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Effects of a Drums Alive® Intervention versus Hand-Foot Coordination Training on Motor, Cognitive and Motivational Parameters in Seniors

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Abstract

This study was conducted to compare the effects of two different interventions on the physiological, cognitive, and motivational parameters in seniors; and, how they would be accepted as alternative forms of exercise in the senior population. The facilitators recruited 26 randomly selected participants from two senior care facilities in Chemnitz, Germany who were required to complete two 45-minute exercise periods a week for 30 days. The first group completed the Drums Alive intervention which included a multi-dimensional approach using music, movement, drumming choreographies, games, and activities. The second intervention group completed a series of Hand-Foot Coordination exercises that used beat-keeping patterns on various parts of the body. Each intervention group had three divisions of participants, *i.e.* "healthy" to define those with no diagnosed malady, "dementia" for those with varying degrees of diagnosed dementia, and, "wheelchair" and those requiring a wheelchair for movement. The pre- and post-testing measurements consisted of age, heart rate, blood pressure, rate of perceived exertion (RPE), bar-drop test, chair-raise test, 6-minute walk test, memory, concentration, balance, reaction, coordination, and cognitive flexibility. In addition, to measure the level of motivation, *i.e.* fun, the participants used a tool that was developed by the Psychology Department of the Chemnitz University. The results demonstrated that both interventions were suitable alternates for senior-focused conventional sports offerings, however, the Drums Alive intervention outperformed the Hand-Foot Coordination intervention in a majority of the measured domains by an overall average of 9.45 percent. Of note, the data, vis a vis motivation, demonstrated a 38.4 percent increase for Drums Alive vice a 13.3 percent increase for Hand-Foot Coordination, suggesting the Drums Alive intervention offered more effective protocols that could inspire seniors to make this a part of an overall health and wellness plan to improve their quality of life.

Keywords

Motivation, Cognition, Physicality, Quality of Life

1. Introduction

Over the past several years, the number of seniors in Germany has been steadily increasing, for example, the age group 65 years and older is on track to rise by 41 percent to 24 million by 2050, which will account for almost one-third of the total population. At the same time, the population of ages 15 through 64 years will decrease by almost 23 percent from a total of 53 million in 2015 to 41 million by 2050 (**Figure 1**). Additionally, in 1970, about 2 percent of the population was 80 years and older which rose to 5 percent by 2010, and by 2050 around 15 percent will be older than 80 with the average age being 50 years old (*Federal Statistical Office* 2006). This increase in the number of seniors aged 80 and over is likely to lead to an increase in the number of people in need of extended care to maintain their social confidence and competence in performing daily living skills. To be more succinct, there will be a significant increase in people who will spend their golden years in a retirement home or senior care facility due to physical and cognitive changes that make independent living very difficult to impossible [1]. About 80% of nursing home residents suffer from limitations in physical and mental mobility, and 70% of residents have depressive symptoms [2].

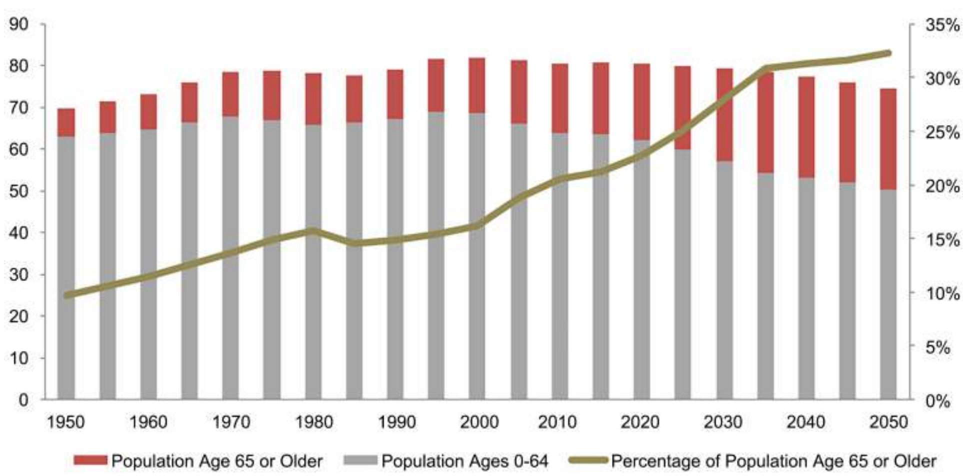


Figure 1. Population by age group (in Millions) and percentage of older population age 65 or older (UN Population Division).

The progressive degradation processes in age and the associated reduction in physical performance can be characterized by physiological and anatomical changes. In addition, the age-related changes in the immune system are particularly evident in the increasing number of new cases of certain tumors, autoimmune diseases, and the increased incidence of infections [3]. In terms of cost, nearly half of healthcare spending is attributed to the elderly population 65 years and older with older women generating significantly more costs than older men (Federal Statistical Office, 2011). Of all the maladies that seniors experience, more than 50 percent of the health care costs are attributed to four disease groups, *i.e.* cardiovascular disease, musculoskeletal disorder, mental or behavioral disorder, and digestive system disease (German Federal Statistical Office, 2008). Within this context, in the 60- to 79-year-old age group, about one in six men and one in four women suffer from five or more diseases [4].

Aging processes lead to an increase in the vulnerability of the organism and to diseases or pathological conditions that shorten the life span [5]. Frequently, several diseases occur in parallel in the elderly which is referred to as multimorbidity or multiple illnesses [6]. The annual prevalence rate of multimorbidity is higher for women than for men in all age groups. The age group of 65 - 79-year-olds counts on average 3.4 diseases among women and 2.3 diseases in men. In the age groups up to 80 years, the prevalence rate for multimorbidity in women is two times higher than in men [5]. The following data shows the most common diseases in seniors (**Table 1**).

The most important parameter influencing cardiac performance is cardiac post-intervention calculated as the product of maximum heart rate and heartbeat volume. Throughout the aging process, there is a decrease in stroke volume due to the reduced contractility and elasticity of the cardiac muscle leading to a reduction in the contraction rate of the cardiac muscle fibers resulting in an increase in systolic and diastolic blood pressure [7]. This chronic disease of the cardiovascular system is an important risk factor for coronary heart disease [8].

Table 1. Proportion of older people in need of care and assistance with the six most common diseases (*Source*: *Fourth Report on the Situation of the Older Generations in the Federal Republic of Germany*, 2002).

Diseases	65 - 79 Years		80 Years and older	
	Rank	(%) needing care	Rank	(%) needing care
Joint disorders (disease)	(1)	40	(1)	74
Heart disease	(2)	31	(2)	64
Visual impairment	None	None	(3)	77
Blood vessels (*i.e.* arteriosclerosis)	(5)	35	(49)	40
Cerebrovascular disease (*i.e.* stroke)	(6)	61	(5)	81
Metabolic diseases (*i.e.* diabetes)	(4)	29	(6)	59
Diseases of the nervous system	(3)	59	None	None

The reduction in lung capacity, also known as vital capacity, and the increase in residual volume, is among the pulmonary changes that occur in seniors. They are caused by the reduced distensibility of the lungs as well as by the increasingly restricted mobility of the thorax [7]. In addition, an increase in airway resistance means that more energy is required for inhalation and exhalation [9]. Despite age-related changes in all maximum oxygen uptake, also referred to as the gross criterion for endurance performance, exercise and training can provide positive improvements that can delay the onset and lessen its severity [8].

The musculoskeletal system, consisting of bones, muscles, joints, and ligaments, is also affected by aging processes. From the age of fifty, the decrease in vitamin D metabolism leads to an annual loss of bone mass of about 0.5% - 1%. In menopausal women, bone loss is even higher due to the rapid decrease in estrogen concentration—up to 3% per year. Consequences of age-related demineralization of the bones are changes in shape and increased susceptibility to fracture [10]. Muscle mass atrophies by about 30% with age, leading to decreased muscle strength and lower physical performance which often results in limited ability to confidently cope with daily living activities and an increased risk of falls [5].

The term cognitive aging is associated with physiological changes in the brain that includes the loss of neurons, reduction of synaptic connectivity, and atrophy as well as general mental mechanisms such as motivation [11]. One of the cognitive diseases in seniors is dementia which is a "chronically progressive brain degradation with loss of earlier thinking abilities" [12]. According to the Berlin Study on Aging, dementia is the most frequent mental illness among seniors, with the prevalence among those over 65 years of age at six percent [13]. Participants with dementia experience a progressive decline in motor-functional performance which primarily affects strength, balance, and gait performance [14]. Memory plays a vital role in the development and maintenance of identity and independence and is therefore of fundamental importance for all, but especially, seniors. Only through increased task complexity or the number and complexity of novel tasks, do differences become more visible [15].

Age-related changes in anatomical and physiological parameters of the auditory system led to a decrease in hearing performance and the associated information intake which can have a negative effect on social relationships and cognitive performance. The aging process of vision includes, among other things, a reduction of visual acuity, which occurs in approximately 50 percent of seniors over the age of 75 years. In addition, there are changes in contrast sensitivity, which is important for distance, color perception, and peripheral vision. Similar to hearing, visual performance is a valuable tool for the reception of information [16].

Further age-related developments can be observed in psychomotor performance. The reaction time of people over 65 years of age is about 25 percent longer than that of younger people [16]. The physical inactivity of seniors is considered a principal factor influencing the loss of strength and muscle mass [9]. Late adulthood, beginning between the ages of 45 and 50, is characterized by an increasing decline in motor performance [17]. Gradual degeneration of the coordinative abilities is particularly noticeable in daily living skills capability. Due to the reduced balance capability, ordinary situations such as climbing stairs or carrying objects become significantly more difficult. A lack of reaction, spatial awareness, orientation, and ability to reposition lead to reduced security of movement in seniors, especially in unfamiliar surroundings [18]. The deficits become particularly apparent in occupations with high physical and mental performance requirements. In the 60- to 70-year-olds, the decline in motor performance is generally so far advanced that significant deteriorations in overall motor function become apparent. Among the essential features of pronounced motor involution include a greatly reduced need for movement, slow execution of movement, and a certain rigidity or restricted mobility [17].

These statistics beg the question of what is to be done to reduce the negative age-related maladies. The structural change in the population and the accompanying challenges make it necessary to take a closer look at sports for seniors. Physical activity can help to counteract the age-related decline in physical and mental performance. Studies point to motor improvements in this context and support physical training as an effective form of therapy because of its favorable influence on numerous risk factors and diseases in seniors [1]. Therefore, it is essential for seniors to remain physically and mentally fit for as long as possible to improve their quality of life, contribute to the overall performance of society and relieve the burden on the social systems [19].

Appropriate coordinative training improves the ability to learn motor skills and increasingly improves reaction and balance leading to more security in movement and thus serving to prevent accidents, promote motor adaptability, and ensure adequate reaction in unexpected situations [20]. In addition to the physical aspects, an active lifestyle also has a favorable effect on the mental function of seniors and can significantly counteract the development of Alzheimer's disease, dementia, and depression [21]. The psychological effects of sporting activity include the reduction of stress, anxiety, and depressive moods as well as promotion the general well-being, satisfaction, and self-esteem where a senior does not only become a participant, but also as a contributor to the development of improving the aging process [19]. Through a targeted training program, biological degradation in endurance, strength, balance, and bone density can be decreased by up to 10 or 20 years [22].

