

The Effects of Deep-tissue Massage On Functional Fitness and Wellbeing
An Experimental Study

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Declaration

I hereby declare under oath that all information obtained in this bachelor's thesis/dissertation obtained and presented is in accordance with academic rules, regulations, and ethical conduct. This bachelor thesis is a product of my own independent work. In addition, I declare as required I have fully cited and referenced all materials and results that are not my original work. This thesis has neither been submitted to another committee, nor has it been published before.

A handwritten signature in black ink, consisting of stylized, cursive letters, is written over a horizontal line.

Date, Signature

Abstract

Background

The research aims to analyze the improvement of functional fitness and well-being after performing deep-tissue massage. The functional test performed was the stair climb and balance test using the single leg stance, 30 seconds sit-to-stand, 2-minute step test, and the sit-&-reach test. To test the well-being, the SF-36 questionnaire was used. The data was collected and analyzed using the SPSS software.

Aims

This study aims to investigate and determine if deep-tissue massage positively changes overall well-being and functional fitness over the course of treatment by impacting functional fitness parameters such as mobility, flexibility, endurance

Objective: To measure and analyze whether there were any changes after receiving the treatment and to assess well-being by analyzing the three (3) dimensions: General, Physical, and Mental Health.

Method

16 (n=16) participants were recruited, and 15 (n=15) completed the study. They were placed into 2 groups: the Control Group (n=7) and the Intervention Group (n=8). The testing took 5 days, and the intervention group had three (3) consecutive days of a 45-minute full-body massage. Both groups were tested on day 1 and then on 5.

Results

The Intervention Group showed significant improvement in the Balance; left leg ($p < 0.021$, $Cohen's d = -1.042$), 30 seconds sit-to-stand ($p < 0.019$, $Cohen's d = -1.076$), 2-minute step test, ($p < 0.041$, $Cohen's d = -.884$), sit and reach ($p < 0.005$, $Cohen's d = -1.409$) and SF-36; General Health ($p < 0.014$, $Cohen's d = -1.142$). Highlighting improved physiological and psychological. No significant differences were found in the balance, right leg, or stair climb test.

Introduction

Background of the Study

Background

Functional fitness plays a key role in enhancing the quality of life and preventing injuries, which are inevitable when aging occurs. It involves performing daily tasks and activities without acquiring injuries or strains, contributing to physical and mental well-being, which is vital for overall well-being (Jarden and Roache, 2023). Ensuring quality of life is present as aging occurs is crucial for fostering healthy cognitive functioning and overall well-being (Winstead *et al.*, 2014). Research has demonstrated that interventions focusing on activities and social engagement can significantly influence the well-being of older adults, particularly in environments where social networks may be limited. This is because factors including depression (Brett *et al.*, 2011), diabetes, family dynamics, and emotional well-being greatly affect one's overall quality of life in individuals with these conditions (Laffel *et al.*, 2003; Kübler *et al.*, 2005). Furthermore, the relationship between functionality, well-being, and age is intertwined, aging is usually associated with increased life satisfaction, even if there is a decrease in health-related quality of life domains (Jarden and Roache, 2023; Tóth *et al.*, 2023).

Functional fitness is defined as different exercise programs designed to condition and enhance muscles, aiming to perform daily tasks efficiently and without issues (Donat Tuna *et al.*, 2009). It incorporates multi-joint movements and high-intensity circuit training, often incorporating equipment like gym balls, balance boards, and resistance bands to simulate common movements (Hernández-Lougedo *et al.*, 2021). The significance of functional fitness is rooted in its potential to enhance general physical performance, foster good health, and improve the capacity to carry out daily tasks including carrying groceries or maintaining balance (Ketelhut & Ketelhut, 2020; Liebenson, 2006). Functional fitness is beneficial across all age groups, not just older adults. Johnson, Whitlatch and Menne (2013); Tóth *et al.*, (2023) highlighted that functional fitness interventions can significantly improve physical and psychological measures, such as strength, flexibility, coordination, aerobic endurance balance, mental health, and well-being. Moreover, specific functional training programs have been documented to improve sports performance and functional fitness in older populations, demonstrating that the program can be used by any population group (Thompson, Cobb and Blackwell, 2007).

The principles of functional fitness, when tailored to individual needs, give multiple of benefits surrounding health and improved quality of life (Leirós-Rodríguez *et al.*, 2018; Batista *et al.*, 2020; Ciaccioni *et al.*, 2022; Tóth *et al.*, 2023). In general, holistic approaches are used to improve a better quality of life (Rippe, 2018). An example of this would be therapeutic intervention using massage (Dakić *et al.*, 2023)

Massage, a multifaceted modality (Poppendieck *et al.*, 2016), is defined as a mechanical manipulation of soft tissues applying different movements, pressure, and speed (Dakić *et al.*, 2023). Research from Koren and Kalichman (2018) suggests that massage stimulates muscular relaxation, lessens tension, boosts local circulation, and promotes the enhancement of overall health and well-being (B. Hemmings, 2001). This is why it is a popular tool used in the athletic world.

Sports massage is a specialised form of massage therapy that focuses on enhancing athletic performance through various avenues (Weerapong, Hume and Kolt, 2005). Athletes frequently utilise sports massage as a recovery aid (Davis, Alabed and Chico, 2020) from vigorous training and exercise (Brummitt, 2008) and are prescribed for pre-events, post-events, and maintenance (Davis, Alabed and Chico, 2020) based on the different techniques used.

The first technique is Effleurage; it incorporates long, sweeping strokes applied with the palms or fingers in the direction of blood flow to warm up the muscles and promote relaxation (Ivanova and Alexiev, 2022; Welis, Darni and Mario, 2023). Then there is the Petrissage, which involves the kneading, rolling, or wringing motions to compress and release muscle tissue, intending to improve circulation and reduce muscle tension (Welis, Darni and Mario, 2023). In addition, the stroking technique has gently gliding movements aimed at warming up muscles, improving circulation, and preparing the body for deeper massage techniques (Welis, Darni and Mario, 2023). Additionally, there is the Tapotement technique, which involves rhythmic tapping or pounding motions to stimulate muscles and invigorate the body (Ayudi, 2022). Another technique used is the Friction technique which uses deep, circular movements with thumbs or fingertips to target specific muscle fibres and break down adhesions (Welis, Darni and Mario, 2023). Furthermore, there is Shaking, a technique that carries out the action of shaking or vibrating movements to relax muscles and release tension (Welis, Darni and Mario, 2023). Also, there is the Skin-rolling Technique that involves lifting and rolling the skin and underlying tissues to improve circulation and reduce adhesions (Welis *et al.*, 2023). Finally, vibration which is the action of a rapid shaking or trembling movement applied to muscles to reduce tension and enhance blood flow.

