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A Virtual Camp for Adolescents with Developmental Disabilities During the COVID-19 Pandemic: Changes in Physical Activity, Function, and Psychosocial Health

Sarah Creveling

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A VIRTUAL CAMP FOR ADOLESCENTS WITH DEVELOPMENTAL DISABILITIES DURING
THE COVID-19 PANDEMIC:

CHANGES IN PHYSICAL ACTIVITY, FUNCTION, AND PSYCHOSOCIAL HEALTH

by

SARAH CREVELING

(Under the Direction of Gavin Colquitt)

ABSTRACT

Adolescents with developmental disabilities (DD) have low levels of physical activity (PA), are more likely to be overweight or obese, and are at an increased risk of developing secondary conditions compared to their typically developing peers. Participation in PA has been linked to a myriad of benefits including improvements in psychosocial health, decreased risk of developing secondary conditions, and opportunities for socialization. Summer camps provide opportunities for adolescents with DD to participate in meaningful activities while being physically active during the summer months when school is out and there is a change in routines, skill and learning loss is a threat, and adolescents are more sedentary than during the school year. Camp RAD (recreation for adolescents with disabilities) is a 4-week summer day camp in southeast Georgia that uses an interdisciplinary approach to teach health, PA, nutritional, and life skills to adolescents with DD in a fun and educational environment. In response to the COVID-19, Camp RAD staff adapted the camp curriculum to a 100% virtual format to meet the needs of adolescents with disabilities during the pandemic. The purpose of this study is to evaluate changes in PA and sleep quality, and psychosocial health after attending a virtual camp. Campers wore activity monitors pre-camp, during camp, and post-camp to monitor PA. Parents completed 8 HealthMeasures PROMIS Pediatric Parent-Proxy measures to evaluate family relationships, PA, peer relationships, upper extremity function, strength, sleep, meaning and purpose, and stress. Overall, PA levels did not increase during camp, but were maintained throughout the summer. Significant improvements in PA, peer relationships, and upper extremity function were observed according to PROMIS measure results. Participation in the virtual Camp RAD was beneficial during the COVID-19 pandemic as campers were able to maintain PA and social contact with peers throughout camp.

INDEX WORDS: Developmental disabilities, Summer camp, COVID-19, Transition age, Physical activity, Psychosocial health, Virtual camp

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SARAH CREVELING

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SARAH CREVELING

Major Professor:
Committee:

Gavin Colquitt
Nicholas Siekirk
Ashley Walker
Christopher Modlesky

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CHAPTER 1

INTRODUCTION

Developmental disabilities (DD) are lifelong cognitive, physical, or social disorders or impairments that often present in adolescence. Adolescents with DD face unique constraints to independence and may find it difficult to integrate into society (Odom et al., 2009). There are 14 categories of DD, as defined by the Individuals with Disabilities Education Act (IDEA): autism, deaf-blindness, deafness, emotional disturbance, hearing impairment, intellectual disability, multiple disabilities, orthopedic impairment, other health impairment, specific learning disability, speech or language impairment, traumatic brain injury, visual impairment, and developmental delay (IDEA, 2004). This broad classification encompasses a variety of unique diagnoses including but not limited to; autism spectrum disorder, cerebral palsy (CP), Down syndrome, muscular dystrophy, Prader-Willi Syndrome, intellectual disabilities, spina bifida, and orthopedic disabilities (Odom et al., 2009). As a result, the presentation of DD are varied and the severity is not uniform across diagnoses. However, adolescents with DD may exhibit impaired intelligence quotient, distinct learning disabilities, and maladaptive communication, conceptualization, critical thinking, and social skills (AAIDD). Physical indicators may include impairments of motor function (e.g., poor muscle tone, reduced strength) affecting balance, gait, and coordination of fine and gross motor skills.

It is recommended that adolescents with DD participate in at least 60 minutes of moderate-vigorous physical activity (MVPA) per day that is “developmentally appropriate, enjoyable, and involves a variety of activities” (Strong et al., 2005). Most adolescents with DD do not meet these guidelines (Case et al., 2020). Previous research has demonstrated that adolescents with DD have lower levels of physical activity (PA), muscular performance, cardiorespiratory fitness, and reduced postural control compared to their typically developing peers (Blomqvist et al., 2013; Einarsson et al., 2015; Wouters et al., 2019). As a consequence, adolescents with DD are more likely to be overweight or obese (Rimmer et al., 2010). Sedentary behavior and obesity increase the risk of developing secondary or chronic conditions (Rimmer

et al., 2010). Rimmer et al. (2010), reported that adolescents with DD who were overweight or obese had a significantly higher prevalence of secondary conditions compared to adolescents with DD who had a healthy weight.

PA may offset risk to secondary conditions (Fowler et al., 2007). PA can improve muscular strength, improvements in motor function, and cardiovascular endurance (Fragala-Pinkham et al., 2006; Johnson, 2009; Rimmer et al., 2010). However, it should be noted, adaptations to exercise are indicative to how exercise is performed (i.e., specific adaptations to imposed demands) (Sands, 2012).

Participation in PA has also been linked to improvements in psychosocial health outcomes in adolescents (Dykens et al., 1998). Psychological benefits include improved self-esteem, motivation, and confidence (Eime et al., 2013). Participation in PA and exercise also provides an opportunity for adolescents to socialize with their peers (Martin, 2006). Social benefits such as improved peer acceptance, decreased shyness, decreased social problems, and improved relationships with peers have also been reported (Dykens et al., 1998; Perić et al., 2021).

Among adolescents with DD, improved sleep quality corresponds with increased MVPA levels and reduced sedentary time (Garcia et al., 2020). However, sleep disturbances and poor sleep quality are common in adolescents with DD (Goldman et al., 2012; Tietze et al., 2012). Poor sleep quantity or quality can perturb memory, learning, cognitive function, and mood (Jan et al., 2008; Kotagal & Broomall, 2012). Sleep disturbances can result in diminished cardiovascular, endocrine, and motor functions (Jan et al., 2008). Notably, age can be a moderating factor. That is, advancing age is related to poorer sleep outcomes and reductions in PA (Wachob & Lorenzi, 2015).

Deficits in PA may begin as early as elementary school in adolescents with DD. Reduced PA is not only problematic during school hours (e.g., reduced PA in recess and during physical education classes), but is thought to extend to after-school and weekend days (Wouters et al., 2019). Participation in PA gives adolescents the opportunity to develop motor skills (Stodden et al., 2008). If adolescents with DD are not being physically active, it is plausible to say that they are not working on motor skill competency. As adolescents with DD gain and improve motor skills used to participate in PA, they are

likely to continue to participate because they are successful at the task or activity (Stodden et al., 2008). Motor skills such as catching, throwing, and grasping are fundamental skills that are built on and needed to complete activities of daily living.

The capacity to be independent is related to quality of life. Among the factors influencing independence is motor competency. Therefore, interventions designed to improve PA are warranted for adolescents with DD. Notably, adolescents with DD undergo a transition phase, a prolonged period and/or “gradual process” spanning much of adolescence and early adulthood (Young-Southward et al., 2017). The Individuals with Disability Education Act (IDEA, 2004) requires transitional planning, services, and programs to prepare adolescents with DD for life after high school (IDEA, 2004). This includes evaluating the needs of the individual, setting goals, and developing a plan to help the individual become a successful adult. This can include vocational training, community involvement, and independent living skills such as goal setting, problem-solving, time management, safety, and interpersonal skills (Kingsnorth et al., 2007; youth.gov). Independent living also includes taking charge of one’s health. During the transition into the community, access to school-based services is withdrawn. This can negatively affect the mental (e.g., increased anxiety and depressive symptoms) and physical health of the individual with DD. Therefore, it is plausible sedentary behavior with advancing age is related to the withdrawal of school or community-based services (Young-Southward et al., 2017). Programs and services that aim to increase PA for adolescents during the transition age are imperative to help promote and sustain positive health behaviors into adulthood.

Long-term transition planning for adolescents with DD has become common practice, but short-term planning, such as summer planning, is often not included (Carter et al., 2009). Summer can result in acute stresses, often rooted in the change of routine, absence of support services, and reduced learning opportunities while school is not in session (Alexander et al., 2016; Brookman et al., 2003). Routine and reinforcement are important in skill maintenance for adolescents with disabilities (Cooper, 2003; Volkmar & Volkmar, 2013).