Endurance-oriented training leads to an improvement in cardiopulmonary performance. After only a few weeks of training, peripheral adaptation processes and an economization of cardiovascular work is reflected in a reduced heart rate at rest and during exertion and results in increased stroke volume, reduced oxygen load on the heart muscle, and decreases cardiovascular risk factors such as high blood pressure and reduced lung capacity [23].

Further adaptations can be observed in the musculoskeletal system as regular research-based stresses and strains lead to a strengthening of bones, cartilage, tendon, and ligament structures, and musculature is better supplied with blood due to increased capillarization [24]. Strength training delays function-diminishing processes of the active and passive musculoskeletal system, counteracts age-related muscle atrophy, and can increase muscle mass by 3.3 pounds within 8 weeks. Similar to endurance training, strength training also has a positive effect on blood lipids and improves glucose metabolism [25]. As part of a comprehensive training program, a daily stretching program of 5 - 10 minutes contributes to an improvement of joint mobility and muscular loosening, and flexibility training optimizes body perception and body awareness [20]. By eliminating imbalances in the musculature, incorrect postures can be compensated for or avoided.

The second question that should be asked is what kind of physical, social, and emotional activities or training is best suited for seniors. Gimpel (2008) strongly encourages a multi-disciplinary approach because it will build a more flexible and sophisticated brain for enhanced social skills and memory development [26]. Movement is an important part of a multidisciplinary approach to improving executive function and is essential to learning as it integrates and anchors new information into our neural networks. Every time we move in an organized manner, full brain activation and integration occurs and the door to learning opens [27]. Multi-disciplinary approaches also include the use of music as a well-established professional health discipline and therapeutic stimulus to achieve therapeutic goals. Kemper and Danhour (2005) spoke directly to this when they said, "music is widely used to enhance well-being, reduce stress, and distract patients from unpleasant symptoms. Although there are wide variations in individual preferences, music appears to exert direct physiological effects through the autonomic nervous system. It also has indirect effects by modifying caregiver behavior. Music effectively reduces anxiety and improves mood for medical and surgical patients, for patients in intensive care units and patients undergoing procedures, and for children as well as adults. Music is a low-cost intervention that often reduces surgical, procedural, acute, and chronic pain. Music also improves the quality of life for patients receiving palliative care, enhancing a sense of comfort and relaxation. Providing music to caregivers may be a cost-effective and enjoyable strategy to improve empathy, compassion, and relationship-centered care while not increasing errors or interfering with technical aspects of care" [28]. DeAngelis (2018) reported that Nina Kraus, Professor of Communication Sciences and Neurobiology, studied the biology of auditory learning and strongly suggested that there is a relationship between neural response consistency and the ability to keep a beat as this ability was fundamental and positively affected both sports and musical performance, as well as speech-flow and motor skills [29]. To combine movement and music with simple to complex choreographies, and fun, research-based dance steps with motivational music, as with Drums Alive, the effects can have a very positive effect on balance and gait in seniors [30]. In addition, dancing as physical activity could help to improve functionality and contribute to falling prevention.

Lastly, the evidence-based effects of drumming exercise have been accepted as a therapeutic approach to a myriad of maladies as well as a validated protocol for overall health and wellness. Barry Bernstein conducted research on group therapeutic drumming and concluded that it breaks down social barriers, encourages freedom of expression, exercises non-verbal communication, and embodies unity and cooperation. In addition, it provides a holistic wellness activity involving all aspects of physical, cognitive, emotional, and psychological functionality, stimulating the body's natural physical and emotional healing processes. Therapeutic group drumming has been proved to decrease depression, anxiety, and stress, boost immune system functioning, and benefit physical health [31]. Dr. Ping Ho concluded that participation in group drumming led to significant improvements in multiple domains of social-emotional behavior [32]. Research regarding drumming as exercise has been made accessible by classifying it as an aerobic and sometimes anaerobic activity [33]. Karl Bruhn, known as the Father of the Music-Making and Wellness Movement, said, "without the obstacle of a challenging learning curve, group drumming offers an enjoyable, accessible, and fulfilling activity from the start for young and old alike". He continues, "drumming has great acceptance cross-culturally and is inclusive, regardless of age or ability. Therefore, drumming could be used as a medium to introduce a wider population to exercise and additional therapeutic protocols" [34]. To fully illustrate the comprehensive utility, power, and influence of a multidisciplinary approach and the importance of drumming to contribute as a key component to advancing physical, emotional, social, and cognitive capabilities, Remo Belli, Founder and CEO of Remo, Inc. said, "it's time to stop thinking of the drum as just a musical instrument, and start thinking of it as a unifying tool for every family, a wellness tool for every retiree, and an educational tool for every classroom" [35].

2. Methods

Twenty-six residents of two senior care facilities were selected to participate in this study that consisted of 18 females and 8 males who resided in either the Pro Senior Care Residence or the Azurt Retirement Home in Chemnitz, Germany. The Drums Alive intervention group consisted of 14 participants (10 females and 4 males) which average age, weight and height was 83 years, 156 pounds and 63 inches (**Table 2**). The Hand-Foot Coordination intervention group consisted of 12 participants (8 females and 4 males) which average age, weight and height was 82 years, 161 pounds and 63 inches (**Table 3**).

In addition to anthropometric data, heart rate, blood pressure, and balance, were measured using standard lab equipment. Heart rate was monitored during each session with the Polar Team System which used moistened electrodes, a

Table 2. Anthropometric data of the Drums Alive intervention group (n = 14).

Measurements	Age (years)	Weight (lbs)	Height (in)
Avg	82.54	156.02	62.81
Sx	10.53	38.33	5.23
Min/Max	57.00/92.00	110.23/240.30	53.93/72.83

Table 3. Anthropometric data of the Hand-Foot Coordination intervention group (n = 12).

Measurements	Age (years)	Weight (lbs)	Height (in)
Avg	82.17	161.11	62.77
Sx	7.11	25.94	3.09
Min/Max	69.00/91.00	108.02/202.82	57.87/67.32

sensor strap, and a transmitter to collect data and intervene if an abnormal heart rate was detected. The balance measurement was obtained by using a dynamometric pressure distribution measuring plate to determine the body center of gravity and fluctuations over a 10 second period. The coordination and memory test data were obtained with an Age Scan measurement device.

The bar drop test required the participants were required sit in a chair, extend their stronger arm vertically at their side with the thumb and index finger forming a 90˚ angle. The test supervisor would place the bar drop device, a 3 foot long, 0.25 lbs. round bar between their own thumb and index finger; and, without notice, release the bar at which point the participant was required to reach out as quickly as possible and catch the bar. Before the three scoring rounds, the procedure was demonstrated once and each participant was allowed to practice the test to ensure they understood the concept.

The Chair-Rise Test required each participant to stand up from a chair and sit down again as often as possible in 30 seconds. A support frame was provided for those who needed assistance.

The coordination and memory tests were conducted in a quiet room to avoid distractions. The coordination test began when the participant pressed a start button and arranged randomly placed, pyramid-shaped numbers from 1 to 9 in correct order. If the selected sequence of numbers was incorrect, the test was automatically aborted. There were two practice trials before the test was administered and the best score of two official attempts was recorded. The arrangement of the numbers changed after each press of the start button. The memory test had a fixed number sequence from 0 to 9, which was distributed over two lines. The task was to name the digit which flashed, then when the second digit flashed, the task was to remember and name the first digit, then, then second digit, and continue this pattern until all 9 digits were named in proper order. The test supervisor monitored the test and pressed the selections made the participant. There were two practice trials before the test was administered and the best score of two official attempts was recorded.

The 6-minute walk test recorded the distance a participant would travel in a timed 6-minute period. This test was designed to allow full participation regardless of ability, including those who needed a walker or wheelchair. Chairs were provided in case a participant needed to rest and each participant had a member from the research team accompany them to ensure safety protocols were followed and assistance provided, if needed.

Rate of Perceived Exertion (RPE) was assessed during the entire intervention by having each participant subjectively score themselves using the standardized BORG scale (point value from 6 - 20), vis a vis stress and exertion, 30 minutes following each session. In addition to heart rate, this was a good measure for the estimation and regulation of the physical intensity and is routinely used in diagnostics and therapy. In practice, intensities on the RPE chart of 9 (quite easy) to 13 (somewhat strenuous) are used for training in the health sector with the recommended score being 13. In this study, the average perception of exertion in both groups was mostly within this range over the entire intervention period which indicated an appropriate training intensity. The choices were thoroughly explained before the intervention and each senior had a choice to either point to their score on the scale or tell the test supervisor.

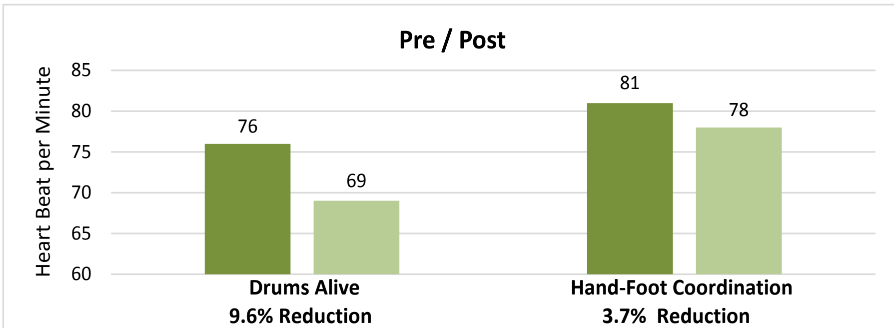
The motivation data was measured using a validated instrument called, the "fun" scale, developed in collaboration between the professorships of Sports Medicine and Media Communication at Chemnitz University of Technology. This analog scale mirrored the criteria of the BORG Scale used to measure RPE with the values between 6 and 20 points were used to measure the motivation vis a vis fun after each session. According to the subjective scale, 6 points equated to no fun at all, and 20 points equated to an enormous amount of fun. The mean value of the scale was 12 - 14 points with the low motivation scores ranging from 6 to 11 points and 15 and above was considered as having fun or a higher degree of motivation.

3. Statistics and Analysis

The data was recorded and graphically processed using Excel version 2007 and 2003 from Microsoft and represented in **Figures 2-13**. The statistical tests and evaluations were produced using SPSS 18 (Statistical Package for the Social Science) and the Wilcoxon signed-rank test that compared two interdependent samples that were not normally distributed. The results of the ultrasound examination were analyzed using one-factor analysis of variance. The significance level was set at 5% for all tests ($p = 0.05$); thereby $p > 0.05$ designated as not statistically significant and $p \leq 0.05$ as statistically significant.

4. Results

In terms of heart rate and blood pressure, the Drums Alive intervention showed statistically significant improvements in the healthy group by lowering their heart rate by 7 beats a minute with little to no appreciable change occurring between pre- and post-test scores for the Hand-Foot Coordination intervention. In terms of blood pressure, the average systolic and diastolic blood pressure pre- and post-measurements of both intervention healthy groups were statistically significantly. The Drums Alive participants lowered systolic blood pressure by 9 mmHg and diastolic blood pressure by 7 mmHg; and the Hand-Foot Coordination measurements lowered their systolic pressure by 9 mmHg and diastolic pressure by 2 mmHg.



