# PHYSICAL ACTIVITY AND SPECIAL OLYMPICS PARTICIPATION IN INDVIDUALS WITH DOWN SYNDROME

by

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INDIVIDUALS WITH DOWN SYNDROME

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# INTRODUCTION

Down syndrome (DS) is a genetic disorder involving a third chromosome 21, resulting in 47 instead of 46 chromosomes. It occurs every one in 1000 births and is the single most common cause of birth defects. There are three different types of Down syndrome. Mosaicism occurs when chromosome 21 separates after fertilization, so some cells have 46 and some have 47 chromosomes. Translocation is when half of chromosome 21 breaks off and attaches to a different chromosome. Trisomy 21, however, is the most frequent and publicized. Trisomy 21 is present when there is a third copy of chromosome 21. Ninety percent of Down syndrome cases are a result of an additional maternal chromosome during meiosis (Sommer & Henrique-Silva, 2007). With over 400,000 individuals with Down syndrome in the United States, it is prevalent in all races and socioeconomic statuses. Individuals with Down syndrome face a variety of medical conditions, but with medical technology advancement the life expectancy has risen to 60 years. Additionally, the total number of pregnancies resulting in Down syndrome is increasing from the larger proportion of older mothers (>35 years), rising from 6% to 15% (Irving et al., 2008).

Due to the excess of genetic material there can be an overexpression of certain traits, leading to many health related problems. With over 300 genes mapped on chromosome 21, affected individuals can see a variety of different phenotypes or traits ranging from mild to profound impairments such as intellectual disability, brachycephaly, and hypotonia (Roizen & Patterson, 2003). A flattened head characterizes brachycephaly and hypotonia as lack of tone in the skeletal muscle. Some common physical traits seen in these individuals are small stature with the average height for men being 5 feet 1inch

and women 4 feet 9 inches, upward slanted eyes, bowed legs, and low muscle tone (Sommer & Henrique-Silva, 2007). People with Down syndrome will experience mild to moderate cognitive delays, and individuals can live normal lives and contribute to society. Doctors and primary caregivers must monitor and prevent a variety of diseases throughout the individual's life such as cancers, early onset Alzheimer's, arthritis, thyroid disease and diabetes mellitus (Roizen & Patterson, 2003). Avoidance of obesity and maintenance of body weight prevent many chronic diseases such as, diabetes and heart disease.

Obesity prevention is critical for individuals with Down syndrome due to a lower than normal resting metabolic rate, negatively affecting mortality and morbidity (Balic et al. 2000). The World Health Organization classifies obesity through body mass index (BMI), which is measured as weight in kilograms divided by height in meters squared. A BMI above 25 indicates overweight individuals and over 30 denotes obesity. As the number of obese individuals continues to escalate, the risks for diseases increases, especially for coronary heart disease and Type 2 diabetes mellitus. Obesity is currently the second preventive cause of death among American adults behind cigarette smoking and will quickly become number one in the coming years, becoming a major epidemic in the non-intellectual disability and intellectual disability populations. With one-third of the US adults obese, it is a large cause of medical costs according to the Center of Disease Control (Roizen & Patterson, 2003). The prevalence of overweight and obesity in individuals with DS is between 10% and 26% higher than the general population (Melville et al, 2005). Specifically there is a gender difference, with a greater risk in women than men. Some obesity reports are as high as 75% in women with intellectual

disabilities (Rimmer, Braddock, & Fujiura, 1993). Additionally, the prevalence of obesity in DS individuals increases in the elderly populations (Melville et al, 2005).

Due to the high obesity prevalence, the risk of a variety of other diseases increases, such as hypothyroidism and diabetes mellitus (Roizen & Patterson, 2003). Encouraging the consumption a nutrient-rich diet and participating in regular physical activity each day aides in preventing these diseases from occurring. The CDC recommends 150 minutes of moderate intensity or 75 minutes of vigorous intensity exercise per week for the average adult. There are no specific regulations for physical activity for individuals with Down syndrome, but they recommended consulting a physician prior to physical activity. Overall, physical activity should engage and interest the individual for daily activity. A sedentary lifestyle can raise certain health risks where utilizing physical activity to reduce inactivity can allow for gains in longevity and prevention of disease (World Health Organization (WHO), 2013). This increases the importance in physical activity throughout one's lifestyle; individuals with Down syndrome must prioritize physical activity because of their higher risk of obesity.