During the summer months, students lose on average, anywhere from 1-2 months of school-year learning (Alexander et al., 2016; Quinn & Polikoff, 2017). It is thought the loss is more extensive at higher grade levels (Cooper, 2003; Quinn & Polikoff, 2017). The problem is compounded with reduced PA observed in summer months. Adolescents who do not attend any summer programs are at increased risk of weight gain (Brazendale et al., 2020) and cognitive regressions (Brookman et al., 2003). Participating in purposeful activities over the summer can reduce summer learning loss and lead to successful transitions in the future (Carter et al., 2009). Summer break also provides an opportunity for adolescents with DD to work on community transition goals outside of the classroom (Carter et al., 2009).

Summer camps for transition aged adolescents with DD can provide opportunities to improve or, at the very least, retain learned skills while building or maintaining peer-based social connections (e.g., social support) (Clark & Nwokah, 2010). Previous research has shown that children with DD who attended summer camps have reported increased PA, decreased feelings of isolation, an increased sense of community, improvements in feelings of self-worth, increased independence and personal responsibility, increased time management, personal, social, and communication skills (Clark & Nwokah, 2010; Goodwin & Staples, 2005).

The COVID-19 pandemic created new challenges and added an additional layer of complexity to the already existing challenges adolescents with DD currently face regarding health and accessibility to programs and services. COVID-19 posed additional health risks for adolescents with DD (Sabatello et al., 2020; Turk et al., 2020). Low levels of PA and the corresponding risk factor of obesity are risk factors for more severe cases of COVID-19 (CDC, 2021; Sabatello et al., 2020).

Social distancing and quarantine measures significantly reduced and, in some cases, eliminated access to support services, healthcare services, and opportunities for community engagement (Jesus, Bhattacharjya, et al., 2021; Navas et al., 2021; Young et al., 2021). In turn, opportunities for participation and social interaction within the community were reduced, daily routines were altered, and increased feelings of isolation, anxiety, depression, and stress increased among adolescents with DD (Goldberg, 2021; Patel, 2020; Young et al., 2021). Some people with DD did not understand why things changed,

and some who did understand hyper-fixated on the pandemic, increasing their stress and anxiety (Jesus, Bhattacharjya, et al., 2021; Navas et al., 2021).

Schools were also disrupted as learning became virtual, risking academic progress for those with DD (Goldberg, 2021). Some individualized education plan (IEP) guidelines were difficult to accommodate. Some students were no longer receiving services required in their IEPs because some services, such as occupational therapy, physical therapy, and speech-language pathology, were not conducive to a virtual format (Goldberg, 2021; Jackson & Bowdon, 2020). Educators reported a profound impact on grades citing reductions in academic performance for those with DD (Goldberg, 2021). COVID-19 may have impacted those with DD more than those without DD (Goldberg, 2021). In comparison to adolescents without an IEP, parents of adolescents with an IEP were more likely to report reduced attendance and participation in virtual learning (Goldberg, 2021). Additionally, attendance was not congruent to virtual participation in adolescents with DD (Goldberg, 2021).

Programs and services had to adjust by transforming the traditional in-person experience to a novel virtual learning platform. This transition was, in part, an effort to provide purposeful services to adolescents with DD remotely. In theory, a virtual platform may help retain routines and provide an opportunity to maintain skills (i.e., prevent cognitive-motor regressions) (Anaby et al., 2021; Jesus, Kamalakannan, et al., 2021). An online program, albeit virtual, can provide an opportunity for social engagement and decrease isolation as much as possible (Anaby et al., 2021; Jesus, Kamalakannan, et al., 2021). Previous examples within occupational therapy (OT) and community programs (e.g., sport and exercise) have utilized virtual platforms during COVID-19 (Blauwet et al., 2020; Carrasquillo & Gerken, 2021; Vincenzo et al., 2021).

The World Health Organization International Classification of Functioning, Disability, and Health (ICF) uses a biopsychosocial model to provide a universal standard and framework to define, measure, document, organize and compare information regarding function and disability (WHO, 2001). The versatility of the ICF lends it to serve as a planning framework for programs and interventions. The ICF can provide a standard comparison between individuals with varied diagnoses and constraints. The

ICF can be used to (1) assess an individual's levels of functioning in the domains of body structures and functions, activities, and participation; and (2) assess the role contextual factors (environmental and personal) play in barriers and facilitators to functioning (WHO, 2001). The ICF analyzes the interaction between the environment and the capacity for performance and identify barriers and facilitators to participation (WHO, 2001). The ICF's mixed-method data analyses combines qualitative and quantitative data and applies a hierarchical coding system to documents, such as interview transcriptions, records, or open-ended survey responses, to identify contextual factors, such as environmental or personal factors, that serve as barriers or facilitators to participation (Burke & Albert, 2014; WHO, 2001). The identification of these factors is beneficial in program planning because behavior change is often required at a variety of levels to be impactful (WHO, 2002). The ICF focuses on the functional capacity and performance of the individual so after assessment, functional profiles and goals are based on their unique needs, interests, and activities of daily living of each participant. Additionally, the common language of the ICF allows for goal development across disciplines. With goal-directed interventions, outcome measures can be established to guide program planning and implementation, and to serve as an evaluation and measurement of individual progress and the effectiveness of the program.

Camp RAD (Recreation for Adolescents with Disabilities) is a 4-week summer day camp in southeast Georgia that uses an interdisciplinary approach to teach health, PA, nutritional, and life skills to adolescents with DD in a fun and educational environment. Camp RAD uses the ICF as a framework for goal setting and program planning. Using the ICF, staff can consolidate information from IEPs, medical records, and interviews with participants, parents and legal guardians) to develop individualized profiles. These individualized profiles can help shape the intervention to transfer to life-skills (e.g., activities of daily living). In response to the COVID-19, Camp RAD staff adapted the camp curriculum and use of the ICF framework to transition the camp to a 100% virtual format to meet the needs of adolescents with disabilities during the pandemic. Therefore, the purpose of this study is to evaluate changes in PA and sleep quality, and psychosocial health after attending a virtual camp. The first research question is "What are the effects of participation in a virtual camp for adolescents with DD during the COVID-19 pandemic

on PA?” The second research question is “What are parent perceptions of changes in physical function, and psychosocial health after participation in a virtual camp for adolescents with DD during the COVID-19 pandemic?”

CHAPTER 2

METHODS

Study Design

Quantitative indicators of PA (i.e., activity monitor output and surveys) and psychosocial variables (i.e., surveys) were used in a repeated measures design.

The Georgia Southern University institutional review board approved this study under limited review because data was kept anonymous in accordance with 45 CFR §46, the U.S. Department of Health and Human Services regulations for the protection of human subjects in research.

Participants and Setting

Camp RAD participants were recruited through social media, email, word of mouth, and flyers distributed through local school districts and therapy clinics. Recruitment focused on reaching the caregivers, legal guardians, and parents of local adolescents with DD. To be eligible to attend Camp RAD, participants, aged 9-21, were to have a diagnosed DD, and recent (i.e., within last 2-years) IEP.

Study participants were conveniently sampled from Camp RAD participants. Participants >18 years of age provided informed consent. For participants <18 years of age, parental assent was obtained. (<18 years of age). All participants in the camp (N = 28) who registered for camp also consented to participate in the study. Participants ranged in age from 9-21 (M = 15.5 years; SD = 3.68) and had a variety of diagnosed DD (Table 1).

