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The Effects of Yoga on Balance for Elementary School Aged Children Receiving Occupational Therapy

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ABSTRACT

Balance is crucial to many daily life activities and is an indicator of independence. The addition of yoga has been shown to improve balance deficits in children, self-reported healthy adults, elderly individuals, and those with Other Health Impairments such as Autism Spectrum Disorder. Yoga is a holistic method, incorporating mind, body, and soul. This holistic method is what occupational therapy operates under as well, allowing the two to work in tandem for the improvement of balance. This study explored the effects of implementing yoga to students receiving occupational therapy services for balance deficits. The Bruininks-Oseretsky Test of Motor Proficiency balance subtest was planned to be used as a measure to determine pre and post-test scores of the participants after 3 yoga sessions. The results of this study were deemed inconclusive due to the study being cut short because of the COVID-19 pandemic; however, anecdotal evidence suggests balance confidence improved.

Keywords: yoga, balance, occupational therapy, children, thesis, honors thesis, BOT-2

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Introduction

The field of occupational therapy is unique in many ways, one is that many interventions of therapy can be implemented through the uses of daily life. A large role of occupational therapists is to teach clients and their caregivers ways that they can effectively implement the skills taught to them in therapy into their daily life. This allows the client to progress to their highest level of independence, which is unique to each individual. Occupational therapists specifically operate from a holistic approach in order to provide the most well-rounded care. Since the holistic approach is so vital to occupational therapy as a profession, yoga has been becoming more popular in the field as it has increased in popularity for research. While the activity has been gaining in popularity, more research to show how the practice can help balance specifically is warranted.

There are many studies on yoga, but hardly any specifically on occupational therapy and yoga. This study reviews how the two can be used in combination as a means to improve balance. This combination is important because of the aforementioned holistic view of occupational therapy. Yoga is classified as a mind–body intervention by the National Center for Complementary and Alternative Medicine (2011) and is often used as a complementary approach in occupational therapy to enhance engagement in occupation (American Occupational Therapy Association, 2005). Occupational therapists take into account any aspect of an individual's life that can influence their ability to perform occupations, including body functions, which balance is a part of (American Occupational Therapy Association, 2014). Balance is a large mechanism of daily life that many individuals don't think about. "Balance is a requisite component for successful

completion of functional activities including locomotor and manipulative skills" (Franjoine, Darr, Held, Kott, and Young, 2010). Locomotor and manipulative skills can include holding your phone up to your ear, trying to write a letter, and grabbing your steering wheel, often things that you don't think about using balance for.

Literature Review

What is yoga?

Merriam-Webster defines yoga as "a system of physical postures, breathing techniques, and sometimes meditation derived from Yoga but often practiced independently especially in Western cultures to promote physical and emotional well-being" (2020). While this is part of the ancient practice, much more is in play than just the aforementioned. Yoga has roots as far back as 500 B.C., though its popularity has skyrocketed in recent years. Many individuals practice yoga for its health and fitness benefits, but its main purpose is to align oneself with the universe in order to achieve the highest level of harmony (Basavaraddi, 2015). While there are many different types of yoga, when techniques from several practices of yoga are used in collaboration, the benefits are greater (American Osteopathic Association, 2020). Yoga goes beyond the typical act of movements, to include an awareness of breathing, dissociation of consciousness, meditation, and integration. Understanding each of the aspects of yoga help to build on one another in order to provide the best practice (Lasater, 2016). Learning how to properly focus yourself, perform correct breathing techniques, and practice the correct stances, are crucial to achieving the previously mentioned harmony.

In the western world, many individuals only practice the physical aspects of yoga (Govindaraj, Karmani, Varambally, Gangadhar, 2016). For many, this means forgoing spiritual, emotional, and mental practices in order to receive the greatest physical benefits. Many only practice the mainstream practices of holding and switching between body positions with a focus on their breathing and a slow progression from one to the next. Some of these positions include Mountain pose, Downward Dog, Child's pose, Tree pose, and Warrior pose. Mountain pose is standing with feet flat on the floor, hip width apart, and palms facing forward. These poses are explained by Schmid, Puymbroeck, and Koceja (2010). Tree pose includes standing on one foot with the other foot bent, and hands in the prayer position. Warrior pose includes standing with legs apart, arms straight out, and dropping the tailbone before bending the knee. "Potential benefits of yoga practice include improvements in energy, muscle tone, fine motor coordination, flexibility, postural alignment, and cardiovascular fitness (Bera and Rajapurkar, 1993; Dash and Telles, 1999; Galantino et al., 2008; Konar et al., 2000; Telles et al., 1997; Telles and Srinivas, 1998, as cited in Donahoe- Fillmore & Grant, 2019). Due to its healing characteristics of the body as a whole, it has been labeled by the medical community as alternative medicine.

Despite popular belief, yoga itself is not a religion (Lasater, 2016). A person from any religion can practice yoga. However, it does operate under the assumption that something larger, and more supreme exists, or theism. In some practices of yoga, specifically the Isvara Pranidhana practice, you are supposed to let go and think of what

you consider to be your particular “something larger”. Lasater (2016) explains that this is different for every person, and you can work it into any religion. For example, if you are a Christian, you can think of Mary, or Jesus during this time. Since there is no particular religion that must be adhered to in order to practice yoga, anyone can reap the benefits by practicing.