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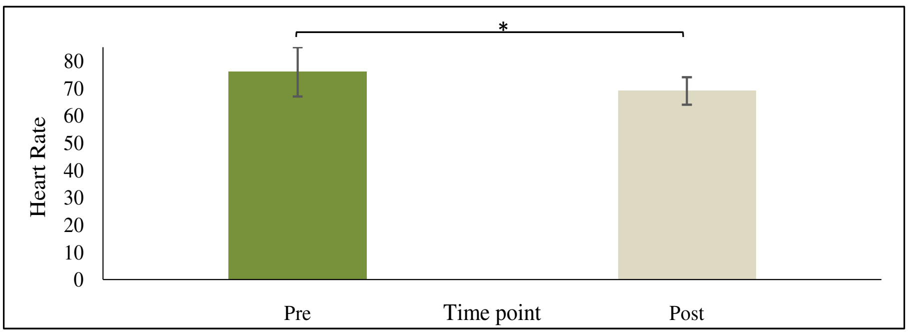

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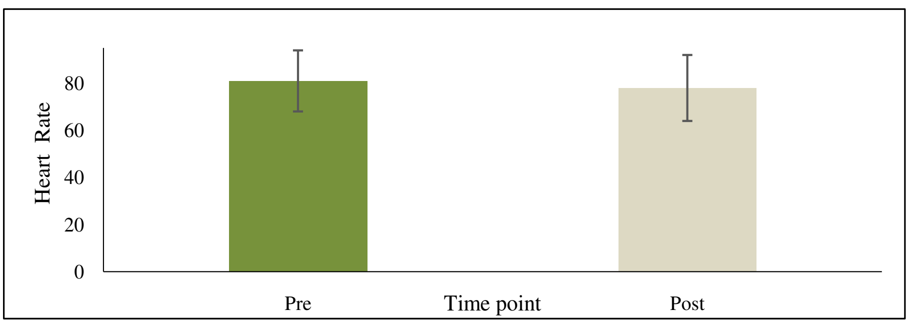

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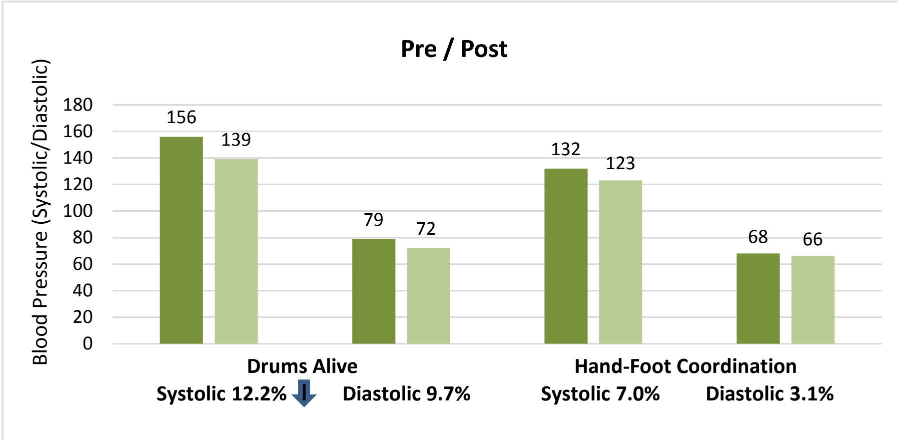
Figure 2. (a) Drums Alive vs Hand-Foot Coordination: Healthy Group Heart Rate; (b) Drums Alive Healthy Group Heart Rate (* indicates $p < 0.05$). There was a significant reduction in the Drums Alive, heart rate, from pre ($M = 76$, $SD = 9$) to posttest ($M = 69$, $SD = 5$, $p < 0.05$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Heart Rate. There was no difference in Hand-Foot Coordination, heart rate, from pre ($M = 81$, $SD = 13$) to posttest ($M = 78$, $SD = 14$, $p > 0.05$) in healthy seniors.



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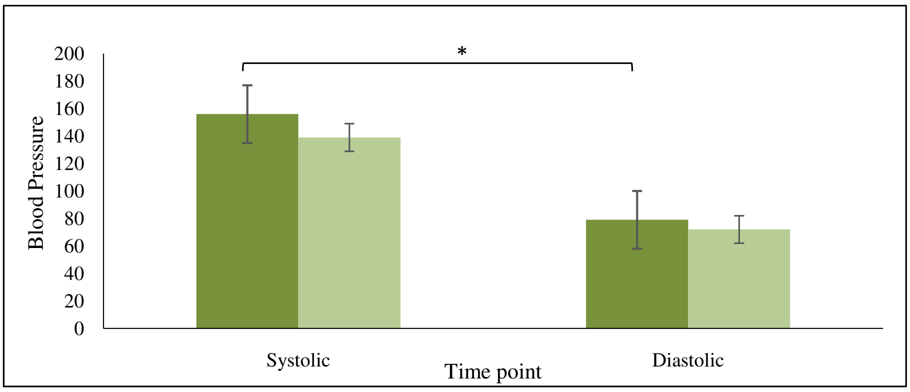

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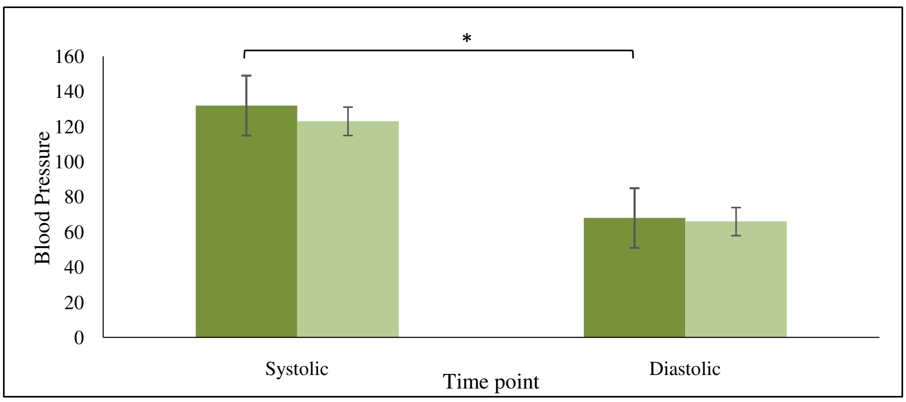

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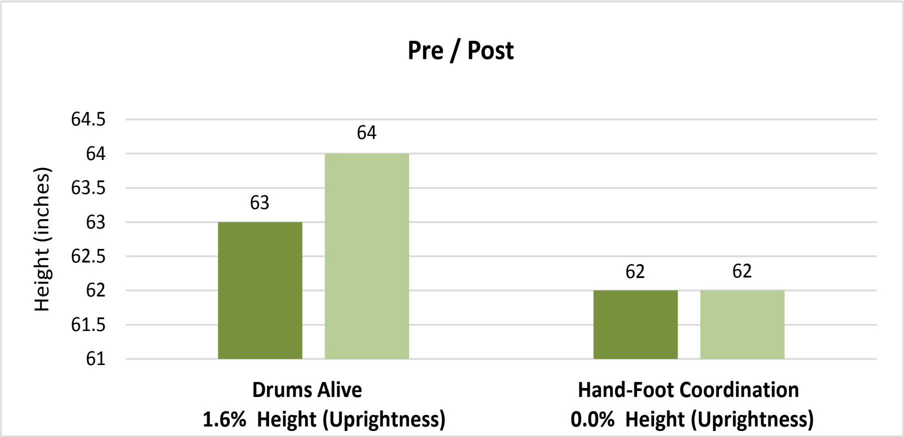
Figure 3. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Blood Pressure; (b) Drums Alive Blood Healthy Group Blood Pressure (* indicates $p < 0.05$). There was a significant decrease in Drums Alive, systolic, from pre ($M = 156$, $SD = 4$) to posttest ($M = 139$, $SD = 4$, $p = 0.026$) in healthy seniors. There was no difference in Drums Alive, diastolic, from pre ($M = 79$, $SD = 5$) to posttest ($M = 72$, $SD = 6$, $p > 0.05$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Blood Pressure (* indicates $p < 0.05$). There was a significant decrease in Hand-Foot Coordination, systolic, from pre ($M = 132$, $SD = 5$) to posttest ($M = 123$, $SD = 4$, $p = 0.033$) in healthy seniors. There was no difference in Hand-Foot Coordination, diastolic, from pre ($M = 68$, $SD = 5$) to posttest ($M = 66$, $SD = 6$, $p > 0.05$) in healthy seniors.



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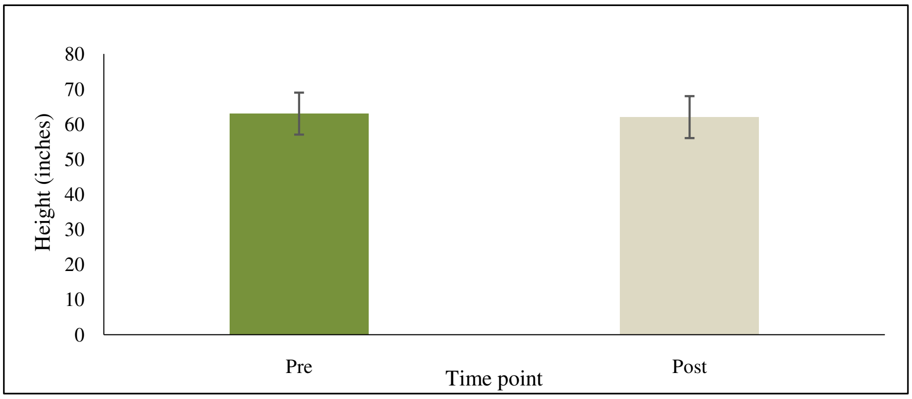

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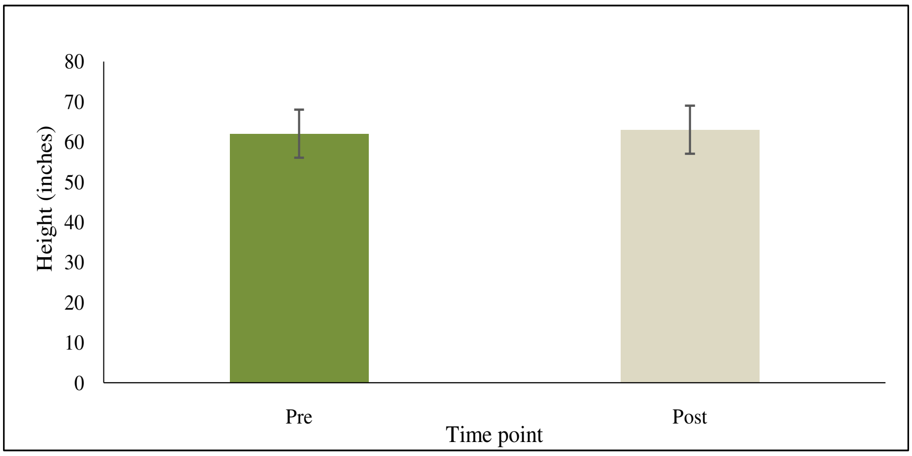