Table 1*Participant Diagnoses**

Diagnosis	N	%
Attention-deficit/hyperactivity disorder	5	18
Genetic Condition	2	7
Autism Spectrum Disorder	17	61
Down Syndrome	4	14
Oppositional Defiance Disorder	1	4
Intellectual Disability	6	21
Spina Bifida	1	4
Muscular Dystrophy	1	4
CP	1	4
Brain Injury	1	4
Epilepsy	2	7

**Includes comorbidities*

Procedures

Camp RAD required the electronic submission of paperwork regarding academic details including school, program, grades, and IEP. The paperwork also included open-ended questions on the participant's social and emotional needs, physical capabilities, and constraints (e.g. influencing individual and interpersonal impairments) (e.g., cognitive impairment, motor deficits), communication, preferences, (e.g., likes, hobbies), and assistive technology (e.g., Activities of Daily Living). Contactless pickup points were established for parents/caregivers to pick up supplies needed for virtual camp every week. Orientation was held through Zoom with each family individually. Parents and/or caregivers participated in a pre-camp interview and an individual in the home was trained to be a peer support for the camper. The peer support person was a designated person in the home of the camper who would participate in daily activities and provide support for the camper as needed. The peer-support training was based on the self-efficacy (i.e., the belief in one's ability to do something) component of the social cognitive theory (Hausenblas & Rhodes, 2016). Self-efficacy can be sourced through personal master experiences (when an individual successfully completes a task) or through vicarious experiences, where the successes or failures of others are observed (Hausenblas & Rhodes, 2016).

Prior to camp, researchers consolidated registration paperwork, IEPs, and pre-camp interview transcripts to code using the ICF as a guide to develop individualized goals and functional profiles for each camper. After all functional profiles were created and goals were set, the research team tailored the Camp RAD Curriculum to include activities designed with each camper's goals in mind. Functional profiles were shared with all members of the research team and all camp staff members for preparation and for reference during the 4-week virtual Camp RAD.

During camp, participants were divided into small groups of 3-4. Group assignments considered age, interests, and functional abilities. Each group was led by a camp counselor who led them through the daily camp activities over Zoom. Other staff members (occupational therapists (OT), student observers) rotated through each Zoom group to lead other activities. Camp RAD was 3 hours per day, 4 days a week, for 4 weeks with the exception of the first week of camp, which was only 3 days long. Camp RAD

combined education with active and interactive interventions with a focus on life skills (e.g., meal preparation, activities of daily living) and PA. A state licensed OT guided the camp's interventions and provided support to participants and their attending peer support.

Instrumentation

Surveys

Subsections of the Patient-Reported Outcomes Measurement Information System (PROMIS®) measures were utilized both before and after camp. Subsections included evaluations of the participant's relationships with family members and peers, PA, strength, sleep, upper extremity function, stress, and feelings of meaning and purpose (Table 2). PROMIS measures use a Likert scale response format and are scored using a T-score metric, with a mean of 50 and a standard deviation of 10. Scores are calculated using item-level calibrations through the HealthMeasures scoring service (HealthMeasures). Higher scores equate to more of the concept being measured, therefore higher scores are not always more favorable.

PROMIS measures are validated and standardized to allow for universal comparison of outcome measures across diverse populations and sub-groups (HealthMeasures; Makhni et al., 2017). Individuals with DD may have trouble with literacy, memory, conceptualization, and attention necessary to complete PROMIS measures independently (Kramer & Schwartz, 2017; Schwartz et al., 2018). Therefore, parent-proxy versions of PROMIS pediatric measures have been developed to allow parents and caregivers to report measures on behalf of the child (Irwin et al., 2012).

Proxy item banks from the 8 pediatric parent-proxy PROMIS measures used were compiled into a single survey that was administered to parents and/or caregivers using Google Forms before and after camp.

Table 2*Summary of PROMIS Measures used*

PROMIS Measure	Validity and Reliability	Description	Favorable Scores
Parent Proxy Short Form v1.0 – Family Relationships 4a	(Bevans et al., 2017; Cox et al., 2020)	4 item measure used to evaluate campers’ relationships with their family from their caregiver’s perspective over the 4 weeks prior to the survey completion	Higher
Parent Proxy Item Bank v1.0 – PA – Short Form 4a	(Tucker et al., 2020; Tucker et al., 2014)	4 item measure used to evaluate campers’ PA from their caregiver’s perspective over the 7 days prior to the survey completion	Higher
Proxy Item Bank v1.0 – Strength Impact – Short Form 4a	(Tucker et al., 2014)	4 item measure used to evaluate campers’ physical strength from their caregiver’s perspective over the 7 days prior to the survey completion	Higher
Parent Proxy Bank v2.0 – Peer Relationships – Short Form 7a	(Irwin et al., 2012)	7 item measure used to evaluate campers’ relationships with their peers from their caregiver’s perspective over the 7 days prior to the survey completion	Higher
Parent Proxy Item Bank v2.0 – Upper Extremity– Short Form 8a	(Irwin et al., 2012)	8 item measure used to evaluate campers’ upper extremity function from their caregiver’s perspective over the 7 days prior to the survey completion	Higher
Parent Proxy Item Bank v1.0 – Sleep-Related Impairment – Short Form 4a	(Meltzer et al., 2020)	4 item measure used to evaluate campers’ impairments from sleep from their caregiver’s perspective over the 7 days prior to the survey completion	Lower
Parent Proxy Item Bank v1.0 – Meaning and Purpose –Short Form 4a	(Forrest et al., 2019)	4 item measure used to evaluate campers’ feelings of meaning and purpose from their caregiver’s perspective over their lifetime	Higher
Parent Proxy Item Bank v1.0 – Psychological Stress Experiences – Short Form 4a	(Bevans et al., 2018)	4 item measure used to evaluate campers’ stress from their caregiver’s perspective over the 7 days prior to the survey completion	Lower

Activity Monitors

Actigraph GT3X+ Activity monitors (Actigraph, Pensacola, Florida) were distributed at contactless pickup points at 4 different timepoints throughout the summer. Parents and caregivers were instructed to have their child put their activity monitors on by 8 pm on Saturday until the following Friday morning. Activity monitors were to be worn 24 hours a day except during showering or swimming. Instructional videos and written instructions were provided to the parents and/or legal guardians. Each participant was instructed to wear (n = 2) activity monitors at the hip and (n=2) at the ankle (total: n = 4) on the nondominant side (Modlesky et al., 2009). Researchers instructed participants to wear the (n = 4) activity monitors at a minimum of (n = 1) weekend day (i.e., Sunday) and (n = 4) weekdays. Instructions was based on previous findings that four days provide adequate validity and reliability of the activity monitor data (Trost et al., 2000; Whitney et al., 2017). Data were collected in 15-second epochs (Modlesky et al., 2009; Sit et al., 2019).

Data Analysis

PROMIS Surveys

PROMIS Surveys were scored using the HealthMeasures Scoring Service. Raw scores and T-scores for each survey (n = 7) are reported. Data were transferred to Microsoft Excel and uploaded to SPSS 28 (IBM, Armonk, NY, USA) for analysis. Change scores were calculated by subtracting the pre-camp score from the post-camp score. Data was analyzed for parametric statistical assumptions including outliers (i.e., boxplot for values greater than 1.5 lengths from the edge of the box) and normal distribution (i.e., Shapiro-Wilks Test). When data met parametric assumptions, data was analyzed using a paired *t*-test. T-scores are reported as mean difference (ΔM) (T-Scores Post-Camp – T-Scores Pre-Camp), and 95% confidence interval (95% *CI*) of the ΔM . Cohen's *d* effect sizes are reported. Cohen's *d* was calculated to determine effect sizes and interpreted according to Cohen (2013). When data contained outliers and violated normal distribution, a Wilcoxon Signed Rank Test (WSRT) was used to analyze related data for median differences. the median change. Data is reported as median (*Mdn*) and interquartile range (*IQR*). The alpha level was set to $\alpha = 0.05$.

Activity monitors

Activity monitor data were processed using ActiLife Software (Actigraph, Pensacola, FL, USA). Data were checked for outliers (i.e., values above ± 3) by studentized residuals. Data were checked for normality by the Shapiro-Wilks test. However, the RM-ANOVA is considered robust to deviations from normality. Lastly, data was checked for sphericity and when in violation, data was adjusted by considering the resultant epsilon. Epsilons greater than 0.75 were adjusted by the Huynh-Feldt correction whereas epsilons less than 0.75 were corrected by the Greenhouse-Geisser adjustment (Maxwell and Delaney, 2004). Vector magnitude counts (VMC) were analyzed using a three-way (location x day x time) repeated measures analysis of variance (RM-ANOVA) to examine effect of location (i.e., ankle vs. hip), day (i.e., weekend vs. weekday) and time (i.e., 1-week before camp, week 3 of camp, and 2-weeks post) on vector magnitude count (VMC). With a statistically significant 3-way RMANOVA, data were examined for simple two-way interactions. With statistically significant 2-way interactions, simple – simple main effects were examined. Post-hoc pairwise comparisons were adjusted with the Bonferroni correction for multiple comparisons.