Over the years, literature has shed light on the benefits of sports massages in terms of physical fitness (Medvedev and Landhuis, 2018). Most studies have focussed on how sports massages can make their performance and recovery better and faster. The evidence of sports massage's physiological and psychological benefits remains ambiguous (Victoria Espí-López *et al.*, 2020; C.-C. Shen *et al.*, 2021). Most studies have focused on exploring the effects of Sports Massage on various aspects of physical fitness, restoration of muscles, improve blood circulation, reduction of muscle tension, and improved flexibility (Goats, 1994; Priyoadi *et al.*, 2020; Azmy, Subrata and Putu Suariyani, 2021; Pa *et al.*, 2021; Mubarak and Sigit, 2023). Along with various aspects of well-being, such as psychological (Morris and Cranney, 2022), emotional (Zammit *et al.*, 2012), and subjective (B. J. Hemmings, 2001). This highlights a gap as there is a lack of research focusing on integrating Sports Massage and Functional Fitness and overall well-being.

This study aims to bridge the gap by focusing on the potential impacts of deep-tissue massage on the various categories of functional fitness and overall perceived well-being. The relationship between fitness and well-being is crucial for promoting overall health and QoL. Investigating these effects can provide evidence to support therapeutic practices to optimise health-related performance and daily living activities and provide a comprehensive understanding of an individual's perceived health and well-being status. No study has combined the themes of deep-tissue massage and functional fitness and well-being. Therefore, it would be helpful to fill the gap.

A range of functional fitness tests and a well-being measure were utilized to gather the requisite information to assess functional fitness and overall well-being. The study used the SF-36 questionnaire as the overall well-being questionnaire, which is reliable in recording a person's perceived General, Physical, and Mental health. This was validated by a study done by Tapak *et al.*, (2022).. Functional fitness tests evaluate a person's ability to complete daily tasks and activities. Therefore, several tests were used to measure functional fitness. Firstly, the Single leg stance was used to test static posture and dynamic balance (Ageberg *et al.*, 2003; Berg-Hansen *et al.*, 2023). Secondly, the Sit to stand test was established and validated using the right protocols (Morita *et al.*, 2018; Muñoz-Bermejo *et al.*, 2021) .The test was used to assess leg strength and endurance. Thirdly, the two (2) minutes step test was validated and proven reliable by Nogueira *et al.* (2021), who used it to measure active and sedentary adults. Fourthly, the Stair climb was proven reliable and valid according to Rodriguez's protocol (2020). Fifthly, the sit-and-reach test was proven reliable and valid and was used in hamstring flexibility testing by (Baltaci, 2003). These tests were chosen because they were cost-effective, did not require any equipment apart from the sit and reach test, and were not

time-consuming; prior to conducting the testing, a Par-q was issued. This was used because it was one of the quickest and easiest methods of gathering information and identifying a client's contraindications, which can affect the study results. This has been validated and deemed reliable by the UWTSD and by Helmerhorst et al., (2012). The study consisted of students from the University; this population and Sample were chosen because it was easy, convenient (Elfil and Negida, 2017) and a less time-consuming method of recruiting participants (Winton and Sabol, 2022). However, it was stated that this method has a risk of bias (Stratton, 2021).

The study's limitation was participant variability, as there was not an equal number of males and females. Additionally, recruitment was difficult because university students were usually busy since most of them work and attend university.

Aim of Study

This research aims to evaluate the effects of a structured sports massage (deep-tissue) program on non-professional athletes' functional fitness and well-being.

Objectives of the Study

Measure and analyse whether there were any changes after receiving the treatment and assess well-being by analysing the three (3) dimensions: General, Physical, and Mental Health.

Hypothesis

The Hypothesis is that regular Deep-tissue Massage can improve functional fitness test scores compared to the control group who received no massage.

Additionally, participants receiving deep-tissue sports massage report higher well-being scores on the SF-36 questionnaire, indicating improved overall health status.

Health-related Quality of life and perceived wellbeing

The concept of HRQL is made up of several dimension including physical, social, cognitive, and emotional functioning (Dvorak *et al.*, 2021). It is commonly referred to in the context of an aging population, where maintaining health and independence among older adults becomes a societal challenge (Mohamed and Ali Isa, 2020). However, HRQL research is expanding into different populations, including children and adolescents, highlighting the need for age-appropriate assessment tools (Megari, 2013). The assessment of HRQL involves evaluating health status, which includes physical, psychological, and social functioning, along with an emotional response to this assessment (Pickard and Knight, 2005). HRQL assessments aim to capture subjective well-being and health-related status (Gates et al., 2010). The SF-36 questionnaire is a popular instrument used for estimating the HRQoL scores (Lins and Carvalho, 2016).

Several elements can impact HRQoL. One of them is Chronic diseases, which tend to affect all domains. Studies across various populations and geographic locations have consistently shown that individuals with chronic conditions report lower HRQoL compared to those without such diseases (Mari *et al.*, 2020; Mohamed and Ali Isa, 2020). For example, in Trinidad and Tobago, patients with major chronic diseases such as heart disease and diabetes exhibited lower HRQoL, along with having depressive symptoms (Seecheran *et al.*, 2020). The domains of health that are affected can also have an impact on HRQoL. Psychological health, including Mental and Emotional well-being, plays an important role. For example, Cognitive impairments and depressive symptoms have been shown to negatively impact HRQoL in patients with heart failure (Vetter, 2010). Another domain that impacts QoL is Physical Health. It affects HRQoL by influencing functional ability with chronic conditions and pain (Parsons and Snyder, 2011; Beck and Shah, 2012). Macías-Valle et al. (2023) explored functional capacity by implementing home-based exercise program to improve health outcomes in patients with chronic illness and a low QoL in patients through a randomized control trial and found improvement in overall QOL after implementing at home workout. Similarly, (Furtado *et al.*, 2022) both had the positively HRQOL scores were correlated with enhanced functional fitness due to being physically active. Highlighting functional fitness is an impactful aspect to the overall health.