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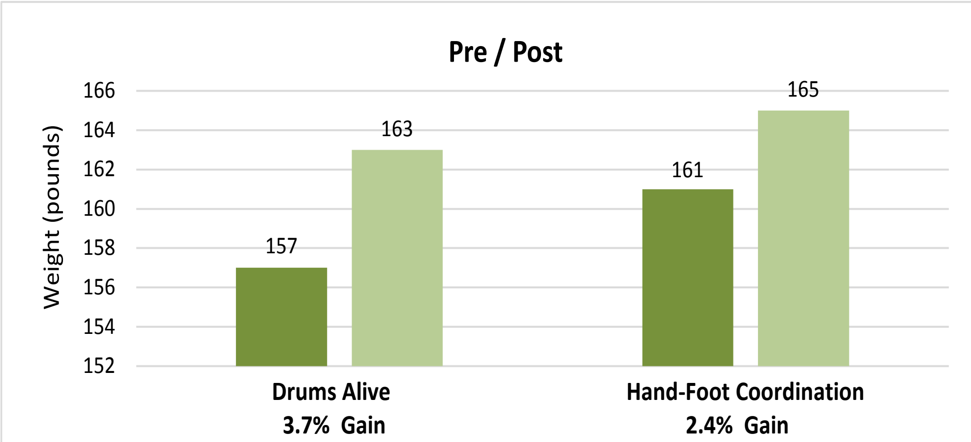
Figure 4. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Height (Uprightness); (b) Drums Alive Healthy Group Height (Uprightness). There was no difference in Drums Alive, height (uprightness), from pre ($M = 63$, $SD = 6$) to posttest ($M = 64$, $SD = 6$, $p > 0.05$) in healthy seniors; (c) Hand-Foot Coordination Healhty Group Height (Uprightness). There was no difference in Hand Coordination, height (uprightness), from pre ($M = 62$, $SD = 4$) to posttest ($M = 62$, $SD = 4$, $p > 0.05$) in healthy seniors.



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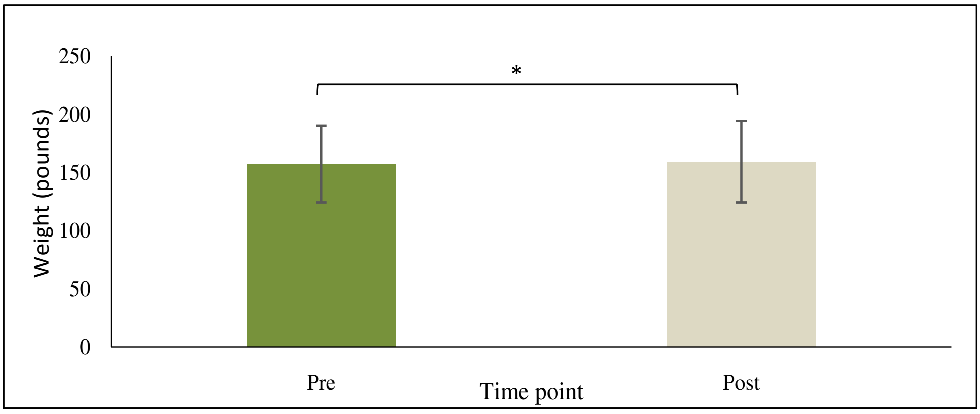

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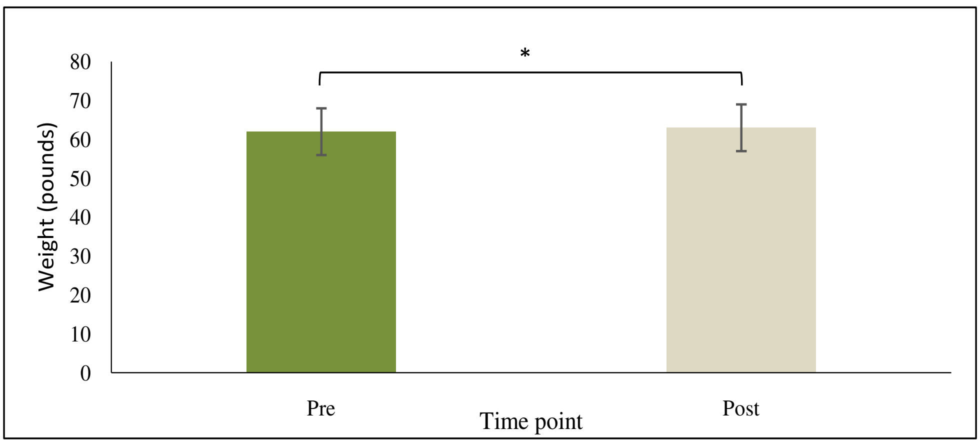

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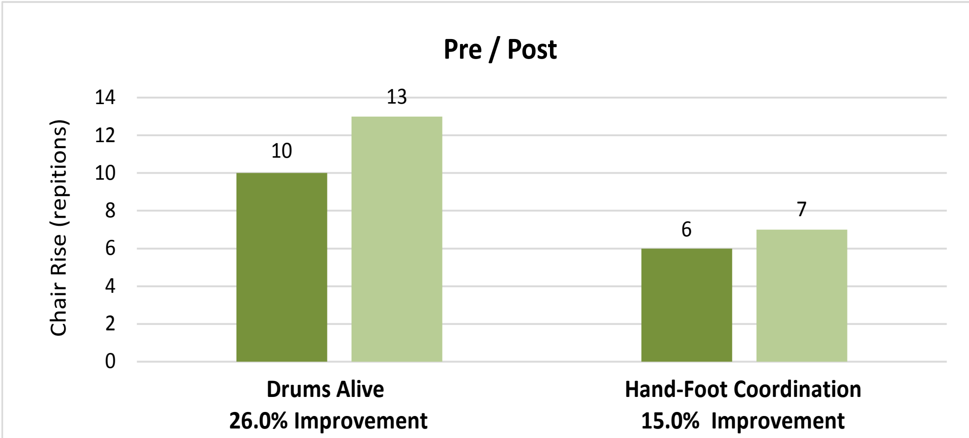
Figure 5. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Weight; (b) Drums Alive Healthy Group Weight (* indicates $p < 0.05$). There was a significant increase in Drums Alive, weight, from pre ($M = 157$, $SD = 33$) to posttest ($M = 163$, $SD = 35$, $p = 0.017$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Weight (* indicates $p < 0.05$). There was a significant increase in Hand-Coordination, weight, from pre ($M = 161$, $SD = 35$) to posttest ($M = 165$, $SD = 35$, $p = 0.027$) in healthy seniors.



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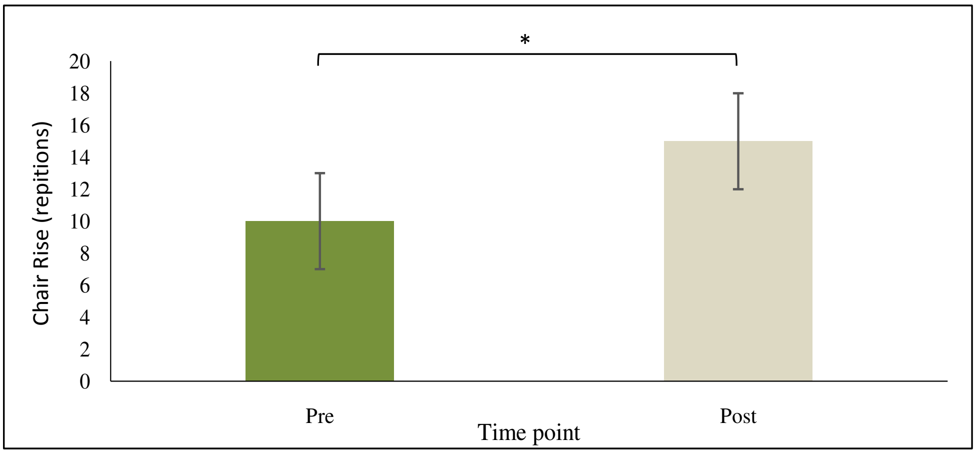

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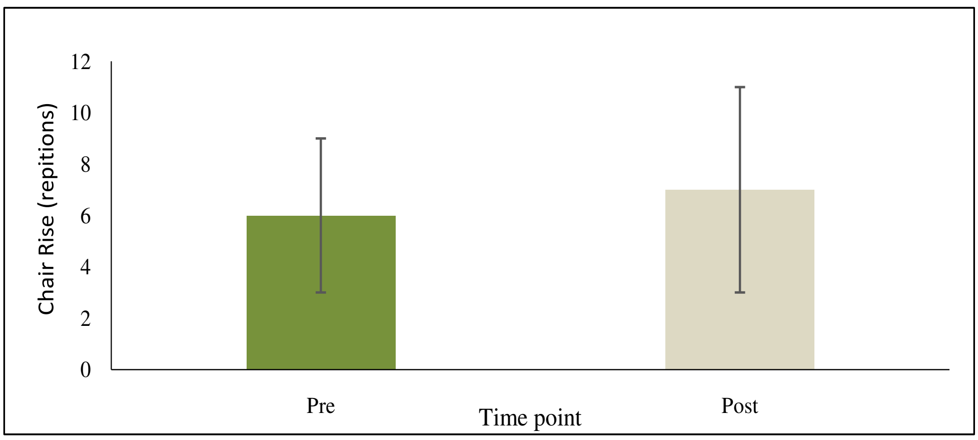

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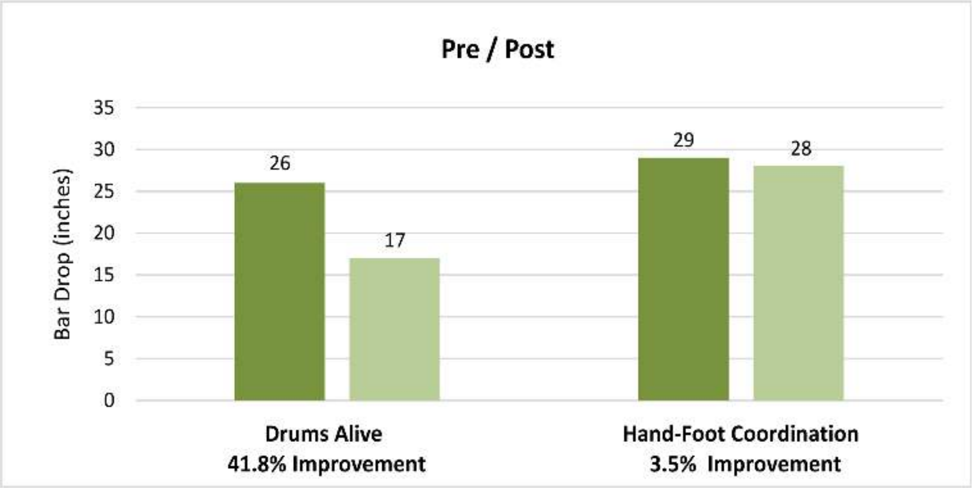
Figure 6. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Chair Rise; (b) Drums Alive Healthy Group Chair Rise (* indicates $p < 0.05$). There was a significant increase in Drums Alive, chair rise, from pre ($M = 10$, $SD = 3$) to posttest ($M = 13$, $SD = 3$, $p = 0.016$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Chair Rise. There was no difference in Hand-Foot Coordination, chair rise, from pre ($M = 6$, $SD = 3$) to posttest ($M = 7$, $SD = 4$, $p > 0.05$) in healthy seniors.