Physical activity can involve certain risks for people with DS. Atlantoaxial instability can have an effect on physical activity since it results from a lack of stability in the ligaments of the first and second vertebrae. The atlas of the spine may impinge on the spinal cord, resulting in possible nerve damage. This occurs in a lower proportion of the Down syndrome population and is treated through surgery (National Down Syndrome Society (NDSS), 2013). Although it is recommended for individuals with Down syndrome to participate in regular physical activity, approximately 50% of the Down syndrome population does not meet the recommended guidelines of 150 minutes of

activity per week, similar to the non-intellectual disability population. The most common excuses of not engaging in physical activity include lack of time and facilities. This low activity adherence is similar in the non-intellectual disability population as well.

There are numerous determinants and hindrances of physical activity in the general population. Individuals typically exercise to lower risk of chronic disease, weight control, reduce stress and depression, and usual notable exercise excuses are lack of time, energy, and motivation (Berger et. al, 2007). Exercise participation and adherence studies are common in the general population, but research lacks concerning individuals with Down syndrome. Heller, Hsieh, and Rimmer (2010) investigated the barriers and supports for exercise participation among adults with Down syndrome. They noted the most common determinants of inactivity being lack of energy, difficulty, boredom, health concerns, and laziness. Additionally, there was a significant barrier of inability to access fitness facilities, costliness of facilities, and a lack of knowledge on how to use equipment. In order to get individuals with DS participating in increased physical activity, more education and training for community fitness centers and families is needed. Heller, Hsieh, and Rimmer (2010) stated a potential motivator for exercise adherence in this population is the opportunity for experiences that are fun, enjoyable, and offer social opportunities along with social support from peers and care givers.

Sport and exercise participation is an option recommended to get all individuals, both with and without intellectual disabilities, from being sedentary. The use of early intervention programs (EIP) in both Down syndrome and normal children gets individuals active and social. From previous studies, children who participate in EIP had higher scores on adaptive functioning, the degree of how well one handles life's

demands, a common measurement of intellectual disability (Connolly et al. 1993). Additionally, Fromel, Pelclova, & Skalik, et al (2011) observed physical activity levels in adolescent girls. Using accelerometers, activity logs, and questionnaires, the girls accumulated data for seven days during their waking hours. Organized physical activity consisted of physical education classes in school and any other exercise or training lessons under a supervision of a teacher or coach. Their results found that those who participated in organized physical activity more than three times a week had the highest values of steps per day, moderate and vigorous physical activity, and leisure time physical activity on both week and weekend days. Although weekdays had a higher number of steps than weekend days, the importance of organized exercise participation was still apparent with girls participating in more leisure time physical activity. A study done by Flohr, Todd, and Tudor-Locke (2006) investigated physical activity levels in adolescents using a pedometer. They evaluated the steps per day on weekdays and weekend days and found that those who participated in an after school activity/sport had significantly higher steps on both week and weekend days. The after school activities were typical individual and team sports, such as cross-country, soccer, and volleyball. From these two studies, those who participate in organized physical activity tend to be more active throughout each day.

Special Olympics (SO) is an international program specifically designed for individuals with intellectual disabilities to participate and compete in sport activities, another form of an EIP or organized physical activity. Founded by Eunice Kennedy Shriver in 1968, SO offers 26 Olympic-type sports to over 2 million athletes in over 160 countries, making it the largest sports program for people with intellectual disabilities.

Athletes compete with individuals of similar abilities by providing an enjoyable experience and challenging athletes (Roswal & Damentko, 2006). Research has shown that SO improves physical fitness and motor skills, enhances self-esteem, and promotes greater self-confidence (Roswal & Damentko, 2006 & Balic et al. 2000). Athletes will carry these improvements in home life and career goals. Special Olympic athletes are provided an important source of friendship with many reporting friends inside and outside of Special Olympics. Though Special Olympics aides in many aspects of an athlete's life, research is lacking in the amount of physical activity occurring outside of the competition arena.

Long-term physical activity programs can improve the fitness level of individuals with Down syndrome (Balic, Mateos, Blasco, Fernhall, 2000). Body composition assessment, isometric strength tests, oxygen uptake, and a variety of other laboratory testing evaluated a group of Special Olympic athletes and non-Special Olympics individuals. The experimental group, Special Olympic athletes, trained on average for 4.9 hours per week for at least one year. There was no significant difference in body composition between the two groups; however, maximum oxygen consumption ($VO_2$ max) and isometric muscle contraction strength were significantly higher in the Special Olympics group. This can indicate a higher aerobic capacity and muscular strength to their intellectual disability peers, suggesting better physical fitness levels.

