

Spring 2019

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Kayla E. Wilson

The University of Akron, kew69@zips.uakron.edu

Please take a moment to share how this work helps you [through this survey](#). Your feedback will be important as we plan further development of our repository.

Follow this and additional works at: https://ideaexchange.uakron.edu/honors_research_projects

Part of the [Other Rehabilitation and Therapy Commons](#), [Recreational Therapy Commons](#), [Social and Behavioral Sciences Commons](#), and the [Sports Sciences Commons](#)

Recommended Citation

Wilson, Kayla E., "The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder" (2019). *Williams Honors College, Honors Research Projects*. 986.

https://ideaexchange.uakron.edu/honors_research_projects/986

This Honors Research Project is brought to you for free and open access by The Dr. Gary B. and Pamela S. Williams Honors College at IdeaExchange@UAkron, the institutional repository of The University of Akron in Akron, Ohio, USA. It has been accepted for inclusion in Williams Honors College, Honors Research Projects by an authorized administrator of IdeaExchange@UAkron. For more information, please contact mjon@uakron.edu, uapress@uakron.edu.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism
Spectrum Disorder
Kayla E. Wilson
The University of Akron
April 2019

Table of Contents

ABSTRACT.....3
CHAPTER
 I. INTRODUCTION.....4
 II. LITERATURE REVIEW.....5
 III. METHODS.....11
 IV. RESULTS.....13
 V. DISCUSSION.....16
 VI. EXPERIENCE.....19
WORKS CITED20
APPENDICES
 A. VERBAL SCRIPT.....23
 B. INFORMED CONSENT DOCUMENTATION.....24
 C. SLEEP LOG AND SURVEY INSTRUCTION.....26
 D. SLEEP LOG AND SURVEY INSTRUMENTS.....27

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Abstract

Autism Spectrum Disorder (ASD) may alter not only cognitive but also physical aspects of individuals. One physical element that is commonly impacted by ASD is sleep pattern. In fact, there is a large margin of sleep disturbances in the ASD population compared to typically functioning individuals. **PURPOSE:** To examine the effect of various levels of physical activity intensity in an aquatic setting and the impact on sleep quality. The question in focus is simply, “What is the effect of swimming exercise on quality and amount of sleep for children with Autism Spectrum Disorder?” **METHODS:** Guardians of children with Autism Spectrum Disorder between the ages of 4-13 years and taking swim lessons at the Kohl Family YMCA were considered for the study. The children participated in two aquatic exercise sessions each week with each session lasting 30 minutes. These days were also recorded for sleep patterns by parents/guardians into a sleep log and evaluated in the survey. **RESULTS:** Average sleep per night ranged between 8.57 and 9.93 hours (N=6). Only one participant had a recorded sleep disturbance on one night during the study period. The result of the t-test is a p value of 0.14 so there is statistically no difference between the aquatic exercise and non-aquatic exercise nights. However, there is an overall trend for more sleep on non-swim days for 5 of the 6 children. **DISCUSSION:** The insignificant data could be due to the amount of external physical activity performed. The guardians’ survey responses reveal perceived improved sleep in their children on nights of aquatic exercise, although this is not made significantly clear in the results obtained from the sleep log. If the observational period is longer there may be a greater likelihood of more sleep disturbances occurring thus helping to draw stronger conclusions.

Introduction

Autism Spectrum Disorder (ASD) is a cognitive disorder with limitations of communication, social interaction and repetitive behaviors (Hodgson, Grahame, Garland, Gaultier, Lecouturier, & Le Couteur, 2018). ASD may alter not only cognitive but also physical aspects of individuals. One physical element that is commonly impacted by ASD is sleep pattern. Inconsistent sleep such as disturbances, trouble falling asleep or being very active during sleep are among common sleep issues experienced by individuals with ASD. In fact, there is a large margin of sleep disturbances in the ASD population compared to typically functioning individuals. Lawson & Little (2017) highlight factors specific to ASD that may underlie many common sleep difficulties, including: a) biological abnormalities affecting circadian rhythm and melatonin levels, b) the relationship between core features of ASD and sleep problems and c) the relationship of sleep disorders to psychopathology. It has been established that being more physically active assists individuals to prepare for and increase the quality of their sleep (Lawson & Little 2017). Aquatic exercise has appeared to be a beneficial match to ASD individuals by providing sensory stimulation, a social environment and of course physical activity (Aleksandrovic, Jorgic, Block & Jovanovic, 2015).

Given that being physically active improves sleep for all individuals whether or not they have ASD, the purpose of the study is to examine the effect of various levels of physical activity intensity in an aquatic setting and the impact on sleep quality in children with Autism Spectrum Disorder.

Literature Review

Autism Spectrum Disorder (ASD) is a cognitive disorder that influences the lives of those with the disorder and many others around them. The range of severity of the disorder is wide, with possibility of multiple aspects being impacted (Hodgson, Grahame, Garland, Gaultier, Lecouturier, & Le Couteur, 2018). The disorder is found more frequently in males than females and the overall prevalence continues to rise. ASD is summarized by developmental delays, impairments in social interaction and communication with repetitive behaviors and behaviors causing impairment to daily activities (Schmitz Olin et al., 2017). In ASD, restricting repetitive behaviors typically include repetitive motor mannerisms, rigid adherence to specific routines, highly circumscribed interests and extreme responses to everyday sensory experiences which are often extremely challenging for parents to understand and learn how to manage (Hodgson et al., 2018).