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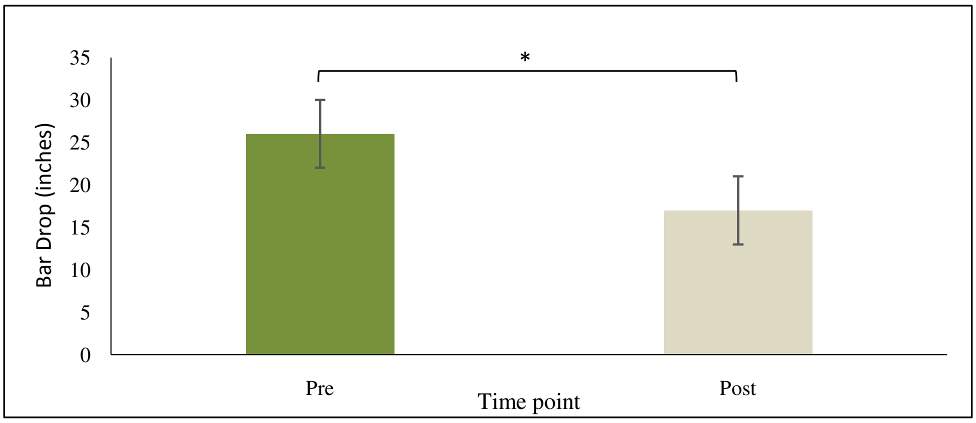

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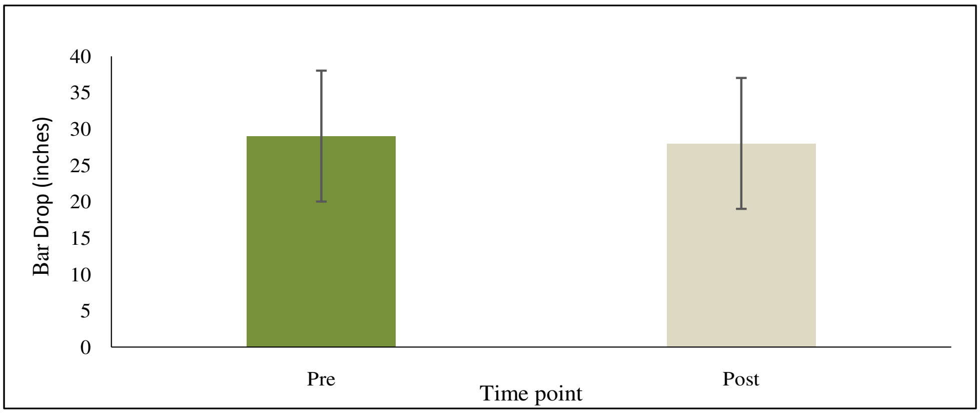

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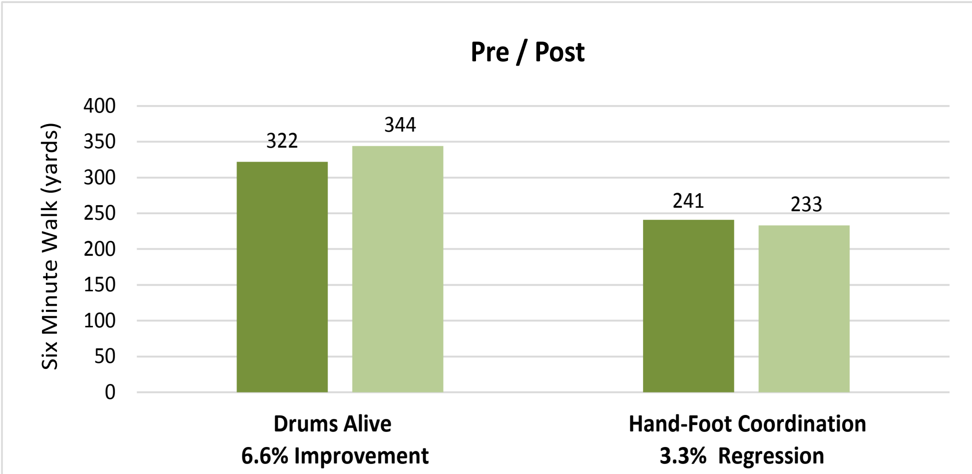
Figure 7. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Bar Drop; (b) Drums Alive Healthy Group Bar Drop (* indicates $p < 0.05$). There was a significant decrease in Drums Alive, bar drop, from pre ($M = 26$, $SD = 4$) to posttest ($M = 17$, $SD = 4$, $p = 0.028$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Bar Drop. There was no difference in Hand-Foot Coordination, bar drop, from pre ($M = 29$, $SD = 9$) to posttest ($M = 28$, $SD = 9$, $p > 0.05$) in healthy seniors.



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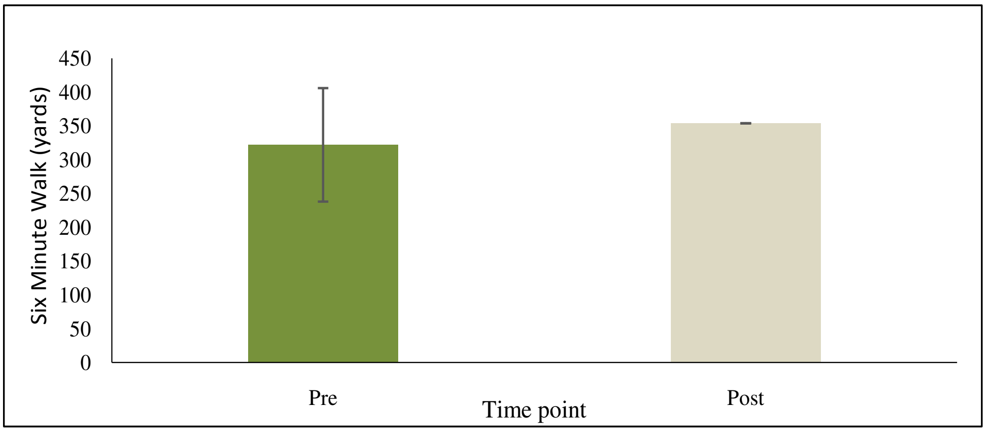

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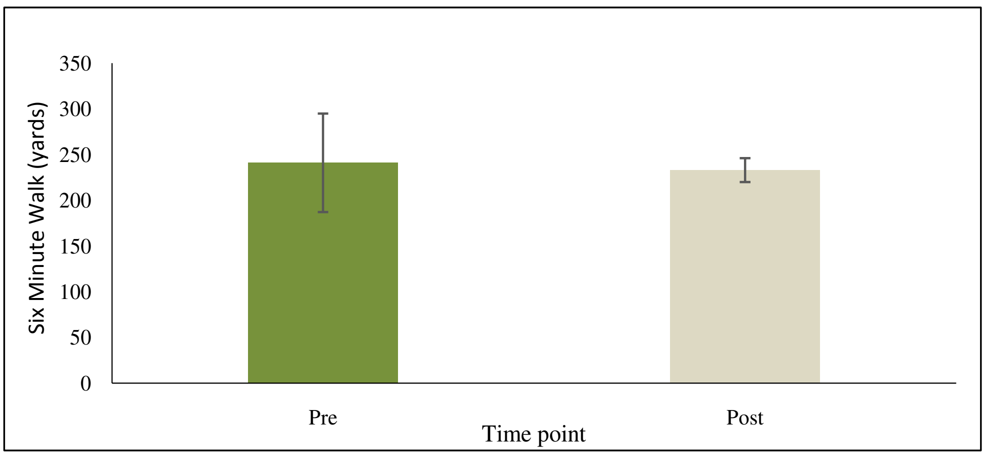

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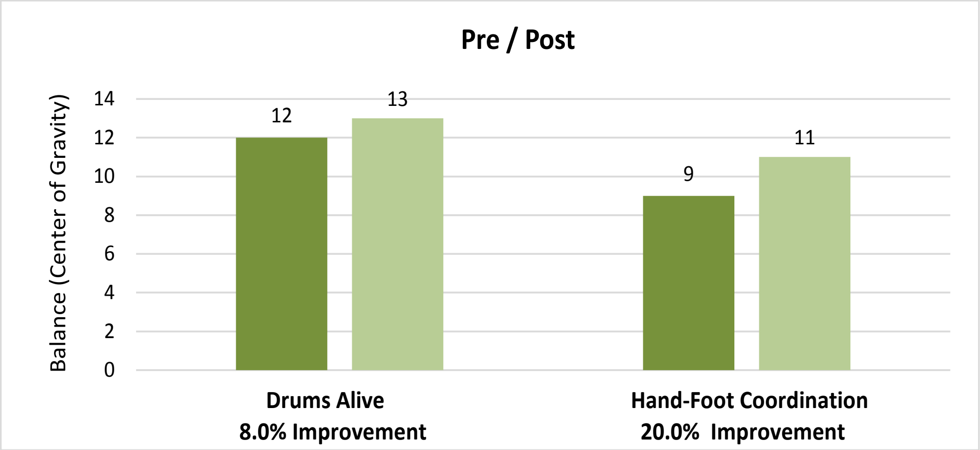
Figure 8. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Six-Minute Walk; (b) Drums Alive Healthy Group 6-Minute Walk. There was no difference in Drums Alive, 6-minute walk, from pre ($M = 322$, $SD = 84$) to posttest ($M = 344$, $SD = 0$, $p > 0.05$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Six Minute Walk. There was no difference in the six minute walk from pre ($M = 241$, $SD = 54$) to posttest ($M = 233$, $SD = 13$, $p > 0.05$) in healthy seniors.