Functional fitness and its Relevance to Overall Health

With its transformative power on various health-related components, functional fitness emerges as a cornerstone for overall health and quality of life. Functional fitness is important to perform daily activities as it is needed to complete everyday task which involve strength, balance, and endurance (Padua et al., 2018) which is a crucial part of injury prevention (Knapik, 2015). Fuentes-Lopez et al. (2021); Resende-Neto et al. (2021) and Thompson, Cobb and Blackwell (2007) highlighted the pivotal role of functional fitness, affirming its significant enhancement of health-related components, particularly in the physical fitness domain. Samoliuc and Cheban (2022) had similar findings in their study. Engaging in this physical activity improves functional fitness performance which is crucial for reducing the risk of falls as persons age (Hsin Hung *et al.*, 2021). This correlates with Resende-Neto et al. (2021) findings where it was highlighted that functional fitness training is proven to enhance physical fitness and movement quality, making it beneficial to the older adult population and individuals who have a chronic condition, including asthma. Resende-Neto et al. (2021) highlighted that the training improves not only function but also cardiorespiratory fitness. Interestingly, functional fitness programs often differ from the normal fitness training methods. Ide et al. (2022) conceptual review found that functional fitness training is similar, if not the same, to strength, power, flexibility, and endurance training. Additionally, Morucci et al. (2022) 24-weeks experimental study on older adults found there were improvements in various health-related components, including flexibility, physical strengths. Similarly in a cross-sectional study, Batista et al. (2020) found similar. Functional fitness impact is not only physiological but also psychological. Maintaining functional fitness through an active lifestyle produces cognitive-emotional benefits. In their mediation analysis, Ciaccioni et al. (2022) highlight these benefits positively influence mental health and quality of life, which is prominent among the older adult population regardless of whether they have a decline in their physical capabilities. Morucci et al. (2022) study found that engaging in regular functional fitness program helped in regulating the levels of cortisol suggesting there is a positive effect on stress management. Therefore suggesting that massage provides physiological and psychological benenfits

The Physiological & Psychological Effects of Massage

The paramount use of sports massage is due to its potential benefits due to several mechanisms. Due to the mechanics of different techniques in sports massage, it is reported in to have physiological, biomechanical, and psychological effects (Dakić et al., 2023) thus improving overall performance (Hemmings *et al.*, 2000). Weerapong et al. (2005)

highlighted these effects, which aid in increasing blood circulation and enhance lymphatic drainage, thus removing metabolic waste. Furthermore, studies found that massage expedited recovery rates and increased range of motion (White *et al.*, 2020). Given that the literature is outdated, the research may lack definitive data on the current physiological effects. The physiological literary critics commonly claim that sports massage releases tension, muscle stress and stiffness caused by daily activities (Moraska, 2007; Ayudi, 2022). In their analysis of a systematic review, Dakić *et al.* (2023) found that massage immediately improved flexibility in most of the studies. Bhutta *et al.* (2023) corroborated similar findings in their randomized control trial for athletes with limited Range of Motion. The results of the study indicated that only participants who did specific muscle stretching showed improvement from the massage. The study had a good design but it possess the risk of performance bias. In addition, Scott and Swenson (2009) highlighted that their findings in the equine sports massage show an increased range of motion and stride length, making the study analogous to studies in humans. (C. C. Shen *et al.*, 2021) saw improvements in the test group but no significant differences. The participants results were self-reported, there should have been response bias. Additionally, due to missing information it is hard to analyse if some confounding factors affected the results. However, scientific evidence remains inconsistent. Dakić *et al.* (2023) found that overall massage generally do not impact motor abilities inclusive of force, speed, strength and endurance. Furthermore, Bayer and Eken (2021) found they had no positive effect on strength and flexibility.

An additional dimension of sports massage efficacy pertains to its psychosomatic impact. Weerapong, Hume and Kolt (2005) highlighted due to its physiological effects of increased blood flow, reduced muscle tension and heightened neural responses thus contributing to an overall sense of wellbeing. Receiving massage therapy tend to increase a stress reduction hormone, oxytocin which results in anxiolytic effects (Riem *et al.*, 2017), reduce cortisol levels (Weerapong, Hume and Kolt, 2005) and increase serotonin levels (Field *et al.*, 2005). Research indicates that massage positively impacts athletes by increasing psychological stimulation, reduce anxiety, and increase motivation and mood state (Dakić *et al.*, 2023). (Reichert, 2020) quasi-experimental study observed an increase in mood elevation along with a decrease in low moods after receiving massages, suggesting that massage effectively contributes to one's mental health but results vary on the duration and techniques used.

Materials and Methods

Objectives of the study

Introduction

This chapter presents the research methodology and provides a descriptive overview of approaches, design and setting used. The method section was created using the SMART (Specific, Measurable, Achievable, Relevant, Timely) goals in order to achieve all the aims and objectives of investigating the effects of deep-tissue massage on functional fitness and wellbeing.

Study design

The study was conducted using a quantitative experimental approach, and a between-subject design was adopted to collect the primary data. A quantitative approach for this study was considered the most appropriate and best suited. Leavy (2017) emphasised that numerical and statistical data are used in quantitative studies to ensure objectivity and accuracy (Noble and Smith, 2015) throughout the research process. Additionally, the study used a quantitative approach, which was deemed the most appropriate method for data collection, and it is best suited for the expression of results using numerical (Borgstede and Scholz, 2021). It is more resistant to bias when compared to qualitative design (Almeida, Faria and Queirós, 2017).

A pilot study was conducted prior to the formal data collection. This was done to assess the quality, feasibility, and efficiency of the study and to apply any modifications to the main study (Westlund and Stuart, 2017).

The final study recruited 16 participants. These participants were divided into 2 equal groups: Control and Intervention Groups. A pre-test and post-test approach was used. Both groups were tested on day 1 and retested on day 5. The experimental group participants received a 3-day intervention of deep-tissue massage which started the day after being tested. This approach was used due to its great advantage of measuring the effectiveness of the intervention (Alessandri, Zuffianò and Perinelli, 2017).

Ethical considerations

This study was conducted in accordance with the ethical principles of the University of Wales Trinity St David. Ethical approval was sorted from the ethics committee prior to working with participants and conducting the study.

Study procedures

Population & Sample

The study consisted of Sixteen (16) conveniently sampled individuals ranging from the ages of 18-35 years. Participants who volunteered were recruited on the UWTSD campus via verbal presentation explaining the participation opportunity/benefit. This was to facilitate the availability and the willingness of participants. Participants who volunteered were placed into two (2) groups of eight (8). The recruits were given a Par-Q and consent form to complete and return to the researcher. Participants were excluded if they had any contraindications mentioned in the exclusion criteria.