CHAPTER 3

RESULTS

PROMIS Measures

Participant survey data was only included if both the pre-and post-survey were completed, which resulted in (n = 19) complete sets of surveys. All survey data was normally distributed ($p > 0.129$) except Strength Impact ($p = 0.009$). No severe outliers were detected. Comparison of pre vs. post PROMIS Measure outcomes are summarized in Table 3.

Table 3*PROMIS Measures Results*

	Mean (M) T-Score		ΔM	SD	ΔM 95% Confidence Interval		<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
	<i>Pre-Camp</i>	<i>Post-Camp</i>			<i>Lower Bound</i>	<i>Upper Bound</i>				
<i>Peer Relationships</i>	34.29	44.56	10.27	14.85	3.11	17.43	3.014	18	[†] 0.007	0.96
<i>Family Relationships</i>	52.21	53.19	0.99	7.92	-2.83	4.80	0.545	18	0.593	0.12
<i>Physical Activity</i>	47.24	52.17	4.93	7.86	1.14	8.71	2.73	18	[†] 0.014	0.61
<i>Sleep-Related Impairment</i>	53.74	51.52	-2.23	12.20	-8.11	3.66	-0.795	18	0.437	0.20
<i>Meaning and Purpose</i>	42.78	46.05	3.27	12.45	-2.73	9.27	1.145	18	0.267	0.33
<i>Psychological Stress Experiences</i>	55.65	52.77	2.88	8.91	-6.81	1.07	-1.533	18	0.143	0.26
<i>Upper Extremity Function</i>	34.33	35.97	1.64	3.12	0.14	3.15	2.295	18	[†] 0.034	0.14
	Median (Mdn) T-Score		ΔMdn	SE	ΔMdn Interquartile Range		Test Statistic	<i>n</i>	<i>p</i>	Cohen's <i>d</i>
[^] <i>Strength Impact</i>	39.80	39.80	0.50	1.62	4.60		68.00	19	0.115	0.23

Table 3: Parents or Guardians of the (n = 19) participants completed PROMIS surveys prior to (Pre-Camp) and after the 4-week virtual camp. (n = 7) of the (n = 8) PROMIS measures were evaluated by paired *t*-test. Strength Impact T-scores included (n = 6) outliers and was not normally distributed at Pre-Camp (p = 0.027) and post-Camp (p = 0.003). [^]As a result, Strength Impact T-Scores was evaluated using a Wilcoxon Signed Rank Test. [†]Alpha for all comparisons was set at $\alpha = 0.05$. Mean (*M*); Change Score (Δ); degrees of freedom (*df*); median (*Mdn*); standard error (*SE*)

Activity Monitors

Activity Monitors

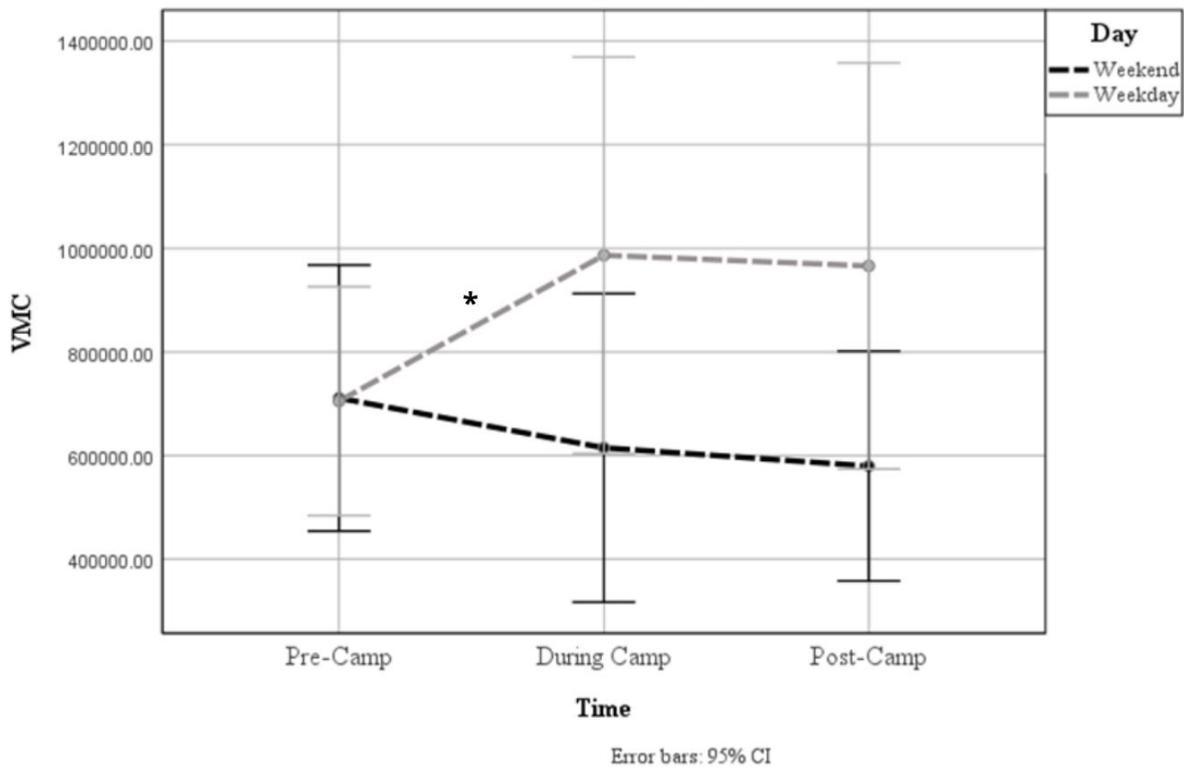
Participants who wore at least 1 activity monitor at the hip and 1 at the ankle a minimum of 1 weekend day (i.e., Sunday) and 1 weekday (e.g., Monday, Tuesday, Wednesday, Thursday, Friday) at each time point were included in the analysis. Data was collected approximately 1 week prior to camp, week 3 of the camp, and 2 weeks post-camp. As a result, (n = 14) of (n = 20) participants met these criteria.

A three-way repeated-measures ANOVA was conducted to determine the effects of location, day and time points on vector magnitude counts (VMC). Data did not contain outliers as assessed by studentized residuals greater than ± 3 standard deviations. Data were assessed by Shapiro-Wilk's test for normality. All data except Camp Weekday ANKLE ($p = 0.040$) were normally distributed ($p > .05$),. Mauchly's test of sphericity indicated that the assumption of sphericity was met for the three-way interaction, $\chi^2(2) = 0.351, p = 0.839$.

A 3-way interaction between location (i.e., ankle vs hip), day (i.e., weekend vs. weekday), and time (pre-camp, during camp, and post-camp) was detected, $F(2,20) = 6.714, p = 0.006, \eta^2 = 0.402$. Post-hoc analysis detected a statistical difference in VMC at the hip (Figure 1) and ankle (Figure 2) between Pre-Camp and Camp weekday measurements