Maintaining a consistent daily schedule is important to limit external variables for those with ASD; this limits stimuli and helps focus on the tasks at hand (Verstrat & Hedges, 2015). Some common behaviors that accompany the disorder may be self-stimulating such as fidgeting, finger snapping and other movements that help with focus. Some individuals respond positively to certain types of stimulation whether physical, emotional or intellectual (Murdock, Dantzer, Walker & Wood, 2014).

Autism Spectrum Disorder and Exercise

Children with ASD may be at risk for being physically inactive because characteristics of the disability that interfere with successful participation in traditional forms of physical activity (Sandt & Frey, 2005). In addition to the limiting elements of the disorder, ASD also increases likelihood of being overweight due to limited appropriate physical activity depending on severity

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

(Yilmaz, Yanardağ, Birkan, & Bumin, 2004).

Functional independence of individuals with ASD is hindered along with the lack of physical activity. Aside from the notable health risks with being inactive and overweight, exercise could provide benefits in areas such as behaviors, school readiness, academic engagement and motor skills (Verstrat & Hedges, 2015). A meta-analysis of eight studies were summarized by Schmitz Olin et al. (2017), with results showing aerobic exercise to reduce self-stimulating behaviors such as fidgeting or pacing performed by those with ASD possibly due to the fatigue factor.

Individuals with autism spectrum disorder have fewer outlets to perform physical activity than those without the disorder. There are independence barriers that some ASD individuals are unable to overcome, therefore only certain modes of exercise are feasible. Modes with the barriers present include: riding a bike to school, going on a run, or any type of activity without supervision (Sandt & Frey, 2005). As previously mentioned, maintaining a consistent schedule is also very important for those with the disorder, therefore, participating in different types of physical activity that do not provide structure are difficult (Verstrat & Hedges, 2015).

Coaches and trainers should have experience with this population before taking on the responsibility to work with these individuals. Some studies focus on the ACSM recommended amount and modes of exercise, which are not appropriate for this population, thus not producing beneficial results (Aleksandrovic, Jorgic, Block & Jovanovic, 2015). The American College of Sports Medicine recommendations are difficult for this population to meet due to difficulty to perform these tasks alone and the difficulty some of the modes of exercise present.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Aleksandrovic et al., 2015 compares three studies performed and their relevance to this group of children. The authors concluded adaptations certainly need to be made for the severity of the disorder and ASD children should not be compared to normal functioning children in the age range.

The intensity of exercise or level of exertion could also produce an array of results on ASD individuals, however there is some ambiguity in the intensity of previously conducted experiments due to inconsistency of terms. Although vigorous exercise is a relative term, in a constructed schedule, vigorous physical activity can reduce off-task behaviors and improve desired learning outcomes (Verstrat & Hedges, 2015). There appears to be a positive correlation with an increase in intensity of exercise and reduction in self-stimulating behavior; this could be due to the fatigue factor thus performing less movements due to less energy remaining (Schmitz Olin et al., 2017). Monitoring a quantitative value for individuals with ASD during exercise can produce difficulty; for example, there may be unwanted stimulation provided by a heart rate monitor or a cognitive limitation to express rate of perceived exertion. Depending on the exercise mode, some monitors may not bother individuals, however monitoring radial heart rate appears to be a common resolution to this difficulty. Duration of exercise bout does not have the same correlation as intensity. Exercise could be used as a sensory break in school or physical stimulation for enjoyment, however anything over 10 minutes has appeared to have less of an effect on behavior (Schmitz Olin et al., 2017).

Autism and Aquatic Exercise

Individuals with ASD have a desire of self-stimulation that could be fulfilled by exercising in the water thus making aquatic exercise a positive outlet of exercise (Kraft, E., & Leblanc, R. 2018). Water provides sensory input which is appreciated by many with ASD.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Swimming is a repetitive mode of exercise which requires fewer social cues, both elements beneficial to ASD individuals (Verstrat & Hedges, 2015). Most swim programs have a routine and schedule adapted for students that may require consistency. It has been shown that aquatic activities are among the preferred forms of physical activity for persons with a disability, including children with ASD. A program designed specifically for individuals with ASD has shown adaptations for these students through visual supports, sensory supports, communication strategies, physical supports and modeling (Kraft & Leblanc, 2018). One effective program summarized by Lawson & Little (2017), is Sensory Enhanced Aquatics. It was a twice-weekly program with one-on-one lessons with instructors. However, at the beginning and end of each session social opportunities were presented in the form of songs or games.