Inclusion criteria

- A student at the UWTSD.
- Individuals between the ages of 18 – 40.

Exclusion criteria

- Individuals with acute trauma of up to 48-72 hours including haematoma, sprain or strain, fracture or bleeding from an open wound
- Individuals with serious contradictions such as Deep Vein Thrombosis, Cancer or uncontrolled hypertension or sensory deficiency.
- Individuals with a serious injury; broken bones, myositis ossificans, infectious skin infection, fractures and dislocation.
- Individuals with a vital, bacterial or fungal infection.
- Individuals with burns on the massage area.

Instrumentation

PAR-Q and Consent form

The PAR-Q is a self-assessment tool that highlights health and lifestyle issues. It indicates whether participants need to consult with their doctor prior to participating in the study. The study used the standard UWTSD PAR-Q and sports massage consent form to document participants' consent.

36 items Short Form Questionnaire (SF-36)

The SF-36 is a 36-item health survey that covers the eight health concepts and measures health-related quality of life in individuals. Participants completed the SF-36 pre-test and post-test.

Stair climb

The stair climb test measured speed, functional strength, balance, and agility. Participants had to climb 15 flights of stairs, 7 inches in depth and 7 inches in height, as fast as possible. The stair climb was timed and recorded.

Single-leg stance test

This is a one-leg stance test used to measure static posture and dynamic balance. Participants had to stand while placing their hands on the hip and stand on one foot. The position was timed and recorded. The timer stopped when their hands were removed from the hip or foot touched the ground. The test was repeated on the next leg.

30 sec Sit-to-Stand

The Sit-to-stand test was thirty (30) seconds timed test done using a chair. It was done to measure lower body strength. Participants had their arms crossed on their shoulders with their feet flat on the floor. Participants were told to sit completely on a chair and stand using the correct form, doing as many as they could in 30 seconds. The number of reps done were recorded.

2-minute Step test

This test is a 2-minute step in place test used to measure endurance and lower body. Participants had to bring their knees up to a 90-degree angle or to their hips and count how many steps they've taken for a duration of two (2) minutes. The number of steps were recorded.

Sit and Reach Test

This test was used to test flexibility and involved using a sit-and-reach baseline box. Participants had to be bare feet, with legs extended in front of them, feet placed against the box, and toes facing up. Then, they had to stretch forward using both hands to touch the further point on the ruler. Testing was done three (3) times, and the best score was recorded.

Intervention

Massage

The manual techniques used for this massage consisted of effleurage and petrissage accompanied by manual vibration and tapotement, with the main focus being petrissage: deep-tissue massage.

The massages were done using hypoallergenic massage oil and lotion. In addition, the massage was performed by a certified massage therapist using the same massage protocol on all participants in the experimental group. This protocol was followed to ensure consistency and validity of the results.

The massage lasted 45 minutes and was considered a full-body massage, covering the back with a minor focus on the shoulder, neck, and the deltoids in the upper arm and legs.

Massage of the back- 00:00 – 10:00

- 00:00-01:00* –Effleurage on the entire back
- 01:00-03:30*- Petrissage on the back, neck, shoulder and deltoids
- 03:30-04:00*- Trigger point
- 04:00-08:00*- Petrissage; deep tissue techniques of the back
- 08:00-09:00*-Tapotement
- 09:00-10:00*-Effleurage on the entire back

Massage of the posterior left leg- 10:00 – 20:00

- 10:00-11:00* –Effleurage on the hamstring
- 11:00-12:00*- Effleurage on the Calf
- 12:00-15:00*- Petrissage on the hamstring; deep tissue techniques
- 15:00-18:00*- Petrissage on the calf muscles
- 18:00-19:00*- Tapotement on the leg
- 19:00-20:00*-Effleurage on the entire leg

Massage of the posterior right leg- 20:00 – 30:00

- 20:00-21:00* –Effleurage on the hamstring
- 21:00-22:00*- Effleurage on the Calf
- 22:00-25:00*- Petrissage on the hamstring; deep tissue techniques
- 25:00-28:00*- Petrissage on the calf muscles
- 28:00-29:00*- Tapotement on the leg
- 29:00-30:00*- Effleurage on the entire leg

Massage of anterior left leg- 30:00 – 37:30

- 30:00-31:00- Effleurage on the thigh muscle
- 31:00-31:30- Effleurage on the lower leg
- 31:30-34:30- Petrissage on the thighs; deep tissue techniques
- 34:30-35:00- Petrissage on the lower leg
- 35:00-35:30- Petrissage of the bottom-foot
- 35:30-36:30- Tapotement and vibration on the leg
- 36:30-37:30- Effleurage on the entire leg

Massage of anterior right leg- 37:30 – 45:00

- 37:30-38:30- Effleurage on the thigh muscle
- 38:30-39:00- Effleurage on the lower leg
- 39:00-42:00- Petrissage on the thighs; deep tissue techniques
- 42:00-42:30- Petrissage on the lower leg
- 42:30-43:00- Petrissage of the bottom-foot
- 43:00-44:00- Tapotement and vibration on the leg
- 44:00-45:00- Effleurage on the entire leg

Study Procedures

Before the testing began, all 16 participants in Group A (control group) and Group B (Experimental group) were assigned a random testing number as their Identification number for the data collection. Upon signing the PAR-Q and consent form participants were briefed on what to expect. Then, on the first visit, participants were rebrief of protocols.

Participants were given the SF-36 questionnaire to fill out. All the participants undertook the functional fitness test: stair climb, , single-leg stance test, 30 seconds sit-to-stand test, 2-minute Step test, and sit-and-reach test in the chronological order listed. All data were recorded accurately. Participants were told they had to be retested in four (4) days.

All participants in the Intervention Group were given the timeslots to choose from for the massages, and they were booked in. Intervention Group participants received 3 days of 45 minutes of full-body massage. Groups A and B were both retested.

Data Analysis & Statistical Method

The data analyses were carried out using the Statistical Package for Social Science (SPSS) software. After collecting the data from the numerous tests, the data were placed into Microsoft Excel to analyse and create a visual representation of the information using graphs and charts. Then, the information was analysed in SPSS using a statistical paired t-test test for means and standard deviations. The difference between the test and retest is also determined using a paired sample T-test with alphas values of $p < .01$ and $P < .05$.