An individuals activity rate relates to the amount of calories per minute (kcal/min) expended, otherwise known as energy expenditure. However, energy expenditure differs in people with Down syndrome. Their lower body stability from joint laxity, muscle hypotonia, and decreased strength, causes those with Down syndrome to use a greater

amount of energy expenditure during basic physical activity (Agiovlasitis, Motl, Foley & Fernall, 2012). Agiovlasitis et al (2012) investigated the energy expenditure between non-Down syndrome individuals and those with Down syndrome using a wrist accelerometer. When the activity intensity increased, those with Down syndrome showed a greater increase of metabolic equivalents (METs) than those without Down syndrome. They noticed higher step frequency, or cadence, concluding increased energy expenditure. This study was an accurate depiction of the energy expenditure during physical activity for individuals with Down syndrome.

This investigation will use accelerometers worn around the ankle for seven consecutive days, only taking the device off when bathing or swimming. By having the accelerometer around the ankle, it will track activity when the individual is moving around on their feet. We will look at the activity levels of those with Down syndrome who do not participate in Special Olympics and those who are Special Olympic athletes to see if there is a significant difference in daily total values. We hypothesize that those who participate in a organized physical activity, Special Olympics, will have a higher activity levels than those who do not.

## METHODS

### Participants

The sample of participants was recruited in the Dallas-Fort Worth Metroplex area via fliers, word-of-mouth, social networking and media, and existing contacts in the community. Recruitment was additionally utilized through a variety of organizations including: Special Olympics Texas Area 11, Down syndrome Partnership of Tarrant County, and Down Syndrome Guild of Dallas. Six participants signed the consent form

and participated in the study. All of the participants were Caucasian males with three being Special Olympians diagnosed with Down syndrome and the resulting three participants being typically developing individuals. The subjects ranged from 15-36 years old and were matched based on respective ages (±2 years) and grouped into the Special Olympics group and the typically developing group control group.

The participants in the Special Olympics group all participated in at least one of the Special Olympic activities, including swimming, track and field, basketball, soccer, etc. The typically developing group did not participate in a formal physical activity program.

After prospective participants, parents, guardians, or caregivers contacted us to participate in the study, informed consent was obtained. The consent explained the requirements of the participants and allowed for questions. Because individuals with Down syndrome have mild-to-moderate intellectual disabilities, they had the opportunity to have assistance from a parent or guardian. In every instance, oral assent from the participant was documented, confirming the participant made the choice to participate.

**Apparatus**

After the consent/assent procedure participants were shown all of the study materials and allowed to interact with the instruments. For body composition, the participants were shown the calipers and allowed to feel the pressure when used prior to testing. Participants were also shown the Actigraph accelerometer physical activity monitor that was used. They were instructed on when and how to use the monitor for the next seven days. Familiarization with the instruments was repeated until the participants felt comfortable with everything.

Anthropometric measures were calculated through body mass index (BMI), body composition, and waist and hip circumference measures. Body mass index was calculated using the standard formula: body mass (kg) divided by height ($m^2$). Body fat percentage was measured through Lange skinfold thickness on the right side of the body using the gender-specific Jackson and Pollack (1985) equation for four sites, including tricep, suprailiac, abdominal, and thigh. Waist and hip circumference was measured to the nearest centimeter through two measurement trials. A waist to hip ratio was then calculated according the World Health Organization (2008).

The Actigraph accelerometer physical activity monitor is the size of a watch and was worn around the participant's ankle for a total of seven days. The only time the monitor was not worn was during bathing or swimming. It detects vertical acceleration over a specific time interval (Kinnuen et. al, 2011). The monitor measures the rate of acceleration and separates activity levels into sedentary, light, moderate to vigorous, and vigorous physical activity.

**Procedure**

After the participants, guardian, or caregivers contacted the research investigators to participate in the study they were contacted by email or telephone to see if the individual was a good fit for the study. The potential participants were then enrolled in the study and scheduled an appointment for measurements at the TCU physical activity lab or at a designated location the participants consented
to meet.

Once at TCU, individuals heard the purpose of the study and were informed of their requirements in the study through the university consent and assent forms. All

individuals had the opportunity to ask any questions and provided informed consent. Because the Special Olympian population has a mild-to-moderate intellectual disability, they had an opportunity to seek assistance from a parent, guardian, or caregiver. In all instances after the parent, guardian, or caregiver provided consent, the participant needed to express an oral assent that was documented.