Balance and Yoga

Yoga has been proven to have a positive impact on different types of balance. “Balance is the ability of people to maintain a certain body posture under dynamic or static conditions, especially the ability to control the body’s center of gravity on a small supporting surface, and is mainly divided into static balance and dynamic balance” (Karlsson & Frykberg, 2000, as cited in Jiang et. al, 2018). Dynamic balance is an individual’s balance while moving, or performing movements versus static balance, which is when one is still. Balance is important to daily life because it is how we are able to function throughout life, and to be able to stay as an upright human. “Poor balance inhibits a person's ability to perform activities such as walking, running, jumping, and throwing” (Silver & Mokha, 2008). Since these important physical functions of independence can be impaired when balance is diminished, other necessary activities of daily life can be limited as well. According to Franjoine, Darr, Held, Kott, and Young (2010) “Balance is a requisite component for successful completion of functional activities including locomotor and manipulative skills.” Some of these can include basic Activities of Daily Living such as dressing, showering, toileting, and feeding, as well as

Instrumental Activities of Daily Living, including meal preparation and cleanup, shopping, driving, and child rearing (American Occupational Therapy Association, 2014).

Silver and Mokha (2008) explore how yoga can impact dynamic and static balance in a study of 30 individuals from a university (staff, student, or faculty) that were recruited for a 6 week assessment of the addition of yoga to their routine and its impact on dynamic and static balance, specifically. Participants were free from neurological conditions, had practiced yoga one or fewer times, and practiced no similar activity to yoga. A pre and post-test was implemented using an Advanced Mechanical Technology Inc. (AMTI) force plate, which allows for minute changes in balance to be accurately tracked. All participants were given a pre and post-test, despite their placement into either a control or the intervention group. The static test was performed by standing on the plate, looking forward at an x with hands on hips, and standing on one leg with the other bent at the knee. The dynamic test started in the same position, but with the non-stabilizing leg swinging in the frontal plane (testing medial/lateral balance) and then the sagittal (testing anterior/ posterior balance). Going to a yoga class taught by a certified yoga instructor two times a week for 50 minutes was the intervention for the intervention group. The results of this study reveal that while the standard deviation of both groups for the dynamic motion in the frontal plane were similar in the pre-test, the group that received yoga was able to maintain medial lateral balance throughout the 6-week timeframe while the control group's fluctuated. This indicates that six weeks of yoga may

not be enough to significantly impact a person's static or dynamic balance, but it could lead to improved balance with continuation (Silver and Mokha, 2008).

Static motor performance and yoga were assessed in a healthy population of college students in 10-day long study. This study measured students' ability to insert a metal stylus into holes that decrease in size without hitting the sides of the hole with the arm extended. Telles, Hanumanthaiah, Nagarthna, and Nagendra (1994) decided to implement this study to college aged students after doing the same study on school aged children, aged 9-13 years old, and finding significant improvement in static motor performance. This study had a control and experimental group of 20 students each, with each having five females. The researchers first completed a pretest of steadiness in both groups in order to measure the efficacy of the implementation of yoga daily for 10 days. The pre and post-test consisted of a custom-made metal pegboard with nine holes decreasing in size. The holes start at 8 millimeters and end at 2 millimeters. Hitting the side of the hole would be considered a mistake, and mistakes were measured in a pre and post-test in both groups. After intensive yoga sessions at a yoga camp for 8 hours a day, 10 days in a row, it was shown that there was a lower number of errors by the yoga group. Using the Wilcoxon's paired signed-ranks test, two tailed, it was revealed that the decrease in mistakes was significant, at $P<0.02$.

The researchers decided to replicate the study mentioned above to college aged students after doing the same study on school aged children and finding significant improvement in static motor performance. 90 Students, aged 9-13 years old, were recruited into two groups of 45 subjects, with one group being the control and one group

being the ‘yoga’ group. The control group had 21 boys with a mean age of 12 and the yoga group had 34 boys with a mean age of 11. The yoga group received ten days of yoga focused on specialized postures, regulatory breathing, and cleansing of the internal organs for eight hours a day. An error is considered hitting the side of the hole with the metal stylus. After those ten days of yoga there was a 17.7% decrease in the number of errors for the yoga group, showing statistically significant data that yoga improves static motor performance. A group of 25 adults that participated in 14 days of yoga (with no matching control group) had a 14% reduction in errors on the peg board. The findings of these studies show that neuroplasticity is still available through adulthood, to allow yoga to have a positive impact on static motor performance, despite age. Telles, Hanumanthaiah, Nagarthna, and Nagendra (1993) explains that many postures require balance and static motor performance, even though the individual may feel as if they are only waiting to move. Some examples the authors mention are a diver, poised to jump or a runner crouched in preparation for the race to start. Many motions and activities throughout an individual’s life start with the ability to keep one’s hand and extended, which is why it is so important to have this static balance.