Results

Overview

The final sample size for the study consisted of 15 (n=15) participants, although 16 participants (n=16) were recruited during the initial stage. However, one participant dropped out due to health reasons. Therefore, there were 7 participants (n=7) in the Control Group and 8 participants (n=8) in the Intervention Group. A paired sample t-test was used to test the hypothesis of the effectiveness of deep-tissue massage on functional fitness and well-being. The analysis revealed that the Control Group exhibited no difference in all the measured variables. However, for the Intervention Group, the analysis shows there was a difference in some of the dependent variables. These consisted of aspects of balance, sit-to-stand test, 2-minute step test, and reach test, but not in the stair climb.

The SF-36 questionnaire assessed a person's health status across multiple dimensions related to General Health, Physical Health, and Mental Health. A paired sample t-test was done to analyse the data. The analysis for the SF-36 questionnaire highlighted no difference in all three dimensions: General Health, Physical Health and Mental Health for the Control Group. However, the analysis found that there was a significant difference in one of the dimensions for the Intervention Group.

The Effect of Deep-Tissue Massage on functional strength using Stair climb

As shown in the Table 1, the analysis revealed the timing of both groups. The control group's stair climb means before (**4.3 ± SD=1.9 seconds**) was lower than the means after (**4.4 ± SD=1.9 seconds**). There was essentially no change in the time it took to complete the stair climb. Therefore, there was in no significant difference $t(7) = -.030$, $P = .977$, with an extremely small Effect size (Cohen's $d = -.011$).

For the Intervention Group, the results showed the means pre-test (**4.5 ± SD=0.5 seconds**) used more time than the means post-test (**4.3 ± SD=0.4**). The time to complete the stair climb test slightly decreased showing an improvement. However, this change did not hold any significant difference. The effect size was moderate (Cohen's $d = .518$), suggesting a small practical improvement, but it was not enough to be considered statistically significant. Furthermore, Figure 1 shows the mean % difference of both groups. The Control Group had a performance increase of **0.1%**. The Intervention Group had a performance percentage decrease of **4.4%** suggesting a slight improvement.

Table 1 Paired t-test results for stair climb times pre-test and post-test for the Control group and Intervention Group

Group	Means (Before)	Means (After)	<i>t</i>	Df	P	Difference
Control	4.3 ± 1.9	4.4 ± 1.9	-.030	7	.977	No
Intervention	4.5 ± 0.5	4.3 ± 0.4	1.465	7	.186	No

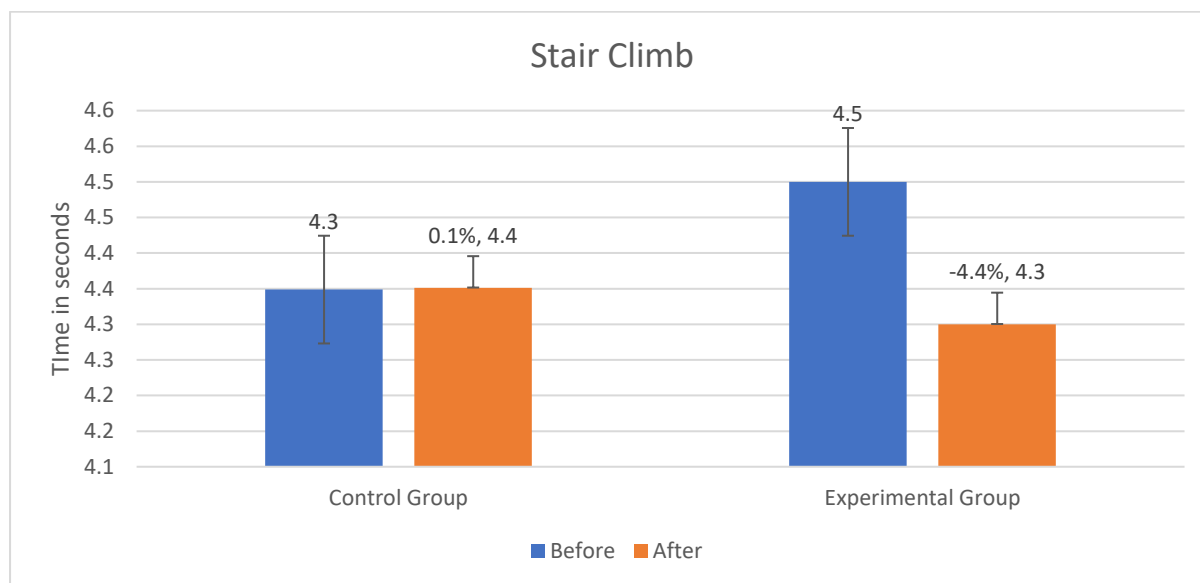


Figure 1 The % mean difference results for stair climb times pre-test and post-test for the Control group and Intervention Group

The Effect of Deep-Tissue Massage on Balance

Single leg Stance: Right leg

The control group's time for the right leg on the balance pre-test (**75.8 ± SD=87.2 seconds**) is lower than the post-test (**64.3 ± 47.7 seconds**) which is shown in Table 2. The results **t(7) = .344, P=.741** shows no significant difference and had a small effect size (**Cohen's d=.122**), any differences observed were minimal. The Intervention Group single right leg stance test shows that the means pre-test (**125 ± SD=116.9 seconds**) is lower than the means post-test (**138 ± SD=87.1**). This showed no significant difference after the intervention **t(7) .535, P= 0.610**. With a small effect size (**Cohen's d=-.189**), indicating a minimal practical significance.

Based on the mean of both groups, Figure 2 shows that the Control Group's right leg had a performance percentage decline of **15.2%**. The Intervention Group had a performance percentage difference of **10.9%** revealing an increase.

Single Leg Stance: Left leg

The control group's single-leg stance shown in Table 2, the left leg pretest (**56.7 ± 42.3 seconds**) which took less time than the post-test (**76.3 ± 68.4 seconds**). These results indicated no significant change, **t(7)=-1.554, P=.164**. The group effect size (**Cohen's d=-.550**) was medium, indicating a change but not enough to be significant.

In addition, the Intervention Group's single stance left leg means pre-test (**101.9 ± SD=72.9 seconds**) is lower than the Means post-test (**129.1 ± SD=91.5 seconds**). The results **t(7) 2.947, P=.021** shows that there was a statistical difference highlighting an improvement. There was a large effect size (**Cohen's d=-1.042**), indicating that the intervention was effective.

Figure 2 shows that the left leg of the Control Group had a performance percentage increase of **34.7%**, revealing an improvement.