After the consent/assent procedure participants were shown all study materials and allowed to interact with the instruments used for measurements. Familiarization with the instruments was allowed until the participants felt comfortable. Height was measured to the nearest centimeter and weight to the nearest tenth of a kilogram through two measurement trials and the average of the trials was recorded. Body mass index (BMI) was then calculated using the standard formula: body mass (kg) divided by height ($m^2$). Skinfold thickness was then measured using Lange calipers on the right side of the body. Four sites were measured (tricep, suprailiac, abdominal, thigh) twice with the average of the trials recorded. Body fat percentage was then calculated using the gender-specific Jackson and Pollock (1985) regression equations. Finally, hip and waist circumference was measured to the nearest centimeter. Two measurement trials was administered with the average of the trials being recorded to calculate waist to hip ratio.

Following anthropometric measures, the participants were administered the Actigraph accelerometer physical activity monitor along with a self-addressed, pre-stamped envelope to be returned following seven days. The participants were shown the monitor, how to wear it on the ankle, and to only remove it during bathing and swimming. Participants were allowed to ask questions, interact, and test the monitor before leaving the lab. During the seven-day period, the research investigators contacted

the participants twice, once to check adherence to the monitor and then to return the monitor.

**Design and Analysis**

Descriptive analysis for each variable was collected. Independent sample t-tests were completed to compare individuals who participated in Special Olympics and those who are typically developing. Dependent variables of interest included height, weight, BMI, percent body fat, and time spent in sedentary and moderate-to-vigorous physical activity. Correlational analyses were also conducted to determine relationships between relevant dependent variables (percent body fat, BMI, and physical activity). All analysis will be performed using IBM SPSS Statistics version 19 and a p value of less than or equal to 0.05 will be accepted as statistically significant.

## RESULTS

Following descriptive analysis and independent sample t-test, it was concluded that there was no statistically significant differences in body composition assessments between the two groups. The average BMI for the Special Olympics group was 27.8 with a standard deviation of 9.02 and for the typically developing group BMI had a mean value of 23.6 with a standard deviation of 7.61. The American College of Sports Medicine (ACSM) defines overweight individuals with a BMI above 25 and obese individuals as 30 or greater (Temple, Walkley, & Greenway, 2010; American College of Sports Medicine (ACSM), 2008). The Special Olympics group is classified as obese and the typically developing group in a normal weight range.

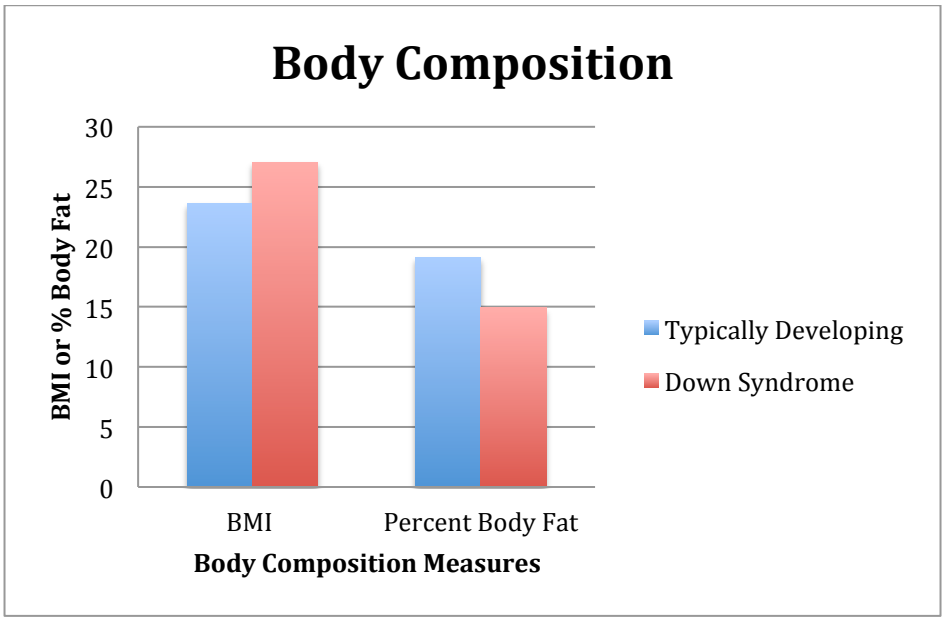
Percent body fat is the percentage of the total weight represented by fat and can be used to evaluate an individual's body composition. Optimal percent body fat for

males is less than or equal to 15%. Obese males are classified with a percent body fat as greater than or equal to 25%. The Special Olympians had an average percent body fat of 14.92% with a standard deviation of 10.5 and the typically developing individuals had an average percent body fat of 19.12% with a standard deviation of 11.5. Overall, from the body composition assessments, the Special Olympians are classified as obese and the typically developing individuals in the normal body composition range to overweight. There was a statistically significant correlation concerning body mass index with the correlation being -.815.

