

Children's Physical Activity and Sedentary Behavior in Summer Camp

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Abstract The average daily amount of physical activity (PA) expended by children in summer camp is unknown. The purpose of this study was to investigate the trends in PA and sedentary behavior in school-aged summer campers during an outdoor adventure summer camp. Participants were a convenience sample of school-aged children ($N = 183$; 102 males and 81 females; mean age = 9.69 ± 1.47 years) who attended one week of an outdoor adventure summer camp. PA and sedentary behavior were assessed and collected via wrist-worn Actigraph GT3X+ accelerometers during camp hours, from 9am to 4pm daily. Outcome variables included percentage of time spent in sedentary behavior, percentage of time spent in moderate-to-vigorous PA (MVPA), and average steps per day. Data were analyzed using a Multivariate Analysis of Variance (MANOVA) test. Results indicated a decreasing trend of PA across the eight-week summer camp period. Both boys and girls engaged in MVPA for about 9% of the total time during weeks one and two, which decreased to about 7% of the total time by weeks seven and eight. Sedentary behavior remained constant, with an increase during weeks 5 and 6 of camp. Average daily step count decreased by about 3,000 steps per day from the first to the final week of camp. There was a significant main effect for sex on PA (Wilk's $\Lambda = 0.000$, $F = 6.77$, $p < 0.05$) and a significant main effect for week on PA (Wilk's $\Lambda = 0.000$, $F = 3.05$, $p < 0.05$). This indicates the influence of camper sex and week of attendance on PA variables. Overall, weekly PA decreased during the duration of the summer camp. Seasonal outdoor weather patterns and counselor teaching styles may have impacted PA levels of campers. It is recommended that camp staff implement strategies to encourage consistent levels of PA across the summer camp season.

Keywords: *Outdoor adventure summer camp, moderate-to-vigorous physical activity (MVPA), accelerometer*

1. Introduction

Many American children do not participate in enough physical activity (PA) (Child and Adolescent Health, 2016). The Centers for Disease Control and Prevention (CDC) recommends that children and adolescents between the ages of 6–17 years should participate in at least 60 minutes of moderate-to-vigorous PA (MVPA) per day (United States Department of Health and Human Services, 2018). However, in the United States, only 24% of children in this age range participate in 60 minutes of MVPA daily (Child and Adolescent Health, 2016). Children who do not engage in sufficient PA are at a higher risk for chronic conditions, like overweight/obesity, hypertension, type II diabetes, heart disease, and other diseases (Centers for Disease Control and Prevention, 2021). One solution to increase the daily PA of children is to provide physical education classes in schools (Fu et al., 2017). However, this solution is ineffective when children are not attending school, such as during the summer or holiday breaks (Fu et al., 2017).

Children are less active during the summer months, which may lead to fitness loss and weight gain (Brusseau et al., 2019; Fu et al., 2017). It is hypothesized that the loss in fitness occurs due to the lack of structured days, which includes a lack of participation in physical education classes (Brusseau et al., 2019; Fu et al., 2017). Without structured schedules, including regular class and meal times, children may experience more weight gain during the summer months than they do during the school year (Brusseau et al., 2019). To help combat these conditions, parents may elect to enroll their children in summer camps. Summer camp has been an effective intervention to increase PA in children (Brazendale et al., 2017; Lammler et al. 2019).

More than 14 million children in the United States attend summer camp per year nationwide (American Camp Association, 2016). Summer camps are programs that feature a wide variety of activities and games for children (Brazendale et al., 2017; Wahl-Alexander, 2022). Summer camp also allows children to engage in unique outdoor adventure physical pursuits, including hiking, orienteering, fishing, birdwatching, rock climbing, and more (Brazendale et al., 2017; Wahl-Alexander, 2022). This setting

gives children the opportunity to be active in an outdoor environment.