Figure 1

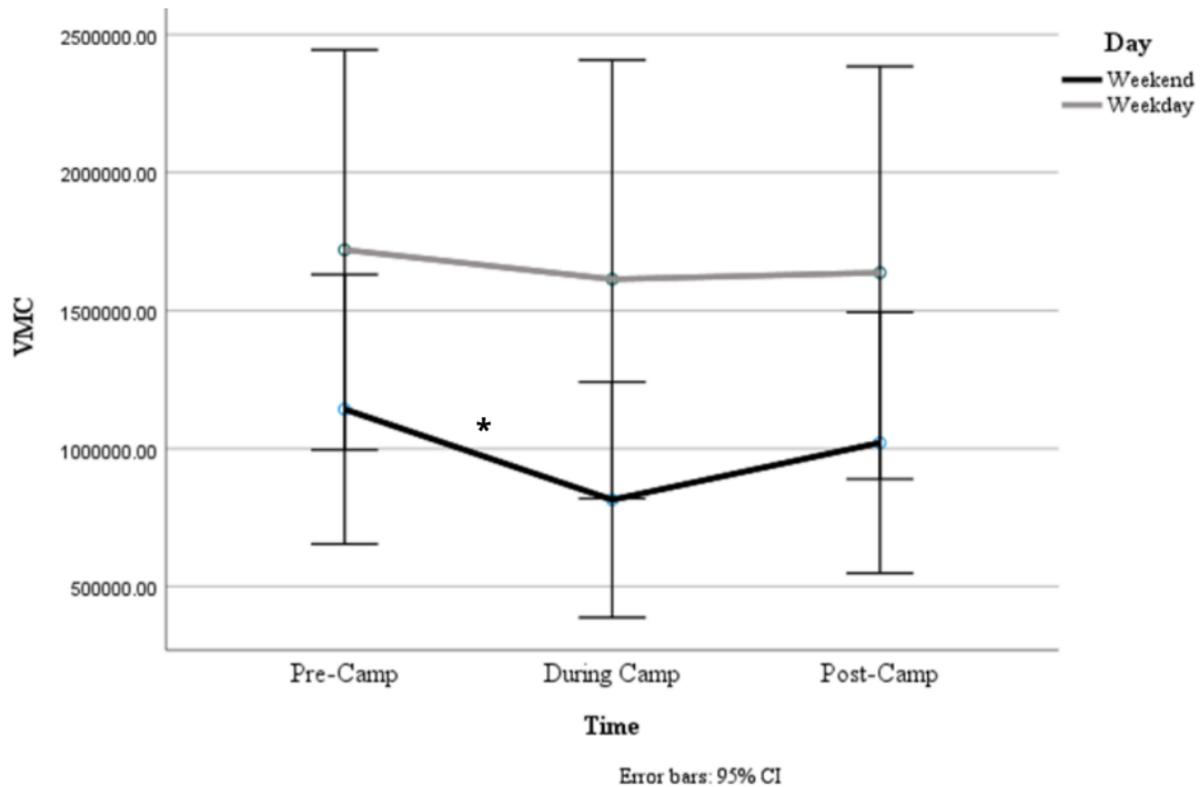
Hip - Vector Magnitude Count (VMC) at Pre-Camp, during Camp and Post-Camp



Note. The VMC at the hip during camp ($M = 986,757.79$, 95% CI: 603,860.55 to 1,369,655.03) was greater than Pre-Camp VMC ($M = 705,149.75$, 95% CI: 484,191.8 to 926,108.42), a ΔM of 281,608.041 (95% CI: 11,381.318 to 551,834.764), $*p = 0.041$

Figure 2

Ankle - Vector Magnitude Count (VMC) at Pre-Camp, during Camp and Post-Camp



Note. Differences in VMC measurements at the ankle during the weekend were statistically different.

The Ankle's weekend Pre-Camp VMC ($M = 1,142,839.90$, 95% CI: 654,678.10 to 1,631,001.69) was higher than Camp VMC ($M = 814,869.20$, 95% CI: 388,284.69 to 1,241,453.71), a ΔM of 327,970.70 (95% CI: 86,577.64 to 569,363.75), $*p = 0.009$.

A simple 2-way interaction between time and day was detected, $F(2,20) = 4.815, p = 0.020, \eta^2 = 0.325$. Post-hoc comparisons are outlined in Table 4. A simple 2-way interaction between time and location was detected, $F(2,20) = 8.291, p = 0.002, \eta^2 = 0.453$. Post hoc comparisons are outlined in Table 5. A simple 2-way interaction between location and day was detected, $F(1,10) = 15.508, p = 0.003, \eta^2 = 0.608$. Post hoc comparisons are outlined in Table 6.

A simple – simple main effect of day, ($F(1,10) = 24.357, p = 0.001, \eta^2 = 0.709$) was detected (Table 7). A simple – simple main effect of location was detected, ($F(1,10) = 8.149, p = 0.017, \eta^2 = 0.449$) (Table 8). Lastly, A simple – simple main effect of time was not detected, ($F(2, 20) = 0.581, p = 0.569, \eta^2 = 0.055$) (Table 9).

Table 4*Pairwise Comparison between Time and Day*

Time	Mean Difference	Std. Error	<i>p</i> -value	95% Confidence Interval for Difference	
	(Weekend – Weekday)			Lower Bound	Upper Bound
Pre-Camp	-285843.045*	65775.971	.001	-432401.042	-139285.048
Camp	-585396.003*	140999.696	.002	-899562.905	-271229.102
Post-Camp	-501262.232*	107173.496	.001	-740059.662	-262464.801

*. The mean difference is significant at the .05 level.

^b. Adjustment for multiple comparisons: Bonferroni.

Table 5*Pairwise Comparison between Time and Location*

Time	Mean Difference (Hip - Ankle)	Std. Error	p-value	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
Pre-Camp	-723533.191*	226248.182	.010	-1227645.556	-219420.825
Camp	-413507.413	191860.795	.057	-840999.903	13985.078
Post-Camp	-556587.486*	187438.733	.014	-974227.011	-138947.962

*. The mean difference is significant at the .05 level.

^b. Adjustment for multiple comparisons: Bonferroni.

Table 6*Pairwise Comparison between Location and Day*

Location	Mean Difference	Std. Error	<i>p</i> -value	95% Confidence Interval for Difference	
	(Weekend – Weekday)			Lower Bound	Upper Bound
Hip	-250844.371*	51081.451	.001	-364660.937	-137027.805
Ankle	-664156.483*	141721.543	.001	-979931.760	-348381.206

*. The mean difference is significant at the .05 level.

^b. Adjustment for multiple comparisons: Bonferroni.

Table 7*Simple - Simple Main Effect of Day*

Mean Difference (Weekend - Weekday)	Std. Error	<i>p</i> -value	95% Confidence Interval for Difference	
			Lower Bound	Upper Bound
-457500.427*	92699.979	.001	-664048.851	-250952.003

*. The mean difference is significant at the .05 level.

^b. Adjustment for multiple comparisons: Bonferroni.

Table 8*Simple -Simple Main Effect of Location*

Mean Difference (Hip - Ankle)	Std. Error	<i>p</i> -value	95% Confidence Interval for Difference	
			Lower Bound	Upper Bound
-564542.697*	197757.710	.017	-1005174.333	-123911.060

*. The mean difference is significant at the .05 level.

^b. Adjustment for multiple comparisons: Bonferroni.

Table 9*Simple - Simple Main Effect of Time*

I (Time)	J (Time)	Mean Difference (I - J)	Std. Error	p-value	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Pre	Camp	62241.087	42819.517	.530	-60654.033	185136.207
Camp	Post	-43630.714	72282.644	1.000	-251087.148	163825.720
Post	Pre	-18610.373	59049.350	1.000	-188086.293	150865.547

^b. Adjustment for multiple comparisons: Bonferroni.

CHAPTER 4

DISCUSSION AND CONCLUSION

The purpose of this study was to evaluate the effects of participation in a virtual camp for adolescents with DD during the COVID-19 pandemic on parent perceptions of psychosocial health via PROMIS measures and PA via accelerometry VMC outputs.

Physical Activity

VMC outputs differed pre-and post-camp based on the location of the activity monitor (hip vs. ankle). PA during camp did not lead to differences in VMC outputs between the hip and ankle. There is a lack of consensus on the best activity monitor wear location and data processing procedures for adolescents with DD (McGarty et al., 2014). Whitney et al. (2016) had participants with CP wear activity monitors on the ankle on the more affected side, while Johnson et al. (2009) and Modlesky et al. (2008) had participants with CP wear activity monitors on their waist on the more affected side, and Gorter (2012) had participants with CP wear one on the right hip. A study in 2020 had participants with Muscular dystrophy wear activity monitors on the wrist and ankle on their dominant side .(Arteaga et al., 2020) Another study published in 2019 had participants with a variety of disabilities including visually impaired and DD who wore activity monitors on their waist on the center of their backs (Lobenius-Palmér et al., 2018). We had a variety of camper diagnoses and functional abilities, and there is no “one size fits all” procedure for data collection and processing.

