Measuring Physical Activity in Youth with Down Syndrome and Autism Spectrum Disorders: Identifying Data-Based Measurement Conditions

by

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ABSTRACT

Measuring Physical Activity in Youth with Down Syndrome and Autism Spectrum Disorders: Identifying Data-Based Measurement Conditions

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Few studies have paid attention to identifying physical activity (PA) in children and adolescents with disabilities using objective measures. The overall goal of this dissertation is to objectively measure PA in youth with Down syndrome (DS) and autism spectrum disorders (ASD) and to determine the minimum monitoring period needed for each group using data-based evidence. In study 1, I sought to objectively estimate PA in youth with DS using accelerometers and to determine the minimum monitoring days and hours needed. Results indicated that there were significant differences in daily PA between genders and age groups, not between weekdays and weekends, and that overall, 95% of the youth with DS who participated met the national physical activity guidelines. Regarding the minimum monitoring period, the results demonstrated that 4 days and 14 hours of monitoring per day were required to reliably estimate typical PA in youth with DS. In study 2, I aimed to objectively estimate PA using accelerometers and to determine the minimum monitoring days and hours needed in youth with ASD. Results demonstrated that there were significant differences in daily PA between genders and age groups, not between weekdays and weekends, and that approximately 90% of the youth with ASD who participated met the physical activity guidelines. In addition, at least 2 days and 9 hours of monitoring per day were needed to reliably estimate typical PA in youth with ASD. Finally, in study 3, I aimed to compare PA and the minimum monitoring days and hours needed between youth with DS and youth with ASD with the PA data measured on the ankle using accelerometers. Results indicated that placing an accelerometer on the ankle as the monitoring placement appeared to be reliable when measuring PA in youth with DS and ASD. No significant differences were observed for PA between the DS and ASD group, and 3 days of monitoring may be the most reasonable minimum number of monitoring days if both groups are combined into a larger group, categorized as developmental disabilities. However, the minimum monitoring hours appeared to need more investigation to be established.

CHAPTER 1

ESTIMATING PHYSICAL ACTIVITY IN YOUTH WITH DOWN SYNDROME USING ACCELEROMETERS

The increased prevalence of obesity among children and adolescents is one of the primary health concerns in the United States (Strauss & Pollack, 2001). Numerous studies have consistently provided the evidence that obese children were less physically active (Jassen, Katzmarzyk, Boyce, King, & Pickett, 2004; Vandewater, Shim, & Caplovitz, 2004) and spent more time in sedentary behaviors (Caroli, Argentieri, Cardone, & Masi, 2004; Hesketh, Wake, Graham, & Waters, 2007) compared to their age-matched peers without obesity. To reduce the rate of obesity in children and adolescents with typical development (TD), physical activity (PA) has been introduced as an intervention, and many efforts have been made to accurately understand PA using objective measures. However, PA among children with Down syndrome (DS) has rarely been investigated using objective measures (Angulo-Kinzler et al., 2002), even though children and adolescents with DS have generally been characterized as being less active than their peers with TD (Henderson, 1986; McKay & Angulo-Barroso, 2006; Sharav & Bowman, 1992; Ulrich & Ulrich, 1995; Whitt-Glover, O'Neill, & Stettler, 2006). It is obviously helpful to use objective measures when assessing PA for several reasons: 1) obtaining objective information about the frequency, intensity, and duration of PA; 2) determining the appropriate amounts of PA required to provide health benefits; 3) evaluating the effectiveness of intervention programs designed to increase PA; and 4) providing quantitative information about various factors that influence PA (Freedson et al., 2005; Trost, Pate, Freedson, Sallis, & Taylor, 2000).

Since the last two decades, numerous PA measures with acceptable reliability and validity values have been developed. However, it still appears to be challenging to choose the most appropriate PA measure for each study because one advantage in one study can be a disadvantage in others. For example, self-reported measures would be the most appropriate if examiners are interested in identifying previously performed PA in population-based studies. However, previous studies have shown that children and adolescents tend to overestimate their PA behavior when completing self-report measures (Pate et al., 2002). This disadvantage may make objective measures, including accelerometers, more popular in research studies because PA can be measured in short intervals (e.g. seconds or minutes) for several days without direct observation of examiners (Freedson et al., 2005; Trost et al., 2000).

Despite this advantage, limited attention has been paid to estimating minimal monitoring periods when using accelerometers. Several research studies have been conducted on the minimum monitoring period needed in general populations when using accelerometers and indicated that four to nine days were needed to reliably estimate usual PA behavior in typically developing youth, and three to five days were needed in healthy adults (Trost, McIver, & Pate, 2005). These results indicated that adults appear to be more consistent in their level of PA across days compared to youth. Tudor-Locke and Myers (2001) suggested that future studies were needed to examine the minimum number of days required to monitor PA in sedentary populations because they may need shorter monitoring days than more active groups. However, the minimum monitoring period needed in sedentary populations, including youth with disabilities, has rarely been examined. Kim and Yun (2009) examined the minimum number of PA monitoring days needed in youth with developmental disabilities, and indicated that their typical PA behaviors were reliably patterned after four days of monitoring.

However, their findings should be interpreted with caution for two reasons. First, they used the data collected from a small sample size (*n*=16). Second, a variety of disabilities, including intellectual disabilities, DS, traumatic brain injury, developmental delays, and autism, were included under the category of developmental disabilities in the previous study. This second limitation should be approached in disability studies with caution because children with DS tend to have some mental and/or physical impairment (e.g. inferior muscular strength, abnormal foot, knee, hip, and ankle kinetics) which may severely limit their ability to engage in physical activity and make them less physically active compared to those with other developmental disabilities (Jobling, 1998) as well as those with TD (Whitt-Glover, O'Neill, & Stettler, 2006). For these reasons, Mahy and collaborators (2010) suggested that measurement protocols should be designed for each sedentary group. Therefore, the purpose of this study was to objectively estimate PA in youth with DS using accelerometers, to examine the prevalence of compliance with the physical activity guidelines published by the U.S. Department of Health and Human Services (USDHHS) (2008), and to estimate the minimum number of monitoring days and hours with the data collected from youth with DS using Generalizability theory. It was hypothesized that: a) there would be no differences in PA between weekdays and weekends in participants with DS, b) boys with DS would be more active than girls with DS, c) younger participants with DS would be more active than older participants with DS, d) the normal weight group with DS would be more active than the overweight group with DS, e) participants with DS would not meet the PA guidelines (≥60 minutes of MVPA per day, ≥5 days/week), and f) the minimum monitoring period would be shorter than 7 days and 10 hours of monitoring per day when measuring PA in youth with DS using accelerometers.

METHODS

Participants

This study used secondary analysis with the PA data collected from youth with DS who participated in an intervention program to increase PA through riding a two-wheel bicycle. The data were initially collected before and one year after the intervention program as a follow-up, but the data collected before the intervention were used only in the current study because of the belief that their PA level would be influenced by participation in the program. Participants were included if they were 8 to 18 years of age at the time when they were initially enrolled and diagnosed with having DS. However, they were excluded if they had a dual diagnosis (e.g. DS and ASD), history of any medical conditions (e.g. uncontrolled seizures) which restricted to their ability to physically exert themselves at a moderate or higher level. Also, they were excluded if they had diagnosed as having one or more orthopedic impairments which caused them use of assistive mobility devices (e.g. crutch, wheelchair, walker) because previous research studies consistently reported that accelerometers were less sensitive to detecting movements without obvious vertical accelerations (e.g. wheelchairs, slow walking, cycling, mountain climbing) (Frey, Stanish, & Temple, 2008; Lorenzi, Horvat, & Pellegrini, 2000).

Research Design

Participants were asked to wear an accelerometer between the first week of April and the first week of June based on the assumption that their PA patterns during a school semester would be different from the ones during summer vacation. Also, all participants were instructed to wear the accelerometer on the right hip (anterior to the iliac crest) with an elastic belt for seven consecutive days and at least ten hours each day. If their total accumulated wearing time was less than ten hours on a day, the data collected on that day were excluded as non-valid observation. If zero activity counts lasted for longer than 20 minutes, we excluded this period of time as non-wearing time or indicative of sleeping. All procedures were approved by the Institutional Review Board at the University of Michigan. Assent was completed by all participants, and written informed consents were obtained from their parents or legal guardians before participation. Finally, parents were provided with a parent log to record when their child did not wear an accelerometer during their waking hours.

Accelerometry

Actical (Philips Respironics Inc., OR, USA) is a small-sized and light weight uni-axial accelerometer used to record changes in the vertical acceleration ranging in magnitude from 0.05 to 2.00 Gs with a frequency response from 0.25 to 2.50 Hz. Through these parameters, most human movements are detected, and movements with high frequency (e.g. vibrations from a lawn mower) can be excluded (Trost et al., 2000). The recorded data are digitized and filtered by an internal analog converter, and the magnitude is accumulated automatically over a user-specified period of time, an epoch. In the present study, a 15-second epoch was used throughout data analyses because previous studies have recommended using an epoch with less than one minute in PA studies among children due to their unique activity pattern lasting for short period (Trost et al., 2005). Other research has used epoch lengths ranging from 15 seconds to 60 seconds (Reilly et al., 2008).

Physical Activity Guidelines

The U.S. Department of Health and Human Services (USDHHS) (2008) has addressed the *Physical Activity Guidelines for Americans* designed to provide information and guidance on the types and amount of PA that provides substantial health benefits. According to the guidelines, youth are encouraged to participate in moderate-to-vigorous physical activity (MVPA) for more than 60 minutes at least 5 days a week, which is consistent with other currently used PA guidelines including the guidelines published by the National Association for Sport and Physical Education (NASPE) (2009) and the United Kingdom Expert Consensus Group (UKECG) (1998).

Generalizability Theory

Generalizability theory (G-theory) has been considered to be one of the most appropriate statistical methods to estimate reliability because of the characteristic of identifying multiple sources which contribute to total variance and estimating relative contributions of each source to total variance in a single analysis. Also, the G-theory provides data-based evidence to help determine the most effective measurement protocol resulting in high generalizability coefficients obtained through modifying the number of measurement conditions used. Two different types of studies, Generalizability study (G-study) and Decision study (D-study) are used depending on the purpose of research.

Generalizability study (G-study) aims to identify various factors contributing to total variance and to assess the precision of the measurement conditions used based on their relative and absolute generalizability coefficients (G-coefficients). Variance components associated with each factor are calculated and quantified by analysis of variance (ANOVA) to obtain G-coefficients, similar to the Cronbach's α -coefficients used in a classical test theory. Those G-coefficients can be used selectively depending on research questions. For instance, a relative G-coefficient can be used to explain how precisely and reliably a measurement procedure has differentiated among objects or individuals relative to one another, while an absolute G-coefficient can be used to evaluate how exactly a measurement procedure has located objects or individuals on a scale in absolute terms. Typically, an absolute G-coefficient tends to be greater than a relative G-coefficient, but both G-coefficients are considered to be "acceptable" when they are equal to or greater than 0.80 (Roebroeck, Hariaar, & Lankhorst, 1993).

Decision study (D-study) is used to make evidence-based decisions to improve measurement protocols. By changing the number of measurement conditions, the examiner can select a set of conditions providing the highest relative and absolute G-coefficients. The final decision is to choose a set of conditions that achieve a G-coefficient at or above 0.80. Commonly used measurement conditions in the area of education can include the number of trials, occasions, days, items, and any other conditions contributing to dependability of collected data. Therefore, the D-study helps establish appropriate measurement procedures for a specific group because of the assumption that each population has a different amount of error variance in the data collected. For example, we would expect youth with DS to be less varied in their physical activity requiring fewer days or trials to reach a G-coefficient of 0.80 compared to their non-disabled peers.

Data Reduction

All recorded activity counts were downloaded by Actical 2.12, a software program developed by its manufacturer (Philips Respironics Inc., OR, USA), to identify time spent and activity counts recorded in sedentary, light, moderate, and vigorous PA. Age-specific activity counts cut-off points for each PA level were derived from the energy expenditure prediction equation developed by Puyau and coworkers (2004). In their study, epoch-by-epoch detected activity counts were summed from a 1-hour treadmill protocol. According to the prediction equation, sedentary level was defined as activity energy expenditure (AEE) < 0.01 $kcal \cdot kg^{-1} \cdot min^{-1}$, indicating minimal body movements in a sitting or reclined position (e.g. sleeping, resting). Light level was defined as $0.01 \leq AEE < 0.04$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a low level of exertion in a standing position (e.g. casual walking). Moderate level was set at $0.04 \leq AEE < 0.1$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a medium level of exertion in a standing position (e.g. brisk walking). Vigorous level was set at $AEE \geq 0.1$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a high level of exertion in a standing position (e.g. race walking, running) (Puyau, Adolph, Vohra, Zakeri, & Butte, 2004).

Statistical Analysis

Independent t-tests for monitoring time, time spent, and activity counts in all PA levels were conducted to examine various group differences, including gender, age, and obesity level. Because the PA guidelines used recommend youth to achieve more than 60 minutes of MVPA at least five days a week, the percentage of participants who met the guidelines and daily total time spent in moderate-to-vigorous physical activity (MVPA) were presented using descriptive statistics. All participants were divided into either female or male by gender, 8-11 years group (elementary school students) or 12-18 years group (secondary school students) by age, and the normal weight group (less than 85th BMI percentile) or overweight group (equal to or greater than 85th BMI percentile) based on the age- and gender-specific BMI percentile rank calculated. All statistical analyses were performed using SPSS version 18.0 with a significance level of 0.05. In addition, effect sizes and their associated 95% confidence intervals were calculated using Cohen's d within Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA). Effect sizes were interpreted as having small (0.2-0.49), moderate (0.50-0.79), or large (≥0.80) impacts in accordance with Cohen's guidelines (1969). To determine the minimum number of monitoring days and hours needed in youth with DS, EduG 6.0 (The Institute for Educational Research and Documentation, Neuchatel, Switzerland) was used. It provides information on the sources contributing to total variance and helps make evidence-based decisions on the minimal measurement protocol by modifying the number of measurement conditions (e.g. number of days: 1, 2, 3,…, 7) which might contribute to total variance. Total accumulated activity counts per minute were used as a main dependent variable throughout our data analysis. A generalizability coefficient of 0.80 was employed as a minimum reliability coefficient (Cardinet, Johnson, & Pini, 2009) for making a decision of the minimum number of monitoring days and hours.

RESULTS

A total of 81 individuals (42 girls, 39 boys; age: 11.6±2.1 years; height: 135.0±10.9 cm; weight: 41.0±13.1 kg; Body Mass Index (BMI): 22.1±5.1 kg/m^2; BMI percentile: 76.1±23.9 %) participated in this study. Participants wore an accelerometer for 6.1 days on average and 817.7 minutes per day on average.

The estimates of percentage of time spent in each PA level, and total activity counts on weekdays and weekends are presented (Table 1.1). Participants spent more time in sedentary PA on weekends, and more time in light and moderate-to-vigorous physical activity (MVPA) were spent on weekdays, but no significant differences were noted between weekdays and weekends. In addition, we found participants demonstrated more PA counts on weekdays compared to weekends, but no significant differences were observed.

Significant gender differences were noted for daily PA (t=-2.30, p=.024) and time spent in MVPA (t=-2.61, p=.011) on weekends, while we found no significant gender differences for all variables on weekdays (Table 1.2). Specifically, girls with DS recorded significant differences for daily PA (t=2.46, p=.018), time spent in sedentary PA (t=-2.62, p=.012), and time spent in MVPA (t=3.13, p=.003) between weekdays and weekends, though boys with DS showed no significant differences for all PA variables between day types (Table 1.3).

All participants were divided into either the 8-11 years group or 12-18 years group because of our hypothesis that elementary school students are more physically active than secondary school students. Significant age group differences were noted for daily PA (t=4.82, p=.000), time spent in sedentary PA (t=-5.37, p=.000), light PA (t=4.08, p=.000), and MVPA (t=4.76, p=.000) on weekdays. On weekends, significant age group differences were observed for daily PA (t=2.88, p=.000), time spent in sedentary PA (t=-3.11, p=.000), and MVPA (t=3.37, p=.000) (Table 1.4). Interestingly, in the 8-11 years group, significant day-type differences were identified for time in sedentary PA (t=-3.16, p=.003) and light PA (t=2.67, p=.010), while no significant day-type differences were noted for all variables in the 12-18 years group (Table 1.5).

All participants were divided into either the normal weight group ($<85^{th}$ in the BMI percentile), or the overweight group ($\geq 85^{th}$ in the BMI percentile). Statistical analyses failed to reveal significant group differences for all the PA variables used on both weekdays and weekends (Table 1.6). Similarly, both groups failed to show significant day-type differences for all the PA variables used in the current study (Table 1.7).

Table 1.8 presents time spent in MVPA and percentage of the participants meeting the PA guidelines issued by the USDHHS (≥60 minutes of MVPA per day, ≥5 days/week) by gender, age, and obesity level. Participants with DS spent nearly two hours and forty minutes in MVPA per day, and overall, 95% of the participants in this present study met the PA guidelines (≥60 minutes of MVPA per day, ≥5 days/week).

The estimated variance components of the sources contributing to total variance in total activity counts and their relative magnitude are presented. Results indicated that the largest source of variance was Participant (P) (51.5%), while Day (D) and their interaction (P×D) were associated with 2.7% and 45.8% for total variance, respectively (Table 1.9). On the other hand, results showed that the largest source of variance was their interaction (P×H) (62.6%), while Participant (P) and Hour (H) were associated with 21.2% and 16.2% of total variance, respectively (Table 1.10).

Figure 1.1 shows the estimated relative and absolute generalizability coefficients (G-coefficients) for the monitoring days selected, indicating that the estimated relative and absolute G-coefficients increased as the number of monitoring days increased, and that at least four monitoring days were required to achieve the minimum level of both G-coefficients of 0.80 in youth with DS.

Figure 1.2 shows the estimated relative and absolute generalizability coefficients (G-coefficients) for the monitoring hours selected, indicating that the estimated relative and absolute G-coefficients increased as the number of monitoring hours increased, and that at least 12 monitoring hours were required to achieve the minimum level of a relative G- coefficient of 0.80 and 14 monitoring hours required to achieve the minimum level of an absolute G-coefficient of 0.80 in participants with DS.

DISCUSSION

In the present study, we observed several meaningful findings. First, youth with DS showed similar PA regardless of day types. This finding seems to be important when deciding the minimum monitoring period criteria in DS research studies. Given the fact that no significant differences in PA between weekdays and weekends were observed, it appears unnecessary to include data collected on weekends when employing objective PA measures in children and adolescents with DS. Trost and collaborators (2005) published a literature review addressing evidence-based guidelines or recommendations on how to successfully implement an accelerometer-based measurement protocol and suggested that a 7-day monitoring period be used if differences between weekdays and weekends in PA estimates are observed. Previous studies have consistently documented that weekday versus weekend differences in PA were observed among typically developing children and adolescents using objective measures (Armstrong, Balding, Gentle, & Kirby, 1990; Gilbey, & Gilbey, 1995; Sallo, & Silla, 1997; Trost et al., 2000). However, we found no differences in PA between weekdays and weekends among youth with DS. From our findings, why this may have occurred remains unclear. However, it seems that PA of our participants may not have been influenced by the physical education (PE) curriculum and recess time offered by the school they were enrolled in during weekdays. These findings were similar to those reported previously for youth with developmental disabilities. The previous study indicated that children and adolescents with developmental disabilities were more PA on weekdays than weekends, but no significant differences were observed (Kim & Yun, 2009). Compared to the findings of the previous study, our participants showed less daily PA counts on weekdays, but the difference in daily PA counts on weekends was very small. This finding may be explained by that the youth who participated in both studies demonstrated a similar PA pattern on weekends. It would be interesting to see if both groups' PA levels were differentiated by various factors, but that is currently unknown in the present study. Future studies should elucidate patterns of PA on weekdays and weekends with use of data collected in qualitative methods.

Second, PA on both weekdays and weekends was consistently higher for boys than girls and declined considerably with age. Previous studies examining PA in typically developing youth have consistently indicated that boys were more physically active than girls (Pate et al., 2002; Sallis, 1993) and that adolescents were more physically inactive compared to children (Trost et al., 2002). This finding can be explained by the evidence that youth with DS have more difficulties when participating in PE classes as they get older. A number of studies have consistently identified an attitude toward peers with disabilities as one of the barriers to PA participation, and bullying, staring by others, and segregation in PE classes were introduced as other examples of barrier (Heah et al., 2007; Imms, 2008; Lawlor et al., 2006; Mihaylov et al., 2004). Also, as youth with disabilities enter a stage of adolescence, they tend to be more sensitive to the reactions expressed by others, including teachers and peers, compared to adults with disabilities, which may make them feel isolated and afraid of participating in PA (Mihaylov et al., 2004). From a public health perspective, our findings suggest that PA intervention programs should be designed to maximize PA of girls and adolescents with DS, by satisfying their unique needs, and more efforts should be made to lead to socially friendly environmental changes in PE classes. Also, future studies may consider using longitudinal research methods to understand changes in the perception of barriers to PA participation as youth with DS are age.

Third, it was interesting to see if there were differences in a level of PA between the normal weight group ($<85^{th}$ BMI percentile) and the overweight group ($\geq 85^{th}$ BMI percentile). In this current study, we found both groups demonstrated very similar PA patterns on both weekdays and weekends, which is not consistent with the previous study's result that obese children are less physically active (Jassen, Katzmarzyk, Boyce, King, & Pickett, 2004; Vandewater, Shim, & Caplovitz, 2004) and spent more time in sedentary behaviors (Caroli, Argentieri, Cardone, & Masi, 2004; Hesketh, Wake, Graham, & Waters, 2007). This finding seems to be related to selecting an ineffective criterion for classification. All participants were categorized into one of the obesity groups based on the growth chart issued by CDC where BMI percentile was estimated with use of information about gender, age, height, and weight. However, numerous previous studies consistently indicated that people with DS were not necessarily overweight in relation to their height because short stature is consistent characteristic of most people with DS (Myrelid et al., 2002; Styles et al., 2002). Although the growth charts for DS were developed by Cronk and collaborators based on the US data published in 1988, the study sample was not representative of the total population with DS because the study sample was recruited from five different clinics or research studies. In addition, the growth charts provided information about Body Mass Index (BMI) raw scores, not BMI percentile. Body Mass Index percentile should be used to interpret BMI raw scores in children and adolescents because BMI is both age- and gender-specific. These criteria are different from those used to interpret BMI raw scores for adults and do not take into account age or gender. Therefore, future research studies should use other criteria, including skinfold measurement, to determine if a child with DS may be at risk of being classified as overweight or obesity.

This is the first study of PA in youth with DS using objective measures to evaluate compliance with the national physical activity guidelines. To track compliance with these types of PA guidelines, measures of PA have traditionally been combined with several public health surveillance systems, including the National Health and Nutrition Examination Survey (NHANES), the National Health Interview Survey (NHIS), and the Youth Risk Behavior Surveillance System (YRBS). Each of these systems has exclusively relied on self-report methods, and the application and validity of which were in considerable question (Baranowski, 1988; Pate, 1993; Sallis & Saelens, 2000). Previous studies have shown that the discrepancies in prevalence rates between self-reported national estimates and objectively measured estimates raised the possibility that self-reported surveys produced prevalence rates that were grossly inflated (Pate et al., 2002) and that children and adolescents tended to overestimate their PA behavior when completing self-report instruments (Sallis & Saelens, 2000). Our finding indicated that almost all youth with DS met the PA guidelines issued by USDHHS. Based on our findings, the guidelines issued by USDHHS appear to be a very low standard because the vast majority of youth with DS met the recommendation. However, the issue regarding appropriate accelerometer cut-off points requires careful consideration. Two previous studies have clearly indicated that accelerometer cut-off points have a strong impact on the prevalence of participants meeting the guidelines used (Beets, Bornstein, Dowda, & Pate, 2011). Cardon and De Bourdeaudhuji (2008) using the cut-off points developed by Sirad and collaborators, reported that 7% of Belgium children met the 60 minutes of daily MVPA at least 5 days a week. Using the cut-off points developed by Pate and collaborators, Vale and collaborators reported that 93.5% and 77.6% of Portuguese children met the 60 minutes of daily MVPA, respectively. These findings can be explained by several reasons: 1) the cut-off points used in the present study used different structured physical activities to simulate light-to-vigorous intensities (e.g. slow-to-fast walking on a treadmill); 2) were developed on a small number of typically developing children; or 3) were developed on younger participants than those who participated in the study conducted by Puyau and collaborators. Therefore, future research should focus on establishing the validity of the cut-off points used in youth with DS.

Establishing the minimum monitoring period needed to achieve a reliable estimate of PA would be critical in research studies examining PA. Previous studies investigating the minimum number of monitoring days in children and adolescents with typical development suggested that 4 to 9 days of monitoring are required to reliably estimate habitual PA (Janz et al., 1995; Murray et al., 2004; Trost et al., 2001; Trueth et al., 2003), and a 7-day monitoring protocol would be a reasonable choice if differences between weekdays and weekends are observed among children and adolescents (Trost et al., 2001; Trost et al, 2005). Among adults, however, a 3 to 5 day monitoring protocol would be appropriate to obtain reliable PA estimates when using accelerometers (Coleman & Epstein, 1998; Gretebeck & Montoye, 1992; Levin et al., 1999; Matthews et al., 2002). While evidence-based findings on the minimum monitoring period needed in youth with disabilities has rarely been investigated, most PA studies have used 7 days and 10 hours as a minimal measurement protocol in all people regardless of being diagnosed with a disability.

Our finding was that 4 days and 14 hours of monitoring per day were required to reliably estimate typical PA among youth with DS. The previous study was conducted with the data collected from 16 children and adolescents with developmental disabilities which included two children with DS, indicated that 4 days of monitoring were required when using accelerometers (Kim & Yun, 2009). The finding of the Kim & Yun's study was consistent with the finding obtained from the current study, even though they recruited youth with intellectual disability, autism, DS, cerebral palsy, traumatic brain injury, and other developmental delays, and their mean age was higher than our participants. Regarding variance component estimates and their relative contribution to total variance, the Kim & Yun's study indicated that 49.9% of total variance was explained by Participant (P), 4.1% by Day (D), and 46.0% by their interaction (P×D), which was very similar with what we found in this study. This means that the total variance of the data collected from youth with other developmental disabilities seems to be similar to the data collected from our participants with DS, and the finding that 4 monitoring days were required among youth with developmental disabilities may have a possibility of being generalized to research for youth with DS. Regarding the minimum number of monitoring hours, a previous study was conducted using the data collected from 76 young children without disabilities, aged 4-5 years (Penpraze et al, 2006). Their finding was that the reliability of total PA estimates were maximized when 10 hours of monitoring per day were used (r=0.80), but only small differences (r=~0.02) were noted in the reliability of estimates as the number of hours monitored increased from 3 to 10. On the other hand, our finding was that the reliability of estimates of total PA were maximized when 14 hours of monitoring were taken and that small differences were observed as the number of monitoring hours increased from 10 to 12 (r=~0.03). The discrepancy between these two studies might be explained by the fact that the participants of the previous study were non-school aged children, indicating that PA of those participants might not be influenced by physical education curriculum, which might take less hours to obtain reliable PA estimates. Despite those differences in PA patterns between those two samples, it might be meaningful to note that 4 days and 14 hours of monitoring per day would be an "acceptably" reliable monitoring protocol needed in youth with DS.

The strength of this study is that this was the first study on the estimation of the minimum number of monitoring days and hours needed for youth with DS, the extensive PA data collected by objective measures, and prevalence of compliance with the national PA guidelines with the cut-off points validated in a previous study, with the large age range and a large sample size relative to previous disability studies. Weaknesses include the restriction to one geographic region, inability to examine ethnic differences, and the use of the cut-off points not validated in single research studies among youth with DS. Considering the important implications mentioned, future studies may be needed to elucidate typical pattern of PA in youth with DS and provide more specific and objective information about the accumulated sufficient amount of health enhancing PA for youth with DS.