Current data about the effectiveness of summer camp as a PA intervention are mixed results (Brazendale et al, 2017; Ventura & Garst, 2013; Wahl-Alexander, 2022; Zarrett et al., 2013). Some campers often meet daily PA recommendations of 60+ minutes of MVPA, (Brazendale et al., 2017; Wahl-Alexander, 2022) while other sources noted that daily PA participation relies heavily on factors like exercise promotion from camp staff, outdoor temperatures, and sex of the camper (Ventura & Garst, 2013; Zarrett et al., 2013). Therefore, there is a need to further investigate the effectiveness of summer camp as a PA intervention for children. The purpose of this study was to determine weekly trends in PA participation for school-aged summer campers during eight weeks of summer camp. These trends may inform differences in MVPA and PA participation based on sex and/or temperature (Brazendale et al, 2017; Ventura & Garst, 2013; Wahl-Alexander, 2022; Zarrett et al., 2013).

2. Methods

2.1. Participants

Participants were a convenience sample of 183 school-aged children (102 males and 81 females; mean age = 9.69 ± 1.47 years) that each attended one full week of summer camp during the eight-week long summer camp season. A new cohort of campers attended each week, and all returning campers from previous weeks were excluded from data collection if they had already participated in the study. Participants were from local counties surrounding the camp in the Western region of the United States. Approximately 75% of the participants were White, 17% were Hispanic/Latino, 7% were mixed race (two or more races), and 1% were Black. Written parental consent and verbal assent from the campers were obtained before participation in the study. This study was approved by a University's Institutional Review Board.

PA and sedentary behavior were assessed using Actigraph GT3X+ wrist-worn accelerometers (60 Hz, ActiGraph, v3.2.1, Florida, USA). Actigraph GT3X+ accelerometers are a valid measurement of PA in children (Chandler et al., 2015; Lee et al., 2015). Accelerometers were charged and initialized before each camp week. Accelerometers utilized an epoch length of 15 seconds and a sampling rate of 60 Hertz.

Campers wore accelerometers from 9am to 4pm on all five days of camp, Monday through Friday. Accelerometers were excluded from data analysis if campers took them off earlier than 4pm, or if they did not wear them for all five consecutive days. Accelerometers were programmed to record PA data between 9am and 4pm each day. Campers were informed of their ability to accept or decline participation in the study, so some chose to take the accelerometers off early (mainly due to discomfort). In total, 41 campers chose to decline participation during the summer. Accelerometers were collected by staff members and put back into staff offices if campers chose to take them off early. Data from these accelerometers were not included in the data analysis.

Outcome variables, including average percent of time spent in sedentary behavior and average percent of time spent in MVPA were calculated by dividing time spent in PA behaviors by total wear-time of the accelerometers each day. Data was recorded and uploaded to the Actilife computer software (ActiGraph, 2020,

USA) weekly. Freedson et al.'s cut points (2005) were used to analyze data. These cut points are used to determine children's PA intensity during movement (Freedson et al., 2005).

2.2. Daily Schedule

Each camper attended one full week of summer camp during the eight-week long summer camp season. Each week of camp was five days long, from Monday through Friday. Each day, campers participated in roughly the same activities. Campers were divided into trail groups by age, and campers often played with children of the same age during free-play. Campers participated in a daily group hike, science-based trail lessons, lunchtime, and an hour-long guest presentation (at which point they were expected to be sedentary). During the afternoon, campers were given the choice to either complete an art project or to play a PE-style group game. This two-hour afternoon block gave campers the opportunity to choose an active or sedentary activity, based on their interests or physical state.

2.3. Statistical Analysis

For all analysis, statistical significance was reported at $p < 0.05$, and data was analyzed using SPSS v25.0 statistical software package (IBM corp., Armonk, NY, USA). Percentage of total time in sedentary and MVPA and average step counts per day were analyzed by age, sex and week using a factorial 7 (age) \times 2 (sex) \times 4 (week) Multivariate Analysis of Variance (MANOVA) test to examine possible group differences. To simplify the data, weeks were grouped into two-week cohorts, therefore dividing the summer into four distinct time periods instead of eight. Wilks lambda was used to determine the statistical significance of the multivariate model. A Bonferroni post hoc test was employed to determine statistically significant mean differences in average steps per day between weeks. Levene's test of equality was used to examine homogeneity of variance between weeks.