In addition to the physical benefits provided by aquatic programs, such programs may prevent drowning, a leading cause of death for children with ASD (Schmitz Olin, 2017). The more children understand the necessary precautions with water, the safer they will be. Even if ASD individuals are not performing strokes with the most precise techniques, they are learning how to be safe around water and are being physically active. In a 10-week study conducted by Yilmaz et. al (2004), children with autism learned two skills much quicker than the rest of the skills in a swim program designed for normal-functioning children. These two skills were kicking on back and exiting the pool using the ladder or side of the pool (Huettig & Darden-Melton, 2004). Other feedback provided by guardians with regard to the sensory enhanced aquatics include: 64.3% of parents stated their children were more active during and outside of the program, 60% noted improved sleep patterns, 20% improved eating patterns, 10% increased willingness to potty train, 10% showed more readiness toward physical activity, and 10% showed increased listening skills. The magnitude of the effects could be impacted by age,

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

amount of sessions missed, severity of autism, sensory seeking and sensory avoiding (Lawson & Little, 2017). A different 10-week study using a case study method showed improvements in typical behaviors of ASD such as spinning, rocking, and echolalia. The authors found that the program enhanced the child's balance, agility, muscle strength and cardiovascular fitness (Caputo et al., 2018).

Autism and Sleep

Inconsistent sleep and sleep disturbances are a common symptom of Autism Spectrum Disorder. The prevalence of sleep problems is found to be 66.1% in children with ASD compared to the 45% in typically developing children (Oriel, Kanupka, DeLong & Noel, 2016). Sleep latency, activity during sleep, and length of time awake during the night are all considered sleep disturbances. ASD individuals may lack 2-3 hours of sleep per night due to these dysfunctions (Johnson, Giannotti, Ivanenko & Cortesi, 2009). One week of sleep monitoring confirmed more difficulty in falling asleep in the children with high functioning autism. These individuals also went to bed earlier and spent a longer time in bed before sleep was initiated compared to typical functioning individuals (Allik, Larsson, & Smedje, 2006). Because a correlation of time duration and pattern is lacking, the cognitive aspect clearly plays more of a role than expected.

Another related element of ASD is depression or anxiety; these two disorders bring the comorbidity of irregular sleep patterns to the equation as well (Johnson et al., 2009). One difficulty in collecting research on sleep for individuals with ASD is that it is typically reported by parents; this could limit the validity of information unless the parent notices the sleep disturbance. According to parental reports, night awakenings also commonly occur in children with ASD. Periods of nocturnal awakening lasting for up to 2–3 hours have been reported when

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

the child may simply laugh, talk, scream, or get up and play with toys or various objects in the room. Lack of sleep could lead to worsening of other symptoms of the disorder (Cortesi, Giannotti, Ivanenko, & Johnson 2010). It has been proposed that disturbed sleep-wake patterns and abnormal hormonal profiles suggest an underlying impairment of the circadian timing system in children with ASD (Glickman, 2010). Lawson & Little's (2017), "The Biopsychosocial Model of Sleep" illustrates factors specific to ASD that may underlie many common sleep difficulties, including "a) biological abnormalities affecting circadian rhythm and melatonin levels, b) the relationship between core features of ASD and sleep problems and c) the relationship of sleep disorders to psychopathology" (p.98). Because the correlation of time duration does not match sleep pattern, the cognitive aspect clearly plays more of a role than expected.

Non-biological factors such as family, social status, access to services, and family life could also impact ASD individuals but these are elements that do not have a limiting effect on every individual. If poor sleeping habits, routines and schedules are not addressed, other behavioral interventions will be unsuccessful.

Aquatic Exercise and Sleep for Children with ASD

Given that physical activity improves sleep behavior for typical developing individuals, the extent to which physical intervention via aquatic exercise impact the sleeping patterns in children with ASD is still unclear (Lawson & Little, 2017). Oriel et al.'s (2016) study, *The Impact of Aquatic Exercise on Sleep Behaviors in Children With Autism Spectrum Disorder: A Pilot Study*, concluded that participation in the aquatic exercise program may have led to improved sleep habits. Study participants slept longer and fell asleep faster post-aquatic exercise. Due to the structure of aquatic workouts for ASD individuals, this mode of exercise

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

seems to be the best match for getting these individuals physically active. However, there is paucity in the equation to due to limited studies performed on the topic. This study will help determine whether aquatic exercise has an impact on the duration or quality of sleep in children with ASD.

Methods

Parents/guardians were made aware of the research project during their child's regular swim lessons. A verbal script, found in Appendix A, was read to potential participants after the Institutional Review Board approval was obtained, and a consent form, found in Appendix B, was collected from each participant. Although the Principal Investigator was aware the existing relationship of being their child's swim instructor had the potential to unduly persuade parents/guardians to participate, it was necessary to recruit from existing participants due to the level of trust and cooperation needed to work with children with ASD.

Guardians of children with Autism Spectrum Disorder between the ages of 4-13 years taking swim lessons at the Kohl Family YMCA were considered to take part in the one-week study. The potential sample pool was comprised of guardians of ASD students already voluntarily taking part in the Principal Investigator's swim classes. The children participated in two aquatic exercise sessions each week with each session lasting 30 minutes. The aerobic exercise pool at the Kohl Family YMCA was utilized for all of the lessons thus controlling the variables of the setting.

After obtaining informed consent, instructions of the sleep log and survey, found in Appendix C, were provided to the parent/guardian. Each was encouraged to provide details such as the time their child went to sleep or how much awake time occurred during the night.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Guardians were instructed to record sleep in minutes. They were also instructed to count and record sleep disturbances. Time to bed and time awake were to be rounded to 15 minutes. Notes regarding sleep disturbances/quality were also to be provided in the sleep log.