Table 1 – Body composition results comparing BMI and percent body fat for the Down syndrome and typically developing groups.

| **Variable** | **Group (n=6)** | **Mean** | **Std. Deviation** |
|---|---|---|---|
| Height (cm) | Typical Development | 168.8 | 5.91 |
| | Down Syndrome | 165.25 | 9.00 |
| Weight (kg) | Typical Development | 71.50 | 17.42 |
| | Down Syndrome | 71.53 | 10.23 |
| Body Mass Index (BMI, $kg/m^2$) | Typical Development | 23.61 | 9.02 |
| | Down Syndrome | 27.04 | 7.61 |
| Percent Body Fat | Typical Development | 19.12 | 11.53 |
| | Down Syndrome (n=2) | 14.92 | 10.49 |

Graph 1 – Body Composition of BMI and percent body fat in Down syndrome and typically developing groups.

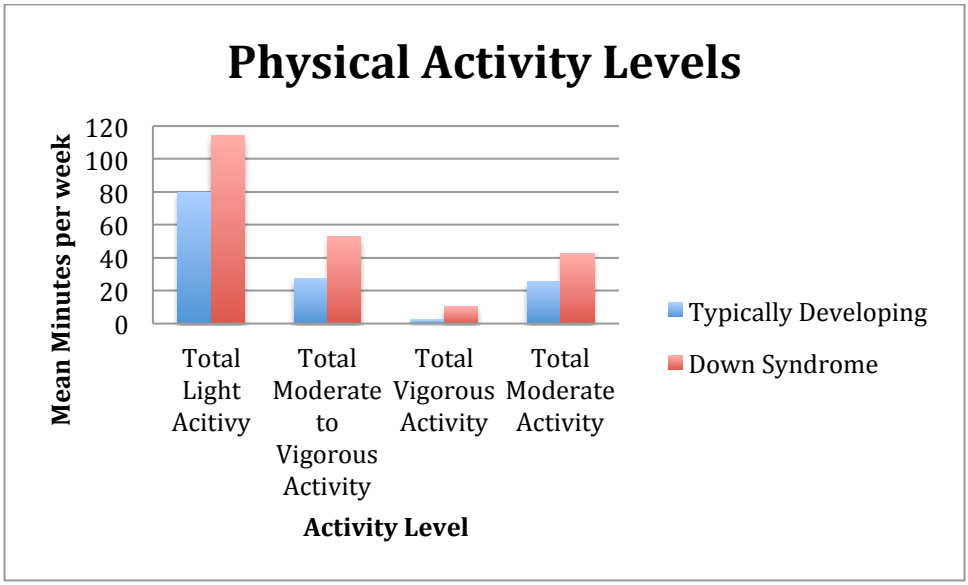



Since statistically significant data was classified with a p value of .05 or lower, there was no statistically significant data. Even though, there was no other statistically significant data, averages were taken of each physical activity sub-category. The Special Olympian group participated in approximately 52 minutes of moderate to vigorous physical activity over the course of the 7-day time period versus the typically developing group participating in only 28 minutes. All of the other physical activity sub-categories reflected the same trends with the Special Olympians performing more physical activity than the typical developing group (see Table 2). There was a significant correlation in light, sedentary, and moderate to vigorous activity with values of -.908, -.945, and .820 respectively.

Table 2 – Physical activity levels for the Special Olympics and typically developing group.

| Activity Level | Group | Mean Minutes per week | Standard Deviation |
|---|---|---|---|
| Total Light Activity | Typical Development | 79.82 | 50.41 |
| | Down Syndrome | 114.13 | 39.66 |
| Total Moderate | Typical Development | 25.31 | 19.34 |
| | Down Syndrome | 42.60 | 26.02 |
| Total Vigorous | Typical Development | 2.29 | 1.37 |
| | Down Syndrome | 10.1 | 9.23 |
| Total Moderate to Vigorous | Typical Development | 27.60 | 20.40 |
| | Down Syndrome | 52.67 | 30.39 |
| Total Sedentary | Typical Development | 1236.60 | 81.61 |
| | Down Syndrome | 1138.74 | 120.59 |

Graph 1 – Physical Activity Levels of mean activity per week of Special Olympians and typically developing individuals.