3. Results

Descriptive statistics for the total sample are reported in Table 1. A factorial 7 (age) \times 2 (sex) \times 4 (week) Multivariate Analysis of Variance demonstrated statistically significant differences in camper's sedentary behavior, MVPA, and daily step counts based on sex and week. There was a significant main effect for sex on PA (Wilk's $\Lambda = 0.000$, $F = 6.77$, $p < 0.05$) and a significant main effect for week on PA (Wilk's $\Lambda = 0.000$, $F = 3.05$, $p < 0.05$). This indicates multivariate differences between sexes and between differences weeks on the PA variables.

Table 1. Descriptive statistics of school children.

Week	N	Males	Females
Weeks 1-2	56	31	25
Weeks 3-4	52	36	16
Weeks 5-6	42	20	22
Weeks 7-8	33	15	18
Total	183	102	81

There was a statistically significant sex main effect on percentage of time spent in MVPA ($F = 7.07$, $p = 0.009$, $\eta^2 = 0.06$) and average steps per day ($F = 13.65$, $p = 0.000$, $\eta^2 = 0.12$). There was also a statistically significant week main effect on average steps per day ($F = 5.99$, $p = 0.000$, $\eta^2 = 0.28$). There was

no statistically significant main effect on PA behaviors based on age. There were also no statistically significant findings for camper's light or moderate levels of PA.

Bonferroni post hoc analysis showed statistically significant mean differences in steps per day between week 1 and weeks 4-8, with a range of 2,485 steps/day-4,435 steps/day mean difference. Data in Figures 1, 2 and 3 show the differences in PA behaviors based on sex and week.

As shown in Figure 1, the average percent of time spent in sedentary behavior illustrated a substantial increase during the eight-week summer camp period. On average, males were sedentary for 79% of time during weeks 1-2, 77% of time during weeks 3-4, 83% of time during weeks 5-6, and 81% of time during weeks 7-8. Sedentary behavior in female campers also showed an increasing trend, with 81% time spent in sedentary for weeks 1-2, 81% in weeks 3-4, 84% in weeks 5-6, and 78% in weeks 7-8.

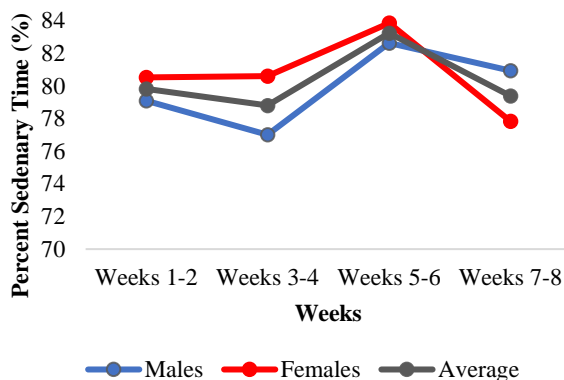


Figure 1. Average percent time in sedentary activity.

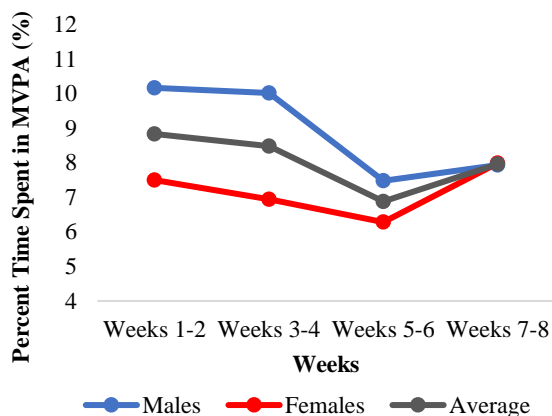


Figure 2. Average percent time spent in moderate-to-vigorous PA (MVPA).

Camper's average percentage of time spent in MVPA declined from the first to final week of summer camp, as indicated in Figure 2. Specifically, during weeks 1-2, the average MVPA engagement for males was 10% of total time, followed by 10% of total time in weeks 3-4, 7% in weeks 5-6, and 8% in weeks 7-8. Similarly, females spent 8% of time in MVPA during weeks 1-2, followed by 7% of time in weeks 3-4, 6% in weeks 5-6, and 8% during weeks 7-8.