In conclusion, it was hypothesized that there would be no differences in PA between weekdays and weekends in participants with DS. Results indicated that participants with DS showed similar PA regardless of day types; therefore, this hypothesis was supported. It was also hypothesized that boys with DS would be more active than girls with DS, that younger participants would be more active than older participants, and that the normal weight group would be more active than the overweight group. Results indicated that PA was consistently higher for boys than girls and declined considerably with age; however, there were no significant differences in PA between two obesity levels. For compliance with the PA guidelines, it was hypothesized that participants with DS would not meet the PA guidelines. It was found that most participants with DS met the PA guidelines, meaning that our hypothesis was not supported from our findings. Lastly, it was hypothesized that the minimum monitoring period would be shorter than 7 days and 10 hours of monitoring per day when measuring PA in youth with DS using accelerometers. The results confirmed that youth with DS needed 4 monitoring days and 14 monitoring hours per day; therefore, the hypothesis of the minimum monitoring days was supported, but the one of the minimum monitoring hours was not supported.

Table 1.1. Mean±standard deviation and effect size for percentage of time spent in each PA level and daily total activity counts in participants with DS.

	Variable	Weekday	Weekend	*p*	ES	95% CI
Time spent in PA levels (%)	Sedentary PA	38.5±11.6	41.1±12.9	.188	0.21	(-2.60, 2.74)
	Light PA	41.7±7.1	39.9±9.0	.157	0.22	(-2.18, 1.32)
	MVPA	19.9±6.1	18.8±8.1	.338	0.15	(-1.92, 1.17)
PA intensity	counts/min	317.9±99.5	303.4±160.1	.488	0.11	(-35.0, 21.6)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval

Table 1.2. Mean±standard deviation and effect size for physical activity estimates on weekdays and weekends by gender.

Day type	Variable	Girls (*N*=42)	Boys (*N*=39)	*p*	ES	95% CI
Weekday	Daily PA (counts/min)	294.7±93.5	333.7±105.9	.213	0.40	(-32.8, 28.7)
	Time in sedentary (%)	39.4±11.1	37.6±12.1	.485	0.16	(-3.95, 3.20)
	Time in light (%)	41.6±6.5	42.0±7.7	.795	0.06	(-2.36, 2.02)
	Time in MV (%)	19.1±5.8	20.7±6.3	.217	0.27	(-1.71, 2.02)
Weekend	Daily PA (counts/min)	265.0±125.5	344.7±183.2	.024*	0.52†	(-57.0, 38.5)
	Time in sedentary (%)	42.9±12.4	39.1±13.3	.178	0.30	(-4.47, 3.45)
	Time in light (%)	40.3±8.3	39.6±9.7	.704	0.08	(-3.12, 2.43)
	Time in MV (%)	16.6±6.6	21.1±8.8	.011*	0.59†	(-2.17, 2.58)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates a significant difference between groups, $p<.05$. † indicates moderate or large effect size (Cohen's $d \geq 0.5$).

Table 1.3. Mean±standard deviation and effect size for physical activity estimates of gender groups by day type.

Gender	Variable	Weekday	Weekend	*p*	ES	95% CI
Girls (*N*=42)	Daily PA (counts/min)	304.6±98.1	265.0±125.5	.018*	0.36	(-38.3, 29.3)
	Time in sedentary (%)	39.4±11.1	42.9±12.4	.012*	0.30	(-3.45, 3.66)
	Time in light (%)	41.6±6.5	40.3±8.3	.222	0.18	(-2.69, 1.79)
	Time in MV (%)	19.1±5.8	16.6±6.6	.003*	0.41	(-2.40, 1.35)
Boys (*N*=39)	Daily PA (counts/min)	332.3±100.2	344.7±183.2	.621	0.09	(-57.4, 31.5)
	Time in sedentary (%)	37.6±12.2	39.1±13.3	.256	0.12	(-4.06, 3.95)
	Time in light (%)	42.0±7.7	39.6±9.7	.068	0.28	(-3.32, 2.14)
	Time in MV (%)	20.7±6.3	21.1±8.8	.697	0.05	(-2.71, 2.03)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates a significant difference between day types, p<.05.

Table 1.4. Mean±standard deviation and effect size for physical activity estimates on weekdays and weekends by age group.

Day type	Variable	8-11 years (*N*=47)	12-18 years (*N*=34)	*p*	ES	95% CI
Weekday	Daily PA (counts/min)	358.0±89.6	262.5±85.6	.000*	1.10†	(-29.9, 24.5)
	Time in sedentary (%)	33.5±8.2	45.5±12.0	.000*	0.34	(-3.69, 13.4)
	Time in light (%)	44.2±5.4	38.3±7.7	.000*	0.92†	(-3.51, 0.62)
	Time in MV (%)	22.3±5.4	16.5±5.4	.000*	1.09†	(-2.90, 0.46)
Weekend	Daily PA (counts/min)	345.1±177.0	245.6±111.9	.000*	0.66†	(-38.3, 49.9)
	Time in sedentary (%)	37.5±11.8	46.1±13.0	.003*	0.71†	(-3.66, 4.08)
	Time in light (%)	41.2±9.1	38.2±8.6	.126	0.34	(-3.23, 2.26)
	Time in MV (%)	21.2±8.2	15.5±6.5	.001*	0.77†	(-2.95, 1.58)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates significant difference between groups, p<.05. † indicates moderate or large effect size (Cohen's $d \geq 0.5$).

Table 1.5. Mean±standard deviation and effect size for physical activity estimates of age groups by day type.

Age	Variable	Weekday	Weekend	*p*	ES	95% CI
8-11 years (*N*=47)	Daily PA (counts/min)	358.0±90.0	345.1±177.0	.575	0.09	(-50.7, 25.6)
	Time in sedentary (%)	33.5±8.2	37.5±11.8	.003*	0.40	(-2.98, 2.74)
	Time in light (%)	44.2±5.4	41.2±9.1	.010*	0.41	(-3.01, 1.14)
	Time in MV (%)	22.3±5.4	21.2±8.2	.251	0.16	(-2.50, 1.38)
12-18 years (*N*=34)	Daily PA (counts/min)	262.5±85.7	245.6±111.9	.300	0.17	(-37.8, 28.6)
	Time in sedentary (%)	45.5±12.0	46.1±13.0	.676	0.05	(-4.32, 4.08)
	Time in light (%)	38.3±7.7	38.2±8.6	.887	0.01	(-2.90, 2.58)
	Time in MV (%)	16.2±5.4	15.5±6.5	.228	0.12	(-2.30, 1.70)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates significant difference between day types, $p<.05$.

Table 1.6. Mean±standard deviation and effect size for physical activity estimates on weekdays and weekends by obesity level.

Day type	Variable	Normal weight (*N*=43)	Overweight (*N*=38)	*p*	ES	95% CI
Weekday	Daily PA (counts/min)	324.7±99.4	310.2±100.3	.514	0.15	(-32.0, 29.6)
	Time in sedentary (%)	37.9±11.2	39.2±12.0	.606	0.11	(-3.70, 3.46)
	Time in light (%)	42.8±6.9	40.6±7.1	.170	0.32	(-2.58, 1.74)
	Time in MV (%)	19.6±5.9	20.2±6.3	.682	0.10	(-1.90, 1.86)
Weekend	Daily PA (counts/min)	299.1±140.9	308.1±181.2	.802	0.06	(-57.6, 42.2)
	Time in sedentary (%)	40.5±11.4	41.7±14.6	.663	0.09	(-4.55, 3.50)
	Time in light (%)	40.9±8.8	38.9±9.1	.312	0.23	(-3.12, 2.40)
	Time in MV (%)	18.3±7.2	19.4±9.0	.534	0.14	(-2.72, 2.29)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates a significant difference between obesity levels, p<.05.

Table 1.7. Mean±standard deviation and effect size for physical activity estimates of obesity groups by day type.

Age	Variable	Weekday	Weekend	*p*	ES	95% CI
Normal weight (*N*=43)	Daily PA (counts/min)	324.7±99.4	299.1±140.9	.176	0.21	(-42.3, 29.5)
	Time in sedentary (%)	37.9±11.2	40.5±11.4	.069	0.23	(-3.17, 3.58)
	Time in light (%)	42.8±6.9	40.9±8.8	.145	0.24	(-2.87, 1.82)
	Time in MV (%)	19.6±5.9	18.3±7.1	.126	0.20	(-2.32, 1.56)
Overweight (*N*=38)	Daily PA (counts/min)	310.2±100.3	308.1±181.2	.932	0.01	(-57.6, 31.9)
	Time in sedentary (%)	39.2±12.0	41.7±14.6	.051	0.19	(-4.45, 4.01)
	Time in light (%)	40.6±7.1	38.9±9.1	.084	0.21	(-3.10, 2.05)
	Time in MV (%)	20.2±6.3	19.4±9.0	.439	0.10	(-2.97, 1.90)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates a significant difference between day types, $p<.05$.

Table 1.8. Time spent in MVPA and prevalence (%) of compliance with the USDHHS physical activity guidelines (≥60 minutes of MVPA per day, ≥5 days/week).

		Gender		Age		Obesity	
Group	All	Girls	Boys	8-11 yrs.	12-18 yrs.	Normal weight	Over weight
N	81	42	39	47	34	43	38
Time in MVPA (min/day)	159.7±49.9	148.8±45.4	171.4±52.5	178.3±46.0	134.0±43.8	157.6±47.4	162.1±53.2
% of compliance*	95.1	94.9	95.2	97.5	92.7	93.0	94.7

MVPA=moderate to vigorous physical activity; * indicates that all results were calculated on the basis of the cut-off points established by Puyau et al. (2004).

Table 1.9. Variance component estimates and their relative magnitude for Participant (P), Day (D), and their interaction (P×D).

				Components				
Source of Variance	SS	df	MS	Random	Mixed	Corrected	%	SE
Participant (P)	225170.7	80	2814.6	575.7	575.7	575.7	51.5	110.5
Day (D)	8768.1	3	2922.7	29.8	29.8	29.8	2.7	22.8
Interaction (P×D)	122862.4	240	511.9	511.9	511.9	511.9	45.8	46.5
Total	356810.2	323					100	

SS=sum of square; df=degree of freedom; MS=mean square; SE=standard error

Table 1.10. Variance component estimates and their relative magnitude for Participant (P), Hour (H), and their interaction (P×H).

				Components				
Source of Variance	SS	df	MS	Random	Mixed	Corrected	%	SE
Participant (P)	7742711.6	80	96783.9	7474.3	7474.3	7474.3	21.2	1516.0
Hour (H)	4365207.4	9	485033.0	5716.0	5716.0	5716.0	16.2	2553.4
Interaction (P×H)	15869492.8	720	22041.0	22041.0	22041.0	22041.0	62.6	1160.1
Total	27977501.8	809					100	

SS=sum of square; df=degree of freedom; MS=mean square; SE=standard error

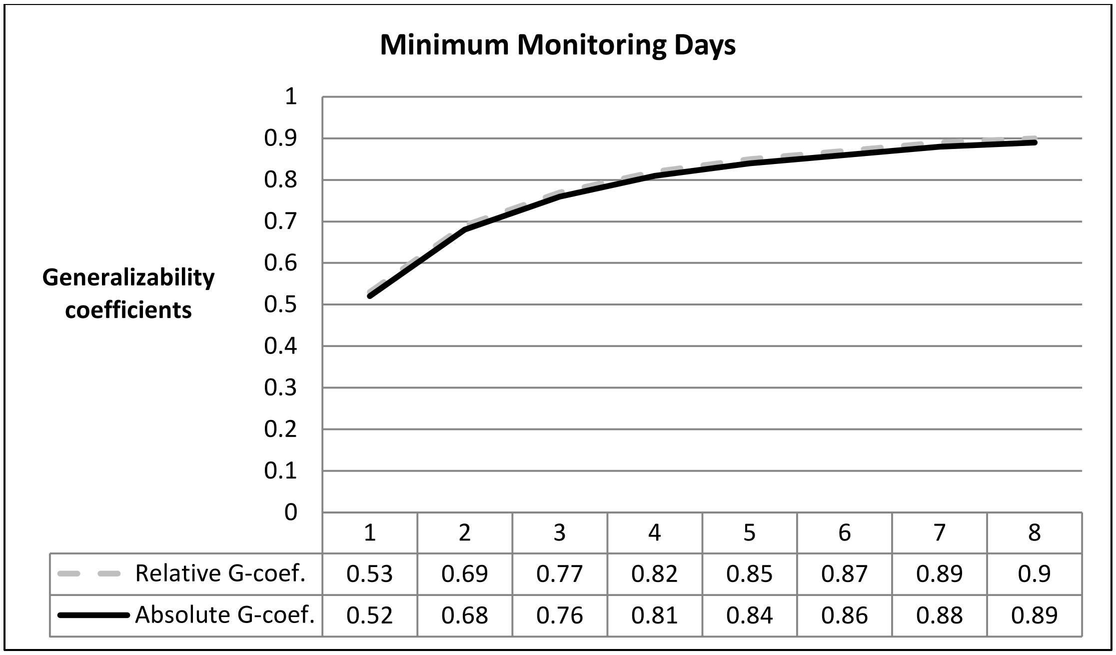
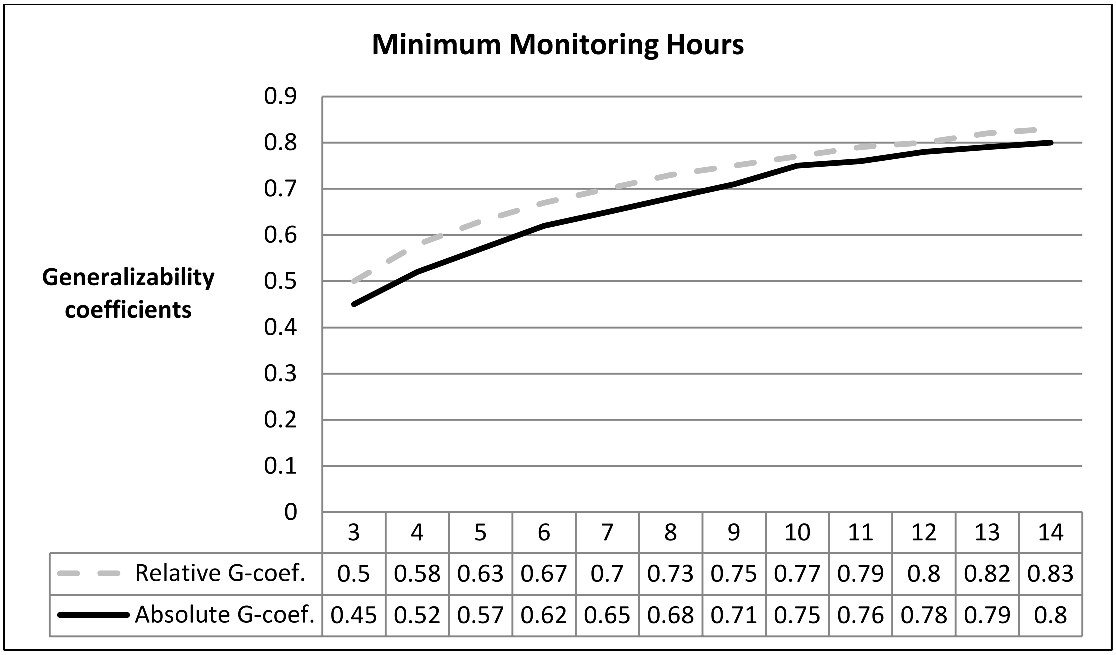


Figure 1.1. Estimated relative and absolute generalizability coefficients for the monitoring days selected.



	3	4	5	6	7	8	9	10	11	12	13	14
Relative G-coef.	0.5	0.58	0.63	0.67	0.7	0.73	0.75	0.77	0.79	0.8	0.82	0.83
Absolute G-coef.	0.45	0.52	0.57	0.62	0.65	0.68	0.71	0.75	0.76	0.78	0.79	0.8

Figure 1.2. Estimated relative and absolute generalizability coefficients for the monitoring hours selected.

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CHAPTER 2

IDENTIFYING PHYSICAL ACTIVITY PATTENRS IN YOUTH WITH AUTISM SPECTRUM DISORDERS USING ACCELEROMETERS

Developmental disabilities have been very common in the United States (Boyle et al., 2011). By definition, developmental disabilities are defined as a diverse group of severe chronic conditions that are caused by mental and/or physical impairments that are "likely to continue indefinitely" (P. L. 98-527). Examples of these conditions include intellectual disabilities, autism, Down syndrome, hearing loss, attention deficit hyperactivity disorder, cerebral palsy, blindness, and other developmental delays. According to a recent report from the Centers for Disease Control and Prevention (CDC), nearly fifteen percent of school-aged American children were diagnosed as having one or more of the developmental disabilities, and these figures appear to be still increasing (Boyle et al., 2011). This increasing prevalence has been used as strong evidence for the need of broader and more specialized health, education, and social services for youth with developmental disabilities and their families. As a result, comprehensive attempts have been made to encourage PA participation in order to reduce childhood obesity rates among children and adolescents with developmental disabilities in the United States.

Despite the comprehensive efforts, youth with developmental disabilities still encounter difficulties when participating in PA programs, and those programs have rarely been objectively evaluated (Baranowski, Anderson, & Carmack, 1998). To evaluate effects of those programs, various measures have been used, but most researchers have exclusively relied on proxy-report measures (e.g. parents' report) to identify typical PA pattern among youth with developmental disabilities. However, previous studies consistently indicated that using self- or proxy-report measures may not be appropriate among young children who cannot validly recall past PA (Freedson & Millller, 2000; Pfeiffer, Mciver, Dowda, Almeida, & Pate, 2006; Trost, Pate, Freedson, Sallis, & Taylor, 2000), that children and adolescents tend to have a possibility of overestimating their physical activity behavior (Sallis, 2000), and that parent proxy reports had low accuracy (Okely, Trost, Steele, Cliff, & Mickle, 2009; Tucker, 2008). For example, a child may count basketball practice which lasted for 60 minutes, but during which the child might be actually playing basketball for fewer than 20 minutes. To reduce discrepancies observed between self- or proxy-report measures and true PA, various objective measures were developed and have been used in free-living situations among typically developing youth and healthy adults, but limited attempts have been made to improve measurement among people with developmental disabilities.

Traditionally, research studies using data collected from people with developmental disabilities seem to have some common limitations. First, due to the limited number of people with developmental disabilities, most research studies did not have sufficient statistical power, which may prevent their research findings from being generalizable to other studies. Second, the amount of data might not be included due to the inclusion/exclusion criteria used among populations without disabilities. To overcome these limitations, determining the minimum monitoring period needed has been examined among general populations. By determining the minimum monitoring period based on data-based evidence, huge contributions can be made to research studies on PA and health promotion. For instance, cost and time spent for data collection can be reduced, and sample size can be increased, which maximize the power of statistical analysis.

According to the literature review on the minimal monitoring days needed for general populations, researchers consistently reported that four to nine days were needed to identify their typical PA among typically developing children (Janz et al., 1995; Murray et al., 2004; Trost, 2001; Trueth et al., 2003), while three to five days needed in healthy adults (Coleman & Epstein, 1998; Gretebeck & Montoye, 1992; Levin, Jacobs, Ainsworth, Richardson, & Leon, 1999; Matthews, Ainsworth, Thompson, & Basset, 2002). In addition, Trost and his collaborators suggested that seven days of monitoring would be a reasonable choice if differences in PA are observed between weekdays and weekends (Trost, 2001; Trost et al., 2005). A previous study suggested that future studies should be needed to examine the minimum monitoring period required to monitor PA in sedentary populations because they may need fewer measurement days compared to more active groups (Tudor-Locke & Myers, 2001). However, the minimum monitoring periods needed in sedentary populations, including youth with developmental disabilities, have rarely been examined. Kim and Yun (2009) recently attempted to examine PA in youth with developmental disabilities using objective measures including accelerometers, indicating that 4 days of monitoring were needed to reliably estimate PA behavior among youth with developmental disabilities. However, their findings should be interpreted with caution because various disabilities were included under the category of developmental disabilities in their study. If there were significant differences in PA across the subgroups with developmental disabilities, the degree of homogeneity in the collected data might be reduced (Jobling, 1998). Therefore, the purpose of this study was to estimate PA in youth with autism spectrum disorders (ASD) using an objective PA measure, accelerometers, to examine the prevalence of compliance with the PA guidelines published by U.S. Department of Health and Human Services (USDHHS), and to estimate the minimum number of monitoring days and hours needed in youth with ASD using Generalizability theory. It was hypothesized that: a) there would be no differences in PA between weekdays and weekends in participants with ASD, b) boys with ASD would be more active than girls with ASD, c) younger participants with ASD would be more active than older participants with ASD, d) the normal weight group with ASD would be more active than the overweight group with ASD, e) participants with ASD would not meet the PA guidelines (≥60 minutes of MVPA per day, ≥5 days/week), and f) the minimum monitoring period would be shorter than 7 days and 10 hours of monitoring per day when measuring PA in youth with ASD using accelerometers.

METHODS

Participants

This is a secondary data analysis using an existing data set of 34 youth with ASD whose age range was from nine to eighteen years, and all participants were recruited from the state of Michigan. Eight females and twenty six males served as participants, and parents or legal guardians reported the diagnosis of their child. None of the participants had any physical limitations that restricted participation in moderate or vigorous physical activity. Also, some participants were excluded if they had orthopedic impairments and used mobility assistance devices which may restrict their active physical activity participation because some non-weight bearing activities (e.g. sitting on a wheelchair) and the increase in energy expenditure during anaerobic exercises (e.g. weight lifting) might not be accurately detected by accelerometers (Frey, Stanish, & Temple, 2008; Lorenzi, Horvat, & Pellegrini, 2000; Pfeiffer et al., 2006).

Research Design

All procedures were approved by the Institutional Review Board of the University of Michigan, and written informed consent was obtained from each child's parents or legal guardians, and assent was obtained from participants before they agreed to participate. After they agreed to participate, several physiological measures including height, weight, and Body Mass Index (BMI) were administered, and all participants were instructed on how to wear an accelerometer by trained staff using demonstration and picture cards to maximize their understanding of the measurement protocol used in this study. Also, they were asked to wear an accelerometer during the spring semester only because their usual PA behavior seemed to be influenced by the period when they were out of school (e.g. vacation). Finally, a parent log was provided to their parents or legal guardians to record when and why an accelerometer was not worn during their data collection period.

Accelerometry

Physical activity in this study was measured by the use of an Actical which is a small sized and light weight uni-axial accelerometer (Philips Respironics Inc., OR, USA). All data were collected using a 15-second interval, an epoch, because previous studies recommended that less than one minute is an appropriate epoch for measuring physical activity in children and adolescents who tend to be physically active for short period lasting a few seconds (Trost et al., 2005). The Actical is known to be the smallest accelerometer commercially available and capable of detecting movements ranging from 0.25 to 2.50 Hz, through which non-human movements with high frequency (e.g. a lawn mower's vibration) can be excluded. Participants wore the Actical on an elastic belt on the right hip (anterior to the iliac crest) during seven consecutive days. Parents or legal guardians were instructed to remove the Actical before their child participated in water activities (e.g. bathing, swimming) and when their child went to bed at night. For the inclusion criteria used in the current study, participants were required to have at least 10 hours per day and at least 1 complete weekend day.

Physical Activity Guidelines

The *Physical Activity Guidelines for Americans* have been issued by the U.S. Department of Health and Human Services (USDHHS) to provide information and guidance on the types and amount of PA that provides substantial health benefits. The guidelines suggest that youth should participate in moderate-to-vigorous physical activity (MVPA) for 60 minutes or more at least 5 days per week, which is consistent with other currently used PA guidelines including those guidelines published by the National Association for Sport and Physical Education (NASPE) (2009) and the United Kingdom Expert Consensus Group (UKECG) (1998). For this current study, a participant was considered meeting the guidelines if the participant participated in MVPA for 60 minutes or more at least 5 days per week, and percentage of the participants who met the guidelines was calculated.

Generalizability Theory

Reformulating classical test theory, Generalizability theory (G-theory) has been developed to estimate reliability of test measures. The G-theory provides a means to identify multiple sources which contribute to total variance and to estimate the relative contributions of each source to total variance in a single analysis. Also, the G-theory provides data-based evidence to help improve measurement precision by finding the measurement conditions that result in the highest generalizability coefficients (G-coefficients). In this way, test users can select the number of measurement conditions (e.g. questions or raters) which provide sufficient measurement generalizability coefficients (0.80 or higher) needed under cost and time constraints.

Data Reduction

Actical version 2.12 was used to download all recorded activity counts from accelerometers and identify time spent, activity counts in sedentary, light, moderate, and vigorous physical activity. Puyau and collaborators (2004) developed the cut-off points to classify activity counts into a sedentary, light, moderate, and vigorous level of PA using the collected data from an 1-hour treadmill protocol. According to their prediction equation, sedentary level was defined as activity energy expenditure (AEE) < 0.01 $kcal \cdot kg^{-1} \cdot min^{-1}$, indicating minimal body movements in a sitting or reclined position (e.g. sleeping, resting). Light level was defined as $0.01 \leq AEE < 0.04$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a low level of exertion in a standing position (e.g. casual walking). Moderate level was set at $0.04 \leq AEE < 0.1$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a medium level of exertion in a standing position (e.g. brisk walking). Vigorous level was set at $AEE \geq 0.1$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a high level of exertion in a standing position (e.g. race walking, running).

Also, we excluded “zero” activity counts which lasted more than 20 minutes as non-wearing time or indicative of sleeping, and more than 15,000 activity counts per minute were set as the upper limit to identify biological implausible readings (Esliger, Copeland, Barnes, & Tremblay, 2005).

Statistical Analysis

Independent t-tests were used to analyze daily total PA counts and time spent in all PA levels by various groups (e.g. gender, age, obesity level) on weekdays and weekends. All participants were divided into either female or male by gender, 9-11 years or 12-18 years by age, and the normal weight group (less than 85^{th} in the BMI percentile) or overweight group (equal to or greater than 85^{th} in the BMI percentile) based on the age- and gender-specific BMI percentile rank calculated. Since the PA guidelines used recommend youth to achieve more than 60 minutes of moderate-to-vigorous physical activity (MVPA) at least 5 days per week, Chi-square tests were used to present differences in percentage of the participants who met the guidelines in each group. All statistical analyses were performed using SPSS version 18.0 with a significance level of 0.05.

To determine the minimum number of monitoring days and hours needed in youth with ASD, EduG version 6.0 (The Institute for Educational Research and Documentation, Neuchatel, Switzerland) was used. The EduG version 6.0 provides specific information on sources contributing to measurement error variance and helps make an evidence-based decision on the minimal measurement protocol needed by modifying the conditions of the measurement sources. Total activity counts per minute, time spent in sedentary, light, and MVPA were used as main dependent variables throughout our data analyses. For determining the minimum number of monitoring days and hours required to be generalizable, 0.80 was employed as the minimum generalizability coefficient (Cardinet, Johnson, & Pini, 2009). If a set of conditions resulted in a generalizability coefficient less than .80, it was considered an inadequate set of measurement conditions.

RESULTS

A total of 34 individuals (8 girls, 26 boys; age: 12.0±2.6 years; height: 147.7±15.9 cm; weight: 50.7±21.7 kg; Body Mass Index (BMI): 22.4±6.4 kg/m^2; BMI percentile: 69.0±33.3 %) participated in this study. Participants wore an accelerometer for 6.2 days on average and 857.1 minutes per day on average. Table 2.1 shows the estimates of time spent in each physical activity (PA) level and total PA counts on weekdays and weekends. No significant differences were observed for percentage of time spent in all PA levels and daily total PA counts between weekdays and weekends.

Boys demonstrated more PA than girls on both weekdays and weekends, and significant gender differences were detected for daily total PA counts (t=-2.17, p=.038) and time spent in MVPA (t=-2.47, p=0.19) on weekdays (Table 2.2). However, no significant day type differences were detected for all PA variables in each gender group (Table 2.3).

Significant age group differences were observed for time spent in sedentary PA (t=-2.23, p=.033) on weekdays, and significant age group differences were observed for daily total activity counts (t=2.42, p=.022) and time spent in sedentary PA (t=-2.41, p=.022) on weekends (Table 2.4). However, both age groups failed to record significant day type differences (weekdays vs. weekends) for all PA variables (Table 2.5).