Jeter, Nkodo, Moonaz, Dangelie (2014) discover in their systematic review of yoga in healthy individuals that yoga is an effective practice to improve balance through an effective study design. Through a search of peer-reviewed articles, it was found that randomized control trials with a pretest, as well as a post-test, are able to show the impacts of the implementation of yoga most clearly. Most studies show that yoga is effective when it is done 2-4 times per week. 11 studies reported positive outcomes for at

least one balance outcome tested. Findings include that “Yoga is a strong candidate for therapeutic intervention, since it provides a comprehensive, integrated approach that can address multiple risk factors at once” (Jeter, Nkodo, Moonaz, Dangelie, 2014, p. 221). Of the 15 studies explored, none reported side effects, and the overall conclusion was that yoga is beneficial to individuals that are self-reported healthy in all age ranges.

Yoga Across the Lifespan

Children and Yoga

Balance is the backbone of most movements throughout an individual's day (Chew-Bullock et al., 2012), but how do you get balance? In a typically developing child, their system of balance matures and progresses as they do, getting better with age (Franjoine, Darr, Held, Kott, and Young, 2010). There is a rapid development of balance throughout childhood until the age of ten, and the ability to focus attention on controlling posture is seen around the age of 4-11 (Bair, Kiemel, Jeka, & Clark, 2007). While the mechanism for balance in the body is about the same as an adult’s when an individual reaches age 7 (Bair, Kiemel, Jeka, & Clark, 2007) a person’s balance ability is typically that of an adult when the person is fifteen (Ionescu, Morlet, Froehlich, & Ferber-Viart, 2006) until the adult reaches older adulthood, in which balance begins to decrease again. While a typically developing child’s balance and ability to have balance increases with age, it is not guaranteed to mature to a certain point. Each individual’s balance abilities

are impacted by their surroundings, including exercise, as they develop. But why is balance so important to children in particular? “If children’s early balance ability were not properly developed, it would lead to late learning of complex motor skills, such as running, jumping, climbing, and other movements, which also increases children’s risk of injury in sports” (McGuine, Greene, Best, & Leverson, 2000; Willems et. al, 2005). These movements are important because these are the movements that make up a child’s occupations. Occupations for children include play, socializing, and learning (AOTA, 2020), allowing them to integrate and develop properly.

Elementary aged children need balance for more than just playing on the playground. Without the necessary core strength and balance, the fine motor skills that children need for their daily occupations such as handwriting, coloring, and scissor skills, will fall behind their peers’ (Occupational Therapy Helping Children, 2020). Jiang et. al (2018) conducted a study of Chinese 3-6-year olds in order to see the correlation between balance, gross motor development, proprioception, and age. After randomly selecting 20 children from each of the three years in a Beijing kindergarten, there were equal boy and girl populations and 60 participants. Their height, weight and BMI were measured, along with their static balance, dynamic balance, proprioception, and gross motor development. Static balance was measured through a foot pressure plate and measured participants' balance while standing with their eyes open, closed and with feet two apart as well as standing on one foot. Dynamic balance was measured by timing students walking on a balance beam. They were allowed two tries, with the better of the two being used. Before measuring static and dynamic balance, warm-up activities were performed. The Test of

Gross Motor Development-2 was used to measure the students' gross motor development. This test consists of verbal cues for a practice trial and then two measured trials to test running, jumping, leaping, hopping, sliding, galloping, throwing, catching, kicking, striking, underhand rolling, and dribbling (Ulrich, 2000 as cited in Jiang et. al, 2018).

It was found that static balance showed significant differences between age groups of 3 and 5-year olds, with the 5-year olds being much better. There were no significant differences between gender. From the dynamic balance test, it was revealed that the time it took the participants to walk on the balance beam decreased each year of school, so that the 5-year olds did better than the 4-year olds, who did better than the 3-year olds. For this group, males showed statistically significant superior dynamic balance in the 5-year olds as compared to the 3-year olds. The gross motor development also followed this trend of showing statistically significant increases for each year. Since "Children aged 3–6 years old are in a critical period for motor development. In this stage, appropriate means should be selected to promote the development of their balance ability and proprioception, and more opportunities should be provided for them to practice" (Jiang, et. al, 2018). These results imply that since yoga has been proven to increase static and dynamic balance, during this crucial period for motor development for three to six-year old children, the addition of yoga could be used to increase their static and dynamic motor balance.

A study conducted by Donahoe-Fillmore and Grant (2019) found that the addition of yoga on children aged 10-12 years old was statistically significant for the improvement of balance. The study was conducted of a convenience sample of 26 children with 12 being male and 14 being female. A pre and post-test were implemented before and after the eight week-long study. To measure balance, the Bruininks-Oseretsky Test of Motor Proficiency, second edition (BOT-2) subtests of balance, bilateral coordination, and strength were used. The participants were led in a 40-minute yoga session by a registered yoga teacher 1-3 times a week, for 8 weeks for a total of 17 yoga sessions. After these 8 weeks, the post-test results of the balance subtest of the BOT-2 revealed statistically significant ($p=0.026$) positive results. While the poses chosen for the sessions were not chosen to target a specific body area, the improvement of balance could be attributed to choosing postures that facilitated static balance and core stability. Yoga is currently being used by physical therapists to improve balance (Donahoe-Fillmore & Grant, 2018). As physical therapists and occupational therapists often work through a collaborative team approach, this study indicates that occupational therapists could also utilize yoga as a technique to improve balance, and therefore independence in functions needed for everyday life.