Since each student with ASD is vastly different in motor ability, each was performing different tasks during their session. Each participant had two 30-minute swim lesson sessions during data collection. The intercession days and the post-exercise days were between the sessions and after the session respectively. These days were also recorded for sleep patterns by parents/guardians. The sleep log and survey questions are included in Appendix D. For the results of the sleep changes to be significant, the critical be value is less than .05.

The survey was formatted as a Likert scale and allowed parents to score their children's quality of sleep in a quantitative way. From disagree (1), to indifferent (3), to agree (5), the parents were able to select how the statements relate to their child's sleep patterns during the study. The log consisted of the sleep data but the survey was designed to help draw conclusions and parent opinions based on their children's sleep.

The sleep logs/surveys were collected from guardians one week after they were distributed. A match list of subject names was kept on the PI's password protected computer. After entering information from the subject logs as Subject 1, Subject 2, Subject 3, etc. the sleep logs/surveys were either returned to parent or shredded according to parent/guardian wishes.

Results

At the end of the week aquatic exercise session, all logs and surveys were collected by the PI. Guardians of six (6) ASD students participated in the study. The sleeping patterns for nights in which the sessions had not occurred served as a baseline for each student. The study was a within-subjects design; thus, the student data was not compared to one other on a daily basis but instead the overall change per student was examined.

Figure 1 shows the average hours of sleep throughout the week per participant. The average ranged between 8.57 and 9.93 hours of sleep per night among the ASD children (N=6). Only one participant had a recorded sleep disturbance on one night during the study period.

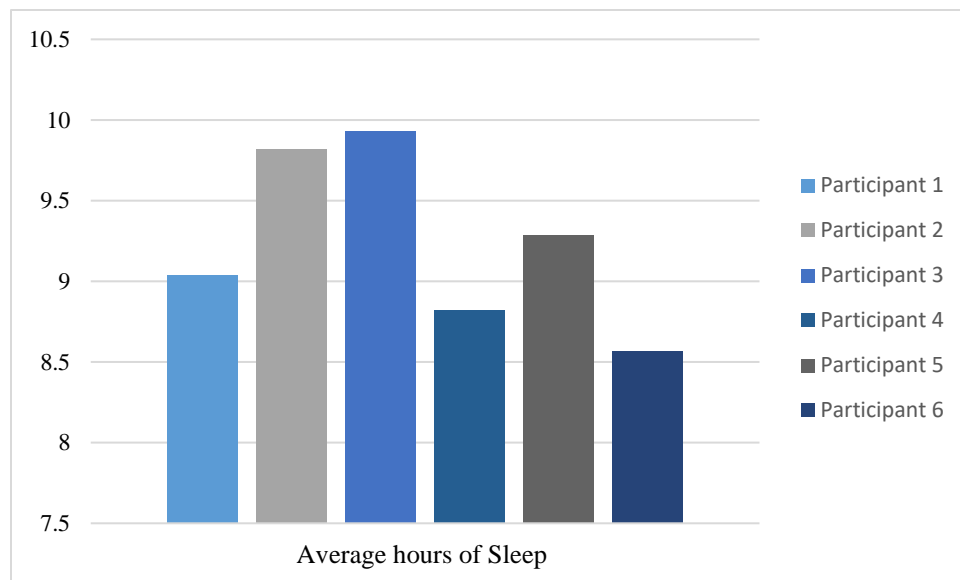


Figure 1 Average hours of sleep per participant on both swim and non-swim days.

The average sleep difference in the aquatic exercise and the non-aquatic exercise days is shown in Figure 2. A two-tailed t-test was performed between the averages of the sleep between the aquatic exercise nights (Nights 1 and 4) and the non-aquatic exercise (Nights 2, 3, and 5-7). The result of the repeated measures t-test is a p value of 0.14 so there is statistically no difference

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

between the aquatic exercise and non-aquatic exercise nights due to a p- value larger than .05.

However, there is an overall trend for more sleep on non-swim days for 5 of the 6 children.