## CONCLUSION

With over 35% of adults classified as obese, physical activity is becoming increasingly more important. ACSM recommends individuals obtain 150 minutes of

moderate to vigorous physical activity over the course of a week for health benefits, such as, losing weight, and reducing risk of cardiovascular disease and Type II Diabetes Mellitus (ACSM, 2008). Not only is obesity a problem for the general population, but also for the Down syndrome community. These individuals have a higher prevalence of obesity than their typically developing peers (Melville, Cooper, McGrother, Thorp, & Collacott, 2005).

Body composition differs in the Down syndrome population due to a variety of reasons. Some of these contributing factors include higher prevalence of hypothyroidism, joint instability, and activity levels (Sommer & Henrique-Silva, 2007). These factors contribute to overweight and obese individuals. Numerous studies have illustrated this population's higher prevalence of obesity. The reasons for why vary, including a lower basal metabolic rate and environmental factors (Chad et al, 1990). These factors tend to be due to a lack of opportunities for physical activity, lack of knowledge, and dependence on care-givers (Heller et al, 2003). Fujiura et al (1997) also found that BMI associated with social opportunities and friendships, relating one's health to a social context. This gives value to organized physical activity for health promotion and prevention of obesity as it fosters community, social support, and friendship. Our research reflected these studies with the Special Olympians having a higher BMI than their typically developing counterparts.

Many studies observe physical activity levels of this population. A previous study researching physical activity patterns in typically developing children and their Down syndrome siblings showed no statistically significant differences in activity levels with both groups participating in roughly the same amount of moderate physical activity

per day (Whitt-Glover et al., 2006). However, in another study investigating activity levels of adults with and with DS there was a statistically significant difference in the moderate to vigorous physical activity and sedentary activity. Individuals with Down syndrome participated in only 29.8 minutes per day compared to individuals without DS that participated in 41.6 minutes per day. Sedentary behavior followed the same trend with the Down syndrome group engaging in more sedentary behavior than the individuals without DS (Phillips & Holland, 2011). This study tends to follow the majority of research illustrating the lack of physical activity this population engages in.

The Special Olympians partook in a mean average of 52 minutes of moderate to vigorous physical activity a week. This is well below the recommended average from ACSM of 150 minutes per week. However, roughly half of the general population does not follow these guidelines (ACSM, 2008). Participating in an organized activity, such as Special Olympics, aids in physical activity levels throughout the day, illustrated by the increased activity levels that Special Olympians engaged in. The typically developing individuals did not necessarily participate in organized physical activity and the decreased activity levels made this apparent. The average time spent in Special Olympics events is approximately five hours per week consisting of mainly instruction instead of movement activities. However, these individuals still are engaging in physical activity, allowing for the Special Olympics program to aid in a variety of health benefits, focusing mainly on obesity prevention.

**Limitations and Future Research**

The purpose of this research study was to measure the physical activity levels and body composition between age-controlled Special Olympians and typically developing

individuals. Although there was no statistically significant data, it is the first study to investigate these two variables. This study lacked a large enough sample size to make what significant data present valid. The small sample size is due to a small interest and response from the Dallas-Fort Worth community. Additionally, there were limited resources to recruit this specialized population. Roughly 40 individuals a year are born in Tarrant County, Fort Worth, Texas with Down syndrome. Because of the limiting condition of heart defects, the potential individuals to recruit dropped by fifty percent. It is encouraged for further studies to repeat this with a larger sample size. These findings may give value to organized physical activity, such as Special Olympics, improving the quality of life of individuals with Down syndrome.

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## ABSTRACT

The purpose of this study was to examine the physical activity levels in Special Olympians and typically developing individuals. The sample included 6 people, 3 Special Olympians and 3 typically developing. Ages were correspondedly matched with a range of 15-36 years old. Basic body composition was measured using BMI and percent body fat. An Actigraph accelerometer physical activity monitor was given to the participants to wear for 7 days, measuring their sedentary, light, moderate, vigorous, and moderate to vigorous activity levels. Using a statistically significant value of p= .05, it was concluded that there was no statistically significant results. From descriptive analysis, the Special Olympians had mean moderate to vigorous activity levels of 52 minutes per week. By using Special Olympics as an organized physical activity, it can be used as a method for obesity prevention.