Yoga and the Geriatric Population

A large area of study is currently how yoga impacts the balance of individuals with balance deficits, in particular, the elderly. Among the geriatric population, a fear of falling is more prevalent among community dwelling older adults. Fear of falling, is a

disabling symptom of impaired mobility among frail older people; this disabling factor has been associated with depression, functional limitations, and gait impairments (Chandler, Duncan, Sanders, Studenski, 1996). “Development of FoF has been associated with worsening in performance of activities of daily living, mobility, mood life satisfaction, and general health” (King, Tinetti, 1995, Chandler, Duncan, Sander, Studenski, 1996, as cited in Schmid, Puymbroeck, and Koceja, 2010).

While it is clear that developing a fear of falling is detrimental to an individual’s mental and physical status, especially those that are living outside of nursing homes (community-dwelling), research by Schmid, Puymbroeck, and Koceja (2010) indicates that yoga can help to improve these. A study of 15 participants who were at least 65 years old and had admitted fear of falling in the past year were led by a registered yoga instructor in 12 weeks of bi-weekly, 75-minute yoga sessions. The intervention was specifically focused on balance poses. Using the Berg Balance Scale at baseline and post-intervention showed significant increase (4%) in static balance. These results indicate that yoga, and its “gentle movements, can address known fall risk factors (poor balance, impaired mobility, reduced strength and flexibility) and focus on increased awareness and proprioception, resulting in decreased Fear of Falling and improved balance in older adults” (Schmid, Puymbroeck, & Koceja, 2010, p. 577). Yoga is effective for improving balance in older adults and is an option to be explored further by rehabilitation specialists.

Krishnamurthy and Telles (2007) explore the effects of yoga on balance on individuals living in a nursing home. Sixty- nine residents of a nursing home were randomly put into three groups to receive either a yoga intervention, a poly-herbal Ayurveda group, and a control group. The Ayurveda group received a 10-gram mix of herbs, twice a day for the duration of the study. The yoga group participated in 75 minutes of yoga daily for 6 days out of every week. The yoga consisted of loosening exercises, breathing exercises, physical postures, voluntarily regulated breathing, and yoga-based guided relaxation. Using the Tinetti balance and gait evaluation test, as well as the Timed up and go (TUG) test, the researchers performed a pre and post-test of the participants. The Tinetti test has 9 maneuvers related to balance. The baseline of participants across the groups was similar, but after the intervention, the yoga group showed significant improvements to gait ($p<0.001$) and balance ($p<0.01$) compared to the control and Ayurveda groups, which saw no significant change. These results show that individuals in a group setting are receptive to yoga as a means to improve balance (Krishnamurthy and Telles, 2007) which could warrant further research into the application of yoga to school-based children.

The effects of yoga in combination with group occupational therapy to improve balance and fear of falling in post-stroke individuals were explored in a study by Hinsey et. al (2016). It is very common for individuals that have had a stroke to experience a fall after having a stroke, with 75% of individuals reporting a fall post-stroke, and 80,000 individuals hospitalized each year due to fall (Centers for Disease Control, 2016). Yoga was explored to decrease this fall risk because yoga has been proven to improve balance

but not fall risk factor management, and group occupational therapy has been shown to improve fall risk management, so the combination should decrease the number of falls in post-stroke clients (Hinsey et. al, 2016). Effectiveness was determined through a pre and post-test design of the Berg Balance Scale and 5 fall risk factor management questionnaires. After 8 weeks of biweekly yoga and group occupational therapy, all 14 individuals showed positive improvements to each test, with significantly improved results on the Berg Balance Scale, Falls Management Behavior Questionnaire, and the Fall Prevention Strategies survey. These results indicate that "merging yoga, a holistic mind–body intervention, with group OT can positively affect physical, emotional, and cognitive variables for people with chronic stroke and should be considered as a possible intervention" (Hinsey et. al, 2016).

Yoga and Other Health Impairments (OHI)

While it clear that yoga can help those with balance deficits, what about other health impairments? These ideas are backed up by a 2016 case study by Schmid, Miller, Puymbroeck, and Schalk (2016) which studied the effects of yoga on individuals with traumatic brain injury. This case study found that when yoga was performed twice a week for eight weeks, all physical outcomes being measured had improved. The outcomes being measured included measures of balance, balance confidence, pain, range of motion, strength of mobility. The source aimed to find out if these yoga interventions could help the aforementioned measures in individuals with traumatic brain injury. In the three individuals studied it was found that balance was increased by 36%, balance

confidence increased by 39%, lower extremity strength by 100%, and endurance by 105%. There were also qualitative interviews after the study was over, and it was found that the yoga improved not only the physical well-being of individuals, but also the mental and emotional states as well.