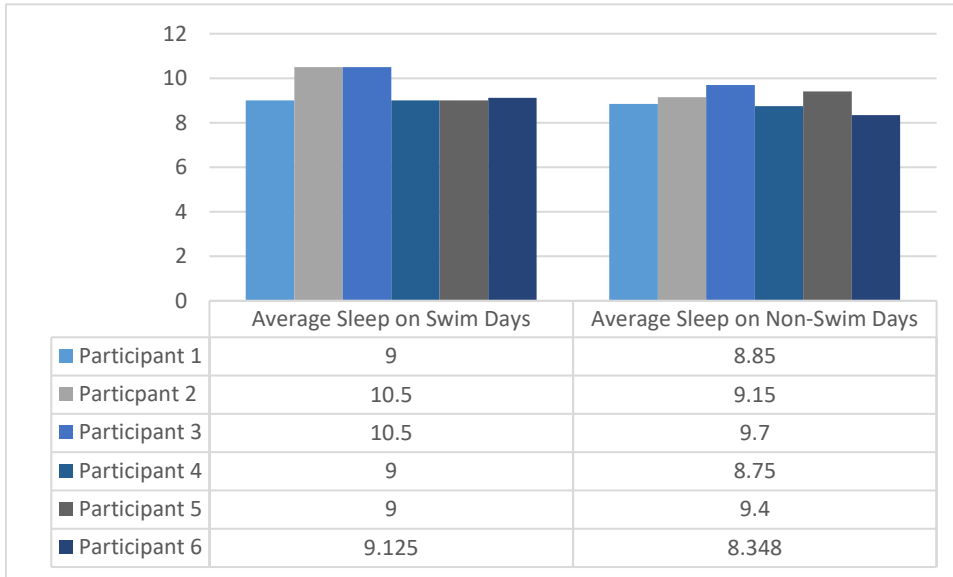


Figure 2: Average Hours of Sleep per Participant on Swim vs Non-Swim Day

The answers to the six survey questions were also recorded and tabulated as shown in Table 1. The most agreed upon question was question 3: “My Child has an easier time going to sleep when he/she has aquatic exercise.” The answers averaged out to a 4 (“somewhat agree”) level for question 3 while the other questions were closer to a response of indifference (question 5) or disagree (questions 2, 4 & 6).

Participant	Q1	Q2	Q3	Q4	Q5	Q6
1	3	1	3	1	4	1
2	4	3	5	5	5	1
3	3	4	4	4	2	3
4	3	2	5	2	3	3
5	1	1	3	1	1	1
6	3	1	4	1	4	1
Average	2.833333333	2	4	2.333333333	3.166666667	1.666666667

Table 1: Average survey responses

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Each child's overall recorded physical activity duration on swim lesson versus non-swim lesson days were also compared as shown in Figure 3. The results of a two-tailed, repeated measures t-test is $p=.00891$. This shows that there is a significant difference between the physical activity on swim days versus non-swim days. There is significantly more physical activity on swim days.

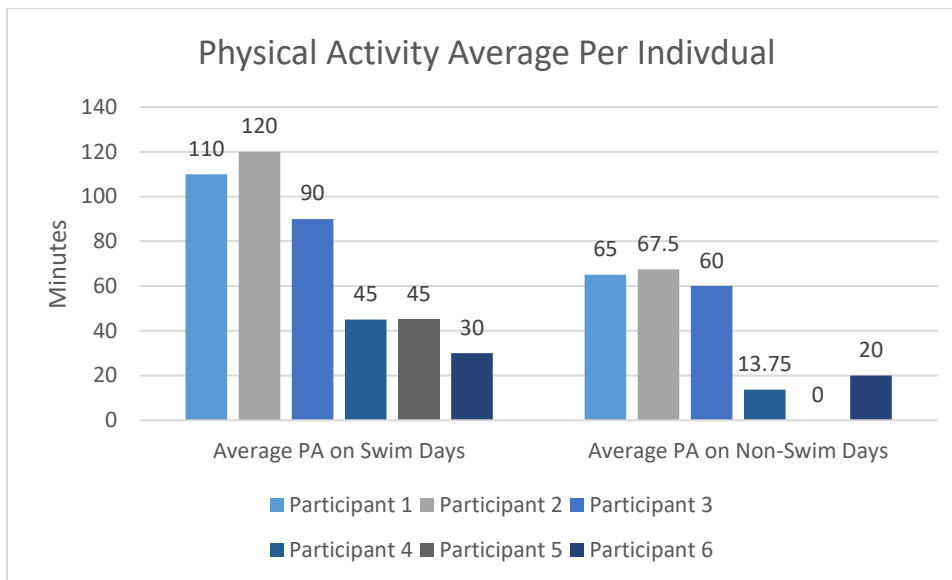


Figure 3: Comparison between Overall Physical Activity on Swim Lesson versus Non-Swim Lesson Days per Individual

Discussion

Previous research, such as Aleksandrovic et al. (2015) and Lawson & Little (2017), predicted the results were likely to be insignificant based on the inconclusive results of whether sleep quality, such as falling asleep faster and sleeping more soundly, are truly influenced by physical activity. However, it was believed that reliable results could have been obtained with this research design. The parents were the subjects of the study as they were the ones recording the observations of their children. The insignificant data could be due to the amount of external physical activity performed. Figure 3 shows the average amount per individual on days both with and without swim lessons. Although having a 30-minute aquatic aerobic exercise on the swim days increased the average, the days without lessons also have bouts of exercise. Days with swim lessons also had other physical activity, thus making the average for the individuals something other than just 30 minutes on swim lesson days. Only participant 5 reported no physical activity on days without swim lessons. However, participant 5 did perform some additional physical activity on swimming days.

The parent's survey responses reveal perceived improved sleep in their children on nights of aquatic exercise, although this is not made significantly clear in the results obtained from the sleep log. This could be due to limitations of the study or external variables. One limitation to the study is the lack of control of the external variables such as time awake, time to bed or additional physical activity. Because the format of the research was observational, no external values were controlled and monitored, just recorded. With insignificant data, it would be difficult to conclude the sleep was indeed impacted by the aquatic exercise rather than another form of exercise. Next, the overall duration of the observation was one week. Only one sleep disturbance was recorded by Participant 1 and the remaining participants did not record a sleep disturbance.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

The survey responses tended to weigh toward the middle for a more indecisive response. This may be because of the inconsistent sleep schedule that individuals with ASD are more prone to. As seen in Table 1, the only two questions that received a clear response average were questions 2 and 3, “My child has sleep disturbances when he/she does not have aquatic exercise” and “My child had an easier time going to sleep when he/she has aquatic exercise.” The answers provoked were “somewhat disagree” and “somewhat agree” respectively. This could be because their child has relatively few sleep disturbances and appears more fatigued after swimming, however this is not a strong response. The lack of strong response is not surprising due to the data recorded.