The Intervention Group had a performance percentage improvement of **26.7%**.

Table 2 Comparative paired t-test analysis of Pre- and Post-Intervention Balance Times Using the Single Leg Stance Test. This test had two groups; Control and Intervention Group

Single leg stance		Group	Means (Before)	Means (After)	t	Df	P	Difference
Pretest	Right leg	Control	75.8 ± 87.2	64.3 ± 47.7	.344	7	.741	No
		Intervention	125 ± 116.9	138 ± 87.1	.535	7	.610	No
Post-test	Left leg	Control	56.7 ± 42.3	76.3 ± 68.4	1.554	7	.164	No
		Intervention	101.9 ± 72.9	129.1 ± 91.5	2.947,	7	.021	Yes

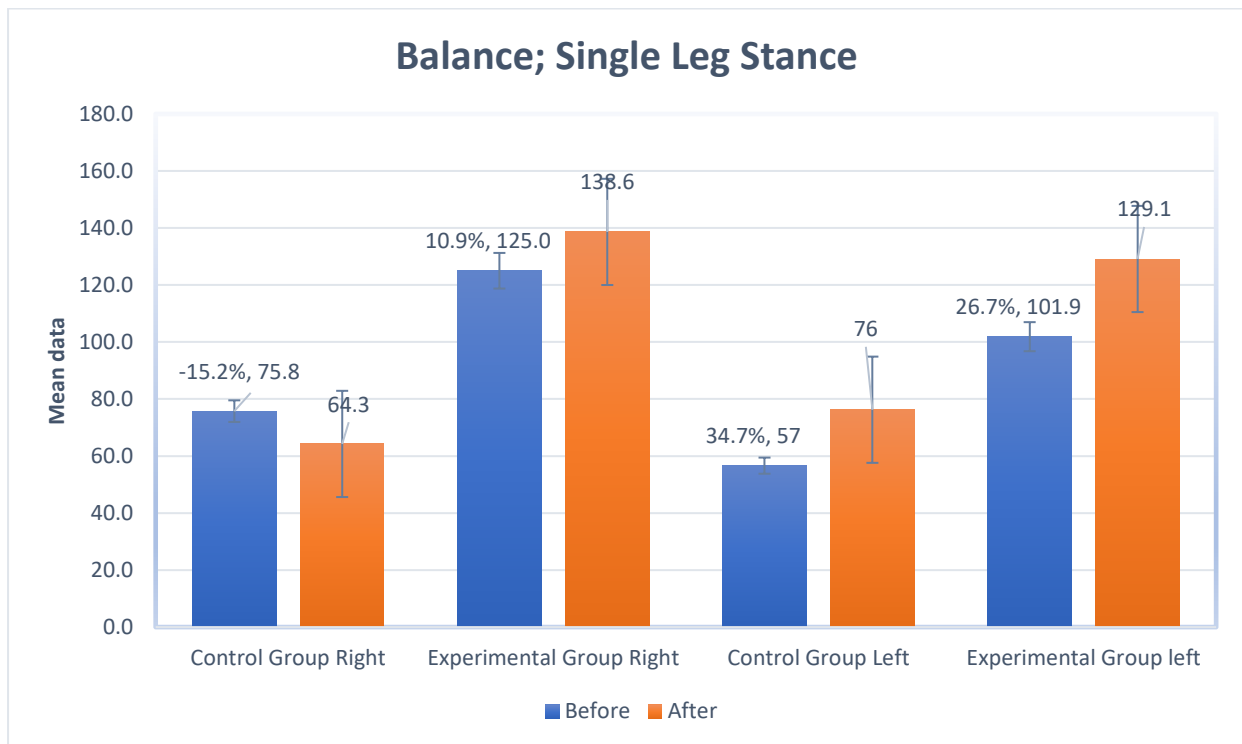


Figure 2 Comparative Results of the mean % difference of Balance Times Using the Single Leg Stance Test. This test had two groups: a control group and an Intervention Group.

Effect of Deep-tissue massage on functional Strength & Balance using 30-sec Sit-to-stand

As shown in the Table 3, the sit-to-stand test analysis shows, the control group means before (14 ± 6.5 reps) are more than the means after (13.75 ± 6.1 reps). These results showed no significant change $t(7)=-.475$, $P=.649$. There was a small effect size (**Cohen's $d=.168$**).

The analysis showed that in the 30-second sit-to-stand test, the experimental group means before (15.3 ± 2.7 reps) are lower than the means after (18.6 ± 4.0 reps). The result $t(7)=-3.045$, $P=.019$ shows a significant increase in the number of repetitions participants performed after the intervention, with an increase in the number of stands. The large effect size (**Cohen's $d=-1.076$**) suggests a substantial improvement.

Based on the mean of both groups, further analysis revealed that the Control Group had a slight decrease in performance of **1.8%**. The Intervention Group had a performance percentage increase of **23.0%** revealing an improvement in performance. This is represented in Figure 1.

Table 3 A Paired t-test Analysis for 30-Seconds Sit To Stand Test For The Control and Intervention Group

Group	Means (Before)	Means (After)	t	Df	P	Difference
Control	14 ± 6.5	13.8 ± 6.1	649	7	.649	No
Intervention	15.3 ± 2.7	18.6 ± 4.0	3.045	7	.019	Yes