All of these physical measures were improved upon the implementation of yoga. Evaluations of the mental characteristics found that the physical bounds made from yoga greatly improved the mental health of individuals participating in the study as well. Despite this study being on individuals with traumatic brain injury, the combination of the physical improvements from this study work together to support that yoga will allow the students I am observing to improve in their therapy more with yoga in a pretest versus a post test of balance.

The effects of yoga and adults at risk for falls with neuromuscular impairments were found in a systematic review by Green et. al (2019). “Safe and stress-free participation in meaningful ADLs is reported to be a challenge for people with balance deficits and increased risk for falls (Berg & Cassells, 1992). Left untreated, stress, anxiety, and neuromuscular decline become progressive issues that further limit engagement in meaningful tasks and negatively affect people’s life and health (Green et. al, 2019). This study included community-dwelling older adults, as well as studies focusing on Traumatic Brain Injury, Parkinson’s Disease, Multiple Sclerosis, Cerebrovascular Attack (CVA), dementia, and Alzheimer’s Disease-type dementia. Of the fourteen articles fitting criteria, one researching yoga implemented once a week for ten weeks and CVA found change, but not significant change, while the other 13 reported

significant change. All studies reporting statistically significant improvements implemented yoga two or more times per week and for at least 45 minutes. It was found that "Yoga, used as an adjunct or modality in occupational therapy intervention, helps reinforce and promote mind–body unity in overcoming the physical and mental barriers of people at risk for falls" (Meyer et. al, 2012, as cited in Green et. al, 2019)

When children in the United States are of age to attend school, they are expected to do so with the proper skills for optimal learning in the classroom, such as maintain a clam state when tasks change, independently work on tasks, and transitioning from one task to another (Koenig, Buckley-Reen, & Garg, 2012). Many children with Autism Spectrum Disorder (ASD) are challenged with regulating their own behavior, which can be a barrier to learning in a typical classroom. The Get Ready to Learn Program is a classroom-based occupational therapy yoga program targeted towards individuals with a variety of disabilities. The 49 elementary-aged participants with ASD completed a pre and post-test of the Aberrant Behavior Checklist- Community (with 5 subscales including: Irritability/ Agitation/Crying, Lethargy/Social Withdrawal, Stereotypic Behavior, Hyperactivity/Noncompliance, and Inappropriate Speech) and the VABS-II, which yields an adaptive behavior score from domains of social, daily living, communication, and motor. The Get Ready to Learn Program was implemented every day for 16 weeks on the intervention group of 25 children, and not implemented for the 24 control group children. At the end of the 16 weeks, teachers rated students who participated in the intervention group as having better behavior than those who did not. Changes in less irritable behavior, noncompliance, lethargy, social withdrawal, and hyperactivity were statistically significant. The number of off-task behaviors dropped,

and all teachers reported improved classroom management after the program (Koenig, Buckley-Reen, & Garg, 2012).

Research Objective

The objective of this study is to determine if the implementation of beginner-level yoga exercises prior to the typical occupational therapy services that a child receives, specifically in a school setting, will improve the child's balance.

Methods

Research Design

This study utilized a descriptive case study design. "Descriptive case studies are in-depth descriptions of the experiences or behaviors of a particular individual or series of individuals" (Taylor, 2017, p. 248). In particular, this study used a quantitative method to collect data. Case studies often involve implementing an intervention to a small number of participants over a period of time, with no control group. The participants of this study were found using a convenience sample of the occupational therapist for Model Laboratory School's clients. This study was approved by the Eastern Kentucky University Institutional Review Board. No funding was provided for this study.

Sample

The participants of this study were from a convenience sample of elementary aged students of Model Laboratory School that received occupational therapy services provided by the school to address balance deficits. Exclusion criteria included students who are in middle school and high school as well as students that are not in the Occupational Therapy caseload for balance. Recruitment materials were sent to the guardians of three students matching these criteria. Two students returned child assent forms, as well as parent/guardian permission forms, allowing them into the study. One participant was male, aged 7 and one was female, aged 10. Student A, the 7-year old male was a second grader, and student S, the 10-year old female was a fourth grader. Recruitment materials, as well as child assent forms and parent/guardian permission forms explicitly stated that participation in this study was voluntary, and would not be compensated, and there would be no cost associated to them. It was made clear that all identifying information would be removed, and confidentiality maintained for purposes of publication.

Intervention

During the participants' occupational therapy session, 10 minutes of beginner's yoga was integrated into 3 of the student's sessions to help strengthen the core and improve the balance of the participant before the session. As they were led in yoga, soft music was played in the background. Poses were chosen that specifically work on the aspects of balance in children. One pose included was the "chair pose", which involves acting as if one was sitting in a chair, with arms outstretched above them. "Dancers

pose", which includes grabbing one foot and maintaining balance on the other with an outstretched arm. "Mountain pose" was included, which is standing with hands facing forward. "Bridge pose", which includes laying on the back with feet flat on the floor, and the back being arched. "Downward dog" was included, which is standing and walking forward with their hands and standing on their hands and feet with the back arched. Another pose incorporated was the "tree pose" which requires one to stand on one leg and hold your arms together at the palms. A belly-down backbend, or "cobra pose" was utilized by having the individual lay down on their stomach, and then stretch their legs and arms up. The final pose that was utilized was the "reverse triangle pose" which involves having the legs spread and leaning forward and touching the opposite foot with the opposing hand. Participants were asked to do each pose, and if they were unable, modified poses were included so that the pose was still able to be implemented. In some cases, this could be something as small as holding onto a wall so as to stay upright.