Statistical analyses failed to reveal significant differences between obesity levels for all PA variables on both weekdays and weekends (Table 2.6). In addition, no significant differences were observed between weekdays and weekends for all PA variables in each obesity group (Table 2.7).

Table 2.8 presents the mean±standard deviation for time spent in MVPA by gender, age group, and obesity level. Means for MVPA were consistently higher for boys than girls, the 9-11 years than the 12-18 years, and overweight group than normal weight group. Overall, more than 90% of the participants in the present study met the PA guidelines issued by USDHHS (≥60 minutes of MVPA per day, ≥5 days/week).

Table 2.9 shows the estimated variance components in activity counts and relative magnitude of the three sources (Participant, Day, and Interaction) contributing to total error variance and their relative magnitude. The largest source of variance was Participant (P) (66.4%), while Day (D) and their interaction (P×D) were associated with 2.3% and 31.4% of total variance, respectively.

Table 2.10 shows the estimated variance components in activity counts and relative magnitude of the three sources (Participant, Hour, and Interaction) contributing to total error variance and their relative magnitude. The largest source of variance was their interaction (P×H) (61.4%), while Participant (P) and Hour (H) were associated with 6.9% and 31.7% of total variance, respectively.

Figure 2.1 shows the estimated relative and absolute generalizability coefficients (G-coefficients) for the monitoring days selected, suggesting that the estimated relative and absolute G-coefficients increased as the number of monitoring days increased, and that at least two monitoring days were required to achieve the minimum level of both relative and absolute G-coefficients of 0.80 in youth with ASD.

Figure 2.2 shows the estimated and relative and absolute G-coefficients for the monitoring hours selected, suggesting that the estimated relative and absolute G-coefficients increased as the number of monitoring hours increased, and that at least eight monitoring hours were required to achieve the minimum level of relative G- coefficient and nine hours to achieve the minimum level of absolute G-coefficient in youth with ASD.

DISCUSSION

To date, few attempts have been made to identify PA patterns in youth with ASD. Based on what we found, day type had no impact on the physical activity variables used among youth with ASD, indicating that they demonstrated very similar PA regardless of weekdays or weekends. Our finding supports results of previous studies indicating that there were no differences in overall PA of typically developing children between weekdays and weekends (Gilbey & Gilbey, 1995; Sallo & Silla, 1997), but other studies have provided inconsistent results that typically developing youth were more active during either weekdays (Trost et al., 2000) or weekends (Huang & Malina, 1996). The observed PA behaviors in the youth with ASD in this study can be partially described by the evidence that many children with ASD received physical education from special education teachers or classroom aides, neither of which might be qualified to provide youth with ASD with appropriate instruction (Rosser & Frey, 2005). Previous research indicated that physical education did not play a role in promoting enough MVPA on weekdays because there was excessive sitting or standing in line before engaging in activities (McKenzie, Marshall, Sallis, & Conway, 2000). To efficiently promote PA among youth with ASD, a few solutions have been suggested. First, PA interventions for this group should focus on using individual activities (e.g. swimming, martial art) rather than team sports (e.g. soccer, basketball) because individual activities seem to require less societal support, need fewer people to participate, less rely on external support, and reduce repetitive behaviors often associated with ASD (Pan & Frey, 2006). However, team sports tend to require an ability to quickly understand, process, and respond to social cues under the pressure of competition, and performance expectations that could influence group outcomes exist, which may make an individual with ASD feel more stressful in team sports (Orsmond, Krauss, & Seltzer, 2004). Second, PA interventions for youth with ASD should use unstructured play environments (e.g. weekend, after-school) to maximize their PA level (Pate, Baranowski, Dowda, & Trost, 1996). Rosser and Frey (2005) observed that children with ASD showed high PA levels in recess because they often engaged in play with playground equipment and activities that were unstructured or less restricted by social interaction. However, recess time seems to be relatively short, and most children tend to be removed from recess early by teachers for easy transitions between classes. Therefore, we suggest that weekends may be the best time to maximize PA levels in youth with ASD because various activities can be performed using familiar resources without excessively relying on external support or social interaction (Pan & Frey, 2006).

It was not surprising to see that boys were consistently more physically active than girls in the youth with ASD participated. However, it might be informative to examine gender difference in PA in the context of exercise intensity. We found that the boys and girls within our sample did not differ with respect to time spent in light PA, and that the majority of the gender difference in overall PA was caused by the girls' low participation in MVPA. Other studies have reported similar findings. Van Mechelen and collaborators (2000) evaluated PA in a group of Dutch youth over a 15-year period, beginning at age 13 and ending at age 27. During adolescence (age 13-16), girls showed very similar participation in light PA when compared to boys, but girls recorded significantly lower overall PA level than boys after their adolescence period. In addition, Fuchs and collaborators (1988) longitudinally examined PA behavior in a population-based sample of German children in grades 6 and 7, indicating that boys reported significantly greater participation in total PA, despite the fact that participation in light PA was similar between boys and girls. Therefore, PA intervention programs need to be designed for girls with ASD to maximize participation in MVPA, not light PA, which may efficiently make gender differences smaller.

In accordance with previous studies (Pate, 1993; Sallis, 2000; Sallis et al., 1998; Trost et al., 2000), we observed that elementary school students (9-11 years) were significantly more physically active than middle and high school students (12-18 years). However, our findings did not support the previous studies indicating that the greatest declines in PA occurred during the transition from middle school to high school in typically developing youth (Caspersen, Pereira, Curran, 2000; Kimm et al., 2000; Telama & Yang, 2000; Van Mechelen et al., 2000), but the participants with ASD in the current study appear to have a negative impact on PA participation earlier than typically developing counterparts. Rosser (2004) indicated that numerous parents and teachers reported that both inclusive and individualized extracurricular PA programs for youth with ASD were lacking. It seems that unavailability of PA programs was a significant barrier to participation in PA among youth with ASD. Pan and Frey (2006) examined access to extracurricular activities among youth with ASD, indicating that approximately 40% of youth with ASD were enrolled in extracurricular PA programs, but only 10% of these participants were middle or high school students and spent minimal time (e.g. less than 20 minutes) in the activities offered by those extracurricular programs, which is consistent with a previous study's results of youth without disabilities (Kann, Warren, & Harris, 1999). In the present study, why middle and high school students with ASD participated in less amount of PA compared to elementary school students remains uncertain, but future studies should focus on identifying the relative contribution of various PA participation determinants in youth with ASD, and designing appropriate in-school and out-of-school PA programs that maximize MVPA and meet the unique needs of youth with ASD. Given that PA decline starts to occur during the transition from elementary to middle or high school level, the middle school years may be suggested as important time to start such intervention programs for youth with ASD (Pate et al., 2002).

To date, this is one of the few attempts to evaluate compliance with the national PA guidelines among youth with ASD using objectively measured PA data. To track compliance with these types of PA guidelines, PA measures have traditionally been combined with several public health surveillance systems, including the National Health and Nutrition Examination Survey (NHANES), the National Health Interview Survey (NHIS), and the Youth Risk Behavior Surveillance System (YRBS). Each of these systems has exclusively relied on self-report methods, but the application and validity of which were in considerable doubt (Baranowski, 1988; Pate, 1993; Sallis, & Saelens, 2000). Previous studies have shown that discrepancies in prevalence rates between self-reported national estimates and objectively measured estimates raised the possibility that self-reported surveys produced prevalence rates that were grossly inflated (Pate et al., 2002) and that children and adolescents tended to overestimate their PA behavior when completing self-report instruments (Sallis & Saelens, 2000). We found that the mean time spent in MVPA was higher in boys than girls, younger participants than older participants, and the overweight group than normal weight group. It was interesting to see that the overweight group spent more time in MVPA than the normal weight group. This interesting finding may be partially interpreted by the evidence that up to 70% of children with ASD are prescribed psychoactive medications to ameliorate “non-purposeful” behaviors associated with ASD such as hyperactivity, inattention, impulsivity, aggression, irritability, self-injury, obsessive compulsiveness, anxiety, and mood disorders (Handen & Martin, 2005; Self, Hale, & Crumrine, 2010) and that weight gain is a common side effect of those medications (Scahill & Koenig, 1999). For example, some youth with ASD were classified as being in the overweight group, but their excessive weight gain might be due to the medications which reduce those behaviors, and their various “non-purposeful” behaviors might be recorded as physical activity by accelerometers. Therefore, future researchers should consider using additional criteria to classify those types of behaviors which might lead to results in an unexpected way as not being appropriate PA.

In addition, we found that more than 90% of the participant in the present study met the guidelines when using the cut-off points established by Puyau and collaborators (2004). Based on our findings, the PA guidelines used appeared to be a low standard in youth with ASD because the majority of youth with ASD met the recommendation. A previous study was conducted to examine how the prevalence estimates vary across different sets of widely used accelerometer cut-off points for classifying preschooler's time spent in PA of light, moderate, and vigorous (Beets et al., 2011). Four different cut-off points were used as the minimal threshold for moderate activity, and indicated that almost all children (99.5%) met the NASPE guidelines (60 minutes of MVPA on a daily basis) when using the cut-off points developed by Freedson and collaborators (2005) which was similar with the ones used in the current study. However, the previous study indicated that anywhere from 0.5% to 65.6% of children met the guidelines when using the cut-off points developed by Reilly et al. (2003) (0.5% to 3.7%), Sirard et al. (2005) (2.4% to 6.9%), and Pate et al. (2006) (52.9% to 65.6%). Since previous two other studies indicated that anywhere from 54% to 80% of typically developing children met the guidelines (Okely et al., 2009; Tucker, 2008), we concluded that the cut-off points used in the present study might not be sensitive to estimating prevalence of compliance with the guidelines among youth with ASD. Therefore, future studies need to focus on establishing the validity of existing cut-off points through independent validation studies (Trost, Way, & Okely, 2006; Wickel, Eisenmann, & Welk, 2007), and comparing multiple available cut-off point definitions of sedentary and MVPA in youth with ASD to provide data-based evidence. Also, the interaction among age, activity intensity, and activity counts also requires investigation in youth with ASD to determine the relevance of age-related changes in the cut-off point definitions of sedentary and MVPA (Cliff, Okely, & Reily, 2009).

Regarding the minimum monitoring period needed in youth with ASD, we found that at least two days and nine hours of monitoring were needed to reliably estimate typical PA among youth with ASD and that estimates of typical PA were influenced by the variability in PA behavior within and between days and hours. In order to provide reliable estimates of typical physical activity with better efficiency, researchers have examined the minimum number of days and hours accelerometers need to be worn. Also, there has been considerable discussion regarding the inclusion of data measured on weekend days and differences in PA patterns between weekdays and weekends, which led to researchers to recommend that estimates of typical weekly PA in school-aged children should include data collected on at least one weekend day (Esliger et al., 2005; Rowland, 2007; Trost et al., 2005). In contrast to the previous findings cited, our findings indicated that youth with ASD showed very similar PA estimates between weekdays and weekends (see Table 2.1), that their overall PA was rarely influenced across days, and that each participant showed similar PA across days (P×D=31.4), even though data measured on weekend days were included into our dataset (see Table 2.9).

Regarding the minimum number of hours of monitoring, our findings indicated that their overall PA was rarely influenced hour by hour, but each participant showed a high variability of PA behavior across hours within a day (P×H=61.4) (see Table 3.10). The high variability of PA showed by youth with ASD may be partially described by the evidence that specific time periods during a day were representative of an entire day's PA behavior (Trost et al., 2000). In the present study, we did not provide any specific instructions of the monitoring start time. Therefore, given that distinct time components for MVPA during the day among youth with ASD exist, the fewer number of hours of monitoring would be possibly representative of an entire day's PA behavior and give important implications for subject compliance and overall study costs (Trost et al., 2000).

Future studies should employ objective PA measures in larger, more diverse samples of youth with disabilities, taking care to include participants from minority groups and children from younger age groups. Also, additional future studies should be required to identify factors contributing to various group differences using qualitative research methods.

In conclusion, it was hypothesized that there would be no differences in PA between weekdays and weekends in participants with ASD. Results indicated that participants with ASD showed similar PA regardless of day types; therefore, this hypothesis was supported. It was also hypothesized that boys with ASD would be more active than girls with ASD, that younger participants would be more active than older participants, and that the normal weight group would be more active than the overweight group. Results indicated that PA was consistently higher for boys than girls and declined considerably with age; however, there were no significant differences in PA between two obesity levels. For compliance with the PA guidelines, it was hypothesized that participants with ASD would not meet the PA guidelines. It was found that most participants with ASD met the PA guidelines, meaning that our hypothesis was not supported from our findings. Lastly, it was hypothesized that the minimum monitoring period would be shorter than 7 days and 10 hours of monitoring per day when measuring PA in youth with ASD using accelerometers. The results confirmed that youth with ASD needed at least 2 monitoring days and 9 monitoring hours per day; therefore, this hypothesis was supported by our findings.

Table 2.1. Mean±standard deviation and effect size for percentage of time spent in each PA level and daily total activity counts in participants with ASD.

	Variable	Weekday	Weekend	*p*	ES	95% CI
Time spent in PA levels (%)	Sedentary PA	42.3±13.2	41.9±15.4	.908	0.03	(-5.20, 4.41)
	Light PA	37.5±7.2	37.1±8.5	.815	0.05	(-2.91, 2.37)
	MVPA	20.3±8.0	20.9±11.7	.790	0.06	(-3.87, 2.75)
PA intensity	counts/min	338.0±147.4	359.7±237.7	.652	0.11	(-79.8, 49.7)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval

Table 2.2. Mean±standard deviation and effect size for physical activity estimates on weekdays and weekends by gender.

Day type	Variable	Girls (*N*=8)	Boys (*N*=26)	*p*	ES	95% CI
Weekday	Daily PA (counts/min)	244.3±135.5	366.8±140.9	.038*	0.90†	(-53.3, 94.8)
	Time in sedentary (%)	49.0±16.6	40.3±11.6	.102	0.70†	(-5.16, 10.8)
	Time in light (%)	36.2±9.9	37.9±6.3	.571	0.24	(-2.18, 7.10)
	Time in MV (%)	14.6±7.4	22.0±7.5	.019*	1.02†	(-1.86, 6.15)
Weekend	Daily PA (counts/min)	226.9±220.2	400.5±231.5	.070	0.78†	(-88.2, 153)
	Time in sedentary (%)	48.6±21.5	39.9±12.8	.164	0.59†	(-5.51, 14.3)
	Time in light (%)	36.9±13.8	37.1±6.5	.959	0.02	(-2.47, 9.59)
	Time in MV (%)	14.5±11.1	22.9±11.4	.078	0.76†	(-3.62, 8.46)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates a significant difference between groups, p<.05. † indicates moderate or large effect size (Cohen's d≥0.5).

Table 2.3. Mean±standard deviation and effect size for physical activity estimates of gender groups by day type.

Gender	Variable	Weekday	Weekend	*p*	ES	95% CI
Girls (*N*=8)	Daily PA (counts/min)	244.3±135.5	226.9±220.2	.676	0.10	(-153, 93.8)
	Time in sedentary (%)	49.0±16.6	48.6±21.5	.901	0.02	(-14.9, 11.5)
	Time in light (%)	36.2±9.9	36.9±13.8	.805	0.06	(-9.50, 6.92)
	Time in MV (%)	14.6±7.3	14.5±11.2	.988	0.01	(-7.77, 5.05)
Boys (*N*=26)	Daily PA (counts/min)	366.8±140.9	400.5±231.5	.312	0.18	(-88.8, 54.3)
	Time in sedentary (%)	40.3±11.6	39.9±12.8	.815	0.03	(-4.95, 4.43)
	Time in light (%)	37.9±6.3	37.1±6.5	.464	0.13	(-2.63, 2.29)
	Time in MV (%)	22.0±7.4	22.9±11.4	.550	0.10	(-4.29, 2.94)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval

Table 2.4. Mean±standard deviation and effect size for physical activity estimates on weekdays and weekends by age group.

Day type	Variable	9-11 years (*N*=18)	12-18 years (*N*=16)	*p*	ES	95% CI
Weekday	Daily PA (counts/min)	378.4±141.8	292.4±144.3	.090	0.62†	(-71.3, 64.9)
	Time in sedentary (%)	37.8±11.2	47.4±13.9	.033*	0.79†	(-6.02, 5.96)
	Time in light (%)	39.7±6.2	35.0±7.6	.053	0.70†	(-4.43, 2.16)
	Time in MV (%)	22.7±7.9	17.5±7.5	.059	0.69†	(-4.37, 2.95)
Weekend	Daily PA (counts/min)	446.4±244.2	262.2±193.8	.022*	0.86†	(-95.8, 112)
	Time in sedentary (%)	36.3±13.0	48.2±15.7	.022*	0.86†	(-6.84, 6.86)
	Time in light (%)	38.9±8.3	35.0±8.6	.191	0.48	(-4.69, 3.36)
	Time in MV (%)	24.5±12.5	16.8±9.6	.054	0.71†	(-5.41, 5.07)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates significant difference between groups, p<.05. † indicates moderate or large effect size (Cohen's $d \geq 0.5$).

Table 2.5. Mean±standard deviation and effect size for physical activity estimates of age groups by day type.

Age	Variable	Weekday	Weekend	*p*	ES	95% CI
9-11 years (*N*=18)	Daily PA (counts/min)	378.4±141.8	446.4±244.2	.130	0.35	(-112, 65.9)
	Time in sedentary (%)	37.8±11.2	36.3±13.0	.534	0.13	(-6.13, 5.05)
	Time in light (%)	39.7±6.2	38.9±8.3	.617	0.11	(-3.95, 2.75)
	Time in MV (%)	22.7±7.9	24.5±12.5	.333	0.18	(-5.60, 3.83)
12-18 years (*N*=16)	Daily PA (counts/min)	292.4±144.3	262.2±193.8	.263	0.18	(-95.1, 70.5)
	Time in sedentary (%)	47.4±13.9	48.2±15.7	.640	0.06	(-7.64, 6.87)
	Time in light (%)	35.0±7.6	35.0±8.6	.985	0.00	(-4.21, 3.72)
	Time in MV (%)	17.5±7.4	16.8±9.6	.641	0.08	(-4.79, 3.54)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval

Table 2.6. Mean±standard deviation and effect size for physical activity estimates on weekdays and weekends by obesity level.

Day type	Variable	Normal weight (*N*=16)	Overweight (*N*=18)	*p*	ES	95% CI
Weekday	Daily PA (counts/min)	336.4±132.2	339.3±163.5	.956	0.02	(-75.5, 64.8)
	Time in sedentary (%)	41.9±11.3	42.7±15.1	.860	0.06	(-6.91, 5.60)
	Time in light (%)	38.7±6.2	36.4±8.0	.371	0.33	(-4.02, 2.71)
	Time in MV (%)	19.3±6.8	21.1±9.1	.514	0.23	(-3.97, 3.56)
Weekend	Daily PA (counts/min)	335.7±190.5	381.1±276.8	.586	0.19	(-128, 93.5)
	Time in sedentary (%)	41.4±11.6	42.4±18.4	.864	0.07	(-8.43, 5.75)
	Time in light (%)	38.6±8.7	35.7±8.3	.318	0.35	(-4.19, 3.91)
	Time in MV (%)	20.0±8.6	21.8±14.1	.664	0.16	(-6.36, 4.37)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval

Table 2.7. Mean±standard deviation and effect size for physical activity estimates of obesity groups by day type.

Age	Variable	Weekday	Weekend	*p*	ES	95% CI
Normal weight (*N*=16)	Daily PA (counts/min)	336.4±132.2	335.7±190.5	.979	0.00	(-93.4, 64.8)
	Time in sedentary (%)	41.9±11.3	41.4±11.6	.847	0.05	(-5.73, 5.49)
	Time in light (%)	38.7±6.2	38.6±8.7	.967	0.01	(-4.28, 3.02)
	Time in MV (%)	19.3±6.8	20.0±8.6	.685	0.09	(-4.12, 3.43)
Overweight (*N*=18)	Daily PA (counts/min)	339.3±163.5	381.1±276.8	.352	0.19	(-128, 75.7)
	Time in sedentary (%)	42.7±15.1	42.4±18.4	.856	0.02	(-8.52, 6.96)
	Time in light (%)	36.5±8.0	35.7±8.3	.543	0.10	(-3.94, 3.59)
	Time in MV (%)	21.1±9.1	21.8±14.1	.727	0.06	(-6.45, 4.26)

PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval

Table 2.8. Time spent in MVPA and prevalence (%) of compliance with the USDHHS physical activity guidelines (≥60 minutes of MVPA per day, ≥5 days/week).

		Gender		Age		Obesity	
Group	All	Girls	Boys	9-11 yrs.	12-18 yrs.	Normal weight	Over weight
N	34	8	26	18	16	16	18
Time in MVPA (min/day)	173.0±69.7	126.5±68.0	187.4±64.9	192.7±70.8	150.9±63.4	163.3±55.5	181.7±80.9
% of compliance*	91.2	75.0	96.2	94.4	87.5	87.5	94.4

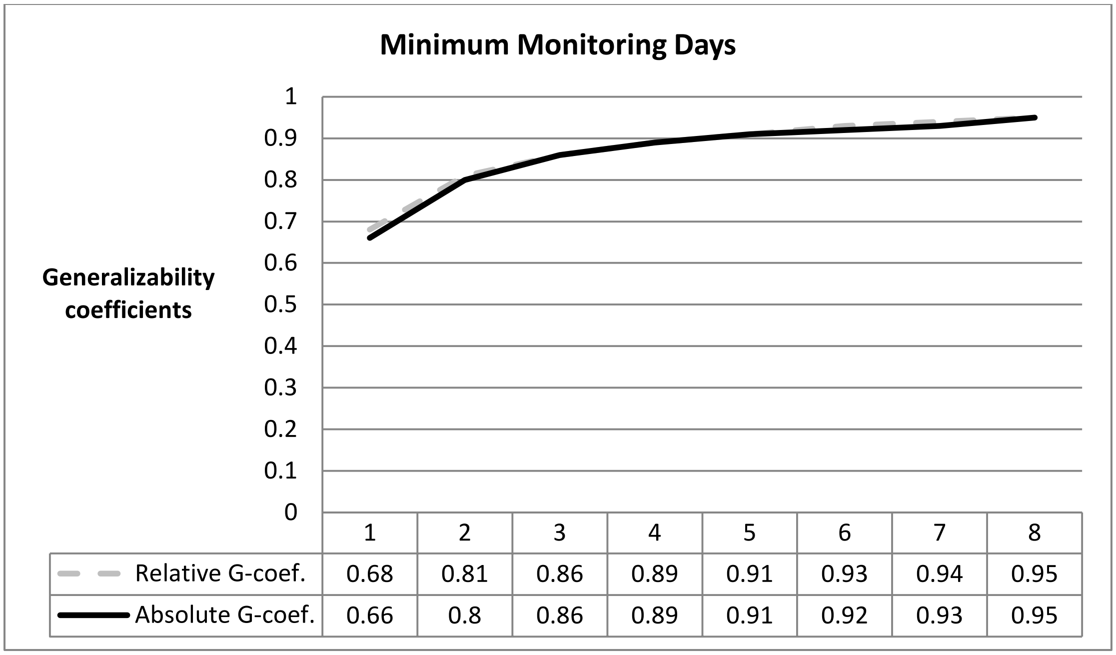
MVPA=moderate to vigorous physical activity; * indicates that those results were calculated on the basis of the cut-off points established by Puyau et al. (2004).

Table 2.9. Variance component estimates and their relative magnitude for Participant (P), Day (D), and their interaction (P×D).

				Components				
Source of Variance	SS	df	MS	Random	Mixed	Corrected	%	SE
Participant (P)	233861.2	33	7086.7	1584.6	1584.6	1584.6	66.4	424.3
Day (D)	7751.0	3	2583.7	54.0	54.0	54.0	2.3	48.2
Interaction (P×D)	74084.0	99	748.3	748.3	748.3	748.3	31.4	105.3
Total	315696.3	135					100	

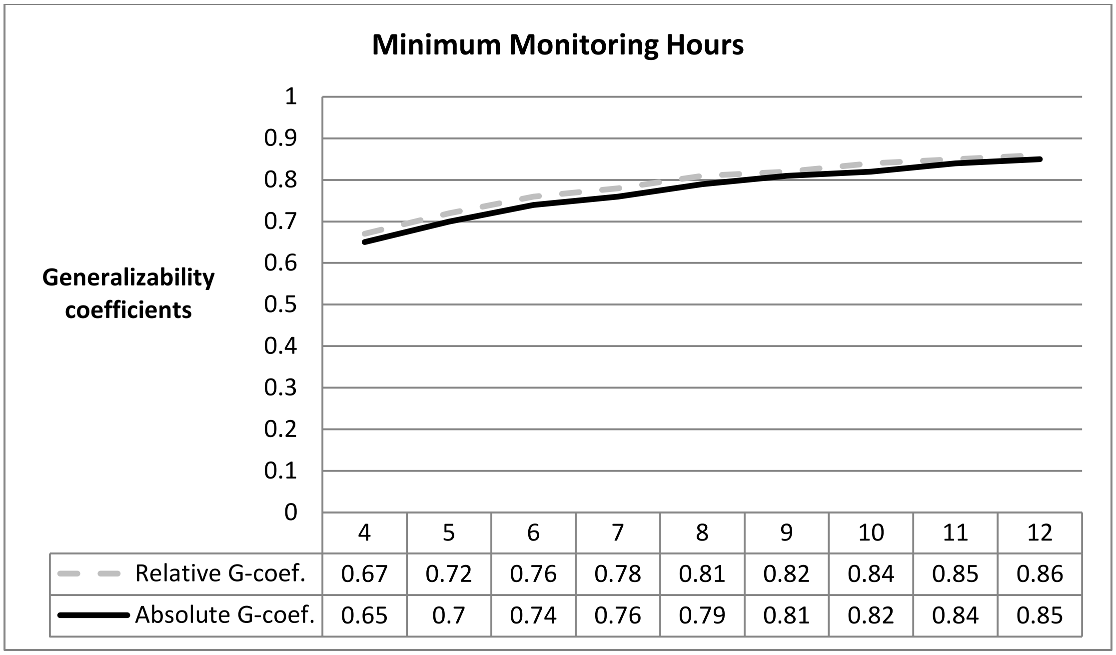
Table 2.10. Variance component estimates and their relative magnitude for Participant (P), Hour (H), and their interaction (P×H).

				Components				
Source of Variance	SS	df	MS	Random	Mixed	Corrected	%	SE
Participant (P)	8485016.9	33	257121.7	21539.9	21539.9	21539.9	31.7	6155.8
Hour (H)	1817271.4	9	201919.0	4711.7	4711.7	4711.7	6.9	2534.3
Interaction (P×H)	12391509.5	297	41722.3	41722.3	41722.3	41722.3	61.4	3412.3
Total	22693797.8	339					100	



	1	2	3	4	5	6	7	8
Relative G-coef.	0.68	0.81	0.86	0.89	0.91	0.93	0.94	0.95
Absolute G-coef.	0.66	0.8	0.86	0.89	0.91	0.92	0.93	0.95

Figure 2.1. Estimated relative and absolute generalizability coefficients for the monitoring days selected.



	4	5	6	7	8	9	10	11	12
Relative G-coef.	0.67	0.72	0.76	0.78	0.81	0.82	0.84	0.85	0.86
Absolute G-coef.	0.65	0.7	0.74	0.76	0.79	0.81	0.82	0.84	0.85

Figure 2.2. Estimated relative and absolute generalizability coefficients for the monitoring hours selected.