For both sexes, average daily step count reduced by about 3,000 steps per day from the first week of camp to the final week as illustrated by Figure 3. Average steps per day for males went from 10,853 steps/day in weeks 1-2 to 7,738 steps/day in weeks 7-8. There was a total reduction of 3,115 steps per day. Female campers demonstrated similar trends, with average steps per day at 9,662 during weeks 1-2 and 6,837 steps per day during weeks 7-8, for an overall reduction of 2,825 steps per day.

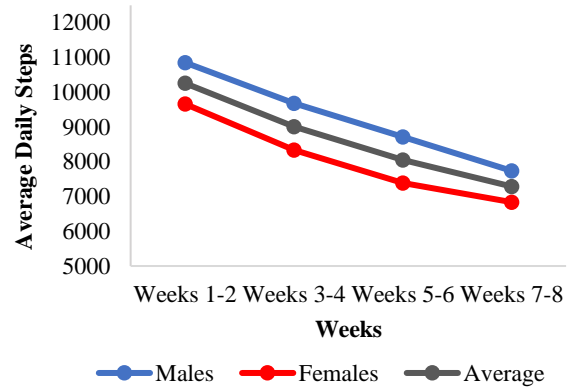


Figure 3. Average daily step count

4. Discussion

The purpose of this study was to investigate the trends in PA and sedentary behavior in school-aged summer campers during an outdoor adventure summer camp. The results indicated that there was a decreasing trend in PA from the first week of camp to the final week. There was an increase in sedentary behavior, a decrease in MVPA, and decreasing average daily step count across the eight-week summer camp period. The results of the study are that summer camp can be used as a PA promotion intervention, especially if children participate in camp during the beginning of the summer. However, it should be specified that not all summer camps involve outdoor adventure PA pursuits, so other types of camp may not be as effective in eliciting PA. Strategies should be created by summer camp administration and staff to encourage consistent high levels of PA participation throughout the summer camp season.

Male campers were more physically active than female campers. Overall, males engaged in MVPA for 9% of their total time at camp and had an average of 9,247 steps per day. Females had slightly lower overall values for MVPA and average daily step counts, with an average of 7% of time and 8,057 steps/day respectively. This supports the trends in the existing literature that male summer campers are typically more active than female summer campers (Brazendale et al, 2017; Lammle et al., 2013; Ventura & Garst, 2013; Wahl-Alexander, 2022; Zarrett et al., 2013).

Differences in PA levels based on sex may be due to camper's preferences for activities, camper's perceptions of physical competency, or a combination of both (Zarrett et al., 2013). Many female campers chose to engage in creative pursuits during their free time, including activities like: making bracelets, beading, drawing, writing, or doing art projects. Conversely, male campers often chose to play organized sports during camp hours, with games like four-square, kickball, soccer, and tag being the most

popular. Campers typically chose to play with children of the same sex, and therefore formed large friend groups based on sex and age.

Additionally, PA trends may be exacerbated by obesity, with obese female campers participating in far less PA than obese male campers (Izzicupo et al., 2021; Mikati et al., 2020). Although this study did not focus on weight, it is relevant to note because of the increasing incidence of childhood overweight and obesity (Centers for Disease Control and Prevention, 2021). Summer camp staff should therefore promote a positive atmosphere that includes all children in physical activities, with special attention for female children and children who are overweight/obese. It is recommended to offer campers a variety of activities with different competition levels, team-building opportunities, and requirements for social engagement (Zarrett et al., 2013).

As part of an outdoor adventure summer camp, participants were expected to engage in outdoor physical pursuits, such as hiking, rock climbing, bird watching, orienteering, and other novel activities. Outdoor adventure physical education combines skill-based learning in an outdoor environment with deliberate reflection and interpersonal team building (Timken & McNamee, 2012). Camp curriculum reflected these themes, and included sport activities like tag, soccer, four-square, and large group games (like “Sharks and Minnows”). In previous studies, children who engage in sports-based summer camps engage in more MVPA than children who attend general summer day camps (Barnett et al., 2018).