This intervention was planned for three total implementations of yoga, with separate meetings for the pre and post-tests, for a total of 5 meetings. Two ten-minute yoga sessions prior to the participants' occupational therapy sessions occurred, as well as the pre-test, before the study was cut short due to the COVID-19 pandemic. To keep the participants' interest up during the two yoga sessions, participants got to take turns picking the next pose from a stack of cards with a picture of the pose on them. This picture, along with researcher demonstration allowed the participants to see how the pose is done correctly, and then modifications were provided if the participant could not do the pose to the full extent.

Measures

In order to measure if there is an improvement in balance, the Bruininks- Oseretsky Test of Motor Proficiency Second Edition (BOT-2) balance subtest was implemented prior to implementing yoga and then after the 2 sessions. When the BOT-2 was implemented, participants were told that we would be looking at their balance, but did not use the term“test,” so as to not induce test anxiety as well as to not skew results. The balance subtest of the BOT-2 consists of 9 static and dynamic items for the examinee to do, as listed below.

- Item 1: *Standing with feet apart on a line- Eyes open*. This requires the examinee to place their hands on their hips, with one foot in front of the other on a line placed on the ground. Examinee looks at a target on the wall and holds pose while examiner times until ten seconds or the examinee breaks pose, whichever comes first. Examinee has 2 trials if the maximum score is not achieved during the first trial.
- Item 2: *Walking forward on a line.* Examinee stands with hands on hips and walks forward on a designated line in a natural stride for six steps, or until the

examinee places a foot off of the line. Examinee has 2 trials if the maximum score is not achieved during the first trial.

- Item 3: *Standing on one leg on a line- Eyes open.* Examinee stands with hands on hips, with one leg bent at a 90-degree angle and shin parallel to the floor while looking at the target. The trial is stopped when the ten seconds passes or if the examinee puts the raised foot on the floor, whichever happens first. Examinee gets 2 trials if the maximum score is not achieved during the first trial.
- Item 4: *Standing with feet apart on a line- Eyes Closed.* Examinee stands on a line with feet spread as if to take a step with hands on hips and eyes closed. The trial will be stopped when the examinee reaches ten seconds, or a foot falls off the line. Examinee has 2 trials if the maximum score is not achieved during the first trial.
- Item 5: *Walking forward heel-to-toe on a line.* Examinee stands on a line with hands on hips and one heel touching the toes of the other foot. The trial ends when six steps have been walked or when the examinee's foot is no longer on the line, in heel-to-toe sequence. Examinee has 2 trials if the maximum score is not achieved during the first trial.
- Item 6: *Standing on one leg on a line- Eyes closed.* Examinee stands with hands on hips, with one leg bent at a 90-degree angle, with their shin parallel to the floor, and their eyes closed. The trial is stopped when the ten seconds passes or if the examinee puts the raised foot on the floor, whichever happens first. Examinee gets 2 trials if the maximum score is not achieved during the first trial.

- Item 7: *Standing on one leg on a balance beam- Eyes open.* Examinee stands on a balance beam with hands on hips, one leg bent at a 90-degree angle, and their shin parallel to the floor while looking at the target. The trial is stopped when the ten seconds passes or if the examinee puts the raised foot on the floor, whichever happens first. Examinee gets 2 trials if the maximum score is not achieved during the first trial.
- Item 8: *Standing heel-to-toe on a balance beam*. Examinee stands with hands on hips, one foot directly in front of the other on a balance beam, while looking at the target. The trial is stopped when the examinee earns the maximum score, or when their foot falls from the balance beam. Examinee gets 2 trials if the maximum score is not achieved during the first trial.
- Item 9: *Standing on one leg on a balance beam- eyes closed.* Examinee stands with hands hips, one foot on balance beam, and the other raised at a ninety-degree angle with the shin parallel to the ground, and their eyes closed. The trial ends when the examinee breaks this form. Examinee gets 2 trials if the maximum score is not achieved during the first trial.

(Bruininks & Bruininks, 2005)

A post-test was planned, but ultimately was not able to happen due to the unforeseen circumstances. This pre and post-test design was in order to collect a baseline to determine if there was improvement through comparison of results from prior to and after the 3 yoga sessions. The test was administered by an occupational science undergraduate student under the supervision of a licensed and registered occupational

therapist employed by the school in order to ensure the test was implemented according to procedure.