The rationale behind the study was the anecdotal response of guardians that their child was sleeping better after performing aquatic exercise. This was not shown statistically in the study, but trends supported the guardians’ anecdotal observation. The children did not sleep poorly any night, but there were no nights that had a significant difference. The largest change in sleep schedule appeared on weekends; children were staying up later and getting inconsistent amounts of sleep. As swim days are Monday and Thursday, there is a possibility of sleep on these nights being affected by weekends. Along the same limitation, the research was observational, therefore some sleep disturbances could have been missed by the recorder. The data received may not accurately show how each child slept that week as it is guardian-recorded. A final limitation was the inability to record intensity of the exercise. All of the children perform their unique instructions during swim lessons and each student’s activities could vary significantly in intensity and endurance requirements. Without measuring HR or intensity another way, it is difficult to be certain the intensity stayed consistent across the board. This inconsistency could be true with exercise outside of the swimming environment.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

For future research on this topic, many alterations are recommended. The observational period in this study was one week. During the one week, only one sleep disturbance was apparent in six children. If the observational period is longer there is a greater likelihood of more sleep disturbances occurring thus helping to draw stronger conclusions. The original plan for the study was to monitor intensity during exercise, both aquatic and non-aquatic, and during rest. Monitoring the intensity would assure the aerobic exercises are all similar intensities and would assist in limiting more external variables. The difficulty presented in this study for measuring intensity was how to encourage the children to wear a monitor or to be comfortable with their radial pulse being taken. Physical activity is highly recommended, however the inconsistency of the physical activity outside of the swim program may have caused alterations in the results. Although swim days still averaged more physical activity, drawing conclusions solely on aquatic activity presented difficult. The last suggestion of future research would be a more reliable recording system. The data recording system was observational and performed by guardians. Although convenient, this could have caused incorrect data to be recorded. Children may have had sleep disturbances their parents did not witness or fall asleep later than expected. The estimate by the guardians was easy to compile but a timer or monitor may add more accuracy.

Experience

Conducting my own individual research protocol was one of the most eye-opening experiences. I was unaware of the amount of typical challenges to be faced even before research is conducted. I understand that research needs to be approved and ethical, but I did not realize the process behind getting the approval. I also learned just how much previously existing information needs to be combed through to form a rationale and hypothesis of a future study. Preparing for research conduction was the most difficult and tedious part of the process.

My eyes were open to the difficulty of working with a timeline and human subjects. Working with individuals to collect data from their private home is difficult, especially when there is already so much on their plate. Only two logs and surveys were received by the deadline, so results and conclusions were delayed.

I realized the likelihood of an inconclusive study. After conducting a t-test and evaluating the results, my end results were not nearly significant. Having insignificant results, although part of research is always disappointing because no conclusions can really be collected. However, this paper could point researchers towards next steps in this topic.

I am so appreciative of the amount of people that were willing to read my drafts and help get the information across as effectively and smoothly. The number of eyes that need to be on one research project truly surprised me, but I could not be more thankful that people were willing to assist me during this challenge.

Acknowledgments

Lastly, I would like to take the time to acknowledge all of the individuals who have made conducting my first research experience possible. My honors project sponsor, Melissa Smith has gone above and beyond to help make this possible. She has manipulated her own schedule to fit me in and keep me grounded. A thank you will never be enough for how much time and effort she put into the success of this project. She has been not my sidekick but my personal superhero!

I would like to thank Dr. Rachele Kappler for being the greatest advisor in the world and keeping me on track to graduation and keeping me sane throughout this chapter of my journey. Her and Melissa both made my college experience what it was and I can never thank them for the springboard they set up for my future.

To Sue Parker and Lisa Thompson, thank you for creating a program that gave me the opportunity to look into another aspect of a disorder I am so passionate about. Swimming with Autism has changed my life and I can never thank you two enough for your involvement in this extraordinary program.

Laura Franz, thank you for enrolling your kids in swim lessons with me and giving me two of the most intentional relationships I have ever had. Swim lessons with your family have changed my life for the better and I will also want to see their growth!

Dr. Judith Juvancic-Heltzel, thank you for allowing me the flexibility to really mold this project into what I desired and for making it something I am very proud to put my name on.

Lastly, thank you to Chris Ray, the aquatic director, and the swim parents at Kohl Family YMCA, for actually allowing my research to exist!