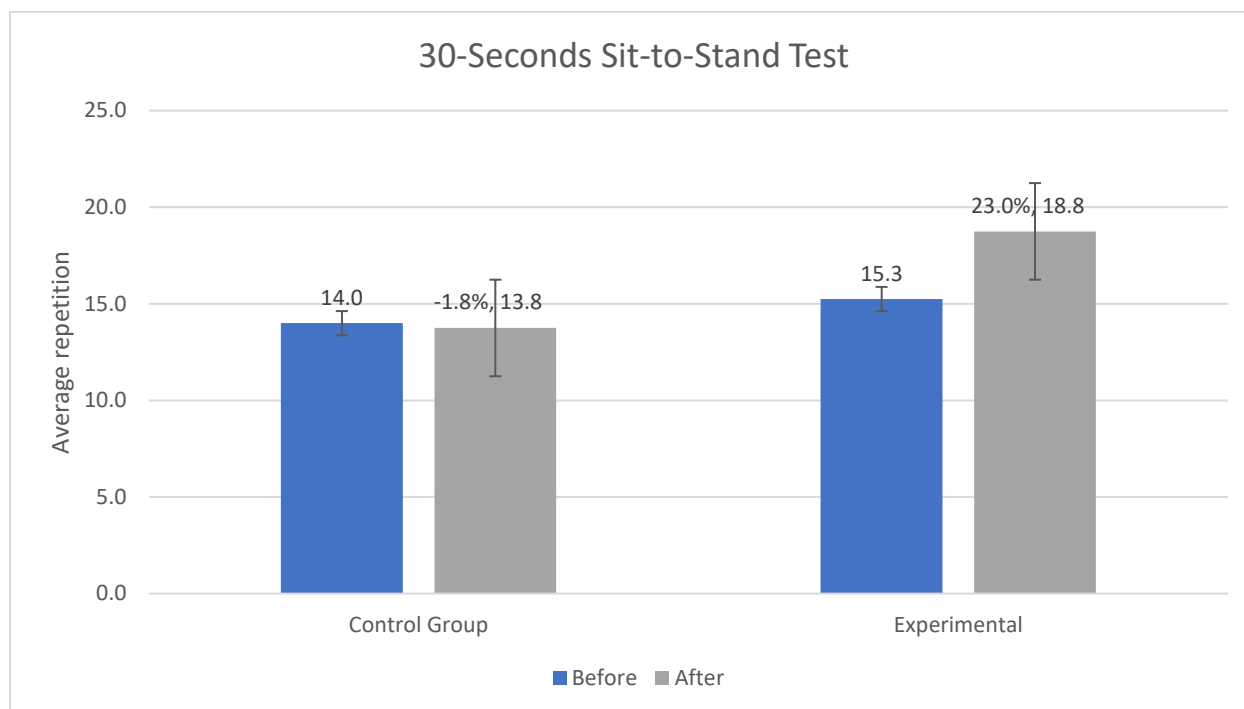


Figure 3 Graphic Representation of Comparative Paired t-test Analysis of Pre- and Post 30-Seconds Sit-to-Stand Test Times Using the Single Leg Stance Test. This test had two groups; Control and Intervention Group.

The Effect of deep-tissue Massage on Endurance Using the 2-minute step test

As shown in Table 4, for the 2-minute step test, the control group means pre-test (**136.5 ± 62.0 steps**) are lower than the means post-test (**144.3 ± 68.7 steps**). These results **t(7)=-.936, P=.380** showed no significant change. There was a moderate effect size (**Cohen's d=-.331**). The analysis showed that in the 2-minute step test, the experimental group means before (**161.9 ± 28.4 steps**) were less than the means after (**183.6 ± 26.3 steps**). The result **t(7)=-2.500, P=.041** showed a significant increase in the number of steps participants performed post-intervention. The intervention group had a large effect size (**Cohen's d=-.884**) indicating an enhancement in endurance.

The mean data for each group were analysed, and it is shown in Figure 4, the Control Group had a performance increase of **5.7%**. While the Intervention Group had a performance increase of **13.4%** indicating a more prominent improvement.

Table 4 A Paired t-test Analysis of 2-minutes Step test of the Control and Intervention Group

Group	Means (Before)	Means (After)	t	Df	P	Difference
Control	136.5 ± 62.0	144.3 ± 68.7	-.936	7	.380	No
Intervention	161.9 ± 28.4	183.6 ± 26.3	2.500	7	.041	Yes

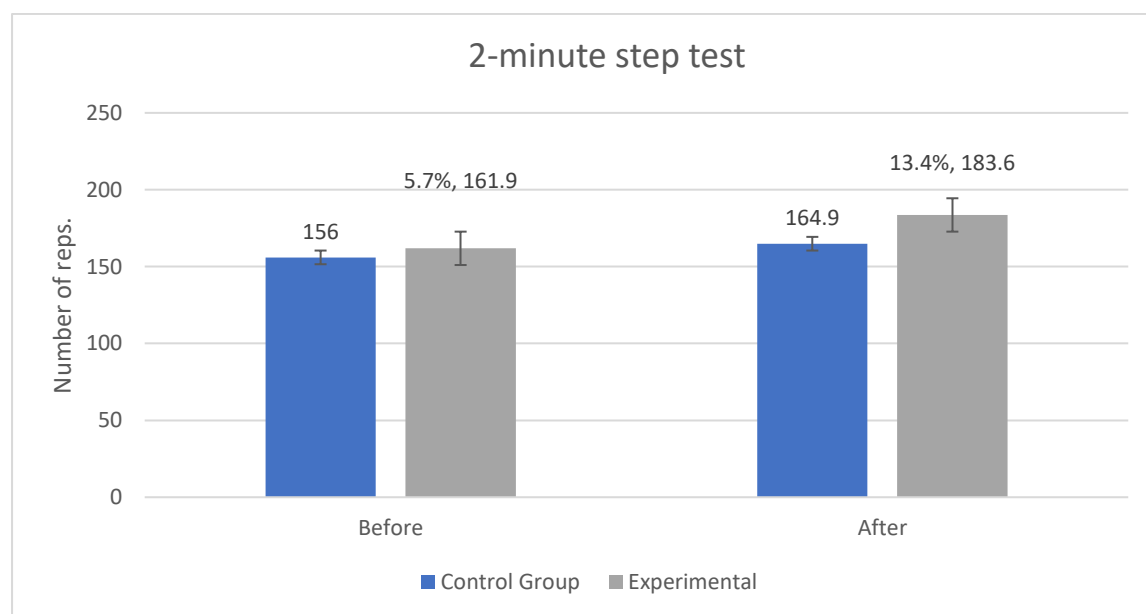


Figure 4 Graphic Representation of Comparative Mean % analysis of Pre- and Post-Test 2-minute Step Test. This test consisted of two groups: control and Intervention Groups.

The Effect of Deep-tissue Massage on Flexibility Using the Sit and Reach Test

The Sit and reach results, shown in Table 5 the control group pretest means (**16.3 ± 9.1 inches**) is less than the post-test means (**16.6 ± 8.3 inches**). The results $t(7)=-.382$, $P=.714$ showed a slight improvement but no statistical difference. The effect size (**Cohen's d= -0.135**) is very small.

The Intervention Group sit and reach results were that the pretest mean (**25.1 ± 4.5 inches**) was less than the post-test mean (**27.5 ± 5.2 inches**). The results **t(7) = -3.987, P = .005** indicated a significant improvement in flexibility. The effect size was large (**Cohen's d = -1.409**).

The comparative analysis in Figure 5 showed the Control Group had a performance increase of **1.8%** suggesting minimal impact. For the Intervention Group had a performance increase of **9.6%** indicating a conspicuous improvement.