PA was greater during the weekday during camp and post-camp in comparison to pre-camp. Physical inactivity is problematic for adolescents with DD after-school and on weekends (Wouters et al., 2019). Future research should examine possible explanations for the decrease in activity over the weekend. Interventions targeting increasing PA during the weekend may also be beneficial. Summer is a period of time where adolescents lack routine, are more sedentary, and experience a loss of skill and learning (Alexander et al., 2016; Brookman et al., 2003). The absence of services and routines that adolescents with DD face over the summer was compounded by the COVID-19 pandemic. It is plausible

to say that Camp RAD helped establish habits and a routine that included being physically active among campers which continued after the conclusion of camp.

We failed to observe differences in PA as measured by VMC at the hip or ankle. Brazendale et al. (2020) also found that children attending summer day camps that took place in non-traditional locations were less physically active during the day camp than children who attended camps in gyms or recreational facilities (Brazendale et al., 2020). Arguably, a home-based virtual camp like Camp RAD could be considered a non-traditional location for a camp. While PA did not increase during or after attending Camp RAD, campers did not show regressions in PA levels, either.

The results of the PROMIS Parent-Proxy PA form suggest that there was an increase in PA after attending Camp RAD. While this is contradictory to the activity monitor data, the Pediatric PROMIS measures are valid and reliable measurements of the adolescent's lived experience (Tucker et al., 2020). Brazendale et al. (2020) suggests that summer day camps are a setting where many adolescents without disabilities meet PA guidelines. Although Brazendale et al. (2020) did not include summer camps for adolescents with DD, Clark and Nwokah (2010) suggest that adolescents with DD experience similar benefits from summer camp compared to adolescents without disabilities. This is supported by previous research that has shown that adolescents with DD who attend summer camps report increased PA (Clark & Nwokah, 2010).

Studies show that adolescents with disabilities who attend summer camps build and/or maintain peer relationships, and experience decreased feelings of isolation (Goodwin & Staples, 2005). There was a significant improvement in PROMIS Parent-Proxy Peer Relationships before and after camp. These results are especially promising as the COVID-19 pandemic increased feelings of isolation and decreased opportunities for participation that many people with disabilities already experience (Goldberg, 2021; Patel, 2020; Young et al., 2021).

While summer camps typically take place in person, other camps similar to Camp RAD had adapted to a virtual format in order to continue through the pandemic. While their data collection methods were different from the present study, there were some similarly reported outcomes. Camp Abilities, an

international sports camp model for adolescents with visual impairments, had two locations adapt to a virtual format during the pandemic (Lepore-Stevens et al., 2021). Participants of the virtual Camp Abilities reported feeling connected to the community and expressed that the camp helped them “start living a healthier lifestyle and stay active during quarantine” (Lepore-Stevens et al., 2021). Camp Abilities collected qualitative data only, providing unique insights into the camper’s experiences and perceived changes before and after camp. Only quantitative data was reported in this study, and the addition of qualitative data in the future may reveal more insights into changes or improvements in psychosocial health.

Adolescents rely on their families for many things as they grow up. Adolescents with DD face unique constraints to independence and therefore have increased reliance on their family for longer, if not indefinite periods of time to facilitate participation in activities of daily living such as PA. Participation in PA provides opportunities for adolescents to improve motor skill competency and health-related components of physical fitness such as muscular strength and endurance (Stodden et al., 2008). Motor skill competency, particularly in the upper extremity is an important component in completing activities of daily living such as bathing, counting money, and cooking, among other things which all contribute to independence (Balzi et al., 2010). Camp RAD is traditionally a summer day-camp where parents drop off their child and pick them up at the end of that same day. Due to the virtual nature of the camp during COVID-19, parents and other family members had the opportunity to participate in Camp RAD with their camper. Past studies have yielded some important insight into how participating in camps together as a family has a positive impact on family dynamics and relationships (Townsend & Van Puymbroeck, 2017; Youngblood, 2021). Townsend and Puymbroeck (2017) conducted interviews with parents who attended a 2-night, 2-day summer camp for families who have a child with autism. Youngblood (2021) examined “family members’ perspectives regarding family relationships as they relate to participation in an adapted summer camp [Rocky Mountain Adaptive] for children and adolescents living with a disability”. At this camp, family members attend a week-long overnight camp with their child who has a disability. Both of these camps differed from the virtual Camp RAD in that the virtual camp was completed in the home

while other things may have been going on compared to the two overnight camps where families spend their undivided attention at camp in an external environment.

Additionally, while some campers prefer to do activities and programs with their families, some campers prefer to do things without their family to feel an increased sense of independence (Youngblood, 2021). This was demonstrated during Camp RAD as well. While Camp RAD had requested that all campers have a peer support person present to participate in camp with their camper, there were some campers who participated without their family. It is fair to say that that these campers who did not have any family participate in the camp with them may not have seen improvements in family relationships.

Time is a barrier to participation in activities for adolescents with DD (Steinhardt et al., 2021). This includes time to travel to activities, time to find activities to participate in, and time supporting the adolescent with DD in participation; especially when comparing this with adolescents without a DD (Steinhardt et al., 2021). During the pandemic, some parents reported increased stress while trying to find activities for their children while also taking on increased workloads while working at home (Young et al., 2021). Some campers did have a peer support person who was not a parent, but a sibling or caretaker who is not a family member. Siblings do not always have opportunities to participate in PA or programs with their sibling who has a disability. Siblings who attended Rocky Mountain Adaptive with their sibling with a DD reported excitement about attending camp as a family (Youngblood, 2021). The parent-proxy measures collected for Camp RAD may not have reflected the changes or improvements in relationships among siblings or other family members who participated in Camp RAD, either.

Limitations

One of the limitations of this study was the broad range of diagnoses and abilities that fall under the definition of “developmental disabilities” among our campers. Other limitations include but are not limited to a small sample size and the lack of a control group.

The pandemic also imposed some additional limitations on this study. Due to the virtual nature, researchers were not able to check the activity monitors to make sure they were worn correctly by the participants. Campers and parents were fatigued by virtual environments by the time school was done,

leading to a lack of engagement at times by campers, who were able to stop participation at any time. When Camp RAD is held in person, it is easier to maintain camper engagement. Additionally, Camp RAD takes approximately one year to plan. Only 2 months prior to the start of Camp RAD was the decision made to adapt the curriculum to fit a virtual format. If a virtual camp were to be done again in the future, more advanced planning may lead to more significant results.

Parent-proxy measures may also be a limitation as the data is collected from the parent's perspective compared to the participant's perspective. However, parent-proxy measures were chosen because of the previously mentioned wide variety of diagnoses and ability of the campers, some of which may not have been able to complete the self-reported measures.

Conclusion

Participation in a virtual camp during the COVID-19 pandemic proved to be beneficial. Parents reported perceived improvements in PA and peer relationships and results did not indicate deteriorations family relationships, strength, upper extremity function, and meaning and purpose, or increases in sleep-related impairments or stress experiences. Overall, PA may not have increased during camp, but it was maintained throughout the summer.