Data Analysis

The results of the pre and post-test of the BOT-2, if found, were to be compared using a paired-samples t-test. These are typically used to compare the means of a group at two different points in time (Taylor, 2017, p. 340). Data could have been analyzed by each item listed in the subcategory, as well as the overall score for the balance subcategory. While quantitative data was not able to be analyzed, anecdotal evidence is available. Student S experienced minimum to moderate difficulty performing poses. During the first of the two yoga sessions, student A experienced minimum to moderate difficulty executing poses, but during the second session, he experienced moderate to maximum difficulty. During the second session, Student A had to have numerous cues to pay attention and to stay on task while the session was taking place. It was obvious he was struggling with staying on task, which could be a reason that he struggled with the second session more than the first.

Results

The results of this study were inconclusive due to an early cease to the study because of the COVID-19 pandemic causing schools to shut down physical attendance. Ultimately, the goal of this study was to find if the addition of yoga improves balance on individuals when implemented prior to an occupational therapy session. To find this goal, the pre-test as well as two sessions of the three planned sessions of yoga occurred. If the pandemic had not cut the study short, one more ten-minute session prior to the participants' occupational therapy session would have occurred, as well as a post-test of the BOT-2 balance subtest.

Since these participants were found through a convenience sample of the occupational therapist and are receiving occupational therapy for balance deficits, it is expected that their balance scores fall below typical range, with the hopes that the addition of yoga to raise them to a typical range. As seen in Table 1, the participants fall well below the maximum score for the balance subtest, and often do not score even half of the maximum score possible for each item. A typically developing child of the same age as student A (7 years and 8 months old) should be achieving a total point score of 32 for the balance subtest, while student A achieved an 18 on the pre-test. The normative score for student S's age for the balance subtest is 33, while student S scored 14. These comparisons can be seen clearly in Table 2.

While definitive quantitative values were not able to be found through the post-test administration for this study, anecdotal information was gathered from observations during the study and from parent/ guardian comments. While testing student A, it was obvious that he was not able to complete many of the trials he was told to do. He was able to complete many and receive the full points for several items, with other items

receiving no points. Researchers stood close by so that the examinee would not fall because he lost balance often. The examinee would not begin to do an item that he did not think he could complete until someone was near him to catch his fall. Several of the trials require the examinee to close their eyes, and he was very reluctant to close his eyes due to his lack of balance confidence. Even though no definitive measures of balance improvement were able to be obtained, parents and teachers of student A feedback expressed improved confidence in balance and a very positive attitude toward the study.

In the two sessions that were able to occur, student S's parents and teachers also expressed improvements in the student's balance confidence. During these two sessions and the pre-test, student S expressed fear when asked to do many test tasks or yoga poses, and would not begin many poses without holding onto something before starting. Many poses were modified for her to complete, particularly those requiring the eyes to be closed or standing on one leg. Throughout the process, she stayed focused and attentive to tasks asked of her.

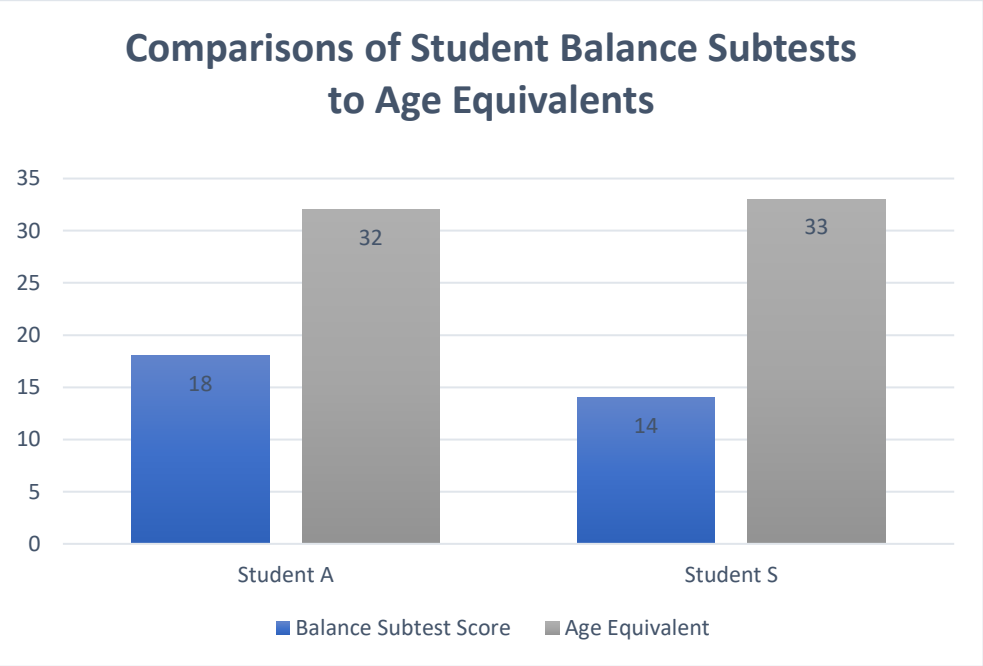
Based on previous literature, the post-test results were expected to show overall improvements from the pre-test of the BOT-2. In a previous study of the addition of yoga that used the BOT-2 as a pre and post-test, Donahoe-Fillmore & Grant (2019) determined that the addition of yoga at the end of 17 sessions was statistically significant for improvement of balance. While this study was not able to complete such large number of sessions, this research indicates that the post-tests results were expected to be higher than the pre-test results for balance. As explained previously, fear of falling is a debilitating fear (Chandler, Duncan, Sanders, Studenski, 1996), and can have serious impacts to daily life. While these participants were not of elderly age, they can still experience a fear of

falling. This fear was demonstrated several times during pre-testing as well as during yoga sessions. As Schmid, Puymbroeck, and Koceja (2010) state, yoga improves balance and fear of falling, which can be seen in anecdotal evidence from the parents of the participants. Both students' parents and/or teachers made comments about how their confidence in balance had risen, even from just the two sessions that were able to be implemented.