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CHAPTER 3

COMPARISON OF PHYSICAL ACTIVITY BETWEEN YOUTH WITH DOWN SYNDROME AND YOUTH WITH AUTISM SPECTRUM DISORDERS

Over the last decade, combating obesity has been a top national health priority in the United States, and the prevalence of childhood obesity has increased at an unprecedented rate (Kimm & Obarzanek, 2002; Lobstein, Baur, & Uauy, 2004). According to the 2007-2008 National Health and Nutrition Examination Survey (NHANES), it indicated that an estimated 16.9%, or nearly 12.5 million children and adolescents aged 2-19 years were obese, and 31.7% were overweight (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010), indicating that the rates of obesity in this age group have more than tripled since 1980 (Hedley, Ogden, & Johnson, 2004; Ogden, Flegal, Caroll, & Johnson, 2002). To reduce the rate of obesity among children and adolescents, a White House Task Force on Childhood Obesity was established in 2009 and has issued various strategies to reduce childhood obesity from 17% to 5% by 2030. Despite these efforts, about 80% of Americans still recognize that obesity is a growing challenge for children living in the United States (Lobstein et al., 2004). This epidemic trend of obesity occurs in not only typically developing children and adolescents but also those with disabilities. According to the 2003-2008 NHANES, the obesity prevalence rate in children with disabilities was 22%, which was 38% higher than that of children without disabilities. A recent study also found that the prevalence of obesity among typically developing children aged 10-17 years was lower than those with developmental disabilities (Chen, Kim, Houtrow, & Newacheck, 2010), indicating those with developmental disabilities may be at more increased risk for obesity compared to their non-disabled peer group.

Numerous research studies have been conducted to identify reasons for high obesity rates in children and adolescents with disabilities (Bandini, Curtin, Hamad, Tybor, & Must, 2005; Chen et al., 2010; Ells et al., 2006). These studies have consistently reported that youth with disabilities have more difficulties in eating healthy, controlling their weight, and being physically active due to various personal, familial, and environmental factors. Among these factors, reduced PA or increased sedentary lifestyle is likely a major determinant contributing to the rise in their obesity level (USDHHS, 2000).

Given higher levels of sedentary behavior, many significant technologies have advanced in the area of PA measurement over the previous decade, and many researchers have measured PA in typically developing children and adolescents using objective monitoring devices (Trost, 2001; Westerterp, 1999). However, few studies have paid attention to how to objectively measure PA in children and adolescents with disabilities. Most large-scaled, population-based research studies have used self- or proxy-reported measures of PA in children and adolescents due to feasibility and relatively low cost. However, using those measures should be considered with caution among youth with disabilities because they may have more difficulties to validly recall their past PA behaviors than those without disabilities (Pate, 1993; Pfeiffer, Mciver, Dowda, Almeida, & Pate, 2006). Direct observation by their parents and guardians may not be valid if parents are away from their child much of the day (Sallis & Saelens, 2000). Examining error associated with PA recall techniques, one study indicated that the estimated error variance was between 35 and 50%, with varying error rates associated with age groups or disease conditions (Welk, 2002). Among these monitoring devices, accelerometers have been the most popular PA measure in research studies because they provide objective information on frequency, intensity, and duration of activity in a light, small, and “tamper-resistant” case (Freedson, & Miller, 2000; Trost, Pate, Freedson, Sallis, & Taylor, 2000).

However, we should know that accelerometers do have some important considerations when used in children and adolescents with disabilities. First, accelerometer placement might influence the accuracy of PA measurement. Ideally, accelerometers should be attached as close as possible to the body’s center of mass because the influence of gravitational component is strongest for limb placement (Bouten, Sauren, Verduin, & Janssen, 1997). However, an issue of tolerability might happen among children with severe behavioral issues when directly putting an accelerometer on their skin. For example, some children with autism might avoid wearing it on the waist because they have sensory issues, or might forget wearing an accelerometer after changing clothes. If both cases happen when they are away from their parents or legal guardians, it might be difficult to control their behaviors and to remind them of putting it back to the original placement. Therefore, we should consider using alternative placements (e.g. wrist, ankle) to maximize compliance of wearing an accelerometer in studies of children and adolescents with disabilities. For this reason, we should make a data-based decision if PA data measured on the limb placement are reliable and valid enough to be used when measuring PA in this population. Without evidence, we should not say that other placements should be avoided. Recently, Kim and Yun (2009) indicated that the hip placement may be less feasible to use in children with developmental disabilities because they have to take an accelerometer off while changing clothes, doing water activities, or going to the bathroom. This finding can be a supporting reason of using the limb as the monitor placement.

Second, fewer monitoring days and hours might be appropriate to identify a level of physical activity in youth with disabilities compared to their non-disabled peer groups. One of the considerations when using accelerometers in research studies is that there were no standardized measurement protocols. Therefore, the minimum monitoring periods participants need to wear an accelerometer has critical implications for compliance and overall cost for research. According to a current literature review on the minimum number of monitoring days, the number of monitoring days ranged from four to nine days for youth, while three to five days were required for healthy adults (Trost et al., 2005). These findings can be interpreted by the evidence that children and adolescents are more physically active compared to adults, and adults tend to be more consistent in PA participation than children and adolescents. However, few studies have been conducted to examine the minimal monitoring days and hours in youth with disabilities, thus this current study will be the initial attempt to provide evidence-based information about the minimum number of monitoring period in youth with disabilities. In this current study, we hypothesized that children and adolescents with Down syndrome (DS) and autism spectrum disorders (ASD) need a fewer number of monitoring days and hours to identify an individual's usual level of PA compared to their non-disabled peer groups. Therefore, the purpose of this study was to examine physical activity patterns among youth with DS and ASD, to determine if there are any differences in these PA patterns between two disability groups, and to estimate the minimum number of monitoring days and hours needed in youth with DS and ASD using the PA data measured on the ankle by accelerometers. This study differs from the first two studies in that in those studies the accelerometer was worn on an elastic belt on the right hip, not the ankle. It was hypothesized that: a) there would be no differences in PA between weekdays and weekends in the DS and ASD groups, b) there would be no differences in PA between the DS and ASD groups, c) PA of both groups would be reliably patterned less than 7 days and 10 hours of monitoring per day when measuring PA using accelerometers.

METHODS

Participants

A total of 107 children and adolescents participated including 43 with Down syndrome (DS) and 64 with autism spectrum disorders (ASD). The children were aged 9-18 years and agreed to participate in an intervention designed to improve PA through bicycle riding in 2010-2011. All procedures for the intervention were approved by the Institutional Review Board at the University of Michigan. Informed consent was obtained from all parents or legal guardians, and assent was obtained from all participants. The diagnosis of each participant was exclusively reported by their parents and legal guardians because we decided that they are the most knowledgeable about their child's health and educational status. However, their reports were not verified by administrative or medical records. If they had an orthopedic impairment or use mobility assistant devices (e.g. clutch, wheelchair, walker), they were excluded from this study because of the evidence that accelerometers may be insensitive to detecting non-weight activities (e.g. cycling, weight lifting) and locomotion movements with very slow speed (Frey, Stanish, & Temple, 2008; Lorenzi, Horvat, & Pellegrini, 2000; Pfeiffer et al., 2006). Descriptive data for participants with DS and ASD are presented in Table 3.1.

Research Design

This study used a secondary analysis which used the data collected from 9-18 year old youth with DS and ASD who participated in the intervention. All participants were asked to wear an accelerometer on the right ankle for seven consecutive days before the intervention started. The physical activity data were not influenced by the intervention. Also, they were asked to wear an accelerometer in the middle of a spring semester only because of the seasonal effect which may result in some differences in a level of PA in the state of Michigan. All participants were informed by a trained research assistant using demonstration and picture cards to help participants and their caregivers maximize their understanding of the instructions needed for wearing an accelerometer. Finally, they were provided a PA log to record when and why their child did not wear an accelerometer during their seven-day monitoring period.

Accelerometry

Physical activity behavior of youth with DS and ASD was measured for seven consecutive days using Actical accelerometers (Philips Respironics Inc., OR, USA). The Actical is a uni-axial accelerometer developed to detect movements using an omni-directional sensor. Also, it is designed to detect changes in the vertical acceleration ranging from 0.05 to 2.00 Gs with a frequency response from 0.25 to 2.50 Hz, through which movements with high frequency vibration such as a lawn mower's vibration can be excluded. Acceleration signals are filtered through an analog converter, and then the magnitude is summed over a user-specific period, an epoch. At the end of each period, the filtered activity counts are stored in memory, and the integrator is reset automatically. For the current study, a 15-second epoch was used based on the evidence that less than one minute may be an appropriate epoch for PA measurement in youth since most children and adolescents tend to be physically active for short period (Trost et al., 2005). The hip or waist has been consistently recommended as the best measurement placement because gravitational components seem to impact minimally when worn on the hip or waist (Bouten et al., 1999). However, it is worthy to consider different monitor placement for accelerometers in youth with severe behavior issues because the limb has been known to be the most tolerable as monitoring placement for children and adolescents (Kim & Yun, 2009). For instance, if over sensory-oriented participants put an accelerometer on the limb, they do not have to take the accelerometer off whenever changing clothes or going to the bathroom, which may maximize their wearing time and minimize the chance of losing an accelerometer. However, limited and inconsistent information has been available on comparison between the hip placement and other placement (Swartz et al., 2000). For this reason, the ankle was selected as a monitoring placement for this current study because it has been reported to be the most tolerable and provide moderate to strong associations with observed energy expenditure, even though it is considered be less accurate than the hip placement in previous studies (Bouten et al., 1999; Trost et al., 2005). Ankle placement might also be a better placement for intervention studies where a child is taught a new PA such as bicycle riding and the researcher is interested in measuring how this new skills changes the child level of PA.

In bicycle riding, since the child is frequently sitting on the seat, an accelerometer placed on the right hip would not be sensitive to detect the bicycle riding PA.

Data Reduction

Actical version 2.12 was used to download all recorded activity counts from accelerometers and classify those activity counts into sedentary, light, or moderate-to-vigorous PA level. Puyau and collaborators (2004) developed the cut-off points to classify activity counts into a sedentary, light, moderate, and vigorous level of physical activity using the collected data from an 1-hour treadmill protocol. According to the prediction equation, sedentary level was defined as activity energy expenditure (AEE) < 0.01 $kcal \cdot kg^{-1} \cdot min^{-1}$, indicating minimal body movements in a sitting or reclined position (e.g. sleeping, resting). Light level was defined as $0.01 \leq AEE < 0.04$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a low level of exertion in a standing position (e.g. casual walking). Moderate level was set at $0.04 \leq AEE < 0.1$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a medium level of exertion in a standing position (e.g. brisk walking). Vigorous level was set at $AEE \geq 0.1$ $kcal \cdot kg^{-1} \cdot min^{-1}$, reflective of a high level of exertion in a standing position (e.g. race walking, running). Also, we excluded “zero” activity counts which lasted more than 20 minutes as non-wearing time or indicative of sleeping, and more than 15,000 activity counts per minute were set as the upper limit to identify biological implausible readings (Esliger, Copeland, Barnes, & Tremblay, 2005). Finally, participants were excluded if their physical activity was measured for less than four days and did not include at least one weekend day. Also, their PA should be measured for at least 10 hours a day, so if physical activity was measured less than 10 hours on one day, the data collected on that day were excluded out of the whole dataset as non-valid observation. This is the most frequently used inclusion/exclusion criteria in PA studies using accelerometers (Masse et al., 2005; Puyau et al., 2004; Trost et al., 2005).

Statistical Analysis

All analyses were conducted separately for participants with DS and ASD. Independent t-tests were used to analyze daily total PA counts and time spent in all PA levels by diagnosis (e.g. DS vs. ASD) and day type (e.g. weekdays vs. weekends). All statistical analyses were performed using SPSS version 18.0 with a significance level of 0.05. Also, EduG 6.0 (The Institute for Educational Research and Documentation, Neuchatel, Switzerland) was used to examine if the commonly used seven-day and ten-hour monitoring period in general populations is generalizable when measuring PA in youth with DS and ASD and to determine the minimum number of monitoring days and hours by modifying conditions of the sources contributing to total variance. Total activity counts were accumulated for each 60-minute block and then divided by 60 to obtain total activity counts per minute which is the most popular reporting format in studies on PA measurement in children without disabilities (Cliff, Reilly, & Okely, 2008). For the final decision of what number of monitoring days and hours is required to be generalizable, 0.80 was employed as the minimum generalizability coefficient (Cardinet, Johnson, & Pini, 2009).

RESULTS

Table 3.1 presents descriptive statistics for the sample. In the DS group, participants were evenly distributed by gender, while about twenty percent were female in the ASD group. There were no significant differences in age and weight, but participants with DS were significantly shorter than those with ASD (p=.000), which made BMI percentiles of the DS group significantly greater than the ASD group (p=.019) and is supported by previous research (Pitetti & Fernhall, 1997; Petetti, Yamar, & Fernhall, 2001). Participants with DS wore an accelerometer for 6.2 days on average and 880 minutes per day on average. Participants with ASD wore an accelerometer for 6.4 days on average and 890 minutes per day on average. No significant differences were observed in those variables between these two groups.

No significant differences were observed for daily total activity counts between participants with DS and those with ASD on both weekdays and weekends. On weekdays, there were no significant differences for time spent in all PA levels. During weekends, there was a significant difference for time spent in light PA between groups (p=.038) in favor of the DS group (Table 3.2).

Table 3.3 demonstrates differences in daily total activity counts per minute between weekday and weekend in both DS and ASD groups. Both groups recorded higher PA counts on weekdays compared to weekends, and spent more time in sedentary PA on weekends than weekdays. Participants with ASD spent less time in light level during weekends compared to weekdays (p=.004), and were more sedentary on weekends (p=.004).

Table 3.4 shows estimated variance components in activity counts and relative magnitude of the sources contributing to total variance (Participant, Day, and Interaction). In the DS group, the largest source of variance was Participant (P) (58.6%), while Day (D) and their interaction (P×D) were associated with 2.7% and 38.7%, respectively. In the ASD group, the largest source of variance was Participant (P) (63.5%), while Day (D) and their interaction (P×D) were 2.0% and 34.5%, respectively.

Table 3.5 shows estimated variance components in activity counts and relative magnitude of the three sources contributing to total variance (Participant, Hour, and Interaction). In the DS group, the largest source of variance was Interaction (P×H) (70.5%), while Participant (P) and Hour (H) were associated with 24.4% and 5.0%, respectively. In the ASD group, the largest source of variance was Interaction (P×H) (63.4%), while Participant (P) and Hour (H) were 3.2% and 33.4%, respectively.

The estimates of absolute generalizability coefficients (G-coefficients) for the monitoring days for both groups are found in Figure 3.1, suggesting that the estimated absolute G-coefficients increased as the number of monitoring days increased, and that the absolute G-coefficient of 0.80 was achieved with three days of PA monitoring in both DS and ASD groups.

Figure 3.2 shows the estimated absolute G-coefficients for the monitoring hours selected. Results indicated that the estimated absolute G-coefficients increased as the number of monitoring hours increased and that at least thirteen hours were needed to achieve an absolute G-coefficient of 0.80 in the DS group, while eight hours were needed in the ASD group.

DISCUSSION

The purpose of this study was to examine PA patterns among youth with DS and ASD and determine if there are any differences in PA patterns between those two groups and to estimate the minimum number of monitoring days and hours needed in youth with DS and ASD with the PA data measured on the ankle using accelerometers. In study 1 and 2, PA was measured while wearing the Actical on the right hip. Given these results, a researcher could consider combining DS and ASD participants into one larger group and labeling them as developmental disabilities. It was recognized that the daily monitoring minutes of both DS and ASD groups were longer when compared to the results in study 1 and 2. Participants with DS in the current study wore the Actical about 63 minutes longer per day than those who participated in study 1. Participants with ASD in the current study wore the monitor about 33 minutes longer than those in study 2. These results suggest that the ankle appears to be a more appropriate placement if the goal is to increase tolerability for the accelerometers. Kim and Yun (2009) suggested the limb placement as secondary monitoring placement for those who avoid wearing an accelerometer on the hip placement. These suggestions may have a critical implication for future research that participants do not have to take an accelerometer off if worn on the ankle when they change clothes or go to bathroom, which may minimize a possibility of missing data and/or losing accelerometers during data collection periods.

Kim and Yun (2009) also suggested that data collected on the limb may be less accurate compared to data collected on the hip even though the limb placement may be more tolerable to youth with disabilities. After comparing the results in study 1 and 2, we found that the both the DS and ASD groups consistently demonstrated higher total daily PA counts regardless of day types. This finding can be explained by that the ankle placement appears to be sensitive to non-purposeful, non-health promoting PA generated at the ankle. This activity could be stereotypical movement, especially in a wide variety of developmental disabilities including ASD, mental retardation, and other psychiatric disorders (Bodfish, Symons, Parker, & Lewis, 2000; Lewis & Bodfish, 1998; Rutter, 1996). However, due to the lack of specific terms or criteria in order to classify these stereotypical behaviors in study 3, those behaviors might be included into our PA data, which may make the results in study 3 different from the results in previous study 1 and 2. In addition, we found that the participants with DS in study 3 spent 3.3 percent more in MVPA than those who participated in study 1 during weekdays and 2.8 percent more during weekends (see Table 1.1), and the participants with ASD in study 3 spent 5.3 percent more during weekdays and 3.1 percent during weekends (see Table 2.1). Based on our findings, we suggest that measuring PA on the limb including the ankle or wrist should be conducted with caution if participants display these non-purposeful behaviors which may influence results in a negative way and if the cut-off points used to categorize PA levels are derived from the data from the hip location. Therefore, future research should focus on examining validity of data collected from various locations and designing more specific guidelines for the use of accelerometers in youth with disabilities.

Regarding the minimum number of monitoring days and hours, we found that both DS and ASD groups needed at least 3 days of monitoring to obtain reliable PA data, and that youth with DS needed more hours of monitoring to reach an acceptable level of reliability compared to youth with ASD. Our findings in study 3 were very similar to the results in study 1 and 2 that both youth with DS and ASD needed less than 7 days, but youth with DS needed more hours of monitoring in order to obtain their typical physical activity behavior compared to those with ASD. These findings may have important implications for increasing the feasibility of the use of accelerometers on a large sample. Measuring PA with objective methods should be a priority for population-based studies in the future because most PA estimates based on self-report methods may be inflated (Pate et al., 2002).

Since we found no significant difference in daily PA counts between DS and ASD groups, 3 days of monitoring may be the most reasonable minimum number of monitoring days if both groups are combined into a larger group, categorized as developmental disabilities. However, the minimum monitoring hours appear to need more investigation to be established in both DS and ASD groups. A previous research study used the principal components analysis and revealed that two separate time components for children and three separate time components for adolescents (Trost et al., 2000). Therefore, future research should identify whether a specific time period during the day are more representative of an entire day's PA behavior among youth with DS and/or ASD. These results would provide more useful guidance to investigators in terms of whether monitoring should be performed continuously or intermittently over an entire day. This type of data-based decision may have important implications for subject compliance and overall cost of the research.

Strengths of the present study include the large age range, inclusion of both DS and ASD, a large sample size relative to previous studies, and the extensive seven consecutive days of data collected by objective measures. However, we found two limitations in study 3. The first limitation was the cut-off points used to classify PA levels. Compared to what we found in study 1 and 2, our results demonstrated that participants with DS spent 3.3% more time in MVPA and that participants with ASD spent 5.3% more time in MVPA (see Table 3.2). Since the cut-off points used in study 3 were derived from individuals without disabilities, and the data measured to validate cut-off points were on the hip placement, PA estimates of our participants might be under-estimated, and PA estimates measured on the ankle might be over-estimated. Therefore, future research should establish the cut-off points derived from various sedentary populations and monitor locations for better interpretation of research findings.

The second limitation was that there was a difference in the number of participants by gender among youth with ASD. In study 3, only 13 girls and 51 boys with ASD participated, while participants with DS were almost evenly distributed by gender. This limitation in the ASD group may be explained by the evidence that ASD is much more prevalent in males (about 4 to 1 ratio) (Fombonne, 2003). Females tend to exhibit a more severe form of the disorders when severity is defined as lower IQ, more impairments in adaptive functioning (Volkmar et al., 1993) or more autistic symptoms (Tsai & Beisler, 1983). Therefore, if gender differences in PA are important to investigate, researchers should recruit the same number of participants in both gender groups, which will be a significant challenge.

In conclusion, it was hypothesized that there would be no differences in PA between weekdays and weekends in the DS and ASD groups. Results indicated that both groups recorded higher PA counts on weekdays compared to weekends, and spent more time in sedentary PA on weekends compared to weekdays; therefore, this hypothesis was not supported. It was also hypothesized that there would be no differences in PA between the DS and ASD groups. It was found that no significant group differences were observed in PA on both weekdays and weekends; therefore, this hypothesis was supported. Lastly, it was hypothesized that PA of both groups would be reliably patterned less than 7 days and 10 hours of monitoring per day when measuring PA using accelerometers. The results confirmed that both groups needed 3 days of monitoring to obtain reliable PA data and participants with DS needed more hours to reach an acceptable level of reliability compared to those with ASD; therefore, this hypothesis was supported by our findings.

In summary, placing an accelerometer on the ankle as monitoring placement appears to be reliable when measuring physical activity among youth with DS and ASD. However, additional research should be needed to validate the PA data measured on the ankle with data collected from other measures including heart rate and energy expenditure. Also, combining youth with DS and youth with ASD into a larger sample appears to be possible in future research, which will maximize the statistical power for interpretation of the research results.

Table 3.1. Mean±standard deviation and effect size for demographic characteristics and PA monitoring period in participants with DS and ASD.

	Variable	DS (*N*=43)	ASD (*N*=64)	*p*	ES	95% CI
Demographic characteristics	% of female	51.2	20.3	-	-	-
	Age (years)	12.7±2.8	12.4±2.5	.575	0.12	(-0.73, 0.72)
	Height (cm)	137.4±12.7	150.2±14.5	.000*	0.94†	(-2.62, 4.73)
	Weight (kg)	44.7±17.0	48.7±19.2	.263	0.22	(-4.48, 5.30)
	BMI (kg/m^2)	22.7±5.7	20.9±5.0	.086	0.34	(-1.57, 1.36)
	BMI percentile	76.9±22.1	64.0±30.7	.019*	0.47	(-7.99, 6.13)
PA monitoring period	Avg. days	6.2±0.8	6.4±0.7	.328	0.27	(0.10, 0.51)
	Avg. minutes	880.0±36.9	890.2±48.5	.247	0.23	(-11.7, 11.3)

DS=Down syndrome; ASD=autism spectrum disorders; PA=physical activity; BMI=Body Mass Index; ES=effect size; CI=confidence interval; * indicates a significant difference between DS and ASD, $p<.05$. † indicates moderate or large effect size (Cohen's $d \geq 0.5$).

Table 3.2. Mean±standard deviation and effect size for physical activity estimates on weekdays and weekends by disability diagnosis.

Day type	Variable	DS (*N*=43)	ASD (*N*=64)	*p*	ES	95% CI
Weekday	Daily PA (counts/min)	479.2±146.8	521.8±206.7	.246	0.23	(-50.4, 44.1)
	Time in sedentary (%)	36.7±10.8	36.7±12.4	.991	0.00	(-3.04, 3.23)
	Time in light (%)	40.1±8.4	38.1±7.1	.188	0.26	(-2.00, 2.25)
	Time in MV (%)	23.2±5.9	25.3±8.2	.159	0.29	(-1.72, 2.05)
Weekend	Daily PA (counts/min)	395.3±187.2	444.9±252.2	.273	0.22	(-61.6, 56.2)
	Time in sedentary (%)	39.3±13.7	40.2±13.9	.742	0.07	(-3.34, 4.16)
	Time in light (%)	39.2±8.4	35.8±7.9	.038*	0.42	(-2.36, 2.09)
	Time in MV (%)	21.6±9.7	24.0±10.7	.228	0.23	(-2.39, 3.13)

DS=Down syndrome; ASD=autism spectrum disorders; PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates significant difference between DS and ASD, $p<.05$.

Table 3.3. Mean±standard deviation and effect size for physical activity estimates of each DS and ASD group by day type.

Diagnosis	Variable	Weekday	Weekend	*p*	ES	95% CI
DS (N=43)	Daily PA (counts/min)	479.2±146.8	395.3±187.2	.000*	0.50†	(-56.6, 43.4)
	Time in sedentary (%)	36.7±10.8	39.3±13.7	.046*	0.21	(-3.88, 3.44)
	Time in light (%)	40.1±8.4	39.2±8.4	.292	0.11	(-2.62, 2.40)
	Time in MV (%)	23.2±5.9	21.6±9.7	.082	0.20	(-3.10, 1.56)
ASD (N=64)	Daily PA (counts/min)	521.8±206.7	444.9±252.2	.001*	0.34	(-62.1, 50.3)
	Time in sedentary (%)	36.7±12.4	40.2±13.9	.004*	0.27	(-3.14, 3.31)
	Time in light (%)	38.1±7.1	35.8±7.9	.004*	0.31	(-2.24, 1.43)
	Time in MV (%)	25.3±8.2	24.0±10.7	.177	0.14	(-2.76, 1.87)

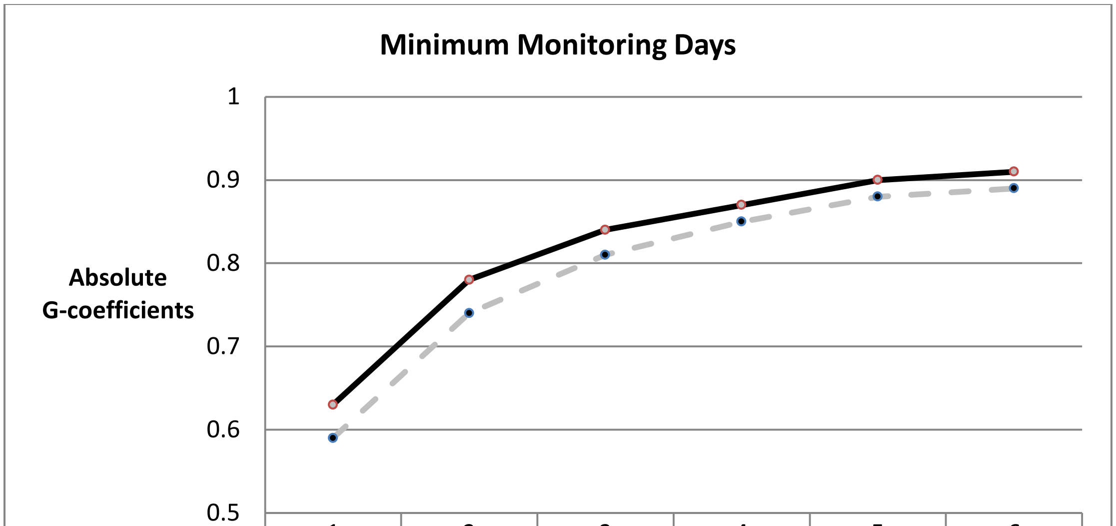
DS=Down syndrome; ASD=autism spectrum disorders; PA=physical activity; MV=moderate to vigorous; ES=effect size; CI=confidence interval; * indicates a significant difference between weekday and weekend by disability diagnosis, p<.05. † indicates moderate or large effect size (Cohen's $d \geq 0.5$).

Table 3.4. Variance component estimates and their relative magnitude for Participant (P), Day (D), and their interaction (P×D).

Diagnosis	Variable	Variance component	Standard error	Percentage of variance
DS	Participant (P)	1290.5	321.7	58.6
	Day (D)	59.9	50.5	2.7
	Interaction (P×D)	853.4	106.7	38.7
ASD	Participant (P)	2220.1	443.5	63.5
	Day (D)	68.9	55.6	2.0
	Interaction (P×D)	1207.6	123.6	34.5

Table 3.5. Variance component estimates and their relative magnitude for Participant (P), Hour (H), and their interaction (P×H).

Diagnosis	Variable	Variance component	Standard error	Percentage of variance
DS	Participant (P)	17730.1	4886.0	24.4
	Hour (H)	3661.6	2071.0	5.0
	Interaction (P×H)	51211.2	3715.3	70.5
ASD	Participant (P)	31000.0	6480.0	33.4
	Hour (H)	3003.4	1673.8	3.2
	Interaction (P×H)	58881.5	3490.9	63.4



	1	2	3	4	5	6
DS	0.59	0.74	0.81	0.85	0.88	0.89
ASD	0.63	0.78	0.84	0.87	0.9	0.91

Figure 3.1. Estimated absolute generalizability coefficients for the monitoring days selected.