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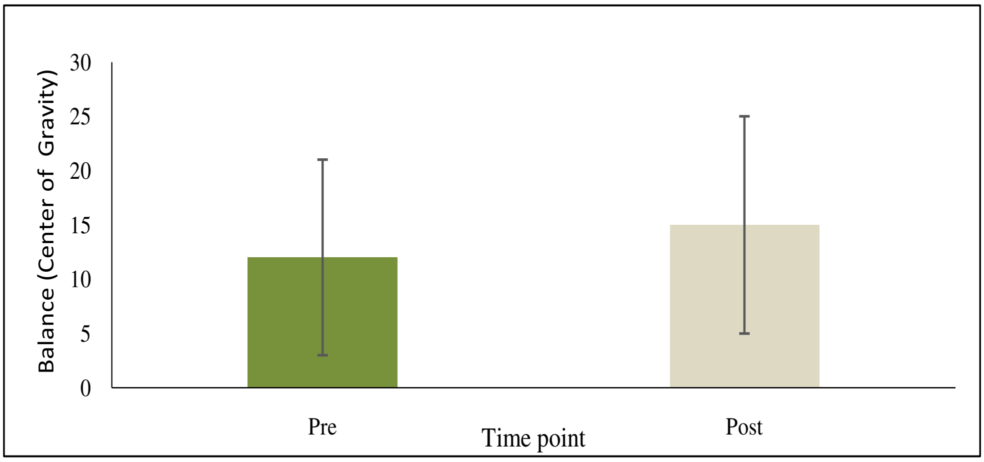

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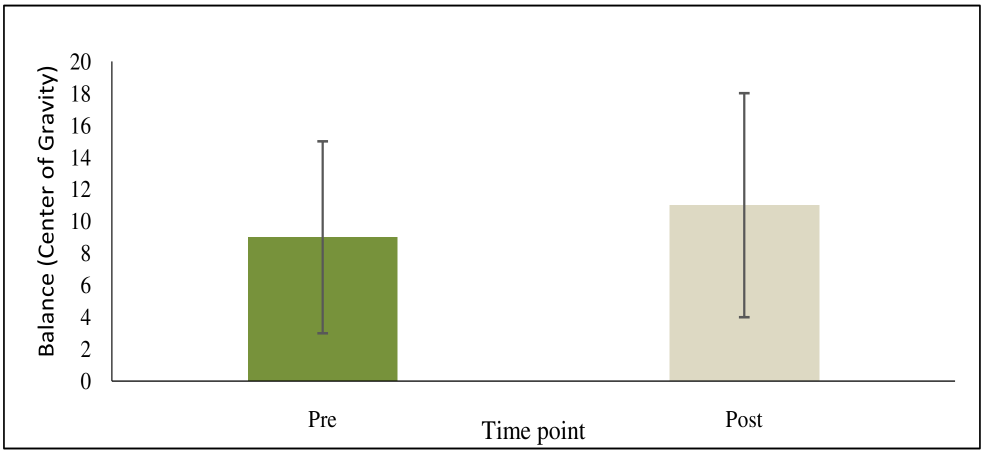

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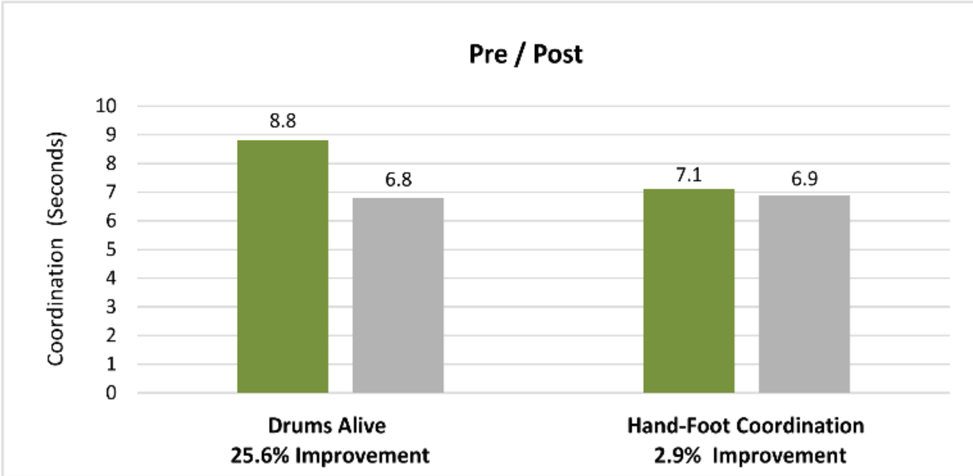
Figure 9. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Balance (Center of Gravity); (b) Drums Alive Balance Healthy Group Balance (Center of Gravity). There was no difference in Drums Alive, balance (center of gravity), from pre ($M = 12$, $SD = 9$) to posttest ($M = 13$, $SD = 10$, $p > 0.05$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Balance (Center of Gravity). There was no difference in Hand-Foot Coordination, balance (center of gravity), from pre ($M = 9$, $SD = 6$) to posttest ($M = 11$, $SD = 7$, $p > 0.05$) in healthy seniors.



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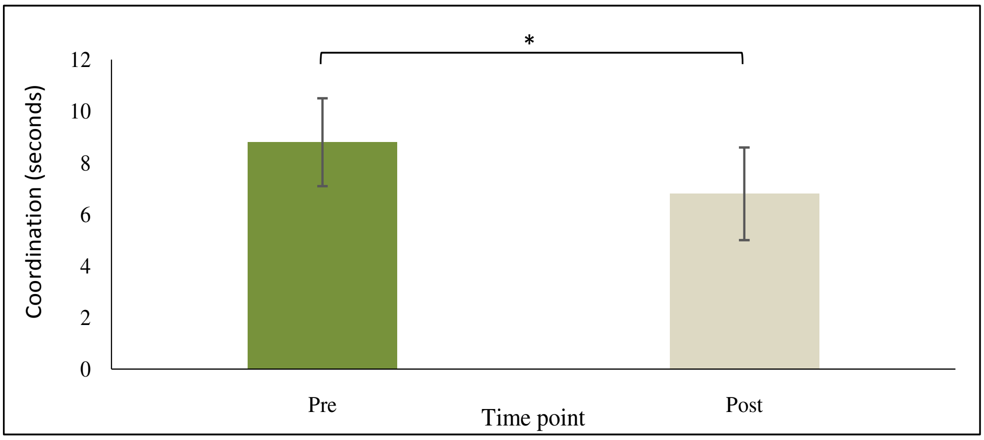

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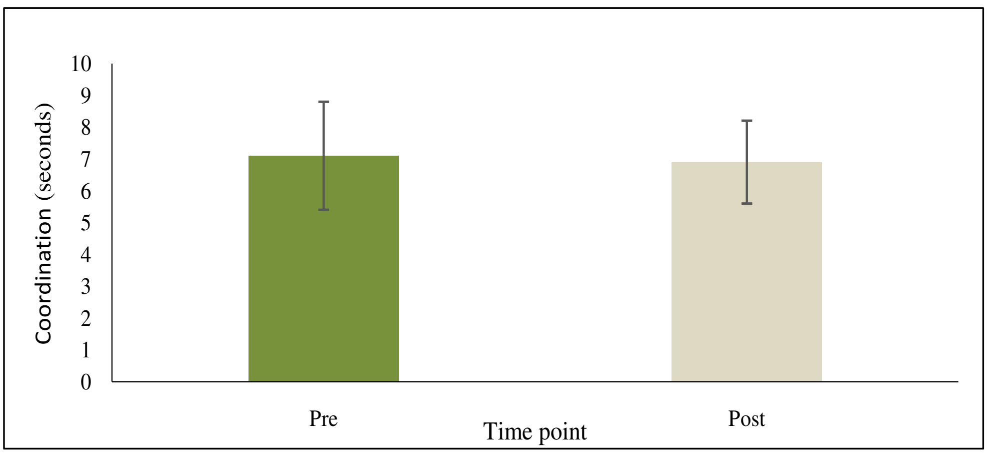

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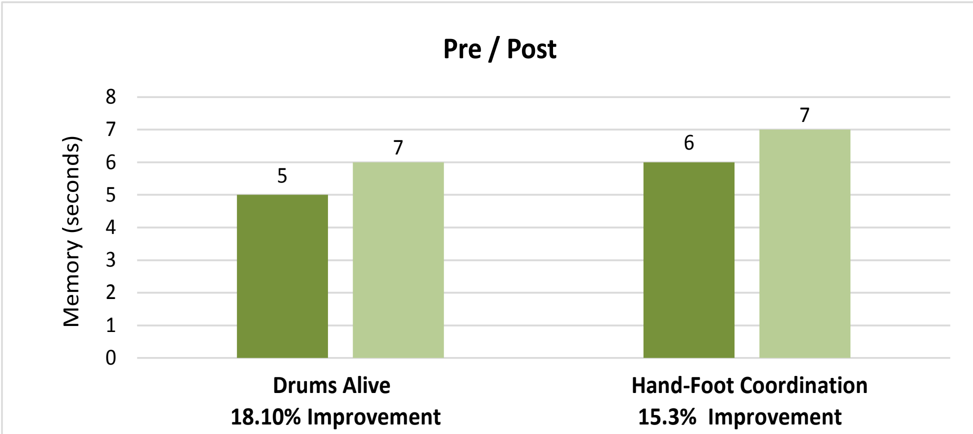
Figure 10. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Coordination; (b) Drums Alive Healthy Group Coordination (* indicates $p < 0.05$). There was a significant decrease in Drums Alive, coordination (reaction), from pre (M = 8.8, SD = 1.7) to posttest (M = 6.8, SD = 1.8, $p = 0.016$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Coordination. There was no difference in Hand-Foot Coordination, coordination (reaction) from pre ($M = 7.1$, $SD = 1.7$) to posttest ($M = 6.9$, $SD = 1.8$, $p > 0.05$) in healthy seniors.



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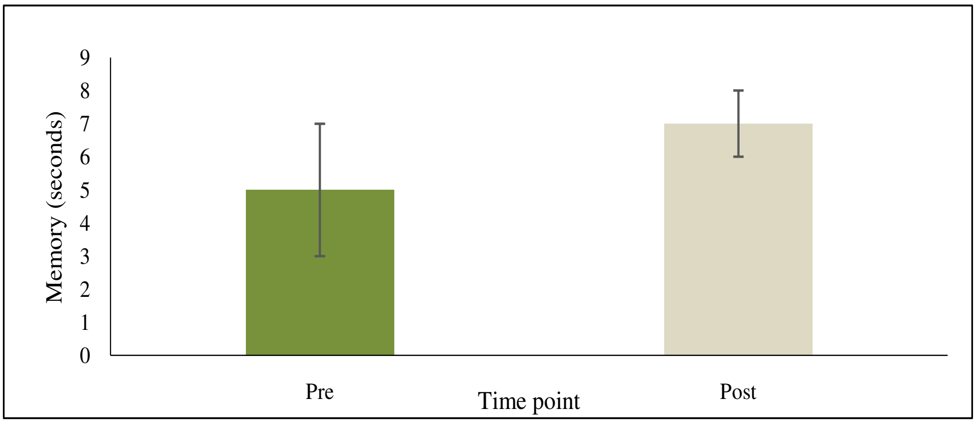

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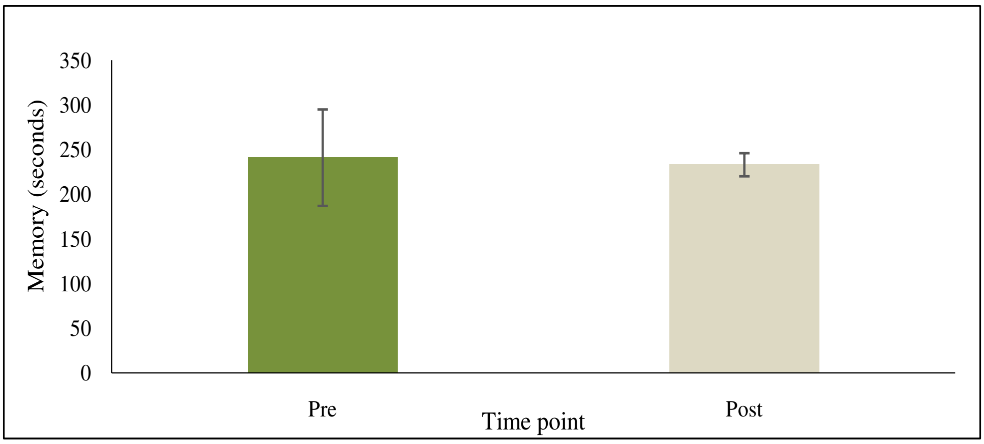

(c)

Figure 11. (a) Drums Alive vs Hand-Foot Coordination Healthy Group Memory; (b) Drums Alive Healthy Group Memory. There was no difference in Drums Alive, memory, from pre ($M = 5$, $SD = 2$) to posttest ($M = 7$, $SD = 1$, $p > 0.05$) in healthy seniors; (c) Hand-Foot Coordination Healthy Group Memory. There was no difference in Hand-Foot Coordination, memory, from pre ($M = 6$, $SD = 3$) to posttest ($M = 7$, $SD = 2$, $p > 0.05$) in healthy seniors.