Table 1: Balance Subtest scores by individual item

Item Number	Student A pre-test score	Student S pre-test score	Maximum score for item
Item 1: *Standing with feet apart on a line- Eyes open*	4	2	4
Item 2: *Walking forward on a line*	4	2	4
Item 3: *Standing on one leg on a line- Eyes open*	3	3	4
Item 4: *Standing with feet apart on a line- Eyes Closed*	3	1	4
Item 5: *Walking forward heel-to-toe on a line*	1	1	4
Item 6: *Standing on one leg on a line- Eyes closed*	1	1	4
Item 7: *Standing on one leg on a balance beam- Eyes open*	1	1	4
Item 8: *Standing heel-to-toe on a balance beam*	1	1	4
Item 9: *Standing on one leg on a balance beam- eyes closed*	0	1	5
Total Point Score	18	14	37

Table 2: Comparison of Student Balance Subtests to Age Equivalents



Discussion

Though conclusive quantitative results were not able to be found, anecdotal feedback from parents and teachers of the participants revealed that the addition of yoga was beneficial to their balance confidence. Evidence from Hinsey, et. al (2016) explains that older adults had their balance improved with the addition of yoga, as well as their fear of falling. This means that their balance confidence, as well as their balance ability was improved due to yoga. Since many individuals that are of geriatric age experience

balance decline (Naik, Mayenkar, 2019), the positive gains in balance and balance confidence could be applied to children since their balance is still developing. Many studies of fear of falling only include elderly individuals as participants, so these studies could be applied to children to see how their balance confidence is improved, as seen from anecdotal evidence of this study.

Based on previous literature, the following benefits were found for individuals that participated in yoga: improved balance in children (Donahoe-Fillmore & Grant, 2019), improved balance in the geriatric population (Krishnamurthy and Telles, 2007), decreased fear of falling in elderly individuals (Schmid, Puymbroeck, & Koceja, 2010) improved balance for geriatric populations receiving occupational therapy (Hinsey, et. al, 2016), improved static balance (Telles, Hanumanthaiah, Nagarthna, and Nagendra, 1994), and improved balance in "healthy" adults (Jeter, Nkodo, Moonaz, Dangelie, 2014) to name a few. Due to these findings, and others, it is clear that yoga is an effective measure for the improvement of balance, across the lifespan. Therefore, future research can be implemented to see how yoga can affect individual's sensory regulation. One participant was bothered by a strong odor coming from a maintenance issue in the building, and possibly impacting her pre-test scores. The combination of sensory overload and the possibility of impacted scores lead researchers to determine that future research could be done as to how yoga could help to provide sensory regulation for children.

The current study can be applied for future implications to occupational therapy as well as teachers and the school systems. Since feedback from parents and teachers was

positive as to the participants' balance confidence, teachers, specifically elementary school teachers, may want to consider adding yoga in the classroom setting in order to help children who are in crucial balance development ages (Jiang, et. al, 2018). Occupational therapists can use these findings in the future for clients that are receiving occupational therapy for balance deficits, and those that have mild sensory processing disorders.

Limitations

The main limitation from this study is the COVID-19 pandemic that yielded this study inconclusive. Had the study been able to continue, inferential data could have been collected through the post-test to have a definitive final result determined. Another limitation of this study is the limited sample size. Eastern Kentucky University's Institutional Review Board approved this study to be conducted with three students from this elementary school. While three was approved, only two returned the correct paperwork and permission to be allowed into the study, despite efforts for recruitment of two other participants.

On the day of the pre-testing, student S complained of dizziness that may have impacted her test results. This dizziness could have been caused by an aforementioned maintenance issue in the building that was used for the pre-test. The stench was overpowering so it could have led to sensory overstimulation, resulting in lowered test scores. Throughout the entire study, student A needed frequent and often attention to task cues during pre-testing and during yoga sessions. During one yoga session, he had to be

pulled aside and reminded that he needed to focus and participate to the tasks given to him.

Conclusion

Evidence shows that yoga is an effective intervention to improve an individual's balance across the lifespan, as well as improve mental well-being. Research on children indicates that after a consistent yoga intervention, children measure statistically significantly higher on the BOT-2 than those children with no yoga intervention (Donahoe-Fillmore & Grant, 2018). Though this study was inconclusive due to unfortunate circumstances, but the evidence that was gathered before the sudden end of the study indicates that more research on yoga as a means to help balance is warranted.

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