et al., 2003; Dunstan et al., 2005; Dunstan et al., 2007; Wijndaele et al., 2009). Moreover, in cross-sectional studies for both adults and children, TV viewing time was found to be the predominant leisure-time sedentary behaviour that may have negative effects on overweight and obesity (Owen et al., 2000). In a recent cross-sectional study, TV viewing time was also associated with cardio-metabolic biomarkers, but not with computer use and reading time in an Asian population (Nang et al., 2013). Our study found that children spent 4.13 ± 3.1 hours per day in watching TV. It is recommended that children younger than 2 years of age should not spend any time watching TV and for children aged between 2 to 5 years TV viewing time should be limited to less than one hour per day (Commonwealth Department of Health and Aged Care, 2010). In general, children should not spend more than 2 hours a day watching TV.

TV viewing is usually assessed by using a questionnaire that has a single question about daily or weekly TV viewing. It is known that self-reported measures suffer from some amount of reporting error. Therefore, measurement error in TV viewing time may lead to weaken the observed findings from previous studies. Although few studies used an objective measurement to monitor TV watching, such as direct observation and videotaping (Anderson et al., 1985; McKenzie et al., 1992; Ferguson et al., 2006), these objective TV monitoring devices are both prohibitively expensive for observational research purposes and are invasive to the person's privacy and may change individual behaviours. To the best of our knowledge, this is the first study to measure TV viewing time directly by using a novel wireless electronic tool that can monitor TV viewing without intrusion to the personal privacy and can be widely used as an objective method of assessing TV viewing time.

It has been suggested that 10000 steps per day may be a reasonable estimate of daily activity for health benefits (Tudor-Locke and Bassett, 2004). Our participants attained similar levels (10731 steps per day). We found that the average TV viewing time was positively associated with the average steps in children, but not statistically significant ($r = 0.74$, $p = 0.056$). This positive association is on contrary to the previous findings. For example, it was found that there was a 16% decrease to meet the 10000 steps per day, for each hour of TV viewing on an average day (Bennett et al., 2006). This may be because TV viewing is just only one of many other potentially high-frequency sedentary behaviours (e.g., sitting, reading, computer and Internet uses) that are

associated with physical inactivity.

In fact, previous research found that there is limited evidence to support a negative association between PA behaviours and TV viewing time in children (Smith et al., 2008). Although assessments of PA and TV viewing time were measured using a self-report questionnaire in the previous study, a negative association between TV viewing time and PA was not found in the current study.

When PA determined by accelerometers which is more accurate than a questionnaire, it was found that children who spent more time watching TV were significantly less physically active (Jackson et al., 2009). A potential explanation could be that the increased TV viewing might take up time that would otherwise be spent being active. However, it is not clear why a negative correlation existed between TV viewing and PA in children. Previous research suggests that low PA would be a consequence rather than a cause of obesity. Children watching TV for a long time are more likely to be fatter for reasons linked to food intake and are less likely to be physically active because of their obesity. Another reason can be the TV food advertising that targets children and adolescents, contributing to an increase in obesity (Harris and Bargh, 2009). It is also recommended that extended periods of inactivity through participation in sedentary activities such as TV watching should be avoided by both children and youth. In a study conducted in Australian young adults, it was found that TV viewing more than 3 hours per day was associated with abdominal obesity, and this association was partly explained by the amounts of food and beverage consumption during TV viewing time (Cleland et al., 2008). This finding supports the possible explanation for the associations of sedentary behaviors with unhealthy dietary habits. Children and adolescents tend to consume more drinks and food while watching TV. When sedentary behaviour and consumption of unhealthy diets are combined, this may contribute to the aetiology of obesity in children and adolescents independent of reduced PA. In longitudinal study, PA and weekly TV viewing were estimated by a self-report in a cohort of 6369 girls and 4487 boys aged between 10 to 15 years (Taveras et al., 2007). In this study, Taveras et al., (2007) have found no substantial relationships between year-to-year changes in TV viewing and changes in leisure time moderate to vigorous PA, suggesting that TV viewing and leisure-time PA are separate constructs.

Moreover, individuals who have low levels of PA are more likely to have lower cardiorespiratory fitness (Blair, 1993). Many overweight or obese

people are likely to be substantially unfit such that they cannot sustain caloric expenditure sufficient to achieve or maintain a negative energy balance (Van Etten et al., 1997). Therefore, a potential explanation could be that overweight/obese individuals could sit more than normal weight individuals, although the current study has not examined the relationship between TV viewing and the sedentary behaviours among both groups.

It is concluded that the current study produced a novel wireless electronic tool that can monitor TV viewing without intrusion to personal privacy and can be widely used as an objective method for assessing TV viewing time. We also found that children who watched more TV were more physically active, suggesting that more research is needed to examine the relationship of sedentary behaviour and PA in children.

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