Summer camp may be an effective PA intervention for youth. (Brazendale et al, 2017; Lammle et al., 2013; Wahl-Alexander, 2022). However, more research is necessary to determine the effects of external factors on summer camp PA, including things such as seasonal outdoor weather patterns and summer camp staff fitness. Data from this study are that campers may experience more opportunities for PA during earlier camp weeks than in later camp weeks, which may be due to factors such as variable weather conditions, decreased motivation, boredom, or a decline in fitness for summer camp staff.

Increasing temperatures throughout the summer camp period may have contributed to decreased PA in campers. In current literature, children are less likely to be physically active in higher temperature environments (Remmers et al., 2017; Ridgers et al., 2015; Zarrett et al., 2013). Although this study did not record daily outdoor temperatures, it is expected that daily temperatures ranged from 75°F to 95°F based on the climate of the summer camp location. It is recommended that future studies measure and record outdoor daily temperatures to further investigate the relationship between higher temperatures and children’s PA.

Furthermore, it is expected that wildfire smoke impacted children’s PA during the second half of the summer camp season. Smoky conditions were variable and inconsistent throughout the summer. Wildfire smoke was more pervasive during weeks 5-6, but air quality readings were not recorded during the summer. Future studies may choose to include air quality index assessments as part of their daily outdoor climate measurements, especially if the camp is located in the Western United States.

Finally, the fitness of summer camp staff may have impacted trends in PA across the summer camp season. Previous studies have indicated that summer camp staff fitness may impact camper’s PA (Ventura & Garst, 2013; Wahl-Alexander, 2022; Zarrett et al., 2013). Staff who are more fit may lead more physically challenging activities, like organized sports or running

games. Fitness levels of the staff members were unassessed, and it is unknown whether the staff experienced changes in their physical abilities throughout the summer. Future studies may benefit from conducting pre- and post-summer camp fitness screenings for staff members, to assess any changes in their fitness.

4.1. Limitations

There were several limitations that may have affected the outcomes of this study. To begin, there was no physical fitness assessment for campers before their participation in the camp, so their general fitness was unknown before coming to camp. The only participation criteria for children to attend camp was the ability to participate in activities, so there were various levels of physical fitness between campers. Similarly, there was a lack of representation for minority groups in the camper cohort, with relatively low amounts of children from underrepresented racial/ethnic groups and no children with physical disabilities. Therefore, results may not be generalizable to the public, and may not accurately represent children who live in the areas surrounding the camp.

Camp staff fitness was also not assessed before camp began, so their levels of fitness may have been variable. There was also variation in the amount of teaching experience that each of the summer camp counselors had, and this experience may have impacted their ability to avert burnout by the end of the summer.

Data collection may have been impacted by children’s preference for wearing accelerometers. Some children preferred to wear the device on their dominant hand, while others preferred to wear it on their non-dominant hand. PA measurements may have been slightly impacted by the camper’s preferences, with the assumption that their dominant hand would experience more movement.

Finally, results of tests for homogeneity of variance showed that Levene’s test assumptions were violated, and tests for normality did not have a normal distribution of the data. This may have been because of the variable sample size between weekly cohorts of campers; possibly indicating that a repeated trial of this study may not yield the same results as the initial trial.

5. Conclusion

In conclusion, there was a reduction in camper PA across the eight-week summer camp period, and campers engaged in more sedentary behavior, less MVPA, and fewer steps per day by the end of the summer camp season. Notably, female campers engaged in less PA than male campers, which supports previous trends in the literature. Despite these outcomes, outdoor adventure summer camp can be an effective PA promotion intervention for children, and especially so if they attend during the first half of the summer.

More research is necessary to further investigate trends in summer camp PA. It is recommended that future research include measurements of outdoor daily weather patterns, to identify any possible relationships between high temperatures and decreased PA. Similarly, it may be beneficial for future research to include standardized fitness tests for camp staff members; as their fitness levels may have an impact on PA trends during the summer. Finally, summer camp administration and staff should proactively implement strategies to encourage PA participation during

summer camp, with a special focus on female campers. These strategies may increase PA participation for all children and further prove the value of summer camp as a PA intervention for youth.

Disclosure Statement

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