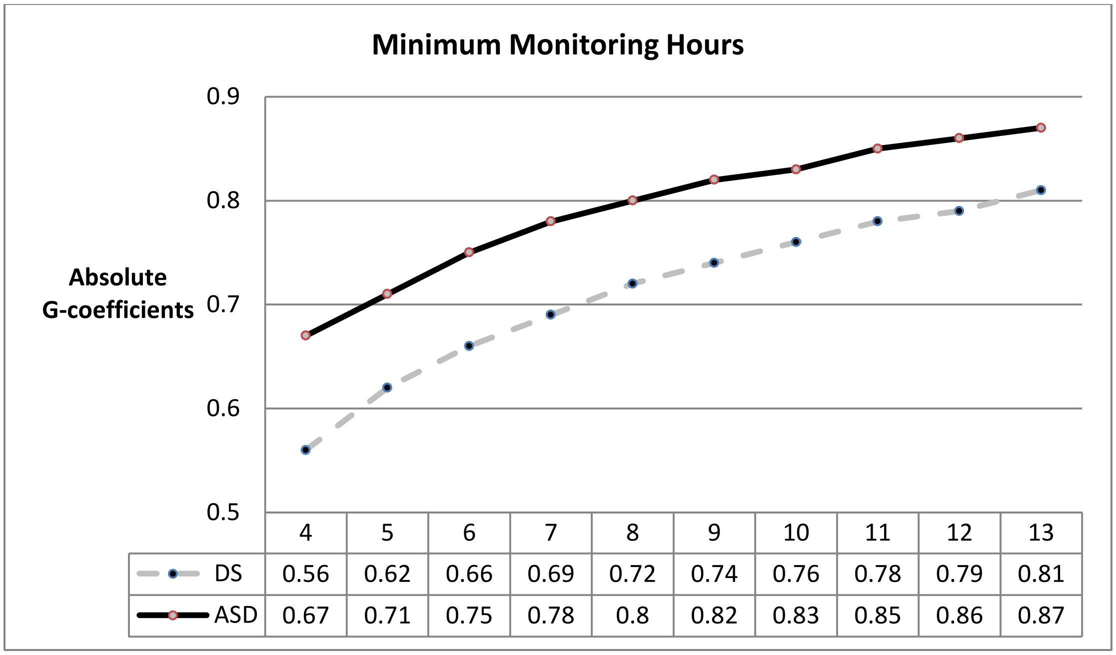


Figure 3.2. Estimated absolute generalizability coefficients for the monitoring hours selected.

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APPENDICES

A. SUPPLEMENTAL DATA (CHAPTER 1)

Table A.1. Demographic data and monitoring periods.

ID	Sex	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	# of days	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
200	1	8	118.7	24.9	17.7	78	4	8:16	21:10	12:54	8:38	20:38	12:00
201	2	14	144.1	41.5	20.0	64	6	6:33	19:42	13:09	8:22	20:07	11:45
202	1	9	123.5	38.0	24.9	98	6	8:13	20:02	11:49	8:08	19:50	11:42
203	2	13	140.5	39.7	20.1	73	7	7:29	20:31	13:02	9:22	20:55	11:33
204	2	12	137.5	38.3	20.2	81	6	7:03	20:51	13:48	6:59	20:40	13:41
205	1	13	136.9	41.8	22.3	82	6	6:36	20:44	14:08	6:36	19:20	12:44
206	1	12	138.3	60.8	31.8	99	7	6:39	21:16	14:37	8:23	22:07	13:44
208	2	14	150.2	49.5	21.9	80	5	7:02	21:14	14:12	9:01	20:12	11:11
209	1	12	140.0	51.9	26.5	96	6	7:35	20:29	12:54	8:02	19:54	11:52
210	1	14	139.0	52.8	27.3	95	7	7:12	22:16	15:04	9:38	22:51	13:13
211	2	8	112.5	20.4	16.1	56	6	7:00	19:41	12:41	7:22	20:31	13:09
212	1	11	128.5	30.8	18.7	66	6	7:17	21:53	14:36	9:03	22:36	13:33
213	2	15	150.4	56.9	25.2	92	6	7:14	21:43	14:29	8:23	22:13	13:50
214	1	10	121.9	30.4	20.5	90	6	6:42	21:04	14:22	7:00	22:07	15:07
215	1	13	142.8	51.6	25.3	93	7	6:31	20:22	13:51	10:15	20:02	9:47
216	1	12	141.8	59.3	29.5	98	6	8:07	21:11	13:04	9:26	21:00	11:34
217	1	11	129.5	43.5	25.9	97	4	8:28	19:59	11:31	10:36	20:21	9:45
219	2	10	139.0	43.8	22.6	96	7	6:21	20:48	14:27	6:48	19:26	12:38
220	1	9	112.5	20.8	16.4	49	7	6:23	19:23	13:00	7:58	19:14	11:16
221	1	12	137.3	58.1	30.8	99	3	6:54	22:02	15:08	7:48	21:40	13:52

BMI=Body Mass Index; 1=female; 2= male; WD=weekday; WE=weekend.

ID	Sex	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	# of days	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
221	1	12	137.3	58.1	30.8	99	6	6:54	22:02	15:08	7:48	21:40	13:52
222	2	13	145.5	44.7	21.1	83	5	7:32	21:10	13:38	8:40	20:54	12:14
223	2	13	138.4	69.2	36.1	99	6	6:06	20:30	14:24	9:17	19:45	10:28
224	2	14	154.7	44.7	18.7	44	5	6:38	21:10	14:32	9:05	21:44	12:39
225	1	10	134.7	32.4	17.9	67	7	6:38	20:25	13:47	8:44	21:08	12:24
227	2	11	139.5	31.7	16.3	35	5	6:50	21:03	14:13	8:44	20:46	12:02
228	1	13	134.3	29.6	16.4	13	7	6:41	21:25	14:44	7:18	19:03	11:45
229	2	13	143.8	42.9	20.7	76	7	7:06	21:21	14:15	8:55	20:46	11:51
230	1	10	130.1	28.6	16.9	50	4	7:39	20:45	13:06	7:56	20:48	12:52
231	1	9	114.0	32.1	24.7	98	6	8:01	20:01	12:00	7:58	19:33	11:35
232	2	14	151.4	49.8	21.7	82	7	6:31	21:04	14:33	9:40	20:59	11:19
234	2	8	124.1	43.3	28.1	99	6	8:03	22:15	14:12	8:29	21:53	13:24
235	1	13	145.9	54.6	25.6	95	7	7:24	19:35	12:11	8:21	18:53	10:32
237	2	14	148.0	43.2	19.7	60	4	7:33	20:24	12:51	8:19	21:13	12:54
238	2	15	149.0	64.1	28.9	97	5	6:50	21:28	14:38	8:00	21:32	13:32
240	2	11	123.1	28.7	18.9	77	5	7:46	21:48	14:02	9:48	23:04	13:16
300	2	13	140.5	36.0	18.2	52	7	7:08	21:45	14:37	7:47	21:29	13:42
302	1	11	131.9	30.5	17.5	47	6	6:18	20:58	14:40	6:51	20:36	13:45
304	2	16	153.3	77.3	32.9	99	6	8:03	21:36	13:33	7:12	21:55	14:43
305	2	11	135.0	33.0	18.1	61	6	6:45	20:13	13:28	7:54	20:31	12:37
308	1	16	147.2	77.1	35.6	99	6	7:00	20:58	13:58	7:10	21:01	13:51
313	1	13	136.0	38.3	20.7	71	5	7:39	20:23	12:44	7:50	19:14	11:24
314	1	11	135.2	36.8	20.1	79	6	6:05	20:18	14:13	6:57	20:46	13:49
315	2	9	131.9	29.1	16.8	58	6	7:11	20:37	13:26	7:33	19:29	11:56
316	1	11	132.7	41.2	23.4	94	6	7:51	19:31	11:40	8:28	21:01	12:33
318	2	12	140.3	58.8	29.9	99	6	7:16	20:58	13:42	7:29	20:19	12:50

BMI=Body Mass Index; 1=female; 2= male; WD=weekday; WE=weekend.

ID	Sex	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	# of days	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
320	1	10	135.8	37.4	20.3	86	6	7:18	21:54	14:36	7:18	21:51	14:33
324	1	10	132.8	37.8	21.4	91	6	6:50	20:20	13:30	7:07	20:24	13:17
400	2	10	130.7	28.5	16.7	53	7	7:25	20:18	12:53	7:55	20:14	12:19
402	2	9	118.3	25.1	17.9	77	6	7:14	21:43	14:29	8:02	20:40	12:38
403	2	10	126.3	40.1	25.1	98	6	7:37	21:04	13:27	9:39	20:25	10:46
404	1	12	138.1	35.0	18.4	55	6	7:32	20:41	13:09	8:00	20:29	12:29
408	1	9	115.3	31.0	23.3	97	6	7:47	20:43	12:56	8:15	21:25	13:10
409	1	11	140.3	54.1	27.5	98	6	7:45	21:16	13:31	9:41	20:49	11:08
413	1	12	121.4	24.7	16.8	30	6	7:24	20:30	13:06	8:25	20:34	12:09
416	2	12	148.8	55.2	24.9	96	7	7:29	20:12	12:43	8:58	20:55	11:57
418	2	16	150.1	61.4	27.3	94	5	6:10	21:40	15:30	8:38	21:48	13:10
419	1	16	143.0	48.0	23.5	80	6	6:35	21:57	15:22	9:39	21:54	12:15
421	2	16	156.4	62.3	25.4	91	7	6:11	20:33	14:22	8:40	21:43	13:03
422	2	10	125.6	28.4	18.0	70	7	7:45	22:21	14:36	8:25	22:42	14:17
425	1	11	139.3	34.6	14.7	7	6	6:36	20:28	13:52	8:16	21:36	13:20
444	1	11	138.2	42.5	15.0	9	5	7:30	21:11	13:41	9:53	20:40	10:47
445	2	12	135.9	37.7	27.8	98	7	7:12	21:29	14:17	7:27	21:55	14:28
460	1	10	116.1	22.2	23.4	96	6	8:40	20:53	12:13	9:19	22:30	13:11
461	1	10	131.2	37.2	18.5	74	5	7:52	21:19	13:27	10:11	21:03	10:52
603	1	12	135.5	33.0	18.0	47	5	7:51	22:32	14:41	8:43	23:17	14:34
610	2	10	121.3	32.4	22.0	95	6	6:31	21:56	15:25	7:36	22:45	15:09
630	1	18	140.1	73.2	37.3	99	7	5:52	21:26	15:34	7:18	21:47	14:29
640	2	13	149.5	40.6	18.2	42	4	7:03	21:01	13:58	10:37	21:24	10:47
701	1	9	126.1	34.8	21.9	95	6	6:40	20:30	13:50	7:34	20:37	13:03
702	1	10	123.0	26.6	17.6	59	6	7:25	21:07	13:42	7:45	20:50	13:05
704	2	9	124.9	34.3	22.0	96	6	6:48	21:30	14:42	7:04	20:19	13:15

BMI=Body Mass Index; 1=female; 2= male; WD=weekday; WE=weekend.

ID	Sex	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	# of days	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
706	2	10	122.2	26.6	17.8	69	7	6:18	20:40	14:22	6:23	20:37	14:14
709	1	9	127.6	27.5	16.9	58	7	6:47	21:38	14:51	7:36	21:52	14:16
715	1	10	131.4	35.2	20.4	88	6	6:46	21:19	14:33	8:04	21:01	12:57
718	2	11	142.6	38.7	19.0	75	7	6:33	23:08	16:35	8:10	23:25	15:15
721	2	10	127.3	33.2	20.5	91	7	7:26	21:41	14:15	9:35	20:57	11:22
729	2	13	153.2	43.4	18.5	49	7	6:30	21:01	14:31	8:25	22:02	13:37
731	2	10	120.7	21.6	14.8	16	6	6:29	21:50	15:21	7:15	21:06	13:51
733	2	10	135.1	46.1	25.3	98	7	7:19	21:46	14:27	8:03	21:07	13:04
735	1	10	119.7	35.8	25.0	97	6	7:28	21:06	13:38	8:21	21:42	13:21
736	1	13	143.7	43.5	21.1	77	7	6:08	21:56	15:48	6:46	21:32	14:46

BMI=Body Mass Index; 1=female; 2= male; WD=weekday; WE=weekend.

Table A.2. Physical activity estimates (counts/min).

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	Days	Success %	Success	% of Time_Sed _WD	% of Time_Lig _WD	% of Time_MV _WD	% of Time_Sed _WE	% of Time_Lig _WE	% of Time_MV _WE
200	286	325	161	150	4	100	1	32	45	23	59	31	10
201	332	436	183	151	6	100	1	39	47	25	37	40	12
202	317	300	402	159	6	100	1	41	38	21	34	34	31
203	315	322	295	158	7	100	1	38	42	21	35	44	22
204	266	266	296	137	6	100	1	46	38	16	40	40	21
205	193	201	153	91	6	100	1	53	35	11	50	42	8
206	255	285	174	131	6	86	1	50	33	17	70	20	10
208	228	214	298	104	5	100	1	56	32	12	50	32	18
209	408	429	288	190	6	100	1	30	44	26	44	37	19
210	158	172	116	104	6	86	1	57	30	13	62	30	8
211	357	374	271	183	6	100	1	25	50	24	37	41	22
212	347	290	658	153	6	100	1	41	42	17	47	31	18
213	136	144	117	72	4	67	2	61	30	9	67	26	7
214	208	224	134	107	6	100	1	52	35	13	66	26	8
215	236	236	236	130	7	100	1	49	35	16	42	39	19
216	258	260	250	127	6	100	1	45	38	17	35	50	16
217	259	272	212	109	4	100	1	37	46	17	37	47	16
219	568	419	991	225	7	100	1	31	45	24	30	36	34
220	377	371	392	175	7	100	1	34	44	22	33	40	27
221	321	330	275	211	6	100	1	35	41	24	36	44	21
222	421	373	638	186	5	100	1	33	45	21	33	36	31
223	314	312	324	209	6	100	1	29	46	25	27	45	28
224	231	239	196	114	5	100	1	53	33	14	53	34	13
225	201	197	212	115	7	100	1	47	39	14	46	39	15

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	Days	Success %	Success	% of Time_Sed _WD	% of Time_Lig _WD	% of Time_MV _WD	% of Time_Sed _WE	% of Time_Lig _WE	% of Time_MV _WE
227	371	386	301	173	5	100	1	24	54	22	22	62	16
228	274	266	301	135	7	100	1	44	40	16	42	42	15
229	405	415	378	192	7	100	1	26	50	24	21	58	21
230	229	229	230	112	4	100	1	40	46	14	40	45	15
231	309	324	232	163	6	100	1	30	46	24	41	40	19
232	327	314	368	136	7	100	1	47	37	16	43	38	19
234	391	337	674	200	6	100	1	33	45	22	28	37	34
235	176	184	152	72	5	71	2	61	28	11	54	36	10
237	274	294	214	122	4	100	1	38	45	16	37	49	14
238	157	163	131	101	5	100	1	46	42	12	56	34	10
240	374	351	473	210	5	100	1	27	49	23	43	23	33
300	243	227	284	123	7	100	1	36	51	13	44	39	17
302	336	350	263	188	6	100	1	27	51	22	33	48	19
304	220	222	211	138	6	100	1	51	33	17	55	28	17
305	489	521	317	250	6	100	1	29	39	32	39	33	28
308	260	280	160	143	6	100	1	47	35	18	61	27	13
313	311	333	216	148	5	100	1	34	44	21	48	39	13
314	326	360	153	168	6	100	1	38	40	22	52	38	10
315	242	250	194	121	6	100	1	41	44	15	50	34	15
316	351	317	415	158	6	100	1	30	49	21	29	47	23
318	268	278	217	160	6	100	1	42	38	21	49	36	14
320	352	368	272	200	6	100	1	33	44	23	35	44	21
324	484	512	484	260	6	100	1	20	45	34	33	38	28
400	384	449	215	169	7	100	1	29	45	26	52	36	12

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	Days	Success %	Success	% of Time_Sed _WD	% of Time_Lig _WD	% of Time_MV _WD	% of Time_Sed _WE	% of Time_Lig _WE	% of Time_MV _WE
402	529	506	666	245	6	100	1	34	39	28	32	34	32
403	499	423	689	263	6	100	1	22	47	31	13	43	44
404	512	499	583	215	6	100	1	29	45	27	25	44	30
408	346	383	273	167	6	100	1	23	54	23	23	59	18
409	440	505	282	192	6	100	1	22	50	28	23	60	18
413	367	378	342	170	6	100	1	30	47	23	30	48	22
416	383	405	325	183	7	100	1	34	41	25	35	42	23
418	380	323	479	209	5	100	1	34	47	19	25	43	32
419	136	125	163	75	4	67	2	61	31	8	46	43	10
421	199	158	309	78	6	86	1	69	22	9	68	22	10
422	400	418	354	215	7	100	1	41	34	25	43	33	26
425	431	438	414	224	6	100	1	28	45	27	31	41	28
444	324	308	410	145	5	100	1	35	48	17	30	46	24
445	385	407	330	215	7	100	1	28	45	27	40	39	20
460	245	222	288	116	6	100	1	32	54	14	34	48	18
461	362	394	205	175	5	100	1	33	43	24	38	48	14
603	143	134	157	78	5	100	1	60	32	9	55	36	9
610	318	334	285	210	6	100	1	33	43	24	31	48	21
630	161	176	120	94	6	86	1	55	33	12	53	41	6
640	144	158	89	63	2	50	2	66	26	8	67	27	6
701	199	204	189	105	6	100	1	45	42	13	47	39	14
702	198	244	100	85	4	67	2	50	37	13	68	26	6
704	356	355	362	197	6	100	1	38	39	23	31	49	20
706	422	429	406	247	7	100	1	12	59	29	16	56	27

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	Days	Success %	Success	% of Time_Sed _WD	% of Time_Lig _WD	% of Time_MV _WD	% of Time_Sed _WE	% of Time_Lig _WE	% of Time_MV _WE
709	404	436	322	211	7	100	1	33	42	25	41	37	22
715	392	395	374	197	6	100	1	30	47	23	35	44	21
718	248	254	231	163	7	100	1	35	48	17	41	42	17
721	506	498	531	251	7	100	1	31	39	29	30	33	37
729	355	369	319	189	7	100	1	25	52	23	27	53	20
731	222	234	196	128	6	100	1	49	35	16	28	62	11
733	356	383	281	196	7	100	1	36	39	25	46	35	20
735	207	247	126	117	5	83	1	48	35	17	61	30	9
736	277	290	242	185	7	100	1	31	48	21	35	47	18

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

B. STATISTICAL OUTPUT (CHAPTER 1)

Table B.1. Differences in percentage of time spent in each PA level and daily total activity counts.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	317.910652	81	99.4862352	11.0540261
	AvgA_E	303.355982	81	160.0685851	17.7853983
Pair 2	% of Time_S_D	38.525978	81	11.5642354	1.2849150
	Avg%Time_S_E	41.076604	81	12.9470931	1.4385659
Pair 3	% of Time_L_D	41.749988	81	7.0590950	.7843439
	Avg%Time_L_E	39.947412	81	8.9576408	.9952934
Pair 4	% of Time_MV_D	19.879272	81	6.0747815	.6749757
	Avg%Time_MV_E	18.802148	81	8.0514266	.8946030

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	81	.559	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	81	.770	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	81	.616	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	81	.691	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	14.5546701	133.0676213	14.7852913	-14.8689972	43.9783374	.984	80	.328
Pair 2	% of Time_S_D - Avg%Time_S_E	-2.5506260	8.4131950	.9347994	-4.4109362	-.6903159	-2.729	80	.008
Pair 3	% of Time_L_D - Avg%Time_L_E	1.8025755	7.2252210	.8028023	.2049479	3.4002030	2.245	80	.028
Pair 4	% of Time_MV_D - Avg%Time_MV_E	1.0771237	5.8408611	.6489846	-.2143967	2.3686442	1.660	80	.101

Table B.2. PA estimates on weekdays by gender.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
AvgAC_D	1	42	304.581622	98.1054076	15.1379930
	2	39	332.264992	100.2223429	16.0484187
% of Time_S_D	1	42	39.397791	11.0665157	1.7076004
	2	39	37.587103	12.1515045	1.9457980
% of Time_L_D	1	42	41.551835	6.4936418	1.0019907
	2	39	41.963383	7.7019785	1.2333036
% of Time_MV_D	1	42	19.072205	5.8486857	.9024718
	2	39	20.748421	6.2679787	1.0036799

1=female; 2=male

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgAC_D	Equal variances assumed	.071	.791	-1.256	79	.213	-27.6833699	22.0438629	-71.5605815	16.1938418
	Equal variances not assumed			-1.255	78.273	.213	-27.6833699	22.0615180	-71.6020664	16.2353267
% of Time_S_D	Equal variances assumed	.013	.910	.702	79	.485	1.8106887	2.5797882	-3.3242513	6.9456286
	Equal variances not assumed			.699	76.833	.486	1.8106887	2.5888277	-3.3445048	6.9658821
% of Time_L_D	Equal variances assumed	.684	.411	-.261	79	.795	-.4115478	1.5789900	-3.5544488	2.7313532
	Equal variances not assumed			-.259	74.598	.796	-.4115478	1.5890321	-3.5773418	2.7542462
% of Time_MV_D	Equal variances assumed	.152	.698	-1.245	79	.217	-1.6762159	1.3462563	-4.3558720	1.0034402
	Equal variances not assumed			-1.242	77.396	.218	-1.6762159	1.3497513	-4.3636948	1.0112630

Table B.3. PA estimates on weekends by gender.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
AvgA_E	1	42	265.003379	125.4923229	19.3638858
	2	39	344.658785	183.2287351	29.3400791
Avg%Time_S_E	1	42	42.948807	12.4444220	1.9202160
	2	39	39.060386	13.3327970	2.1349562
Avg%Time_L_E	1	42	40.314785	8.3412796	1.2870874
	2	39	39.551780	9.6718781	1.5487400
Avg%Time_MV_E	1	42	16.626386	6.6291545	1.0229007
	2	39	21.145277	8.8426579	1.4159585

1=female; 2=male

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgA_E	Equal variances assumed	2.145	.147	-2.297	79	.024	-79.6554062	34.6805648	-148.6853437	-10.6254687
	Equal variances not assumed			-2.266	66.602	.027	-79.6554062	35.1539516	-149.8307002	-9.4801122
Avg%Time_S_E	Equal variances assumed	.034	.854	1.358	79	.178	3.8884212	2.8640523	-1.8123322	9.5891746
	Equal variances not assumed			1.354	77.402	.180	3.8884212	2.8714574	-1.8289072	9.6057496
Avg%Time_L_E	Equal variances assumed	.727	.396	.381	79	.704	.7630047	2.0026822	-3.2232344	4.7492438
	Equal variances not assumed			.379	75.318	.706	.7630047	2.0137501	-3.2483138	4.7743232
Avg%Time_MV_E	Equal variances assumed	2.405	.125	-2.614	79	.011	-4.5188919	1.7285101	-7.9594052	-1.0783786
	Equal variances not assumed			-2.587	70.273	.012	-4.5188919	1.7467869	-8.0025104	-1.0352734

Table B.4. PA estimates of girls with DS by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	304.581622	42	98.1054076	15.1379930
	AvgA_E	265.003379	42	125.4923229	19.3638858
Pair 2	% of Time_S_D	39.397791	42	11.0665157	1.7076004
	Avg%Time_S_E	42.948807	42	12.4444220	1.9202160
Pair 3	% of Time_L_D	41.551835	42	6.4936418	1.0019907
	Avg%Time_L_E	40.314785	42	8.3412796	1.2870874
Pair 4	% of Time_MV_D	19.072205	42	5.8486857	.9024718
	Avg%Time_MV_E	16.626386	42	6.6291545	1.0229007

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	42	.588	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	42	.727	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	42	.646	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	42	.677	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	39.5782431	104.3808117	16.1063089	7.0508924	72.1055938	2.457	41	.018
Pair 2	% of Time_S_D - Avg%Time_S_E	-3.5510158	8.7806918	1.3548902	-6.2872720	-.8147596	-2.621	41	.012
Pair 3	% of Time_L_D - Avg%Time_L_E	1.2370502	6.4617790	.9970741	-.7765819	3.2506823	1.241	41	.222
Pair 4	% of Time_MV_D - Avg%Time_MV_E	2.4458196	5.0619019	.7810684	.8684199	4.0232192	3.131	41	.003

Table B.5. PA estimates of boys with DS by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	332.264992	39	100.2223429	16.0484187
	AvgA_E	344.658785	39	183.2287351	29.3400791
Pair 2	% of Time_S_D	37.587103	39	12.1515045	1.9457980
	Avg%Time_S_E	39.060386	39	13.3327970	2.1349562
Pair 3	% of Time_L_D	41.963383	39	7.7019785	1.2333036
	Avg%Time_L_E	39.551780	39	9.6718781	1.5487400
Pair 4	% of Time_MV_D	20.748421	39	6.2679787	1.0036799
	Avg%Time_MV_E	21.145277	39	8.8426579	1.4159585

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	39	.532	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	39	.808	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	39	.596	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	39	.700	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	-12.3937932	155.1932366	24.8508065	-62.7016208	37.9140343	-.499	38	.621
Pair 2	% of Time_S_D - Avg%Time_S_E	-1.4732832	7.9705489	1.2763093	-4.0570363	1.1104698	-1.154	38	.256
Pair 3	% of Time_L_D - Avg%Time_L_E	2.4116027	8.0073476	1.2822018	-.1840791	5.0072845	1.881	38	.068
Pair 4	% of Time_MV_D - Avg%Time_MV_E	-.3968564	6.3147778	1.0111737	-2.4438706	1.6501578	-.392	38	.697

Table B.6. PA estimates on weekdays by age groups.

Group Statistics

	Age G_New	N	Mean	Std. Deviation	Std. Error Mean
AvgAC_D	1	47	357.998396	89.6410465	13.0754905
	2	34	262.495242	85.6750922	14.6931571
% of Time_S_D	1	47	33.471952	8.2391924	1.2018097
	2	34	45.512426	11.9541563	2.0501209
% of Time_L_D	1	47	44.239757	5.4072779	.7887325
	2	34	38.308248	7.6819101	1.3174367
% of Time_MV_D	1	47	22.302463	5.3638993	.7824051
	2	34	16.529567	5.4251872	.9304119

1=8-11 years; 2=12-18 years

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgAC_D	Equal variances assumed	.061	.806	4.820	79	.000	95.5031543	19.8137645	56.0648425	134.9414661
	Equal variances not assumed			4.856	73.083	.000	95.5031543	19.6686887	56.3042597	134.7020489
% of Time_S_D	Equal variances assumed	8.155	.005	-5.369	79	.000	-12.0404737	2.2426183	-16.5042937	-7.5766537
	Equal variances not assumed			-5.067	54.925	.000	-12.0404737	2.3764137	-16.8030602	-7.2778872
% of Time_L_D	Equal variances assumed	7.714	.007	4.081	79	.000	5.9315089	1.4534316	3.0385256	8.8244922
	Equal variances not assumed			3.863	55.757	.000	5.9315089	1.5354929	2.8552510	9.0077669
% of Time_MV_D	Equal variances assumed	.150	.699	4.758	79	.000	5.7728955	1.2134153	3.3576527	8.1881383
	Equal variances not assumed			4.749	70.782	.000	5.7728955	1.2156579	3.3488129	8.1969780

Table B.7. PA estimates on weekends by age groups.