Works Cited

- Aleksandrovic, M., Jorgic, B., Block, M., & Jovanovic, L. (2015). The effects of aquatic activities on physical fitness and aquatic skills in children with autism spectrum disorders: a systematic review. / Efekti Aktivnosti U Vodi Na Fizički Fitnes I Plivačke Sposobnosti Kod Dece Sa Peremećajima Iz Autističnog Spektra: Sistematsko Pregledno Istraživanje. *Facta Universitatis: Series Physical Education & Sport*, 13(3), 351–362.
- Allik, H., Larsson, J.-O., & Smedje, H. (2006). Sleep patterns of school-age children with asperger syndrome or high-functioning autism. *Journal of Autism & Developmental Disorders*, 36(5), 585–595.
- Cortesi, Flavia & Giannotti, Flavia & Ivanenko, Anna & Johnson, Kyle. (2010). Sleep in children with autistic spectrum disorder. *Sleep medicine*, 11, 659-64.
10.1016/j.sleep.2010.01.010.
- Caputo, G., Ippolito, G., Mazzotta, M., Sentenza, L., Muzio, M. R., Salzano, S., & Conson, M. (2018). Effectiveness of a multisystem aquatic therapy for children with autism spectrum disorders. *Journal of autism and developmental disorders*, 48(6), 1945–1956.
- Glickman, G. (2010). Circadian rhythms and sleep in children with autism. *Neuroscience and Biobehavioral Reviews*, 34, 755-768. doi:10.1016/j.neubiorev .2009.11.017
- Hodgson, A. R., Grahame, V., Garland, D., Gaultier, F., Lecouturier, J., & Le Couteur, A. (2018). Parents' opinions about an intervention to manage repetitive behaviours in young children with autism spectrum disorder: A qualitative study. *Journal of Applied Research in Intellectual Disabilities*, 31, 165–178. <https://doi.org/10.1111/jar.12317>
- Huettig, C., & Darden-Melton, B. (2004). Acquisition of aquatic skills by children with autism. *PALAESTRA*, 20(2), 20–25.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

- Johnson, K. P., Giannotti, F., Ivanenko A. & Cortesi, F. (2009). Sleep patterns in autism spectrum disorders. *Child and Adolescent Psychiatric Clinics of North America*, 18(4), 917–928.
- Kraft, E., & Leblanc, R. (2018). Instructing children with autism spectrum disorder: Examining swim instructors' knowledge building experiences. *Disability And Health Journal*, 11(3), 451–455. <https://doi.org/10.1016/j.dhjo.2017.11.002>
- Lawson, L. M., & Little, L. (2017). Feasibility of a swimming intervention to improve sleep behaviors of children with autism spectrum disorder. *Therapeutic Recreation Journal*, 51(2), 97–108.
- Murdock, L. C., Dantzler, J. A., Walker, A. N., & Wood, L. B. (2014). The effect of a platform swing on the independent work behaviors of children with autism spectrum disorders. *Focus on Autism & Other Developmental Disabilities*, 29(1), 50–61.
- Oriel, K. N., Kanupka, J. W., DeLong, K. S., & Noel, K. (2016). The impact of aquatic exercise on sleep behaviors in children with autism spectrum disorder: A pilot study. *Focus on Autism and Other Developmental Disabilities*, 31(4), 254–261.
- Sandt, D. D. R., & Frey, G. C. (2005). Comparison of physical activity levels between children with and without autistic spectrum disorders. *Adapted Physical Activity Quarterly*, 22(2), 146.
- Schmitz Olin, S., McFadden, B. A., Golem, D. L., Pellegrino, J. K., Walker, A. J., Sanders, D. J., & Arent, S. M. (2017). The effects of exercise dose on stereotypical behavior in children with autism. *Medicine And Science In Sports And Exercise*, 49(5), 983–990.
- Verstrat, A. & Hedges, S. (2015, March). Exercise for adolescents with ASD (Autism at-a-Glance Brief). Chapel Hill: The University of North Carolina, Frank Porter Graham Child Development Institute, CSESA Development Team.

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Yilmaz, I., Yanardağ, M., Birkan, B., & Bumin, G. (2004). Effects of swimming training on physical fitness and water orientation in autism. *Pediatrics International*, 46(5), 624–626.

Appendix A: Verbal Script

Parent Informative Verbal Script

Dear parent/guardian of swimmer,

Thank you so much for all of the time and effort you have been putting into your swimmer's learning experience through private lessons with me. It has truly been a pleasure to work with your swimmer and help increase their safety around water and their swimming abilities. At the University of Akron, I am conducting my Senior Exercise Science Honors Project, through this project, the opportunity for research including your swimmer has been created.

Through my project, I will be conducting research to determine the effect of aquatic exercise on sleep duration for children with Autism Spectrum Disorder. Given my platform I found this to be a perfect opportunity to fill in the gap on this research. However, your swimmer is not at all required to participate.

If you choose to enroll your swimmer in this research, lessons will continue the same as always but I ask you record your swimmers sleep habits. I will provide you a sleep log and survey in which you record the sleep of the listed dates prior, between and after swim sessions. The duration and exercises performed in your swimmer's lesson will not change.

If you would rather your swimmer not enroll in the research nothing will change from our previous lesson plans and outline.

Please let me know if you would like to enroll your student and if you have any questions!

Appendix B: Informed Consent

Parental Consent for Children under 18

Title of Study: The Effect of Swimming Exercise on Amount of Sleep for Children with Autism Spectrum Disorder

Introduction: You are invited to participate in a research project being conducted by Kayla Wilson, an undergraduate student in the School of Sport Science and Wellness Education at The University of Akron.