REFERENCES

- AAIDD. *Definition of Intellectual Disability*. American Association on Intellectual and Developmental Disabilities. <https://www.aaidd.org/intellectual-disability/definition>
- Alexander, K., Pitcock, S., & Boulay, M. C. (2016). *The summer slide: What we know and can do about summer learning loss*. Teachers College Press.
<https://books.google.com/books?id=ZBu5DQAAQBAJ>
- Anaby, D., Ryan, M., Palisano, R. J., Levin, M. F., Gorter, J. W., Avery, L., Cormier, I., Teplicky, R., Coulter, J., & Hanes, J. (2021). Participation during a pandemic: Forging new pathways. *Physical & Occupational Therapy In Pediatrics, 41*(2), 115-119.
- Arteaga, D., Donnelly, T., Crum, K., Markham, L., Killian, M., Burnette, W. B., Soslow, J., & Buchowski, M. S. (2020). Assessing physical activity using accelerometers in youth with duchenne muscular dystrophy. *Journal of Neuromuscular Diseases, 7*(3), 331-342.
- Balzi, D., Lauretani, F., Barchielli, A., Ferrucci, L., Bandinelli, S., Buiatti, E., Milaneschi, Y., & Guralnik, J. M. (2010). Risk factors for disability in older persons over 3-year follow-up. *Age and Ageing, 39*(1), 92-98.
- Bevans, K. B., Gardner, W., Pajer, K. A., Becker, B., Carle, A., Tucker, C. A., & Forrest, C. B. (2018). Psychometric evaluation of the PROMIS® pediatric psychological and physical stress experiences measures. *Journal of Pediatric Psychology, 43*(6), 678-692.
- Bevans, K. B., Riley, A. W., Landgraf, J. M., Carle, A. C., Teneralli, R. E., Fiese, B. H., Meltzer, L. J., Ettinger, A. K., Becker, B. D., & Forrest, C. B. (2017). Children's family experiences: development of the PROMIS® pediatric family relationships measures. *Quality of Life Research, 26*(11), 3011-3023.
- Blauwet, C. A., Robinson, D., Riley, A., MacEwan, K., Patstone, M., & Dubon, M. E. (2020). Developing a virtual adaptive sports program in response to the COVID-19 pandemic. *PM & R: the Journal of Injury, Function, and Rehabilitation*.
- Blomqvist, S., Olsson, J., Wallin, L., Wester, A., & Rehn, B. (2013). Adolescents with intellectual disability have reduced postural balance and muscle performance in trunk and lower limbs compared to peers without intellectual disability. *Research in Developmental Disabilities, 34*(1), 198-206.
- Brazendale, K., Brazendale, A., Garcia, J. M., Leahy, N., McDonald, A. A., Kenney, M., Weaver, R. G., & Beets, M. W. (2020). Breaking tradition: Increasing physical activity and reducing sedentary time of children with developmental disabilities. *Disability and Health Journal, 13*(2), 100869.
- Brookman, L., Boettcher, M., Klein, E., Openden, D., Koegel, R. L., & Koegel, L. K. (2003). Facilitating social interactions in a community summer camp setting for children with autism. *Journal of Positive Behavior Interventions, 5*(4), 249-252.
- Burke, J. G., & Albert, S. M. (2014). *Methods for Community Public Health Research*. Springer.

- Carrasquillo, L., & Gerken, C. (2021). Promoting successful transitions for transition-aged youth with disabilities amid a pandemic. *American Occupational Therapy Association*.
- Carter, E. W., Swedeen, B., & Trainor, A. A. (2009). The other three months: Connecting transition-age youth with disabilities to meaningful summer experiences. *Teaching Exceptional Children*, 41(6), 18-26.
- Case, L., Ross, S., & Yun, J. (2020). Physical activity guideline compliance among a national sample of children with various developmental disabilities. *Disability and Health Journal*, 13(2), 100881.
- CDC. (2021, 12/14/2021). *People with Certain Medical Conditions*. Centers for Disease Control. <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html>
- Clark, M. K., & Nwokah, E. E. (2010). Play and learning in summer camps for children with special needs. *American Journal of Play*, 3(2), 238-261.
- Cooper, H. (2003). Summer learning loss: The problem and some solutions. *ERIC Digest*.
- Cox, E. D., Connolly, J. R., Palta, M., Rajamanickam, V. P., & Flynn, K. E. (2020). Reliability and validity of PROMIS® pediatric family relationships short form in children 8–17 years of age with chronic disease. *Quality of Life Research*, 29(1), 191-199.
- Dykens, E. M., Rosner, B. A., & Butterbaugh, G. (1998). Exercise and sports in children and adolescents with developmental disabilities: Positive physical and psychosocial effects. *Child and Adolescent Psychiatric Clinics of North America*, 7(4), 757-771.
- Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., & Payne, W. R. (2013). A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *International Journal of Behavioral Nutrition and Physical Activity*, 10(1), 1-21.
- Einarsson, I. Ó., Ólafsson, Á., Hinriksdóttir, G., Jóhannsson, E., Daly, D., & Arngrímsson, S. A. (2015). Differences in physical activity among youth with and without intellectual disability. *Medicine & Science in Sports & Exercise*, 47(2), 411-418.
- Forrest, C. B., Bevans, K. B., Filus, A., Devine, J., Becker, B. D., Carle, A. C., Teneralli, R. E., Moon, J., & Ravens-Sieberer, U. (2019). Assessing children's eudaimonic well-being: The PROMIS pediatric meaning and purpose item banks. *Journal of pediatric psychology*, 44(9), 1074-1082.
- Fowler, E. G., Kolobe, T. H., Damiano, D. L., Thorpe, D. E., Morgan, D. W., Brunstrom, J. E., Coster, W. J., Henderson, R. C., Pitetti, K. H., & Rimmer, J. H. (2007). Promotion of physical fitness and prevention of secondary conditions for children with cerebral palsy: Section on pediatrics research summit proceedings. *Physical therapy*, 87(11), 1495-1510.
- Fragala-Pinkham, M. A., Haley, S. M., & Goodgold, S. (2006). Evaluation of a community-based group fitness program for children with disabilities. *Pediatric Physical Therapy*, 18(2), 159-167. <https://doi.org/10.1097/01.pep.0000223093.28098.12>

- Garcia, J. M., Leahy, N., Rivera, P., Brazendale, K., & Rice, D. J. (2020). The association among demographic factors, health behaviors and sleep quality in youth with autism spectrum disorder. *Disability and Health Journal*, *13*(3), 100885.
- Goldberg, S. B. (2021). Education in a pandemic: The disparate impacts of COVID-19 on America's students. *USA: Department of Education*.
- Goldman, S. E., Richdale, A. L., Clemons, T., & Malow, B. A. (2012). Parental sleep concerns in autism spectrum disorders: variations from childhood to adolescence. *Journal of Autism and Developmental Disorders*, *42*(4), 531-538.
- Goodwin, D. L., & Staples, K. (2005). The meaning of summer camp experiences to youths with disabilities. *Adapted Physical Activity Quarterly*, *22*(2), 160-178.
- Hausenblas, H., & Rhodes, R. E. (2016). *Exercise psychology: Physical activity and sedentary behavior*, Jones & Bartlett Publishers.
- HealthMeasures. *HealthMeasures Scoring Service*. https://www.assessmentcenter.net/ac_scoringervice
- HealthMeasures. *PROMIS® (Patient-Reported Outcomes Measurement Information System)*. HealthMeasures. <https://www.healthmeasures.net/explore-measurement-systems/promis>
- Irwin, D. E., Gross, H. E., Stucky, B. D., Thissen, D., DeWitt, E. M., Lai, J. S., Amtmann, D., Khastou, L., Varni, J. W., & DeWalt, D. A. (2012). Development of six PROMIS pediatrics proxy-report item banks. *Health and quality of life outcomes*, *10*(1), 1-13.
- Jackson, D., & Bowdon, J. (2020). Spotlight on students with disabilities. *American Institutes for Research*.
- Jan, J. E., Owens, J. A., Weiss, M. D., Johnson, K. P., Wasdell, M. B., Freeman, R. D., & Ipsiroglu, O. S. (2008). Sleep hygiene for children with neurodevelopmental disabilities. *Pediatrics*, *122*(6), 1343-1350.
- Jesus, T. S., Bhattacharjya, S., Papadimitriou, C., Bogdanova, Y., Bentley, J., Arango-Lasprilla, J. C., & Kamalakannan, S. (2021). Lockdown-related disparities experienced by people with disabilities during the first wave of the COVID-19 pandemic: Scoping review with thematic analysis. *International Journal of Environmental Research and Public Health*, *18*(12), 6178.
- Jesus, T. S., Kamalakannan, S., Bhattacharjya, S., Bogdanova, Y., Arango-Lasprilla, J. C., Bentley, J., Landry, M. D., & Papadimitriou, C. (2021). PREparedness, REsponse and SySTemic transformation (PRE-RE-SyST): A model for disability-inclusive pandemic responses and systemic disparities reduction derived from a scoping review and thematic analysis. *International Journal for Equity in Health*, *20*(1), 1-17.
- Johnson, C. C. (2009). The benefits of physical activity for youth with developmental disabilities: A systematic review. *American Journal of Health Promotion*, *23*(3), 157-167. <https://doi.org/10.4278/ajhp.070930103>
- Kingsnorth, S., Healy, H., & Macarthur, C. (2007). Preparing for adulthood: A systematic review of life skill programs for youth with physical disabilities. *Journal of Adolescent Health*, *41*(4), 323-332.