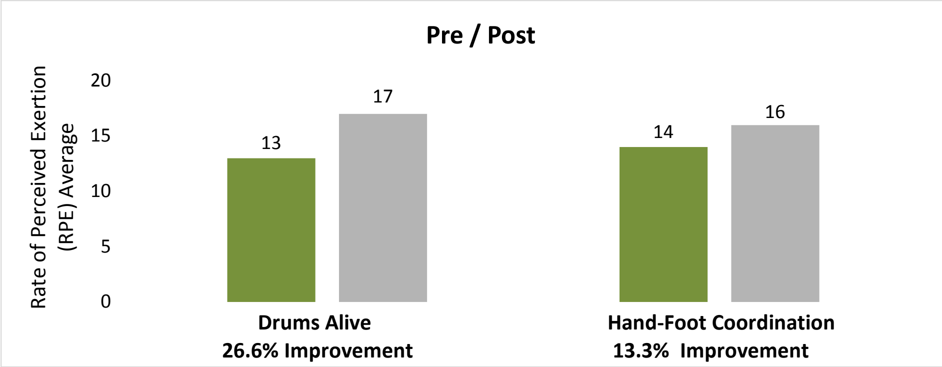

Figure 12. Drums Alive vs Hand-Foot Coordination Healthy Group Rate of Perceived Exertion. There was no sub analysis on this data due to being a subjective only measurement and instead, recorded the differences in percentages of improvement.

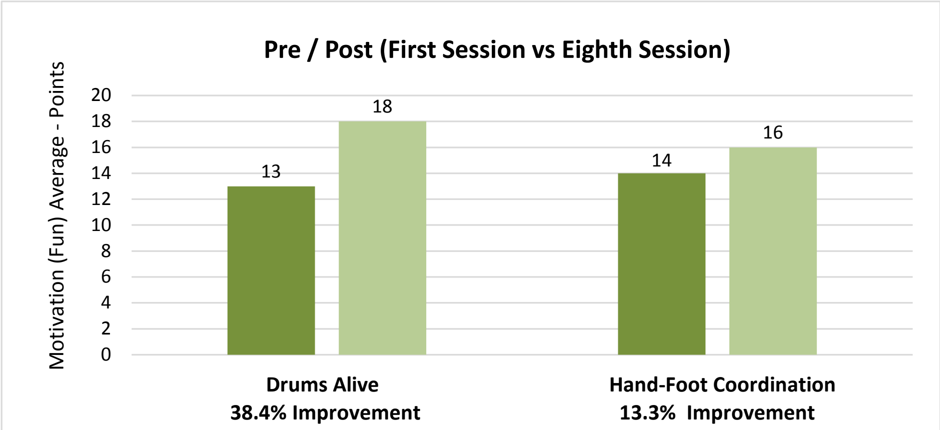

Figure 13. Drums Alive vs Hand-Foot Coordination Healthy Group Motivation (Fun). There was no sub analysis on this data due to being a subjective only measurement and instead, recorded the differences in percentages of improvement.

The comparison of body height showed no significant difference in the healthy group of either intervention; however, the dementia and wheelchair participants in the Drums Alive group demonstrated significant improvements in height (between 1.1 to 1.5 inches) following the intervention whereas there was no improvement, and even a slight negative change in the Hand-Foot Coordination. It is conceivable that the standing exercises of the Drums Alive intervention may have led to increased body uprightness and the lack of standing exercises in the Hand-Foot Coordination led to a negative result in height measurements. The participants in both the Drums Alive intervention and Hand-Foot Coordination who did not require a wheelchair for locomotion or affected by dementia had a slight increase in body weight after the 4-week training phase likely due to an increased appetite resulting from more demanding caloric expenditure.

There were significant improvements in motor skills, as measured by the chair-rise and bar drop testing, for the Drums Alive healthy group which appeared to have a direct positive effect on balance, rapidity of movement and spatial orientation. These results were likely due to the specific games, choreographies, activities, and acoustic and visual stimuli provided by the music, movement sequences and rhythm changes required to perform the Drums Alive intervention exercises. There were no significant improvements in motor skills for the Hand-Foot Coordination healthy group which may have been due to this intervention not providing the appropriate targeted protocols, *i.e.* balance or reaction focused exercises to improve this specific domain. The significant improvement in the chair-rise test for the Drums Alive healthy group could be explained by the participants having to perform these exercises as part of the designed sitting to standing choreographies, games, and activities. The less than significant results in the chair-rise Hand-Foot Coordination healthy group suggested that the training sessions were conducted in the sitting position only which did not allow for the proper exercises to strengthen the appropriate muscle groups that would have improved this domain. The Hand-Foot Coordination healthy group had no significant improvements in the bar drop testing in contrast to the Drums Alive intervention, which demonstrated statistically significant results. This was likely due to the Drums Alive protocols consistent rapidity of movements during most of the intervention; while the exercise protocols in the Hand-Foot Coordination did not provide the required exercises to improve balance or reaction time to garner statistically significant results.

There results for the 6-minute walk test showed improvements in the Drums Alive Intervention primarily due to the better results in heart rate and blood pressure, meaning the protocols improved these measurements sufficiently to expend greater energy during this testing. In addition, there were significant movement patterns throughout this intervention that most likely resulted in the ability to sustain longer periods of walking. The Hand-Foot intervention had a few challenges that did not allow for statistically significant results. The first reason was that this intervention was primarily included only sitting protocols with little movement. In addition, the course design to conduct this testing was not adequate, *i.e.* short walkways with tighter than desired turns and a lack of proper supports to allow for maximum output by the participants.

The center of gravity (balance) results showed improvements in both interventions and are included in this study; however, due to a lack of sufficient measuring equipment to evaluate this domain, only one participant from each intervention was selected as a test subject. This shortfall, in addition to the lack of confidence in the balance device equipment and testing protocols, the results are suspect and are only used for data points for future evaluations.

Regarding the coordination and memory test, although subjective opinion of the test supervisors indicated noticeable improvement for both tests throughout their monitoring, the data did not provide statistically significant data in either intervention group. The reasons were considered four-fold. First, there was only one participant from each intervention selected for this test, thus, the data provided inconclusive results due to a lack of sufficient data; secondly, the relatively short duration and the intensity of the intervention did not adequately provide the length of time to induce increased memory capability; third, the Age Scan test may not have been a suitable or valid method for measuring memory, coordination or cognitive parameters; and lastly, the participants found it difficult to follow the testing protocols.

The RPE mean scores for the Hand-Foot Coordination group remained nearly the same over the entire intervention period and were slightly less positive on average than the Drums Alive group. Only in sessions 1 and 5 did measurements rise above the average with scores of 14 and 15 which was due to a lack of vertical and lateral movement patterns. The RPE scores for the Drums Alive group steadily increased from 13 - 17 because of the content, intensity and creativity of the training units that provided a layered approach to exercise over the entire intervention.

The motivation, *i.e.* fun scores for each intervention healthy group moderated between an average pre-session of 13 and post-session of 18 for Drums Alive; and, between an average pre-session of 14 and post-session of 16 in the Hand-Foot Coordination group. The moderation of scores seemed to depend on two things; first, the intensity of the exercises in the intervention, and secondly, the mood of the participants before the sessions began. Of note, if the intensity or complexity increased, the level of motivation decreased slightly; however, if the protocols were less intense and were more creative, like the Drums Alive group, seemed to demonstrate a higher degree of motivation to continue the intervention vice the Hand-Foot intervention.

5. Discussion

This pilot study compared differences between two interventions, *i.e.* Drums Alive and Hand-Foot Coordination vis a vis their effects on selected physiological, cognitive, and motivational parameters and to what extent these forms of training were feasible and accepted by seniors. The simultaneous interventions were conducted with a total of 26 random participants from two different senior care facilities in Chemnitz Germany. Each randomly selected intervention group volunteered to participate in a biweekly, 45-minute exercise program for four weeks. Before the intervention began tests were conducted to measure the physiological condition of each participant (age, height, weight, heart rate, blood pressure) to ensure they could participate safely. Each intervention was divided into three groups; namely, healthy, which were those without any significant diagnosed malady, those diagnosed with various levels of dementia and those who needed wheelchair assistance for movement. Although data was collected from each of the three groups within the intervention, only the data for the healthy groups was used because they had the highest number of participants and provided the best information to determine the difference and utility as an alternate form of exercise. The partially significant results of the dementia and wheelchair groups was only reviewed and discussed to a limited extent due to the small number of participants and the cognitive and movement limitations they exhibited throughout the study.

For the Drums Alive intervention, two certified trainers from the Technical University of Chemnitz, Germany conducted the exercise intervention. The biweekly, 45-minute sessions were divided into a 5-minute warmup session, a 35-minute physical and cognitive activity session which included music, movement, drumming, choreographies, games, and activities, and concluded with a 5-minute cooldown, relaxation, stretching and affirmation session. The participants were placed in two different formations that was dependent upon the desired physical or cognitive goals, *i.e.* a circle or two rows facing the instructor. The designed protocols included no drumstick, drumstick only, and combined drumstick on 45 - 65 cm stability ball exercises. The warmup session was designed to get the body ready for exercise by moving the limbs and circling the joints to music and designed beat keeping movements. In the physical and cognitive activity session, the protocols required targeted simple to complex movement, activities, games, and drumming choreographies to inspiring music; and, included drumming on other participant's drum to the right and left to safely exercise the brain and body and establish transitory spatial orientation and social-emotional interactive experiences. The level of difficulty increased as the study progressed and sitting to standing protocols were introduced on the second week of the intervention for those who were able to perform those exercises; and for those who were unable to perform, the Drums Alive intervention provided adaptive and modified protocols. The cooldown, relaxation, stretching, and affirmation session was designed with slower tempo music and movements to bring the body into homeostasis while providing affirmation-based emotional experiences.

The Hand-Foot Coordination intervention was conducted by a certified research team. The protocols required simultaneous and/or alternating tapping of hands on the thighs as well as stomping the feet on the floor in patterns designed to challenge the participants, physically and cognitively. The biweekly 45-minute sessions were divided into a 5-minute warm-up, a 35-minute hand-foot exercise session, and a 5-minute cooldown/relaxation session. The warm-up period was designed to get the body ready for more advanced movements and strenuous activity. In the hand-foot exercise period, the movement and tapping patterns ranged from simple to complex with the goal of maintaining the desired level of exercise and motivation. The 5-minute cooldown/relaxation session included muscle stretching protocols or exercises with hedgehog balls and movement patterns that were coordinated with a slower tempo of age-appropriate inspiring music.