Group Statistics

	Age G_New	N	Mean	Std. Deviation	Std. Error Mean
AvgA_E	1	47	345.102464	177.0318417	25.8227481
	2	34	245.647610	111.8663641	19.1849232
Avg%Time_S_E	1	47	37.461850	11.7603197	1.7154189
	2	34	46.073470	13.0094190	2.2310969
Avg%Time_L_E	1	47	41.245185	9.0808751	1.3245818
	2	34	38.153433	8.5940404	1.4738658
Avg%Time_MV_E	1	47	21.213403	8.2454110	1.2027168
	2	34	15.468943	6.5311162	1.1200772

1=8-11 years; 2=12-18 years

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgA_E	Equal variances assumed	4.224	.043	2.883	79	.005	99.4548549	34.4959199	30.7924439	168.1172659
	Equal variances not assumed			3.092	77.768	.003	99.4548549	32.1694824	35.4073311	163.5023787
Avg%Time_S_E	Equal variances assumed	.953	.332	-3.110	79	.003	-8.6116201	2.7686763	-14.1225325	-3.1007077
	Equal variances not assumed			-3.060	66.801	.003	-8.6116201	2.8143304	-14.2293541	-2.9938861
Avg%Time_L_E	Equal variances assumed	.159	.691	1.546	79	.126	3.0917518	1.9994210	-.8879962	7.0714998
	Equal variances not assumed			1.560	73.457	.123	3.0917518	1.9816148	-.8571866	7.0406902
Avg%Time_MV_E	Equal variances assumed	1.388	.242	3.368	79	.001	5.7444604	1.7058088	2.3491329	9.1397880
	Equal variances not assumed			3.495	78.297	.001	5.7444604	1.6435025	2.4726934	9.0162274

Table B.8. PA estimates of the 8-11 years group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	357.998396	47	89.6410465	13.0754905
	AvgA_E	345.102464	47	177.0318417	25.8227481
Pair 2	% of Time_S_D	33.471952	47	8.2391924	1.2018097
	Avg%Time_S_E	37.461850	47	11.7603197	1.7154189
Pair 3	% of Time_L_D	44.239757	47	5.4072779	.7887325
	Avg%Time_L_E	41.245185	47	9.0808751	1.3245818
Pair 4	% of Time_MV_D	22.302463	47	5.3638993	.7824051
	Avg%Time_MV_E	21.213403	47	8.2454110	1.2027168

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	47	.467	.001
Pair 2	% of Time_S_D & Avg%Time_S_E	47	.678	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	47	.539	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	47	.628	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	12.8959315	156.6486507	22.8495541	-33.0978354	58.8896984	.564	46	.575
Pair 2	% of Time_S_D - Avg%Time_S_E	-3.9898979	8.6486459	1.2615347	-6.5292355	-1.4505604	-3.163	46	.003
Pair 3	% of Time_L_D - Avg%Time_L_E	2.9945723	7.6685834	1.1185779	.7429918	5.2461527	2.677	46	.010
Pair 4	% of Time_MV_D - Avg%Time_MV_E	1.0890594	6.4171751	.9360412	-.7950938	2.9732126	1.163	46	.251

Table B.9. PA estimates of the 12-18 years group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	262.495242	34	85.6750922	14.6931571
	AvgA_E	245.647610	34	111.8663641	19.1849232
Pair 2	% of Time_S_D	45.512426	34	11.9541563	2.0501209
	Avg%Time_S_E	46.073470	34	13.0094190	2.2310969
Pair 3	% of Time_L_D	38.308248	34	7.6819101	1.3174367
	Avg%Time_L_E	38.153433	34	8.5940404	1.4738658
Pair 4	% of Time_MV_D	16.529567	34	5.4251872	.9304119
	Avg%Time_MV_E	15.468943	34	6.5311162	1.1200772

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	34	.581	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	34	.810	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	34	.705	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	34	.660	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	16.8476321	93.3333032	16.0065294	-15.7178969	49.4131611	1.053	33	.300
Pair 2	% of Time_S_D - Avg%Time_S_E	-.5610443	7.7651962	1.3317202	-3.2704493	2.1483607	-.421	33	.676
Pair 3	% of Time_L_D - Avg%Time_L_E	.1548152	6.3055568	1.0813941	-2.0452976	2.3549279	.143	33	.887
Pair 4	% of Time_MV_D - Avg%Time_MV_E	1.0606244	5.0300626	.8626486	-.6944474	2.8156962	1.229	33	.228

Table B.10. PA estimates on weekdays by obesity levels.

Group Statistics

	BMI G_New	N	Mean	Std. Deviation	Std. Error Mean
AvgAC_D	1	43	324.739887	99.4345471	15.1636263
	2	38	310.182834	100.3052736	16.2716640
% of Time_S_D	1	43	37.898019	11.2487933	1.7154249
	2	38	39.236564	12.0223833	1.9502881
% of Time_L_D	1	43	42.764191	6.9184051	1.0550469
	2	38	40.602337	7.1317410	1.1569212
% of Time_MV_D	1	43	19.616634	5.9193378	.9026905
	2	38	20.176467	6.3123554	1.0239993

1=normal weight group (less than 85^{th} BMI percentile); 2=overweight group (equal or greater than 85^{th} BMI percentile)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgAC_D	Equal variances assumed	.000	.990	.655	79	.514	14.5570538	22.2297928	-29.6902420	58.8043496
	Equal variances not assumed			.654	77.607	.515	14.5570538	22.2419112	-29.7267208	58.8408284
% of Time_S_D	Equal variances assumed	.742	.392	-.517	79	.606	-1.3385445	2.5866044	-6.4870518	3.8099627
	Equal variances not assumed			-.515	76.211	.608	-1.3385445	2.5973653	-6.5114139	3.8343248
% of Time_L_D	Equal variances assumed	.067	.797	1.383	79	.170	2.1618530	1.5627868	-.9487962	5.2725022
	Equal variances not assumed			1.381	77.134	.171	2.1618530	1.5657556	-.9558780	5.2795840
% of Time_MV_D	Equal variances assumed	.061	.805	-.412	79	.682	-.5598330	1.3596060	-3.2660610	2.1463950
	Equal variances not assumed			-.410	76.273	.683	-.5598330	1.3650732	-3.2784546	2.1587886

Table B.11. PA estimates on weekends by obesity levels.

Group Statistics

	BMI G_New	N	Mean	Std. Deviation	Std. Error Mean
AvgA_E	1	43	299.120038	140.9018048	21.4873238
	2	38	308.149287	181.1578478	29.3876835
Avg%Time_S_E	1	43	40.482263	11.4010645	1.7386460
	2	38	41.749148	14.6291646	2.3731639
Avg%Time_L_E	1	43	40.898750	8.7999323	1.3419771
	2	38	38.870899	9.1293438	1.4809751
Avg%Time_MV_E	1	43	18.274920	7.1902672	1.0965055
	2	38	19.398749	8.9882234	1.4580824

1=normal weight group (less than 85^{th} BMI percentile); 2=overweight group (equal or greater than 85^{th} BMI percentile)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgA_E	Equal variances assumed	.654	.421	-.252	79	.802	-9.0292490	35.8492222	-80.3853408	62.3268429
	Equal variances not assumed			-.248	69.609	.805	-9.0292490	36.4052335	-81.6443618	63.5858638
Avg%Time_S_E	Equal variances assumed	4.136	.045	-.437	79	.663	-1.2668848	2.8973122	-7.0338404	4.5000709
	Equal variances not assumed			-.431	69.691	.668	-1.2668848	2.9419036	-7.1347838	4.6010142
Avg%Time_L_E	Equal variances assumed	.100	.752	1.017	79	.312	2.0278514	1.9939630	-1.9410327	5.9967355
	Equal variances not assumed			1.015	76.983	.313	2.0278514	1.9985469	-1.9517777	6.0074805
Avg%Time_MV_E	Equal variances assumed	.663	.418	-.625	79	.534	-1.1238284	1.7994978	-4.7056393	2.4579825
	Equal variances not assumed			-.616	70.749	.540	-1.1238284	1.8243707	-4.7617437	2.5140869

Table B.12. PA estimates of the normal weight group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	324.739887	43	99.4345471	15.1636263
	AvgA_E	299.120038	43	140.9018048	21.4873238
Pair 2	% of Time_S_D	37.898019	43	11.2487933	1.7154249
	Avg%Time_S_E	40.482263	43	11.4010645	1.7386460
Pair 3	% of Time_L_D	42.764191	43	6.9184051	1.0550469
	Avg%Time_L_E	40.898750	43	8.7999323	1.3419771
Pair 4	% of Time_MV_D	19.616634	43	5.9193378	.9026905
	Avg%Time_MV_E	18.274920	43	7.1902672	1.0965055

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	43	.530	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	43	.678	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	43	.473	.001
Pair 4	% of Time_MV_D & Avg%Time_MV_E	43	.645	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	25.6198491	122.0455621	18.6117737	-11.9402309	63.1799292	1.377	42	.176
Pair 2	% of Time_S_D - Avg%Time_S_E	-2.5842442	9.0913195	1.3864132	-5.3821394	.2136510	-1.864	42	.069
Pair 3	% of Time_L_D - Avg%Time_L_E	1.8654404	8.2272466	1.2546434	-.6665324	4.3974132	1.487	42	.145
Pair 4	% of Time_MV_D - Avg%Time_MV_E	1.3417142	5.6399174	.8600793	-.3939962	3.0774245	1.560	42	.126

Table B.13. PA estimates of the overweight group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	310.182834	38	100.3052736	16.2716640
	AvgA_E	308.149287	38	181.1578478	29.3876835
Pair 2	% of Time_S_D	39.236564	38	12.0223833	1.9502881
	Avg%Time_S_E	41.749148	38	14.6291646	2.3731639
Pair 3	% of Time_L_D	40.602337	38	7.1317410	1.1569212
	Avg%Time_L_E	38.870899	38	9.1293438	1.4809751
Pair 4	% of Time_MV_D	20.176467	38	6.3123554	1.0239993
	Avg%Time_MV_E	19.398749	38	8.9882234	1.4580824

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	38	.600	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	38	.851	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	38	.754	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	38	.733	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	2.0335464	145.1692315	23.5495590	-45.6823927	49.7494854	.086	37	.932
Pair 2	% of Time_S_D - Avg%Time_S_E	-2.5125844	7.6953068	1.2483436	-5.0419688	.0168000	-2.013	37	.051
Pair 3	% of Time_L_D - Avg%Time_L_E	1.7314388	6.0023973	.9737174	-.2415001	3.7043777	1.778	37	.084
Pair 4	% of Time_MV_D - Avg%Time_MV_E	.7777188	6.1223380	.9931744	-1.2346437	2.7900812	.783	37	.439

C. GENERALIZABILITY THEORY OUTPUT (CHAPTER 1)

Table C.1. Generalizability theory data (Day study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Participants	P	81	INF	
Days	D	4	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	225170.7	80	2814.6	575.7	575.7	575.7	51.5	110.5
D	8768.1	3	2922.7	29.8	29.8	29.8	2.7	22.8
PD	122862.4	240	511.9	511.9	511.9	511.9	45.8	46.5
Total	356801.2	323					100%	

G Study Table
(Measurement design P/D)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	575.7		.....		.....	
	.....	D	.....		7.4	5.5
	.....	PD	128.0	100.0	128.0	94.5
Sum of variances	575.7		128.0	100%	135.4	100%
Standard deviation	24.0		Relative SE: 11.3		Absolute SE: 11.6	
Coef_G relative	0.82					
Coef_G absolute	0.81					

Grand mean for levels used: 76.8
Variance error of the mean for levels used: 16.1
Standard error of the grand mean: 4.0

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	81	INF	81	INF	81	INF	81	INF	81	INF	81	INF
D	4	INF	1	INF	2	INF	3	INF	4	INF	5	INF
Observ.		324		81		162		243		324		486
Coef_G rel.		0.8		0.5		0.7		0.8		0.8		0.9
rounded		0.82		0.53		0.69		0.77		0.82		0.87
Coef_G abs.		0.8		0.5		0.7		0.8		0.8		0.9
rounded		0.81		0.52		0.68		0.76		0.81		0.86
Rel. Err. Var.		128.0		511.9		256.0		170.6		128.0		85.3
Rel. Std. Err. of M.		11.3		22.6		16.0		13.1		11.3		9.2
Abs. Err. Var.		135.4		541.7		270.8		180.6		135.4		90.3
Abs. Std. Err. of M.		11.6		23.3		16.5		13.4		11.6		9.5

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	81	INF	81	INF	81	INF	81	INF	81	INF	81	INF
D	4	INF	6	INF	7	INF	8	INF	9	INF	10	INF
Observ.		324		486		567		648		729		810
Coef_G rel.		0.8		0.9		0.9		0.9		0.9		0.9
rounded		0.82		0.87		0.89		0.90		0.91		0.92
Coef_G abs.		0.8		0.9		0.9		0.9		0.9		0.9
rounded		0.81		0.86		0.88		0.89		0.91		0.91
Rel. Err. Var.		128.0		85.3		73.1		64.0		56.9		51.2
Rel. Std. Err. of M.		11.3		9.2		8.6		8.0		7.5		7.2
Abs. Err. Var.		135.4		90.3		77.4		67.7		60.2		54.2
Abs. Std. Err. of M.		11.6		9.5		8.8		8.2		7.8		7.4

Table C.2. Generalizability theory data (Hour study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Participants	P	81	INF	
Hours	H	10	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	7742711.6	80	96783.9	7474.3	7474.3	7474.3	21.2	1516.0
H	4365297.4	9	485033.0	5716.0	5716.0	5716.0	16.2	2553.4
PH	15869492.8	720	22041.0	22041.0	22041.0	22041.0	62.6	1160.1
Total	27977501.8	809					100%	

G Study Table
(Measurement design P/H)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	7474.3		.....		.....	
	.....	H	.....		571.6	20.6
	.....	PH	2204.1	100.0	2204.1	79.4
Sum of variances	7474.3		2204.1	100%	2775.7	100%
Standard deviation	86.5		Relative SE: 46.9		Absolute SE: 52.7	
Coef_G relative	0.77					
Coef_G absolute	0.73					

Grand mean for levels used: 299.3
Variance error of the mean for levels used: 691.1
Standard error of the grand mean: 26.3

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	81	INF	81	INF	81	INF	81	INF	81	INF	81	INF
H	10	INF	1	INF	2	INF	3	INF	4	INF	5	INF
Observ.		810		81		162		243		324		405
Coef_G rel.		0.8		0.3		0.4		0.5		0.6		0.6
rounded		0.77		0.25		0.40		0.50		0.58		0.63
Coef_G abs.		0.7		0.2		0.4		0.4		0.5		0.6
rounded		0.73		0.21		0.35		0.45		0.52		0.57
Rel. Err. Var.		2204.1		22041.0		11020.5		7347.0		5510.2		4408.2
Rel. Std. Err. of M.		46.9		148.5		105.0		85.7		74.2		66.4
Abs. Err. Var.		2775.7		27756.9		13878.5		9252.3		6939.2		5551.4
Abs. Std. Err. of M.		52.7		166.6		117.8		96.2		83.3		74.5

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	81	INF	81	INF	81	INF	81	INF	81	INF	81	INF
H	10	INF	6	INF	7	INF	8	INF	9	INF	10	INF
Observ.		810		486		567		648		729		810
Coef_G rel.		0.8		0.7		0.7		0.7		0.8		0.8
rounded		0.77		0.67		0.70		0.73		0.75		0.77
Coef_G abs.		0.7		0.6		0.7		0.7		0.7		0.7
rounded		0.73		0.62		0.65		0.68		0.71		0.73
Rel. Err. Var.		2204.1		3673.5		3148.7		2755.1		2449.0		2204.1
Rel. Std. Err. of M.		46.9		60.6		56.1		52.5		49.5		46.9
Abs. Err. Var.		2775.7		4626.2		3965.3		3469.6		3084.1		2775.7
Abs. Std. Err. of M.		52.7		68.0		63.0		58.9		55.5		52.7

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	81	INF	81	INF	81	INF	81	INF	81	INF	81	INF
H	10	INF	11	INF	12	INF	13	INF	14	INF	15	INF
Observ.		810		891		972		1053		1134		1215
Coef_G rel.		0.8		0.8		0.8		0.8		0.8		0.8
rounded		0.77		0.79		0.80		0.82		0.83		0.84
Coef_G abs.		0.7		0.7		0.8		0.8		0.8		0.8
rounded		0.73		0.75		0.76		0.78		0.79		0.80
Rel. Err. Var.		2204.1		2003.7		1836.7		1695.5		1574.4		1469.4
Rel. Std. Err. of M.		46.9		44.8		42.9		41.2		39.7		38.3
Abs. Err. Var.		2775.7		2523.4		2313.1		2135.1		1982.6		1850.5
Abs. Std. Err. of M.		52.7		50.2		48.1		46.2		44.5		43.0

D. SUPPLEMENTAL DATA (CHAPTER 2)

Table D.3. Demographic data and monitoring periods.

ID	Sex	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	# of days	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
436	2	9	177.4	82.4	26.2	99	7	7:55	21:47	13:52	8:45	22:26	13:41
437	2	12	138.1	37.8	19.8	76	7	7:58	21:53	13:55	9:42	22:24	12:42
438	1	13	141.6	27.0	13.5	0	5	6:37	20:26	13:49	6:20	19:12	12:52
440	2	9	131.6	25.6	14.8	18	6	7:17	20:06	12:49	5:53	20:29	14:36
441	1	13	170.5	95.7	32.9	99	7	5:39	20:00	14:21	6:05	19:42	13:37
447	2	15	118.3	27.9	19.9	56	5	8:22	22:05	13:43	10:59	21:38	10:39
448	2	10	116.1	22.2	16.5	47	6	7:18	23:10	15:52	10:28	23:58	13:30
452	2	9	132.9	64.7	36.7	100	5	8:35	20:28	11:53	11:20	23:43	12:23
453	2	16	144.2	48.6	23.4	82	6	6:28	22:37	16:09	9:24	23:08	13:44
458	2	9	139.2	65.0	33.5	100	7	7:10	21:16	14:06	8:31	21:23	12:52
604	2	10	146.5	60.9	28	99	6	6:22	22:16	15:54	6:17	22:25	16:08
606	1	14	158.1	66.5	27	94	7	6:36	20:58	14:22	7:48	21:41	13:53
616	2	15	174.6	93.6	31	98	7	5:52	23:25	17:33	7:50	23:58	16:08
618	1	15	152.5	75.3	32	98	6	5:07	19:20	14:13	7:37	20:25	12:48
622	1	13	149.8	54.4	24	91	6	6:32	22:14	15:42	6:53	22:51	15:58
626	2	11	143.7	28.8	14	2	6	6:45	21:34	14:49	13:05	23:11	10:06
627	1	9	138.6	41.3	21	94	6	6:52	21:08	14:16	8:27	21:59	13:32
629	2	10	149.4	42.8	19	86	7	6:25	20:48	14:23	6:57	20:07	13:10
633	2	11	143.6	35.8	17	53	4	7:12	21:47	14:35	7:31	21:44	14:13
635	2	9	138.4	31.2	16	53	7	6:37	20:56	14:19	6:58	21:03	14:05
703	1	17	136.0	38.6	21	49	4	6:33	22:36	16:03	8:21	22:20	13:59
710	2	14	178.0	55.5	18	24	5	6:24	20:26	14:02	8:18	21:00	12:42
711	2	11	134.9	27.9	15	13	7	7:55	21:47	13:52	8:45	22:26	13:41

BMI=Body Mass Index; 1=female; 2= male; WD=weekday; WE=weekend.

ID	Sex	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	# of days	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
712	2	9	139.6	37.4	19	88	7	7:10	21:52	14:42	7:24	21:40	14:16
713	1	12	150	46.4	21	81	6	6:36	20:43	14:07	7:22	23:59	16:37
714	2	12	136.7	31	17	24	5	7:09	21:14	14:05	9:17	23:10	13:53
719	2	15	169	92.6	32	99	7	6:40	21:52	15:12	7:50	22:37	14:47
722	2	18	166.8	76	27	91	7	6:07	21:36	15:29	9:26	21:02	11:36
723	2	12	139.1	33.6	17	41	7	5:49	21:15	15:26	5:16	21:17	16:01
726	2	14	178.8	80.7	25	94	7	6:21	22:20	15:59	7:39	20:24	12:45
727	2	10	145.8	42.8	20	90	6	10:21	23:59	13:38	9:37	23:36	13:59
728	2	11	140.5	30.6	16	19	7	6:19	21:59	15:40	8:11	22:40	14:29
734	2	10	153	54.7	23	97	7	6:55	21:19	14:24	9:13	21:21	12:08
737	2	11	149.7	49.9	22	93	7	6:57	21:48	14:51	7:43	21:50	14:07

BMI=Body Mass Index; 1=female; 2= male; WD=weekday; WE=weekend.

Table D.4. Physical activity estimates (counts/min).

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	Days	Success %	Success	% of Time_Sed _WD	% of Time_Lig _WD	% of Time_MV _WD	% of Time_Sed _WE	% of Time_Lig _WE	% of Time_MV _WE
436	690	666	753	335	7	100	1	15	47	38	12	40	48
437	239	249	214	147	7	100	1	35	46	19	31	53	16
438	557	512	749	239	5	100	1	23	50	26	15	45	40
440	458	422	615	219	6	100	1	32	41	28	43	29	28
441	240	276	145	135	7	100	1	49	33	18	57	33	11
447	471	526	364	210	5	100	1	26	43	31	41	37	22
448	462	466	443	234	6	100	1	37	38	25	33	39	28
452	547	445	695	236	5	100	1	32	38	29	17	46	37
453	589	550	682	240	6	100	1	45	32	23	33	34	33
458	719	599	1049	322	7	100	1	29	38	33	13	32	55
604	335	387	232	191	6	100	1	45	33	23	52	35	14
606	124	133	100	72	5	71	1	66	25	9	67	25	8
616	220	235	181	155	7	100	1	56	28	15	55	31	14
618	62	73	39	27	0	0	2	73	23	4	81	17	2
622	253	269	174	157	6	100	1	50	32	17	60	26	14
626	378	406	295	160	6	100	1	42	36	22	53	32	15
627	284	291	255	163	6	100	1	31	49	20	32	52	16
629	378	353	446	160	7	100	1	56	27	22	42	34	19
633	210	184	288	128	4	100	1	51	37	12	43	34	22
635	252	265	221	122	6	86	1	48	37	14	57	29	14
703	246	262	191	154	4	100	1	44	39	16	42	41	16
710	166	182	138	70	3	60	2	64	27	8	62	29	9
711	331	324	342	144	6	100	1	47	33	20	46	32	22

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	Days	Success %	Success	% of Time_Sed _WD	% of Time_Lig _WD	% of Time_MV _WD	% of Time_Sed _WE	% of Time_Lig _WE	% of Time_MV _WE
712	227	234	209	131	7	100	1	44	40	16	41	46	13
713	144	140	163	65	3	50	2	55	38	7	35	55	10
714	281	304	185	137	5	100	1	47	36	17	48	41	12
719	421	461	315	195	7	100	1	47	30	23	46	36	18
722	265	262	274	237	7	100	1	32	41	27	37	36	28
723	222	216	236	145	7	100	1	50	35	15	49	35	16
726	179	169	208	95	6	86	1	51	39	10	48	41	12
727	474	387	644	244	6	100	1	26	48	26	25	39	35
728	340	375	243	199	7	100	1	26	50	23	32	51	17
734	558	592	457	263	7	100	1	28	39	33	40	33	28
737	389	276	685	152	7	100	1	37	47	16	38	42	20

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

E. STATISTICAL OUTPUT (CHAPTER 2)

Table E.1. Differences in percentage of time spent in each PA level and daily total activity counts.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	337.954328	34	147.3573583	25.2715785
	AvgA_E	359.686773	34	237.6866719	40.7629279
Pair 2	% of Time_S_D	42.319538	34	13.2449476	2.2714898
	Avg%Time_S_E	41.916229	34	15.3628828	2.6347127
Pair 3	% of Time_L_D	37.513031	34	7.2022676	1.2351787
	Avg%Time_L_E	37.062661	34	8.5168349	1.4606251
Pair 4	% of Time_MV_D	20.258159	34	8.0140084	1.3743911
	Avg%Time_MV_E	20.910316	34	11.7291985	2.0115410

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	34	.770	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	34	.829	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	34	.720	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	34	.814	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	-21.7324450	155.7842828	26.7167841	-76.0881509	32.6232609	-.813	33	.422
Pair 2	% of Time_S_D - Avg%Time_S_E	.4033086	8.5991347	1.4747394	-2.5970713	3.4036886	.273	33	.786
Pair 3	% of Time_L_D - Avg%Time_L_E	.4503702	6.0076931	1.0303109	-1.6458130	2.5465534	.437	33	.665
Pair 4	% of Time_MV_D - Avg%Time_MV_E	-.6521567	6.9896616	1.1987171	-3.0909650	1.7866515	-.544	33	.590

Table E.2. PA estimates on weekdays by gender.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
AvgAC_D	1	8	244.284004	135.4836020	47.9006869
	2	26	366.775967	140.8952467	27.6318312
% of Time_S_D	1	8	49.029619	16.6354035	5.8815033
	2	26	40.254897	11.6291971	2.2806732
% of Time_L_D	1	8	36.226296	9.9437270	3.5156384
	2	26	37.908950	6.3319277	1.2417932
% of Time_MV_D	1	8	14.565576	7.3626094	2.6030755
	2	26	22.009724	7.4858141	1.4680889

1=female; 2=male

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgAC_D	Equal variances assumed	.378	.543	-2.168	32	.038	-122.4919631	56.4931070	-237.5646564	-7.4192698
	Equal variances not assumed			-2.215	12.060	.047	-122.4919631	55.2991311	-242.9120836	-2.0718425
% of Time_S_D	Equal variances assumed	.690	.412	1.684	32	.102	8.7747220	5.2120857	-1.8419492	19.3913931
	Equal variances not assumed			1.391	9.205	.197	8.7747220	6.3082130	-5.4471225	22.9965664
% of Time_L_D	Equal variances assumed	2.984	.094	-.572	32	.571	-1.6826540	2.9420537	-7.6754214	4.3101133
	Equal variances not assumed			-.451	8.817	.663	-1.6826540	3.7285069	-10.1438489	6.7785408
% of Time_MV_D	Equal variances assumed	.004	.949	-2.468	32	.019	-7.4441479	3.0157168	-13.5869619	-1.3013339
	Equal variances not assumed			-2.491	11.826	.029	-7.4441479	2.9885259	-13.9662121	-.9220836

Table E.3. PA estimates on weekends by gender.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
AvgA_E	1	8	226.907726	220.2409368	77.8669299
	2	26	400.541865	231.5470739	45.4101172
Avg%Time_S_E	1	8	48.573169	21.4891356	7.5975568
	2	26	39.867940	12.7945574	2.5092191
Avg%Time_L_E	1	8	36.925705	13.8170682	4.8850713
	2	26	37.104802	6.5027005	1.2752845
Avg%Time_MV_E	1	8	14.531413	11.1598128	3.9455897
	2	26	22.873055	11.3885400	2.2334765

1=female; 2=male

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgA_E	Equal variances assumed	.893	.352	-1.874	32	.070	-173.6341389	92.6347001	-362.3248482	15.0565704
	Equal variances not assumed			-1.926	12.177	.078	-173.6341389	90.1406541	-369.7182736	22.4499959
Avg%Time_S_E	Equal variances assumed	5.173	.030	1.423	32	.164	8.7052284	6.1169730	-3.7546378	21.1650946
	Equal variances not assumed			1.088	8.582	.306	8.7052284	8.0011905	-9.5300852	26.9405421
Avg%Time_L_E	Equal variances assumed	13.749	.001	-.051	32	.959	-.1790963	3.4966342	-7.3015070	6.9433144
	Equal variances not assumed			-.035	7.976	.973	-.1790963	5.0487892	-11.8276612	11.4694686
Avg%Time_MV_E	Equal variances assumed	.328	.571	-1.820	32	.078	-8.3416422	4.5843601	-17.6796781	.9963938
	Equal variances not assumed			-1.840	11.864	.091	-8.3416422	4.5338830	-18.2327223	1.5494380

Table E.4. PA estimates of girls with DS by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	244.284004	8	135.4836020	47.9006869
	AvgA_E	226.907726	8	220.2409368	77.8669299
Pair 2	% of Time_S_D	49.029619	8	16.6354035	5.8815033
	Avg%Time_S_E	48.573169	8	21.4891356	7.5975568
Pair 3	% of Time_L_D	36.226296	8	9.9437270	3.5156384
	Avg%Time_L_E	36.925705	8	13.8170682	4.8850713
Pair 4	% of Time_MV_D	14.565576	8	7.3626094	2.6030755
	Avg%Time_MV_E	14.531413	8	11.1598128	3.9455897

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	8	.908	.002
Pair 2	% of Time_S_D & Avg%Time_S_E	8	.894	.003
Pair 3	% of Time_L_D & Avg%Time_L_E	8	.838	.009
Pair 4	% of Time_MV_D & Avg%Time_MV_E	8	.836	.010

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	17.3762777	112.6870069	39.8408734	-76.8324177	111.5849730	.436	7	.676
Pair 2	% of Time_S_D - Avg%Time_S_E	.4564508	9.9755470	3.5268885	-7.8833152	8.7962168	.129	7	.901
Pair 3	% of Time_L_D - Avg%Time_L_E	-.6994092	7.7218150	2.7300739	-7.1550081	5.7561897	-.256	7	.805
Pair 4	% of Time_MV_D - Avg%Time_MV_E	.0341624	6.4271865	2.2723536	-5.3390999	5.4074248	.015	7	.988

Table E.5. PA estimates of boys with DS by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	366.775967	26	140.8952467	27.6318312
	AvgA_E	400.541865	26	231.5470739	45.4101172
Pair 2	% of Time_S_D	40.254897	26	11.6291971	2.2806732
	Avg%Time_S_E	39.867940	26	12.7945574	2.5092191
Pair 3	% of Time_L_D	37.908950	26	6.3319277	1.2417932
	Avg%Time_L_E	37.104802	26	6.5027005	1.2752845
Pair 4	% of Time_MV_D	22.009724	26	7.4858141	1.4680889
	Avg%Time_MV_E	22.873055	26	11.3885400	2.2334765

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	26	.699	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	26	.770	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	26	.631	.001
Pair 4	% of Time_MV_D & Avg%Time_MV_E	26	.780	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	-33.7658981	166.8507284	32.7221200	-101.1583658	33.6265695	-1.032	25	.312
Pair 2	% of Time_S_D - Avg%Time_S_E	.3869572	8.3512361	1.6378121	-2.9861800	3.7600945	.236	25	.815
Pair 3	% of Time_L_D - Avg%Time_L_E	.8041485	5.5130150	1.0811912	-1.4226065	3.0309034	.744	25	.464
Pair 4	% of Time_MV_D - Avg%Time_MV_E	-.8633318	7.2612351	1.4240454	-3.7962082	2.0695445	-.606	25	.550

Table E.6. PA estimates on weekdays by age groups.