- Kotagal, S., & Broomall, E. (2012). Sleep in children with autism spectrum disorder. *Pediatric Neurology*, 47(4), 242-251.
- Kramer, J. M., & Schwartz, A. (2017). Reducing barriers to patient-reported outcome measures for people with cognitive impairments. *Archives of Physical Medicine and Rehabilitation*, 98(8), 1705-1715.
- Lepore-Stevens, M., Adams, D., Lepore, M., & Foster, E. A. (2021). Camp abilities: Accessibility and virtual summer camps. *Journal of Park & Recreation Administration*, 39(4).
- Lobenius-Palmér, K., Sjöqvist, B., Hurtig-Wennlöf, A., & Lundqvist, L.-O. (2018). Accelerometer-assessed physical activity and sedentary time in youth with disabilities. *Adapted Physical Activity Quarterly*, 35(1), 1-19.
- Makhni, E. C., Meadows, M., Hamamoto, J. T., Higgins, J. D., Romeo, A. A., & Verma, N. N. (2017). Patient Reported Outcomes Measurement Information System (PROMIS) in the upper extremity: the future of outcomes reporting? *Journal of Shoulder and Elbow Surgery*, 26(2), 352-357.
- Martin, J. J. (2006). Psychosocial aspects of youth disability sport. *Adapted Physical Activity Quarterly*, 23(1), 65-77.
- McGarty, A. M., Penpraze, V., & Melville, C. A. (2014). Accelerometer use during field-based physical activity research in children and adolescents with intellectual disabilities: A systematic review. *Research in Developmental Disabilities*, 35(5), 973-981.
- Meltzer, L. J., Forrest, C. B., de la Motte, A., & Bevans, K. B. (2020). Clinical validity of the PROMIS pediatric sleep measures across populations of children with chronic illnesses and neurodevelopment disorders. *Journal of Pediatric Psychology*, 45(3), 319-327.
- Modlesky, C. M., Kanoff, S. A., Johnson, D. L., Subramanian, P., & Miller, F. (2009). Evaluation of the femoral midshaft in children with cerebral palsy using magnetic resonance imaging. *Osteoporosis International*, 20(4), 609-615.
- Navas, P., Amor, A. M., Crespo, M., Wolowiec, Z., & Verdugo, M. Á. (2021). Supports for people with intellectual and developmental disabilities during the COVID-19 pandemic from their own perspective. *Research in Developmental Disabilities*, 108, 103813.
- Odom, S. L., Horner, R. H., & Snell, M. E. (2009). *Handbook of Developmental Disabilities*. Guilford Publications.
- Patel, K. (2020). Mental health implications of COVID-19 on children with disabilities. *Asian Journal of Psychiatry*, 54, 102273.
- Perić, D., Milićević-Marinković, B., & Djurović, D. (2021). The effect of the adapted soccer programme on motor learning and psychosocial behaviour in adolescents with down syndrome. *Journal of Intellectual Disability Research*.
- Quinn, D. M., & Polikoff, M. (2017). *Summer learning loss: What is it, and what can we do about it?* Brookings Institute. <https://www.brookings.edu/research/summer-learning-loss-what-is-it-and-what-can-we-do-about-it/>

- Rimmer, J., Yamaki, K., Lowry, B. D., Wang, E., & Vogel, L. (2010). Obesity and obesity-related secondary conditions in adolescents with intellectual/developmental disabilities. *Journal of Intellectual Disability Research, 54*(9), 787-794.
- Sabatello, M., Landes, S. D., & McDonald, K. E. (2020). People with disabilities in COVID-19: Fixing our priorities. *The American Journal of Bioethics, 20*(7), 187-190.
- Schwartz, A. E., Kramer, J. M., & Longo, A. L. (2018). Patient-reported outcome measures for young people with developmental disabilities: incorporation of design features to reduce cognitive demands. *Developmental Medicine & Child Neurology, 60*(2), 173-184.
- Sit, C. H., Huang, W. Y., Yu, J. J., & McKenzie, T. L. (2019). Accelerometer-assessed physical activity and sedentary time at school for children with disabilities: Seasonal variation. *International Journal of Environmental Research and Public Health, 16*(17), 3163.
- Steinhardt, F., Ullenhag, A., Jahnsen, R., & Dolva, A.-S. (2021). Perceived facilitators and barriers for participation in leisure activities in children with disabilities: perspectives of children, parents and professionals. *Scandinavian Journal of Occupational Therapy, 28*(2), 121-135.
- Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest, 60*(2), 290-306.
- Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B., Hergenroeder, A. C., Must, A., Nixon, P. A., & Pivarnik, J. M. (2005). Evidence based physical activity for school-age youth. *The Journal of Pediatrics, 146*(6), 732-737.
- Tietze, A.-L., Blankenburg, M., Hechler, T., Michel, E., Koh, M., Schlüter, B., & Zernikow, B. (2012). Sleep disturbances in children with multiple disabilities. *Sleep Medicine Reviews, 16*(2), 117-127.
- Townsend, J. A., & Van Puymbroeck, M. (2017). Parental perceptions of changes in family well-being following participation in a camp: Experiences of families with a child with ASD. *Therapeutic Recreation Journal, 51*(2), 143.
- Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (2000). Using objective physical activity measures with youth: How many days of monitoring are needed? *Medicine & Science in Sports & Exercise, 32*(2), 426.
- Tucker, C. A., Bevans, K. B., Becker, B. D., Teneralli, R., & Forrest, C. B. (2020). Development of the PROMIS pediatric physical activity item banks. *Physical Therapy, 100*(8), 1393-1410.
- Tucker, C. A., Bevans, K. B., Teneralli, R. E., Smith, A. W., Bowles, H. R., & Forrest, C. B. (2014). Self-reported pediatric measures of physical activity, sedentary behavior and strength impact for PROMIS®: Conceptual framework. *Pediatric Physical Therapy, 26*(4), 376.
- Turk, M. A., Landes, S. D., Formica, M. K., & Goss, K. D. (2020). Intellectual and developmental disability and COVID-19 case-fatality trends: TriNetX analysis. *Disability and Health Journal, 13*(3), 100942.

- Vincenzo, J. L., Hergott, C., Schrod, L., Rohrer, B., Brach, J., Tripken, J., Shirley, K. D., Sidelinker, J. C., & Shubert, T. E. (2021). Capitalizing on virtual delivery of community programs to support health and well-being of older adults. *Physical Therapy, 101*(4), pzab001.
- Volkmar, F. R., & Volkmar, F. R. (2013). *Encyclopedia of autism spectrum disorders*. Springer New York, NY.
- Wachob, D., & Lorenzi, D. G. (2015). Brief report: influence of physical activity on sleep quality in children with autism. *Journal of Autism and Developmental Disorders, 45*(8), 2641-2646.
- Whitney, D. G., Singh, H., Miller, F., Barbe, M. F., Slade, J. M., Pohlig, R. T., & Modlesky, C. M. (2017). Cortical bone deficit and fat infiltration of bone marrow and skeletal muscle in ambulatory children with mild spastic cerebral palsy. *Bone, 94*, 90-97.
- WHO. (2001). *International classification of functioning, disability, and health : ICF*. World Health Organization.
- WHO. (2002). *Towards a Common Language for Functioning, Disability, and Health ICF*. World Health Organization.
- Wouters, M., Evenhuis, H. M., & Hilgenkamp, T. I. (2019). Physical activity levels of children and adolescents with moderate-to-severe intellectual disability. *Journal of Applied Research in Intellectual Disabilities, 32*(1), 131-142.
- Young-Southward, G., Cooper, S.-A., & Philo, C. (2017). Health and wellbeing during transition to adulthood for young people with intellectual disabilities: A qualitative study. *Research in Developmental Disabilities, 70*, 94-103.
- Young, E., Milligan, K., Henze, M., Johnson, S., & Weyman, K. (2021). Caregiver burnout, gaps in care, and COVID-19: Effects on families of youth with autism and intellectual disability. *Canadian Family Physician, 67*(7), 506-508.
- Youngblood, J. (2021). *Adapted Physical Activity Camps: Family Experiences and Implications for Family Relationships* [Master's thesis, University of Calgary].The Vault.
https://prism.ucalgary.ca/bitstream/handle/1880/113648/ucalgary_2021_youngblood_jessica.pdf?sequence=2
- youth.gov. *Employment and Postsecondary Education*. <https://youth.gov/youth-topics/employment-and-postsecondary-education>