Purpose: Parents/guardians of children with Autism Spectrum Disorder who are taking swim lessons will participate in this study with the intention to determine the relationship between aquatic exercise and sleep quality/duration.

Procedures: Participants will be recruited from parents/guardians of students taking part in swim lessons at the Kohl Family YMCA. Information will be distributed to the parent/guardian of each swimmer in March 2019. In addition to this informed consent, instructions of the sleep log (attached to this application) are included.

You will be encouraged to provide details such as the time your child went to sleep or how much awake time occurred during the night. Sleep amount will be recorded in minutes. Sleep disturbances will each be counted. Time to bed and time awake will be rounded to 15 minutes. Your child will take part in two 30-minute swim lesson sessions during data collection. These days will also be recorded for sleep patterns. Since each student with ASD is vastly different in motor ability, each will be performing different tasks during their session. The PI will be recording the exercises into the log to monitor what was performed in each session. The aerobic exercise pool at the Kohl Family YMCA will be utilized for all of the lessons thus controlling the variables of the setting. Participants will also be asked to complete a brief survey at the end of the week to summarize the child's sleep quality and duration. The survey questions can be found at the end of the log.

Risks and Discomforts: Health risks to the child are no greater during participation in this study than during the swim lessons not included in this study. The Kohl Family YMCA policy requires at least 2 lifeguards supervising swim lessons at all times. There are no other social, legal or economic risks apparent.

Benefits: The benefits to your child for participating in this study may be better sleep. However, there may be no direct benefit from participating in this study.

Right to Refuse or Withdraw: Withdrawal from the study can occur at any time with no penalty. Following your consent, participation of your child in this study remains voluntary.

Anonymous and Confidential Data Collection: *Data collection will be confidential.* Any identifying information collected will be kept in a secure location and only the researchers will

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

have access to the data. Participants will not be individually identified in any publication or presentation of the research results. Only aggregate data will be used. Your signed consent form will be kept separate from the data, and nobody will be able to link your responses to them.

Confidentiality of records: All data and records will be kept only by the Principle Investigator. Names of subjects will be only on paper copy sleep logs and not entered onto the computer in the project document. A match list of subject names will be kept on the Principal Investigator's password protected computer until project completion and then permanently deleted. After entering information from the subject logs, each paper copy will be either returned to parent or shredded (according to your wishes). Data will be reported as Subject 1, Subject 2, Subject 3, etc. The records will be destroyed at the end of the study.

Who to contact with questions: If you have any questions about this study, you may call Kayla Wilson at (330) XXX-XXXX or Melissa Smith at (330) 972-4905. This project has been reviewed and approved by The University of Akron Institutional Review Board. If you have any questions about your rights as a research participant, you may call the IRB at (330) 972-7666.

Acceptance & signature: I have read the information provided above and all of my questions have been answered. I voluntarily agree to the participation of my child in this study. I will receive a copy of this consent form for my information.

Parent / Legal Guardian Signature

Parent / Legal Guardian Signature

Name of Child _____

Appendix C: Sleep Log Instructions

The following information explains how to complete the sleep log:

- Please record your child's information on the respective days of the week.
- Record if your child performed aquatic exercise.
- If you child performed physical activity other than aquatic exercise, please list this as well.
- Record the time your child went to bed as well as what time your child woke up.
- If you notice or observe a sleep disturbance, please record it and the duration it occurred for.

The following information explains how to complete the survey:

- Respond to the questions as accurately and truthfully as possible.
- If you do not feel you have an opinion on any of the survey questions, choose "Neither agree nor Disagree"

If you have any questions while completing the log or survey, you can reach me at:

Phone:(330) XXX-XXXX

Email: XXXX@zips.uakron.edu

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Appendix D: Sleep Log and Survey Instrument

Date:	Amount of sleep per night:	Aquatic Exercise (Y/N):	Amount of Sleep Disturbances:	Time to bed:	Time awake:	Any other physical activity and duration:
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						

The Effect of Swimming Exercise on Amount and Quality of Sleep for Children with Autism Spectrum Disorder

Sunday						
--------	--	--	--	--	--	--

Swimmer's Name:

Please respond to the following questions with how your child did with their sleep schedule this week:

1. My child has a hard time going to sleep when he/she does not have aquatic exercise:

Disagree (1) Somewhat Disagree (2) Neither Agree nor Disagree (3) Somewhat Agree (4) Agree (5)

2. My child has sleep disturbances when he/she does not have aquatic exercise:

Disagree Somewhat Disagree Neither Agree nor Disagree Somewhat Agree Agree

3. My child had an easier time going to sleep when he/she has aquatic exercise:

Disagree Somewhat Disagree Neither Agree nor Disagree Somewhat Agree Agree

4. My child has less sleep disturbances when he/she does have aquatic exercise:

Disagree Somewhat Disagree Neither Agree nor Disagree Somewhat Agree Agree

5. My child goes to bed later when he/she does not have aquatic exercise:

Disagree Somewhat Disagree Neither Agree nor Disagree Somewhat Agree Agree

6. My child wakes up later when he/she does not have aquatic exercise:

Disagree Somewhat Disagree Neither Agree nor Disagree Somewhat Agree Agree