6. Limitations

The Drums Alive and Hand-Foot Coordination intervention groups were designed to be as homogeneous as possible to appropriately compare the results; however, this was difficult due to the differences in physical and cognitive capabilities and comorbidities of the participants. Additionally, some of the participants affected by dementia did not fully understand the exercises and consequently did not perform them correctly. On occasion, the Hand-Foot Coordination group had difficulty meeting the session target time of 45 minutes due to the nature of the exercises needing to be rehearsed multiple times without music and the setting up of the measuring equipment which sometimes led to considerable delays in the intervention schedule. Therefore, in the future, longer preparation times should incorporate the challenges that seniors have to be punctual as well the less understanding their inability to understand the protocols quickly; and the time to be equipped for testing. The 6-minute walking test presented minor challenges with course construction whereas it had relatively narrow walkways with less than desired support railings which affected the ability to complete the testing at a more robust pace. The Age Scan test required 5 - 10 minutes per participant due to only having one device which reduced the time allotted for the exercise periods, and additionally, was only performed on one participant per intervention, therefore, future studies should obtain more devices to reduce the time for this testing and more participants to provide better statistical data. Regarding the memory test, some of the participants had a difficult time understanding the protocol required to complete the test and had to be reminded during the facilitation. The bar drop test challenges included participants dropping the bar or not keeping their hands in the same place when the measurement was taken. The measurements of subjective RPE and motivation (fun), were determined to be accurate, however, on occasion, it appeared some participants may have aligned their scoring to those recorded by the other participants to avoid conflict, peer pressure, or embarrassment.

7. Conclusion

This pilot study satisfied the intended goal of determining the Effects of a Drums Alive® Intervention versus Hand-Foot Coordination Training on Motor, Cognitive and Motivational Parameters in Seniors. The participants were randomly selected volunteers to participate in either the Hand-Foot Coordination or Drums Alive intervention. The designed study required participants to in a bi-weekly, 45-minute intervention session for a period of 30 days. The results showed significant improvements in blood pressure, heart rate, bar drop, and chair rise tests between the pre and post measurements for the Drums Alive intervention and except for improvements in blood pressure, there were little to no improvements in the Hand-Foot Coordination training intervention. In addition, data reflected that both interventions were suitable as an alternative to conventional sports offerings; however, the Drums Alive intervention had a more positive overall effect on the physiological, cognitive, motivational, *i.e.* fun, parameters than that of the Hand-Foot Coordination intervention. Therefore, Drums Alive training seemed to be more suitable from a health sports perspective and more so when determining a program that would motivate the senior population to continue a productive exercise program. In the context of further research projects in this area, it is recommended to choose a longer intervention period and a larger number of participants. In addition, the group structure should be more homogeneous such as dementia-only or those whose maladies require support, *i.e.* wheelchairs, etc., be studied separately to garner more conclusive results within those target groups.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Tittlbach, S., Henken, T., Lautersack, S. and Bös, K. (2007) Psychomotor Activation of Residents of a Nursing Home for the Elderly. *European Journal of Geriatrics*, **9**, 65-72.

[2] Oswald, W.D., Ackermann, A. and Gunzelmann, A. (2006) Effects of a Multimodal Activation Program (SimA-P) for Residents of Geriatric Care Facilities. *Journal of Gerontological, Psychology and Psychiatry*, **19**, 89-101.

[3] Rink, L. and Dalhoff, K. (2004) Age-Specific Changes of the Immune System and their Associated Clinical Pictures. In: Ganten, D. and Ruckpaul, K., Eds., *Molecular Medical Basis of Age-Related Diseases*, Springer, Berlin, 429-464. https://doi.org/10.1007/978-3-642-18741-4_16

[4] Wiesner, G. and Bittner, E. (2005) On the Incidence and Prevalence of Multiple Diseases in German Occupational Medicine. Social Medicine. *Environmental Medicine*, **40**, 1-4.

[5] Weyerer, S., Ding-Greiner, C., Marwedel, U. and Kaufeler, T. (2008) Epidemiology of Physical Diseases and Limitations in Old Age. Kohlhammer, Stuttgart.

[6] Thieme, F. (2008) Age(s) in an Aging Society. A Sociological Introduction to the Science of Old Age(s). VS Verlag für Sozialwissenschaften/GWV Fachverlage GmbH, Wiesbaden.

[7] Lang, E., Gassmann, K.G. and Toplak, J. (1997) Pros and Cons of Physical Activity in Older Age. In: Baumann, H. and Leye, M., Eds., *Exercise and Sport in Older People*, Meyer and Meyer, Aachen, 61-72.

[8] Weisser, B. (2003) Age-Related Limitations of Organ Function and Physical Activity. In: Denk, H., Pache, D. and Schaller, H.-J., Eds., *Handbook of Geriatric Sports*, Hofmann, Schorndorf, 113-137.

[9] Weisser, B., Preuss, M. and Predel, H.G. (2009) Physical Activity and Sport for Prevention and Therapy of Internal Diseases in the Elderly. *Medical Clinics*, **104**, 296-302. https://doi.org/10.1007/s00063-009-1055-1

[10] Ackermann, A. (2005) Empirical Studies in Participants' Geriatric Care. Relevance and Methodological Characteristics of Gerontological Intervention Research with Nursing Home Residents. Lit-Verl, Münster.

[11] Helmchen, H. and Reischies, F.M. (1998) Normal and Pathological Cognitive Aging. *The Nervenarzt*, **69**, 369-378. https://doi.org/10.1007/s001150050285

[12] Messer, B. (2004) Care Planning for People with Dementia. What You Can Write and What You Should Write. Schlüter, Hannover.

[13] Lindenberger, U. (2010) The Berlin Study of Old Age. Akad-Verl, Berlin.

[14] Schwenk, M., Lauenroth, A., Oster, P. and Hauer, K. (2010) Effectiveness of Physical Training to Improve Motor Performance in Participants with Dementia. Exercise Therapy in Internal Medicine Diseases. In: *Effects of Physical Training on the Organism*, Springer, Heidelberg, 168-182.

[15] Voelcker-Rehage, C., Godde, B. and Staudinger, U.M. (2011) Cardiovascular and Coordination Training Differentially Improve Cognitive Performance and Neural Processing in Older Adults. *Frontiers in Human Neuroscience*, **5**, Article No. 26. https://doi.org/10.3389/fnhum.2011.00026

[16] Martin, M. and Kliegel, M. (2005) Psychological Foundations of Gerontology. Kohlhammer, Stuttgart.

[17] Meinel, K. and Schnabel, G. (2004) Theory of Motion Sport Motor Skills. Outline of a Theory of Sport Motor Function under Pedagogical Aspect. Südwest-Verl, Munich.

[18] Schaller, H.J. (2003) Meaning in Old Age. In: Denk, H., Pache, D. and Schaller, H.J., Eds., *Handbook of Sports for the Elderly*, Hofmann, Schorndorf, 207-208.

[19] Pache, D. (2003) Sport for the Elderly as a Current Task and Challenge. In: Denk, H., Pache, D. and Schaller, H.J., Eds., *Handbook of Sports for the Elderly*, Hofmann, Schorndorf, 207-208.

[20] Jacobi, G. and Baake, N. (2005) Course Book Anti-Aging. Thieme, Stuttgart.

[21] Bastone, A.C. and Filho, W.J. (2004) Effect of an Exercise Program on Functional Performance of Institutionalized Elderly. *Journal of Rehabilitation Research and Development*, **41**, 659-668. https://doi.org/10.1682/JRRD.2003.01.0014

[22] Shepard, R.J. (1998) Physical Activity in an Aging Population. Implications for Health. In: Mechling, H., Ed., *Training in Sports for the Elderly*, Hofmann, Schorndorf, 25-38.

[23] Oschütz, H.B.K. (2003) The Importance of Improving Physical and Athletic Endurance Performance in Old Age. In: Denk, H., Pache, D. and Schaller, H.J., Eds., *Handbook of Sports for the Elderly*, Hofmann, Schorndorf, 158-159.

[24] Braumann, K.M. (2010) Effects of Physical Training on the Organism. In: Braumann, K.M., Ed., *Exercise Therapy in Internal Diseases. Effects of Physical Training on the Organism*, Springer, Heidelberg, 14-21.

[25] Bachl, N., Schwarz, W., Zeibig, J. and Gruber, K. (2006) Active into Old Age. Exercise in Everyday Life, Sports and Training. Springer, Vienna.

[26] Gimpel, A., (2008) Brain Exercises to Cure ADHD. Book Surge Publishing, Charleston.

[27] Blakemore, C. (2003) Movement Is Essential to Learning. *Journal of Physical Education, Recreation and Dance*, **74**, 22-25. https://doi.org/10.1080/07303084.2003.10608514

[28] Kemper, K.J. and Danhauer, S.C. (2005) Music as Therapy. *Southern Medical Journal*, **98**, 282-288. https://doi.org/10.1097/01.SMJ.0000154773.11986.39

[29] DeAngelis, T. (2018) Tuning in to Our Amazing Auditory System. https://www.apa.org/monitor/2018/07-08/auditory-system

[30] Krampe, J., Rantz, M.J., Dowell, L., Schamp, R., Skubic, M. and Abbott, C. (2010) Dance-Based Therapy in a Program of All-Inclusive Care for the Elderly. An Integrative Approach to Decrease Fall Risk. *Nursing Administration Quarterly*, **34**, 156-161. https://doi.org/10.1097/NAQ.0b013e3181d91851

[31] Bittman, B.B., Berk, L.S., Felten, D.L., Westengard, J., Simonton, O.C., Pappas, J. and Ninehouser, M. (2001) Composite Effects of Group Drumming Music Therapy

on Modulation of Neuroendocrine-Immune Parameters in Normal Subjects. *Alternative Therapies in Health and Medicine*, **7**, 38-47.
https://pubmed.ncbi.nlm.nih.gov/11191041

[32] Ho, P., Tsao, J.C., Bloch, L. and Zeltzer, L.K. (2011) The Impact of Group Drumming on Social-Emotional Behavior in Low-Income Children. Evidence-Based Complementary and Alternative Medicine: *eCAM*, **2011**, Article ID: 250708.
https://doi.org/10.1093/ecam/neq072

[33] Smith, M. and Burke, C. (2008) Physiological Demands of Rock Drumming: A Case Study. British Association of Sport and Exercise Sciences (BASES) Annual Conference, Brunel University, West London, University of Chichester, School of Sport Exercise and Health Sciences, College Lane, Chichester, West Sussex.

[34] Bruhn, K. (2003) Father of the Music-Making and Wellness Movement.
http://www.dinkydrum.com/school-of-music/workshops/health-rythms
https://remo.com/experience/post/healthrhythms-benefits-of-participation

[35] Bruhn, K. (2004) Why Drums and Drum Circles. Remo.com.
https://remo.com/experience/post/why-drums-and-drum-circles