Group Statistics

	Age Grp_New	N	Mean	Std. Deviation	Std. Error Mean
AvgAC_D	1	18	378.417922	141.7553969	33.4120675
	2	16	292.432785	144.2990905	36.0747726
% of Time_S_D	1	18	37.815314	11.1740696	2.6337535
	2	16	47.386790	13.8816677	3.4704169
% of Time_L_D	1	18	39.748826	6.1728020	1.4549434
	2	16	34.997763	7.6281729	1.9070432
% of Time_MV_D	1	18	22.694821	7.8948700	1.8608387
	2	16	17.516915	7.4507620	1.8626905

1=9-11 years; 2=12-18 years

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgAC_D	Equal variances assumed	.021	.887	1.751	32	.090	85.9851370	49.1176602	-14.0642629	186.0345368
	Equal variances not assumed			1.749	31.391	.090	85.9851370	49.1706770	-14.2485311	186.2188051
% of Time_S_D	Equal variances assumed	.097	.758	-2.226	32	.033	-9.5714764	4.3005362	-18.3313819	-.8115708
	Equal variances not assumed			-2.197	28.819	.036	-9.5714764	4.3566559	-18.4842674	-.6586853
% of Time_L_D	Equal variances assumed	.966	.333	2.006	32	.053	4.7510626	2.3685085	-.0734312	9.5755565
	Equal variances not assumed			1.981	28.903	.057	4.7510626	2.3986817	-.1555039	9.6576292
% of Time_MV_D	Equal variances assumed	.071	.791	1.960	32	.059	5.1779067	2.6421852	-.2040485	10.5598619
	Equal variances not assumed			1.967	31.871	.058	5.1779067	2.6329331	-.1860539	10.5418673

Table E.7. PA estimates on weekends by age groups.

Group Statistics

	Age Grp_New	N	Mean	Std. Deviation	Std. Error Mean
AvgA_E	1	18	446.370966	244.1676615	57.5508697
	2	16	262.167057	193.8064112	48.4516028
Avg%Time_S_E	1	18	36.324718	12.9974280	3.0635231
	2	16	48.206679	15.7498150	3.9374538
Avg%Time_L_E	1	18	38.879077	8.2592417	1.9467219
	2	16	35.019193	8.5939771	2.1484943
Avg%Time_MV_E	1	18	24.541131	12.5142905	2.9496466
	2	16	16.825650	9.5686141	2.3921535

1=9-11 years; 2=12-18 years

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgA_E	Equal variances assumed	1.811	.188	2.415	32	.022	184.2039094	76.2733253	28.8402300	339.5675889
	Equal variances not assumed			2.449	31.630	.020	184.2039094	75.2307146	30.8936515	337.5141674
Avg%Time_S_E	Equal variances assumed	.236	.630	-2.409	32	.022	-11.8819614	4.9317417	-21.9275905	-1.8363323
	Equal variances not assumed			-2.382	29.212	.024	-11.8819614	4.9888592	-22.0821084	-1.6818144
Avg%Time_L_E	Equal variances assumed	.096	.759	1.335	32	.191	3.8598843	2.8922921	-2.0315219	9.7512905
	Equal variances not assumed			1.331	31.190	.193	3.8598843	2.8992678	-2.0517492	9.7715179
Avg%Time_MV_E	Equal variances assumed	1.415	.243	2.000	32	.054	7.7154811	3.8585826	-.1441944	15.5751567
	Equal variances not assumed			2.032	31.348	.051	7.7154811	3.7977379	-.0265767	15.4575390

Table E.8. PA estimates of the 9-11 years group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	378.417922	18	141.7553969	33.4120675
	AvgA_E	446.370966	18	244.1676615	57.5508697
Pair 2	% of Time_S_D	37.815314	18	11.1740696	2.6337535
	Avg%Time_S_E	36.324718	18	12.9974280	3.0635231
Pair 3	% of Time_L_D	39.748826	18	6.1728020	1.4549434
	Avg%Time_L_E	38.879077	18	8.2592417	1.9467219
Pair 4	% of Time_MV_D	22.694821	18	7.8948700	1.8608387
	Avg%Time_MV_E	24.541131	18	12.5142905	2.9496466

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	18	.678	.002
Pair 2	% of Time_S_D & Avg%Time_S_E	18	.670	.002
Pair 3	% of Time_L_D & Avg%Time_L_E	18	.528	.024
Pair 4	% of Time_MV_D & Avg%Time_MV_E	18	.795	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	-67.9530438	180.9681609	42.6546046	-157.9463930	22.0403054	-1.593	17	.130
Pair 2	% of Time_S_D - Avg%Time_S_E	1.4905957	9.9642621	2.3485991	-3.4645153	6.4457067	.635	17	.534
Pair 3	% of Time_L_D - Avg%Time_L_E	.8697482	7.2445096	1.7075473	-2.7328617	4.4723581	.509	17	.617
Pair 4	% of Time_MV_D - Avg%Time_MV_E	-1.8463094	7.8597853	1.8525692	-5.7548887	2.0622699	-.997	17	.333

Table E.9. PA estimates of the 12-18 years group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	292.432785	16	144.2990905	36.0747726
	AvgA_E	262.167057	16	193.8064112	48.4516028
Pair 2	% of Time_S_D	47.386790	16	13.8816677	3.4704169
	Avg%Time_S_E	48.206679	16	15.7498150	3.9374538
Pair 3	% of Time_L_D	34.997763	16	7.6281729	1.9070432
	Avg%Time_L_E	35.019193	16	8.5939771	2.1484943
Pair 4	% of Time_MV_D	17.516915	16	7.4507620	1.8626905
	Avg%Time_MV_E	16.825650	16	9.5686141	2.3921535

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	16	.850	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	16	.900	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	16	.859	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	16	.794	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	30.2657287	104.0552043	26.0138011	-25.1813758	85.7128332	1.163	15	.263
Pair 2	% of Time_S_D - Avg%Time_S_E	-.8198893	6.8658536	1.7164634	-4.4784445	2.8386658	-.478	15	.640
Pair 3	% of Time_L_D - Avg%Time_L_E	-.0214301	4.4129466	1.1032366	-2.3729233	2.3300632	-.019	15	.985
Pair 4	% of Time_MV_D - Avg%Time_MV_E	.6912651	5.8165675	1.4541419	-2.4081650	3.7906951	.475	15	.641

Table E.10. PA estimates on weekdays by obesity levels.

Group Statistics

	BMI Grp_New	N	Mean	Std. Deviation	Std. Error Mean
AvgAC_D	1	16	336.429652	132.2060463	33.0515116
	2	18	339.309597	163.4771918	38.5319436
% of Time_S_D	1	16	41.883607	11.3436199	2.8359050
	2	18	42.707032	15.0552629	3.5485595
% of Time_L_D	1	16	38.704764	6.1744794	1.5436199
	2	18	36.453714	8.0330654	1.8934117
% of Time_MV_D	1	16	19.287207	6.8227778	1.7056945
	2	18	21.121229	9.0510203	2.1333459

1=normal weight group (less than 85th BMI percentile); 2=overweight group (equal or greater than 85th BMI percentile)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgAC_D	Equal variances assumed	.424	.520	-.056	32	.956	-2.8799450	51.4133297	-107.6054706	101.8455807
	Equal variances not assumed			-.057	31.743	.955	-2.8799450	50.7652745	-106.3182141	100.5583242
% of Time_S_D	Equal variances assumed	1.602	.215	-.178	32	.860	-.8234256	4.6191270	-10.2322794	8.5854282
	Equal variances not assumed			-.181	31.218	.857	-.8234256	4.5425358	-10.0853713	8.4385201
% of Time_L_D	Equal variances assumed	2.262	.142	.907	32	.371	2.2510504	2.4813051	-2.8032027	7.3053035
	Equal variances not assumed			.921	31.391	.364	2.2510504	2.4429020	-2.7287638	7.2308646
% of Time_MV_D	Equal variances assumed	1.161	.289	-.660	32	.514	-1.8340217	2.7773844	-7.4913686	3.8233251
	Equal variances not assumed			-.671	31.222	.507	-1.8340217	2.7314023	-7.4031494	3.7351059

Table E.11. PA estimates on weekends by obesity levels.

Group Statistics

	BMI Grp_New	N	Mean	Std. Deviation	Std. Error Mean
AvgA_E	1	16	335.650587	190.4936457	47.6234114
	2	18	381.052272	276.8048274	65.2435235
Avg%Time_S_E	1	16	41.425600	11.5735480	2.8933870
	2	18	42.352344	18.4265144	4.3431711
Avg%Time_L_E	1	16	38.633738	8.6965533	2.1741383
	2	18	35.666149	8.3477936	1.9675938
Avg%Time_MV_E	1	16	19.962560	8.6298047	2.1574512
	2	18	21.752766	14.1331805	3.3312226

1=normal weight group (less than 85^{th} BMI percentile); 2=overweight group (equal or greater than 85^{th} BMI percentile)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgA_E	Equal variances assumed	3.233	.082	-.550	32	.586	-45.4016848	82.5442328	-213.5387850	122.7354154
	Equal variances not assumed			-.562	30.219	.578	-45.4016848	80.7756565	-210.3174838	119.5141142
Avg%Time_S_E	Equal variances assumed	2.502	.124	-.173	32	.864	-.9267443	5.3579048	-11.8404392	9.9869506
	Equal variances not assumed			-.178	28.971	.860	-.9267443	5.2186994	-11.6006492	9.7471606
Avg%Time_L_E	Equal variances assumed	.156	.695	1.015	32	.318	2.9675888	2.9250184	-2.9904787	8.9256562
	Equal variances not assumed			1.012	31.179	.319	2.9675888	2.9322863	-3.0114601	8.9466376
Avg%Time_MV_E	Equal variances assumed	3.125	.087	-.439	32	.664	-1.7902053	4.0802915	-10.1014872	6.5210765
	Equal variances not assumed			-.451	28.558	.655	-1.7902053	3.9688335	-9.9128443	6.3324336

Table E.12. PA estimates of the normal weight group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	336.429652	16	132.2060463	33.0515116
	AvgA_E	335.650587	16	190.4936457	47.6234114
Pair 2	% of Time_S_D	41.883607	16	11.3436199	2.8359050
	Avg%Time_S_E	41.425600	16	11.5735480	2.8933870
Pair 3	% of Time_L_D	38.704764	16	6.1744794	1.5436199
	Avg%Time_L_E	38.633738	16	8.6965533	2.1741383
Pair 4	% of Time_MV_D	19.287207	16	6.8227778	1.7056945
	Avg%Time_MV_E	19.962560	16	8.6298047	2.1574512

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	16	.798	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	16	.669	.005
Pair 3	% of Time_L_D & Avg%Time_L_E	16	.629	.009
Pair 4	% of Time_MV_D & Avg%Time_MV_E	16	.665	.005

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	.7790643	116.5774065	29.1443516	-61.3406507	62.8987794	.027	15	.979
Pair 2	% of Time_S_D - Avg%Time_S_E	.4580068	9.3272300	2.3318075	-4.5121232	5.4281368	.196	15	.847
Pair 3	% of Time_L_D - Avg%Time_L_E	.0710264	6.8010600	1.7002650	-3.5530027	3.6950554	.042	15	.967
Pair 4	% of Time_MV_D - Avg%Time_MV_E	-.6753536	6.5317809	1.6329452	-4.1558940	2.8051867	-.414	15	.685

Table E.13. PA estimates of the overweight group by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	339.309597	18	163.4771918	38.5319436
	AvgA_E	381.052272	18	276.8048274	65.2435235
Pair 2	% of Time_S_D	42.707032	18	15.0552629	3.5485595
	Avg%Time_S_E	42.352344	18	18.4265144	4.3431711
Pair 3	% of Time_L_D	36.453714	18	8.0330654	1.8934117
	Avg%Time_L_E	35.666149	18	8.3477936	1.9675938
Pair 4	% of Time_MV_D	21.121229	18	9.0510203	2.1333459
	Avg%Time_MV_E	21.752766	18	14.1331805	3.3312226

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	18	.764	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	18	.900	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	18	.785	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	18	.877	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	-41.7426755	184.9798842	43.6001768	-133.7310078	50.2456568	-.957	17	.352
Pair 2	% of Time_S_D - Avg%Time_S_E	.3546881	8.1714719	1.9260344	-3.7088893	4.4182655	.184	17	.856
Pair 3	% of Time_L_D - Avg%Time_L_E	.7875647	5.3845266	1.2691451	-1.8900974	3.4652268	.621	17	.543
Pair 4	% of Time_MV_D - Avg%Time_MV_E	-.6315372	7.5624790	1.7824934	-4.3922696	3.1291951	-.354	17	.727

F. GENERALIZABILITY THEORY OUTPUT (CHAPTER 2)

Table F.1. Generalizability theory data (Day study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Participants	P	34	INF	
Days	D	4	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	233861.2	33	7086.7	1584.6	1584.6	1584.6	66.4	424.3
D	7751.0	3	2583.7	54.0	54.0	54.0	2.3	48.2
PD	74084.0	99	748.3	748.3	748.3	748.3	31.4	105.3
Total	315696.3	135					100%	

G Study Table
(Measurement design P/D)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	1584.6		.....		.....	
	.....	D	.....		13.5	6.7
	.....	PD	187.1	100.0	187.1	93.3
Sum of variances	1584.6		187.1	100%	200.6	100%
Standard deviation	39.8		Relative SE: 13.7		Absolute SE: 14.2	
Coef_G relative	0.89					
Coef_G absolute	0.89					

Grand mean for levels used: 87.6
Variance error of the mean for levels used: 65.6
Standard error of the grand mean: 8.1

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	34	INF	34	INF	34	INF	34	INF	34	INF	34	INF
D	4	INF	1	INF	2	INF	3	INF	5	INF	6	INF
Observ.		136		34		68		102		170		204
Coef_G rel.		0.9		0.7		0.8		0.9		0.9		0.9
rounded		0.89		0.68		0.81		0.86		0.91		0.93
Coef_G abs.		0.9		0.7		0.8		0.9		0.9		0.9
rounded		0.89		0.66		0.80		0.86		0.91		0.92
Rel. Err. Var.		187.1		748.3		374.2		249.4		149.7		124.7
Rel. Std. Err. of M.		13.7		27.4		19.3		15.8		12.2		11.2
Abs. Err. Var.		200.6		802.3		401.2		267.4		160.5		133.7
Abs. Std. Err. of M.		14.2		28.3		20.0		16.4		12.7		11.6

Table F.2. Generalizability theory data (Hour study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Participants	P	34	INF	
Hours	H	10	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	8485016.9	33	257121.7	21539.9	21539.9	21539.9	31.7	6155.8
H	1817271.4	9	201919.0	4711.7	4711.7	4711.7	6.9	2534.3
PH	12391509.5	297	41722.3	41722.3	41722.3	41722.3	61.4	3412.3
Total	22693797.8	339					100%	

G Study Table
(Measurement design P/H)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	21539.9		.....		.....	
	.....	H	.....		471.2	10.1
	.....	PH	4172.2	100.0	4172.2	89.9
Sum of variances	21539.9		4172.2	100%	4643.4	100%
Standard deviation	146.8		Relative SE:	64.6	Absolute SE:	68.1
Coef_G relative	0.84					
Coef_G absolute	0.82					

Grand mean for levels used: 350.2
Variance error of the mean for levels used: 1227.4
Standard error of the grand mean: 35.0

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	34	INF	34	INF	34	INF	34	INF	34	INF	34	INF
H	10	INF	1	INF	2	INF	3	INF	4	INF	5	INF
Observ.		340		34		68		102		136		170
Coef_G rel.		0.8		0.3		0.5		0.6		0.7		0.7
rounded		0.84		0.34		0.51		0.61		0.67		0.72
Coef_G abs.		0.8		0.3		0.5		0.6		0.6		0.7
rounded		0.82		0.32		0.48		0.58		0.65		0.70
Rel. Err. Var.		4172.2		41722.3		20861.1		13907.4		10430.6		8344.5
Rel. Std. Err. of M.		64.6		204.3		144.4		117.9		102.1		91.3
Abs. Err. Var.		4643.4		46433.9		23217.0		15478.0		11608.5		9286.8
Abs. Std. Err. of M.		68.1		215.5		152.4		124.4		107.7		96.4

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	34	INF	34	INF	34	INF	34	INF	34	INF	34	INF
H	10	INF	5	INF	6	INF	7	INF	8	INF	9	INF
Observ.		340		170		204		238		272		306
Coef_G rel.		0.8		0.7		0.8		0.8		0.8		0.8
rounded		0.84		0.72		0.76		0.78		0.81		0.82
Coef_G abs.		0.8		0.7		0.7		0.8		0.8		0.8
rounded		0.82		0.70		0.74		0.76		0.79		0.81
Rel. Err. Var.		4172.2		8344.5		6953.7		5960.3		5215.3		4635.8
Rel. Std. Err. of M.		64.6		91.3		83.4		77.2		72.2		68.1
Abs. Err. Var.		4643.4		9286.8		7739.0		6633.4		5804.2		5159.3
Abs. Std. Err. of M.		68.1		96.4		88.0		81.4		76.2		71.8

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	34	INF	34	INF	34	INF	34	INF	34	INF	34	INF
H	10	INF	11	INF	12	INF	13	INF	14	INF	15	INF
Observ.		340		374		408		442		476		510
Coef_G rel.		0.8		0.9		0.9		0.9		0.9		0.9
rounded		0.84		0.85		0.86		0.87		0.88		0.89
Coef_G abs.		0.8		0.8		0.8		0.9		0.9		0.9
rounded		0.82		0.84		0.85		0.86		0.87		0.87
Rel. Err. Var.		4172.2		3792.9		3476.9		3209.4		2980.2		2781.5
Rel. Std. Err. of M.		64.6		61.6		59.0		56.7		54.6		52.7
Abs. Err. Var.		4643.4		4221.3		3869.5		3571.8		3316.7		3095.6
Abs. Std. Err. of M.		68.1		65.0		62.2		59.8		57.6		55.6

G. SUPPLEMENTAL DATA (CHAPTER 3)

Table G.5. Demographic data and monitoring periods.

ID	Sex	Diag.	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
1001	1	1	10	131.6	33.8	19.5	85	6:29	21:16	14:47	7:20	21:23	14:03
1002	2	1	12	143.8	45.2	21.9	91	11:47	2:24	14:28	11:20	2:23	15:02
1003	1	1	11	129.2	32.0	19.2	78	6:16	21:26	15:10	6:18	22:03	15:45
1004	1	1	12	133.1	39.4	22.2	90	6:48	21:27	14:39	7:45	21:36	13:51
1005	2	1	18	156.8	59.1	24.0	74	6:23	22:30	16:07	7:39	22:24	14:45
1006	2	1	12	113.8	21.1	16.3	25	7:06	20:49	13:43	9:01	22:14	13:13
1007	1	1	13	145.0	60.2	28.6	97	7:41	22:59	15:18	8:24	22:34	14:10
1010	2	2	16	152.1	41.4	17.9	11	7:14	22:29	15:15	8:07	23:37	15:30
1011	2	2	13	144.1	44.7	21.5	86	7:54	21:52	13:58	9:33	23:09	13:36
1013	1	1	18	141.2	40.7	20	41	6:40	21:46	15:06	8:24	22:59	14:35
1014	1	1	14	142.8	58.2	19	86	6:55	21:48	14:53	8:20	21:52	13:32
1016	2	2	10	129.9	32.7	19	86	6:14	21:53	15:39	6:46	22:32	15:46
1017	2	1	11	123.7	47.2	31	99	6:43	21:02	14:19	8:28	23:43	15:15
1019	2	2	14	153.5	45.2	19	56	8:08	21:25	13:17	9:07	21:44	12:37
1020	2	2	10	142.0	35.5	18	68	5:49	20:06	14:17	5:35	20:31	14:56
1021	1	1	17	138.7	48.1	25	85	6:25	22:11	15:46	8:17	20:56	12:39
1023	1	1	11	123.3	29.8	20	81	6:41	22:47	16:06	7:30	23:51	16:21
1024	2	1	16	156.4	57.2	23	80	5:48	22:18	16:30	8:44	22:25	13:41
1026	2	1	11	131.4	30.4	18	60	7:34	21:46	14:12	7:28	21:32	14:04
1027	2	2	15	155.7	41.5	17	13	6:02	20:57	14:55	6:59	21:22	14:23
1028	2	2	11	136.5	30.5	16	40	7:09	21:29	14:20	7:36	21:16	13:40
1030	2	2	11	142.9	38.3	19	77	6:53	21:34	14:41	9:56	23:35	13:39
1031	2	2	15	164.1	63.5	24	85	7:13	21:24	14:11	8:34	23:31	14:57

BMI=Body Mass Index; 1=female; 2= male; 1=DS; 2=ASD; WD=weekday; WE=weekend.

ID	Sex	Diag.	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
1032	1	2	9	116.3	21.1	16	39	6:29	21:32	15:03	7:21	21:54	14:33
1033	2	2	10	141	48.1	24	98	6:06	21:07	15:01	6:49	21:35	14:46
1035	2	1	14	151	72.6	32	99	6:30	21:36	15:06	8:35	23:11	14:36
1036	2	1	17	149.9	75.6	34	99	6:25	21:37	15:12	6:26	22:32	16:06
1037	2	2	9	138.2	45.4	24	98	7:12	22:05	14:53	7:59	22:14	14:15
1038	1	1	9	123.6	45.6	30	99	6:26	21:06	14:40	6:18	21:13	14:55
1040	1	2	16	156.7	63.9	26	89	6:01	21:38	15:37	7:32	22:10	14:38
1041	1	2	10	131.1	36.4	21	91	6:20	22:34	16:14	6:37	19:50	13:13
1042	2	2	16	164.2	74.0	27.4	95	6:06	21:52	15:46	8:21	22:10	13:49
1046	2	2	18	174.5	62.3	20.5	33	7:06	22:42	15:36	7:36	21:59	14:23
1050	2	2	10	138.0	31.9	16.8	50	7:17	21:52	14:35	8:34	22:27	13:53
1051	1	2	13	147.4	42.3	19.5	62	5:58	21:28	15:30	7:53	22:17	14:24
1054	2	2	10	138.0	38.8	20.4	90	6:03	20:44	14:41	6:54	21:16	14:22
2001	1	1	10	134.5	35.5	19.6	82	6:14	21:08	14:54	8:29	21:22	12:53
2002	1	2	13	152.6	56.9	24.4	92	6:40	20:39	13:59	8:31	20:20	11:49
2003	2	2	11	137.1	30.6	16.3	30	7:31	22:58	15:27	9:30	23:46	14:16
2005	2	2	14	164.3	51.8	19.2	49	5:55	23:28	17:33	9:20	23:23	14:03
2006	2	2	12	147.8	66.7	30.5	99	7:09	22:40	15:31	8:01	22:43	14:42
2008	2	2	12	157.7	61.8	24.8	96	6:00	22:02	16:02	8:16	22:58	14:42
2010	1	1	9	114.7	21.4	16.3	49	6:51	21:34	14:43	7:47	21:00	13:13
2011	2	2	10	144.8	32.0	15.3	23	7:11	20:56	13:45	7:03	21:03	14:00
2012	2	2	10	141.7	30.1	15	15	5:32	21:17	15:45	6:57	21:20	14:23
2013	1	1	9	113.1	23.9	18.7	83	7:23	20:26	13:03	7:24	20:23	12:59

BMI=Body Mass Index; 1=female; 2= male; 1=DS; 2=ASD; WD=weekday; WE=weekend.

ID	Sex	Diag.	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
2014	1	1	12	125.0	37.5	24	94	6:15	21:38	15:23	6:49	21:13	14:24
2015	2	2	10	132.7	28.1	16	35	5:28	20:06	14:38	6:14	20:49	14:35
2017	2	2	10	129.9	31.7	18.8	83	6:11	20:15	14:04	6:30	21:10	14:40
2018	2	1	11	139.9	37.3	19.1	76	6:41	20:36	13:55	8:30	21:08	12:38
2019	1	1	13	131.9	37.8	21.7	82	6:24	21:08	14:44	6:49	22:59	16:10
2020	2	1	13	152.9	82.6	35.3	99	6:20	20:35	14:15	6:55	20:17	13:22
2021	2	1	11	125.9	26.4	16.7	38	6:10	20:29	14:19	6:48	21:03	14:15
2024	2	2	11	144.3	42.3	20.3	88	4:59	20:46	15:47	6:31	20:12	13:41
2025	1	1	12	140.1	38.5	19.6	73	6:54	21:29	14:35	7:27	22:03	14:36
2026	1	1	11	137.1	40.2	21.4	89	6:40	20:38	13:58	8:19	20:35	12:16
2027	2	2	13	165.2	90.3	33.1	99	6:01	22:21	16:20	8:19	21:57	13:38
2028	2	2	9	136.6	39.9	21.4	95	6:19	21:37	15:18	6:35	21:28	14:53
2029	2	1	12	150.3	62.1	27.5	98	6:58	22:11	15:13	6:51	22:18	15:27
2030	2	2	10	132.2	41.9	24	98	7:16	20:21	13:05	8:04	21:52	13:48
2032	2	1	17	159.8	72.6	28.4	95	6:05	22:22	16:17	11:52	23:56	12:04
2034	1	1	12	141.8	46.9	23.3	92	6:36	21:54	15:18	7:48	21:28	13:40
2036	1	1	10	124.8	24.6	15.8	37	6:59	21:58	14:59	8:29	21:40	13:11
2037	2	1	11	137.2	37.3	19.8	83	6:31	21:20	14:49	8:27	21:38	13:11
2038	2	1	10	131.1	26.7	15.5	25	6:25	20:51	14:26	6:46	20:55	14:09
2039	2	2	9	128.8	21.2	12.8	0	7:32	22:06	14:34	8:02	20:02	12:00
2040	2	2	15	176.2	92.9	29.9	98	6:16	23:13	16:57	7:45	22:58	15:13
2042	1	2	12	160.1	47.3	18.5	58	6:36	21:17	14:41	9:11	21:41	12:30
2045	2	2	12	145.9	46.7	21.9	91	6:44	21:39	14:55	6:37	21:46	15:09

BMI=Body Mass Index; 1=female; 2= male; 1=DS; 2=ASD; WD=weekday; WE=weekend.

ID	Sex	Diag.	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
2046	1	2	13	154.8	49.0	20.4	70	6:54	22:14	15:20	7:16	21:36	14:20
2048	1	1	12	129.5	37.3	22.2	89	7:42	21:55	14:13	8:20	21:54	13:34
2052	1	2	9	130.7	30.7	18	73	8:26	22:05	13:39	9:19	21:55	12:36
2056	2	2	14	160.7	65.6	25.4	94	6:47	22:15	15:28	7:55	22:09	14:14
2058	2	1	11	136.0	34.6	18.7	71	6:10	22:39	16:29	5:59	20:42	14:43
2063	1	2	15	164.7	49.3	18.2	22	6:54	20:58	14:04	9:09	20:52	11:43
2064	1	2	19	163.4	69.6	26.1	85	7:26	22:54	15:28	8:30	23:26	14:56
2065	2	2	16	172.5	55.6	18.7	26	6:19	21:30	15:11	8:18	21:39	13:21
3003	2	2	10	150.1	64.4	28.6	99	6:46	22:07	15:21	6:36	23:04	16:28
3007	2	2	15	163.7	58.5	21.8	79	6:56	22:19	15:23	8:28	23:34	15:06
3008	2	2	11	145.2	35.9	17	53	6:25	21:26	15:01	7:24	21:51	14:27
3010	1	2	11	134.5	27.1	15	13	7:36	22:05	14:29	7:32	22:40	15:08
3013	1	1	10	125.0	28.4	18.2	73	6:25	20:59	14:34	7:14	21:31	14:17
3015	2	1	16	163.8	77.2	28.8	97	5:58	20:52	14:54	7:15	20:17	13:02
3016	1	1	19	140.1	77.4	39.4	99	6:10	21:18	15:08	6:21	21:36	15:15
3021	2	1	17	154.9	47.0	19.6	29	6:31	21:50	15:19	8:18	21:37	13:19
3022	1	2	14	167.9	61.4	21.8	76	5:28	20:44	15:16	7:01	19:49	12:48
3023	1	1	14	141.2	40.7	20.4	63	6:08	20:53	14:45	7:20	20:57	13:37
3025	1	2	15	153.4	59.2	25.2	91	5:56	21:59	16:03	8:14	22:46	14:32
3028	2	2	15	171.1	57.5	19.6	48	6:00	21:53	15:53	6:53	20:14	13:21
3029	2	2	11	178.6	101.6	31.9	99	6:34	22:10	15:36	7:47	22:44	14:57
3030	2	1	15	156.1	66.9	27.5	96	5:46	22:11	16:25	8:15	22:24	14:09
3031	2	1	11	138.5	32.6	17	50	7:00	21:17	14:17	6:34	21:25	14:51

BMI=Body Mass Index; 1=female; 2= male; 1=DS; 2=ASD; WD=weekday; WE=weekend.

ID	Sex	Diag.	Age	Height (cm)	Weight (kg)	BMI	BMI %tile	Avg. Start_WD	Avg. End_WD	Monitor Time_WD	Avg. Start_WE	Avg. End_WE	Monitor Time_WE
3039	2	2	13	150.5	38.3	16.9	28	7:14	22:02	14:48	8:59	21:37	12:38
3040	2	2	14	163.0	53.4	20.1	70	6:44	22:59	16:15	7:43	22:49	15:06
3042	2	2	11	141.1	32.0	16.1	27	7:52	23:19	15:27	9:28	22:40	13:12
3044	2	2	11	151.1	61.4	26.9	98	6:51	21:49	14:58	7:43	20:08	12:25
3045	2	2	16	151.1	43.5	19.1	30	5:57	23:30	17:33	12:01	23:43	11:42
3048	2	2	13	156.1	70.0	28.7	98	4:52	21:53	17:01	6:45	21:11	14:26
3050	2	2	16	184.9	121.3	35.5	99	6:35	23:02	16:27	7:17	21:35	14:18
3051	2	2	9	143.0	35.1	17.2	68	6:40	21:38	14:58	8:10	21:52	13:42
3054	2	1	10	128.2	30.3	18.4	80	7:12	21:37	14:25	6:59	22:26	15:27
3063	2	2	10	133.9	29.0	16.2	47	7:33	22:14	14:41	8:23	22:20	13:57
3066	2	2	12	159.6	41.2	16.2	25	6:49	20:58	14:09	6:50	21:08	14:18
3074	2	2	11	138.0	31.2	16.4	41	7:09	21:57	14:48	7:43	21:57	14:14
3076	2	2	10	144.6	37.1	17.7	69	7:35	20:44	13:09	8:19	21:36	13:17
3077	2	2	17	173.9	52.7	17.4	4	6:28	22:15	15:47	7:43	21:40	13:57
3081	2	2	11	147.5	36.9	17	51	6:13	21:55	15:42	6:22	21:24	15:02

BMI=Body Mass Index; 1=female; 2= male; 1=DS; 2=ASD; WD=weekday; WE=weekend.

Table G.6. Physical activity estimates (counts/min).

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	% of Time_Sed_WD	% of Time_Lig_WD	% of Time_MV_WD	% of Time_Sed_WE	% of Time_Lig_WE	% of Time_MV_WE
1001	345	341	367	176	34	46	20	31	46	23
1002	340	360	291	181	52	27	21	55	26	19
1003	641	665	583	284	24	45	31	28	41	31
1004	705	772	528	318	35	29	36	36	31	33
1005	189	228	125	110	58	30	11	55	38	7
1006	301	343	126	155	49	33	19	65	29	7
1007	660	600	820	220	37	39	24	40	30	30
1010	374	396	332	272	29	42	30	35	40	25
1011	224	226	221	105	38	50	13	41	47	12
1013	283	303	243	144	58	26	16	56	30	15
1014	391	431	279	174	54	26	19	66	21	12
1016	1064	1114	963	410	11	46	44	27	31	42
1017	311	344	250	133	51	34	15	40	43	17
1019	553	620	410	193	32	44	24	44	38	18
1020	616	580	704	293	23	43	34	13	43	44
1021	276	300	216	150	42	42	16	46	45	10
1023	626	611	685	273	33	39	28	21	41	38
1024	418	433	393	190	44	37	19	40	40	20
1026	557	511	672	211	33	41	25	26	38	37
1027	436	492	205	226	44	31	25	55	32	13
1028	334	341	319	171	42	38	20	49	32	19
1030	393	449	271	194	43	35	22	51	32	16
1031	376	389	353	196	49	28	23	54	21	25

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	% of Time_Sed_WD	% of Time_Lig_WD	% of Time_MV_WD	% of Time_Sed_WE	% of Time_Lig_WE	% of Time_MV_WE
1032	530	567	453	282	18	50	31	23	48	29
1033	540	595	427	294	23	44	33	39	34	27
1035	952	987	879	340	33	30	38	22	35	43
1036	480	474	507	208	38	39	23	33	40	27
1037	527	477	659	246	25	47	28	25	36	39
1038	366	350	406	168	21	60	19	23	52	25
1040	289	278	320	119	61	26	13	49	36	15
1041	501	492	523	236	38	38	24	30	41	29
1042	470	451	359	231	41	35	24	39	39	22
1046	547	580	455	231	46	29	25	46	32	22
1050	670	682	617	275	29	39	31	34	36	30
1051	352	419	171	169	49	33	18	62	28	10
1054	351	300	613	155	52	31	18	37	29	35
2001	348	370	281	165	46	35	18	48	39	13
2002	431	487	266	219	36	38	26	38	44	18
2003	619	667	413	273	35	36	29	49	29	21
2005	575	624	268	251	41	35	24	53	31	16
2006	414	447	326	193	37	42	21	34	45	21
2008	727	791	554	305	30	38	32	34	36	30
2010	487	515	329	263	20	50	30	27	53	20
2011	523	623	327	240	31	40	29	52	32	16
2012	408	454	284	250	44	30	26	51	27	22
2013	624	622	628	270	18	48	34	18	44	38

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	% of Time_Sed_WD	% of Time_Lig_WD	% of Time_MV_WD	% of Time_Sed_WE	% of Time_Lig_WE	% of Time_MV_WE
2014	320	345	192	158	35	48	17	49	40	11
2015	680	684	673	309	18	47	35	20	43	37
2017	546	604	405	264	19	50	31	20	57	23
2018	490	548	329	213	35	40	26	43	35	22
2019	509	543	359	248	18	54	28	16	64	21
2020	305	349	116	151	50	32	18	58	35	7
2021	475	495	425	220	47	27	26	48	30	21
2024	510	497	549	242	35	40	26	19	51	30
2025	522	572	431	198	47	30	23	48	31	21
2026	523	549	373	203	34	42	24	43	38	18
2027	367	368	363	169	46	37	17	45	35	20
2028	891	730	1219	322	22	43	35	17	32	52
2029	397	405	358	196	35	44	21	48	34	18
2030	600	563	672	209	24	49	27	29	36	35
2032	479	483	453	258	35	39	26	23	47	30
2034	530	541	470	232	42	32	25	42	32	26
2036	467	509	347	199	33	45	22	40	43	17
2037	639	645	619	291	19	48	33	24	42	34
2038	364	388	304	188	37	41	22	42	40	18
2039	1410	1405	1424	500	12	31	57	18	24	58
2040	352	407	197	189	54	28	19	60	27	13
2042	265	307	167	124	61	25	14	73	18	10
2045	340	380	242	165	42	39	18	42	44	14

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	% of Time_Sed_WD	% of Time_Lig_WD	% of Time_MV_WD	% of Time_Sed_WE	% of Time_Lig_WE	% of Time_MV_WE
2046	297	331	114	161	54	29	17	60	34	7
2048	426	486	269	196	30	47	23	44	40	16
2052	668	632	872	229	26	47	27	30	40	30
2056	385	414	322	201	37	42	22	42	40	19
2058	508	482	588	186	37	43	20	21	47	32
2063	473	458	565	194	42	35	23	43	31	26
2064	312	346	242	175	58	23	19	59	24	16
2065	421	490	264	212	40	37	23	54	32	14
3003	323	285	463	157	38	45	17	24	43	32
3007	437	483	275	226	40	35	24	47	35	18
3008	730	763	645	351	19	42	39	18	45	37
3010	491	524	410	247	22	50	28	35	42	23
3013	512	478	597	233	26	47	27	33	37	30
3015	331	433	99	175	43	37	20	62	33	5
3016	243	253	218	136	33	52	15	43	46	10
3021	370	435	219	195	24	54	21	35	53	12
3022	313	277	397	135	51	34	15	42	35	24
3023	455	497	363	211	28	48	24	29	46	25
3025	222	238	179	134	41	45	14	49	40	11
3028	389	376	428	190	39	41	20	35	39	27
3029	300	339	198	184	49	31	20	61	27	12
3030	287	319	212	168	51	32	17	63	25	12
3031	649	689	553	237	32	41	28	36	38	26

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

ID	AC_Tot	AC_WD	AC_WE	Time_MVPA	% of Time_Sed_WD	% of Time_Lig_WD	% of Time_MV_WD	% of Time_Sed_WE	% of Time_Lig_WE	% of Time_MV_WE
3039	843	845	837	311	28	36	35	25	32	43
3040	335	367	250	162	40	44	17	38	49	13
3042	762	703	932	252	37	36	27	33	29	38
3044	848	896	615	318	31	33	35	42	28	30
3045	255	214	409	122	58	30	12	25	49	27
3048	424	438	341	275	36	37	27	49	32	19
3050	366	389	298	203	40	40	21	43	41	16
3051	597	595	603	240	25	48	27	33	40	26
3054	581	598	497	260	26	44	30	22	47	31
3063	516	524	493	256	30	41	29	38	32	30
3066	415	471	280	187	51	27	22	59	27	14
3074	574	678	304	280	28	40	32	49	35	17
3076	643	726	397	249	33	35	32	34	44	22
3077	370	467	96	122	59	28	13	72	22	6
3081	620	643	524	342	15	49	36	24	45	30

AC=activity count; Tot=total; WD=weekday; WE=weekend; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; Lig=light.

H. STATISTICAL OUTPUT (CHAPTER 3)

Table H.1. PA estimates on weekdays by diagnosis.

Group Statistics

	Disability	N	Mean	Std. Deviation	Std. Error Mean
AvgAC_D	1	43	479.180403	146.7921909	22.3855993
	2	64	521.788123	206.7326030	25.8415754
% of Time_S_D	1	43	36.676301	10.8310889	1.6517256
	2	64	36.651383	12.3801798	1.5475225
% of Time_L_D	1	43	40.067521	8.4090215	1.2823638
	2	64	38.070459	7.0893096	.8861637
% of Time_MV_D	1	43	23.217417	5.9203833	.9028500
	2	64	25.278847	8.2057273	1.0257159

1=DS; 2=ASD

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgAC_D	Equal variances assumed	2.917	.091	-1.167	105	.246	-42.6077202	36.4985238	-114.9775507	29.7621103
	Equal variances not assumed			-1.246	104.641	.215	-42.6077202	34.1892099	-110.4013209	25.1858804
% of Time_S_D	Equal variances assumed	.786	.377	.011	105	.991	.0249182	2.3237927	-4.5827335	4.6325699
	Equal variances not assumed			.011	97.839	.991	.0249182	2.2634096	-4.4668370	4.5166733
% of Time_L_D	Equal variances assumed	1.377	.243	1.325	105	.188	1.9970619	1.5073755	-.9917852	4.9859091
	Equal variances not assumed			1.281	79.591	.204	1.9970619	1.5587633	-1.1052207	5.0993445
% of Time_MV_D	Equal variances assumed	2.901	.091	-1.417	105	.159	-2.0614305	1.4546213	-4.9456759	.8228148
	Equal variances not assumed			-1.509	104.419	.134	-2.0614305	1.3664667	-4.7710574	.6481963

Table H.2. PA estimates on weekends by diagnosis.

Group Statistics

	Disability	N	Mean	Std. Deviation	Std. Error Mean
AvgA_E	1	43	395.335552	187.1575966	28.5412659
	2	64	444.933145	252.1832828	31.5229104
Avg%Time_S_E	1	43	39.266747	13.7067520	2.0902601
	2	64	40.166575	13.8820646	1.7352581
Avg%Time_L_E	1	43	39.208342	8.4246201	1.2847425
	2	64	35.844615	7.8835079	.9854385
Avg%Time_MV_E	1	43	21.557628	9.6706090	1.4747540
	2	64	24.018588	10.6957659	1.3369707

1=DS; 2=ASD

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AvgA_E	Equal variances assumed	1.513	.221	-1.101	105	.273	-49.5975932	45.0374777	- 138.8985920	39.7034055
	Equal variances not assumed			-1.166	103.897	.246	-49.5975932	42.5240842	- 133.9254337	34.7302472
Avg%Time_S_E	Equal variances assumed	.001	.975	-.330	105	.742	-.8998276	2.7235211	-6.3000668	4.5004116
	Equal variances not assumed			-.331	91.019	.741	-.8998276	2.7166722	-6.2961483	4.4964931
Avg%Time_L_E	Equal variances assumed	.009	.927	2.105	105	.038	3.3637270	1.5980215	.1951455	6.5323084
	Equal variances not assumed			2.077	86.092	.041	3.3637270	1.6191517	.1450088	6.5824452
Avg%Time_MV_E	Equal variances assumed	.187	.667	-1.212	105	.228	-2.4609607	2.0305736	-6.4872131	1.5652918
	Equal variances not assumed			-1.236	96.122	.219	-2.4609607	1.9905754	-6.4121576	1.4902362

Table H.3. PA estimates of participants with DS by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	479.180403	43	146.7921909	22.3855993
	AvgA_E	395.335552	43	187.1575966	28.5412659
Pair 2	% of Time_S_D	36.676301	43	10.8310889	1.6517256
	Avg%Time_S_E	39.266747	43	13.7067520	2.0902601
Pair 3	% of Time_L_D	40.067521	43	8.4090215	1.2823638
	Avg%Time_L_E	39.208342	43	8.4246201	1.2847425
Pair 4	% of Time_MV_D	23.217417	43	5.9203833	.9028500
	Avg%Time_MV_E	21.557628	43	9.6706090	1.4747540

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	43	.788	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	43	.799	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	43	.803	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	43	.798	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	83.8448505	115.1616807	17.5619917	48.4033165	119.2863845	4.774	42	.000
Pair 2	% of Time_S_D - Avg%Time_S_E	-2.5904461	8.2432900	1.2570899	-5.1273562	-.0535359	-2.061	42	.046
Pair 3	% of Time_L_D - Avg%Time_L_E	.8591794	5.2846089	.8058953	-.7671831	2.4855420	1.066	42	.292
Pair 4	% of Time_MV_D - Avg%Time_MV_E	1.6597889	6.0981185	.9299544	-.2169349	3.5365128	1.785	42	.082

Table H.4. PA estimates of participants with ASD by day types.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AvgAC_D	521.788123	64	206.7326030	25.8415754
	AvgA_E	444.933145	64	252.1832828	31.5229104
Pair 2	% of Time_S_D	36.651383	64	12.3801798	1.5475225
	Avg%Time_S_E	40.166575	64	13.8820646	1.7352581
Pair 3	% of Time_L_D	38.070459	64	7.0893096	.8861637
	Avg%Time_L_E	35.844615	64	7.8835079	.9854385
Pair 4	% of Time_MV_D	25.278847	64	8.2057273	1.0257159
	Avg%Time_MV_E	24.018588	64	10.6957659	1.3369707

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	AvgAC_D & AvgA_E	64	.737	.000
Pair 2	% of Time_S_D & Avg%Time_S_E	64	.749	.000
Pair 3	% of Time_L_D & Avg%Time_L_E	64	.689	.000
Pair 4	% of Time_MV_D & Avg%Time_MV_E	64	.725	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AvgAC_D - AvgA_E	76.8549775	171.7873083	21.4734135	33.9437846	119.7661703	3.579	63	.001
Pair 2	% of Time_S_D - Avg%Time_S_E	-3.5151918	9.4176639	1.1772080	-5.8676542	-1.1627293	-2.986	63	.004
Pair 3	% of Time_L_D - Avg%Time_L_E	2.2258445	5.9507551	.7438444	.7393901	3.7122989	2.992	63	.004
Pair 4	% of Time_MV_D - Avg%Time_MV_E	1.2602588	7.3836591	.9229574	-.5841244	3.1046419	1.365	63	.177

I. GENERALIZABILITY THEORY OUTPUT (CHAPTER 3)

Table I.1. Generalizability theory data for participants with DS (Day study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Participants	P	43	INF	
Days	D	4	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	252640.9	42	6015.3	1290.5	1290.5	1290.5	58.6	321.7
D	10292.6	3	3430.9	59.9	59.9	59.9	2.7	50.5
PD	107534.2	126	853.4	853.4	853.4	853.4	38.7	106.7
Total	370467.7	171					100%	

G-Study Table
(Measurement design P/D)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	1290.5		.....		.....	
	.....	D	.....		15.0	6.6
	.....	PD	213.4	100.0	213.4	93.4
Sum of variances	1290.5		213.4	100%	228.3	100%
Standard deviation	35.9		Relative SE: 14.6		Absolute SE: 15.1	
Coef_G relative	0.86					
Coef_G absolute	0.85					

Grand mean for levels used: 113.9
Variance error of the mean for levels used: 50.0
Standard error of the grand mean: 7.1

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	43	INF	43	INF	43	INF	43	INF	43	INF	43	INF
D	4	INF	1	INF	2	INF	3	INF	4	INF	5	INF
Observ.		172		43		86		129		172		258
Coef_G rel.		0.9		0.6		0.8		0.8		0.9		0.9
rounded		0.86		0.60		0.75		0.82		0.86		0.90
Coef_G abs.		0.8		0.6		0.7		0.8		0.8		0.9
rounded		0.85		0.59		0.74		0.81		0.85		0.89
Rel. Err. Var.		213.4		853.4		426.7		284.5		213.4		142.2
Rel. Std. Err. of M.		14.6		29.2		20.7		16.9		14.6		11.9
Abs. Err. Var.		228.3		913.4		456.7		304.5		228.3		152.2
Abs. Std. Err. of M.		15.1		30.2		21.4		17.4		15.1		12.3

Table I.2. Generalizability theory data for participants with DS (Hour study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
p	P	43	INF	
h	H	10	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	9597509.3	42	228512.1	17730.1	17730.1	17730.1	24.4	4886.0
H	1877951.6	9	208661.3	3661.6	3661.6	3661.6	5.0	2071.0
PH	19357838.6	378	51211.2	51211.2	51211.2	51211.2	70.5	3715.3
Total	30833299.5	429					100%	

G Study Table
(Measurement design P/H)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	17730.1		.....		.....	
	.....	H	.....		366.2	6.7
	.....	PH	5121.1	100.0	5121.1	93.3
Sum of variances	17730.1		5121.1	100%	5487.3	100%
Standard deviation	133.2		Relative SE: 71.6		Absolute SE: 74.1	
Coef_G relative	0.78					
Coef_G absolute	0.76					

Grand mean for levels used: 505.3
Variance error of the mean for levels used: 897.6
Standard error of the grand mean: 30.0

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	43	INF	43	INF	43	INF	43	INF	43	INF	43	INF
H	10	INF	3	INF	4	INF	5	INF	6	INF	7	INF
Observ.		430		129		172		215		258		301
Coef_G rel.		0.8		0.5		0.6		0.6		0.7		0.7
rounded		0.78		0.51		0.58		0.63		0.68		0.71
Coef_G abs.		0.8		0.5		0.6		0.6		0.7		0.7
rounded		0.76		0.49		0.56		0.62		0.66		0.69
Rel. Err. Var.		5121.1		17070.4		12802.8		10242.2		8535.2		7315.9
Rel. Std. Err. of M.		71.6		130.7		113.1		101.2		92.4		85.5
Abs. Err. Var.		5487.3		18290.9		13718.2		10974.6		9145.5		7839.0
Abs. Std. Err. of M.		74.1		135.2		117.1		104.8		95.6		88.5

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	43	INF	43	INF	43	INF	43	INF	43	INF	43	INF
H	10	INF	8	INF	9	INF	10	INF	11	INF	12	INF
Observ.		430		344		387		430		473		516
Coef_G rel.		0.8		0.7		0.8		0.8		0.8		0.8
rounded		0.78		0.73		0.76		0.78		0.79		0.81
Coef_G abs.		0.8		0.7		0.7		0.8		0.8		0.8
rounded		0.76		0.72		0.74		0.76		0.78		0.79
Rel. Err. Var.		5121.1		6401.4		5690.1		5121.1		4655.6		4267.6
Rel. Std. Err. of M.		71.6		80.0		75.4		71.6		68.2		65.3
Abs. Err. Var.		5487.3		6859.1		6097.0		5487.3		4988.4		4572.7
Abs. Std. Err. of M.		74.1		82.8		78.1		74.1		70.6		67.6

Table I.3. Generalizability theory data for participants with ASD (Day study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
p	P	64	INF	
d	D	4	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	635541.9	63	10088.0	2220.1	2220.1	2220.1	63.5	443.5
D	16860.2	3	5620.1	68.9	68.9	68.9	2.0	55.6
PD	228237.8	189	1207.6	1207.6	1207.6	1207.6	34.5	123.6
Total	880639.9	255					100%	

G Study Table
(Measurement design P/D)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	2220.1		.....		.....	
	.....	D	.....		17.2	5.4
	.....	PD	301.9	100.0	301.9	94.6
Sum of variances	2220.1		301.9	100%	319.1	100%
Standard deviation	47.1		Relative SE: 17.4		Absolute SE: 17.9	
Coef_G relative	0.88					
Coef_G absolute	0.87					

Grand mean for levels used: 123.0
Variance error of the mean for levels used: 56.6
Standard error of the grand mean: 7.5

D-Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	64	INF	64	INF	64	INF	64	INF	64	INF	64	INF
D	4	INF	1	INF	2	INF	3	INF	4	INF	5	INF
Observ.		256		64		128		192		256		320
Coef_G rel.		0.9		0.6		0.8		0.8		0.9		0.9
rounded		0.88		0.65		0.79		0.85		0.88		0.90
Coef_G abs.		0.9		0.6		0.8		0.8		0.9		0.9
rounded		0.87		0.63		0.78		0.84		0.87		0.90
Rel. Err. Var.		301.9		1207.6		603.8		402.5		301.9		241.5
Rel. Std. Err. of M.		17.4		34.8		24.6		20.1		17.4		15.5
Abs. Err. Var.		319.1		1276.6		638.3		425.5		319.1		255.3
Abs. Std. Err. of M.		17.9		35.7		25.3		20.6		17.9		16.0

Table I.4. Generalizability theory data for participants with ASD (Hour study).

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
p	P	64	INF	
h	H	10	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	23239549.8	63	368881.7	31000.0	31000.0	31000.0	33.4	6480.0
H	2259889.3	9	251098.8	3003.4	3003.4	3003.4	3.2	1673.8
PH	33385806.9	567	58881.5	58881.5	58881.5	58881.5	63.4	3490.9
Total	58885246.0	639					100%	

G Study Table
(Measurement design P/H)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	31000.0		.....		.....	
	.....	H	.....		300.3	4.9
	.....	PH	5888.1	100.0	5888.1	95.1
Sum of variances	31000.0		5888.1	100%	6188.5	100%
Standard deviation	176.1		Relative SE: 76.7		Absolute SE: 78.7	
Coef_G relative	0.84					
Coef_G absolute	0.83					

Grand mean for levels used: 548.8
Variance error of the mean for levels used: 876.7
Standard error of the grand mean: 29.6

D Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	64	INF	64	INF	64	INF	64	INF	64	INF	64	INF
H	10	INF	1	INF	2	INF	3	INF	4	INF	5	INF
Observ.		640		64		128		192		256		320
Coef_G rel.		0.8		0.3		0.5		0.6		0.7		0.7
rounded		0.84		0.34		0.51		0.61		0.68		0.72
Coef_G abs.		0.8		0.3		0.5		0.6		0.7		0.7
rounded		0.83		0.33		0.50		0.60		0.67		0.71
Rel. Err. Var.		5888.1		58881.5		29440.7		19627.2		14720.4		11776.3
Rel. Std. Err. of M.		76.7		242.7		171.6		140.1		121.3		108.5
Abs. Err. Var.		6188.5		61884.9		30942.4		20628.3		15471.2		12377.0
Abs. Std. Err. of M.		78.7		248.8		175.9		143.6		124.4		111.3

D Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	64	INF	64	INF	64	INF	64	INF	64	INF	64	INF
H	10	INF	6	INF	7	INF	8	INF	9	INF	10	INF
Observ.		640		384		448		512		576		640
Coef_G rel.		0.8		0.8		0.8		0.8		0.8		0.8
rounded		0.84		0.76		0.79		0.81		0.83		0.84
Coef_G abs.		0.8		0.8		0.8		0.8		0.8		0.8
rounded		0.83		0.75		0.78		0.80		0.82		0.83
Rel. Err. Var.		5888.1		9813.6		8411.6		7360.2		6542.4		5888.1
Rel. Std. Err. of M.		76.7		99.1		91.7		85.8		80.9		76.7
Abs. Err. Var.		6188.5		10314.1		8840.7		7735.6		6876.1		6188.5
Abs. Std. Err. of M.		78.7		101.6		94.0		88.0		82.9		78.7

D Study Table
(Optimization)

	G-study		Option 1		Option 2		Option 3		Option 4		Option 5	
	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.	Lev.	Univ.
P	64	INF	64	INF	64	INF	64	INF	64	INF	64	INF
H	10	INF	11	INF	12	INF	13	INF	14	INF	15	INF
Observ.		640		704		768		832		896		960
Coef_G rel.		0.8		0.9		0.9		0.9		0.9		0.9
rounded		0.84		0.85		0.86		0.87		0.88		0.89
Coef_G abs.		0.8		0.8		0.9		0.9		0.9		0.9
rounded		0.83		0.85		0.86		0.87		0.88		0.88
Rel. Err. Var.		5888.1		5352.9		4906.8		4529.3		4205.8		3925.4
Rel. Std. Err. of M.		76.7		73.2		70.0		67.3		64.9		62.7
Abs. Err. Var.		6188.5		5625.9		5157.1		4760.4		4420.3		4125.7
Abs. Std. Err. of M.		78.7		75.0		71.8		69.0		66.5		64.2