Table 5 Comparative Analysis Results of Paired t-test Results From the Flexibility Test of Control Group and Experimental Group

Group	Means (Before)	Means (After)	t	Df	P	Difference
Control	16.3 ± 9.1	16.6 ± 8.3	-.382	7	.714	No
Intervention	25.1 ± 4.5	27.5 ± 5.2	-3.987	7	.005	Yes

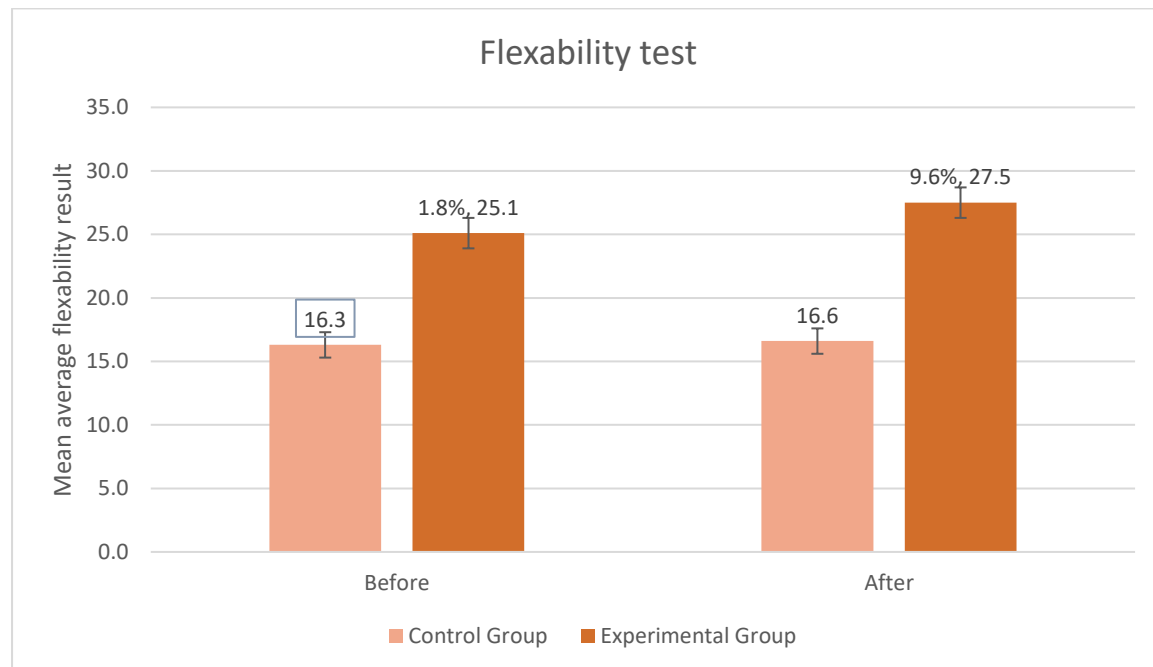


Figure 5 Graphic Representation of Comparative Mean % difference of analysis of Pre- and Post-Testing of Flexibility Using the Sit-To-Stance Test. This test had two groups; Control and Intervention Group.

The Effect of Massage on Overall health and wellbeing using SF-36 Questionnaire

General Health

The Control Group's General Health results pre-test (**63.8±27.4 points**) is lower than the post-test (**65.6± 28.1 points**). The results **t(7)= -1.426, P=.197**, show a slight improvement, but it was not enough to be statistically significant. A medium effect size (Cohen's $s=.504$) suggested a moderate effect.

For the Intervention Group, the General Health dimension results showed that the pretest means (**61.3 ± SD=25.0 points**) is less than the post-test means (**66.3 ± 24.3 points**). The results **t(7)=-2.160, P=.068** has a large effect size (Cohen's **d=-.764**).

The comparative analysis shown in Figure 6, the Control Group had a small performance increase of **2.9%** suggesting minimal impact. The Intervention Group had a performance increase of **8.2%** indicating an improvement of better perceived overall health.

Physical Health

The Physical health dimension scores for the control group pre-test (**67.7 ± 29.5 points**) are more than the post-test (**66.6 ± 31.6 points**). The results **t(7)=.463, P=.658** found no significant difference in the testing. The effect size (Cohen's **d=.164**) was small, indicating that any changes in the Physical Health dimension were minor.

Furthermore, The Intervention Group pretest means (**74.6 ± 14.9 points**) were less than the post-test means (**78.4 ± 13.9 points**). The result **t(7)= -1.677, P=.137** showed no significant difference and had a medium effect size (Cohen's **d= -.593**) suggesting moderate impact.

The comparative analysis showed that the Control Group had a decrease of **-1.6%** indicating a small decline in perceived Physical Health. The Intervention Group had an increase of **5.0%**, indicating an improvement in Physical Health.

Mental Health

The Mental Health dimension scores for the control group pre-test (**45.8 ± 25.6 points**) were less than the post-test (**47 ± 25.3 points**), but the results **t(7)= -1.174, P=.279** showed no statistical difference and had a moderate effect size (Cohen's **d=-.415**).

The Experimental Group Pretest (53.0 ± 22.5 points) was less than the post-test (65.4 ± 21.1 points). The results $t(7)=-3.231$, $P=.014$ showed statistical difference, there was improvement on Mental Health following the intervention. The results also had a large effect size (Cohen's $d=-1.142$).

The analysis in Figure 6 showed that the Control Group had an increase of 2.5%, indicating an improvement in Mental Health. The Intervention Group had a significant improvement of 25.4%, indicating an improvement in Mental Health.

Table 6 Comparative Paired t-test Result of SF-36 Questionnaire testing Three Dimensions: General Health, Physical Health and Mental Health of Control and Intervention Group.

SF-36	Group	Means (Before)	Means (After)	<i>t</i>	Df	P	Difference
General Health	Control	63.8±27.4	65.6± 28.1	-1.426	7	.197	No
	Intervention	61.3 ± 25.0	66.3 ± 24.3	-2.160	7	.068	No
Physical Health	Control	67.7 ± 29.5	66.6 ± 31.6	.463	7	.658	No
	Intervention	74.6 ± 14.9	78.4 ± 13.9	-1.677	7	.137	No
Mental Health	Control	45.8 ± 25.6	47 ± 25.3	-1.174	7	.279	No
	Intervention	53.0 ± 22.5	65.4 ± 21.1	-3.231	7	.014	Yes

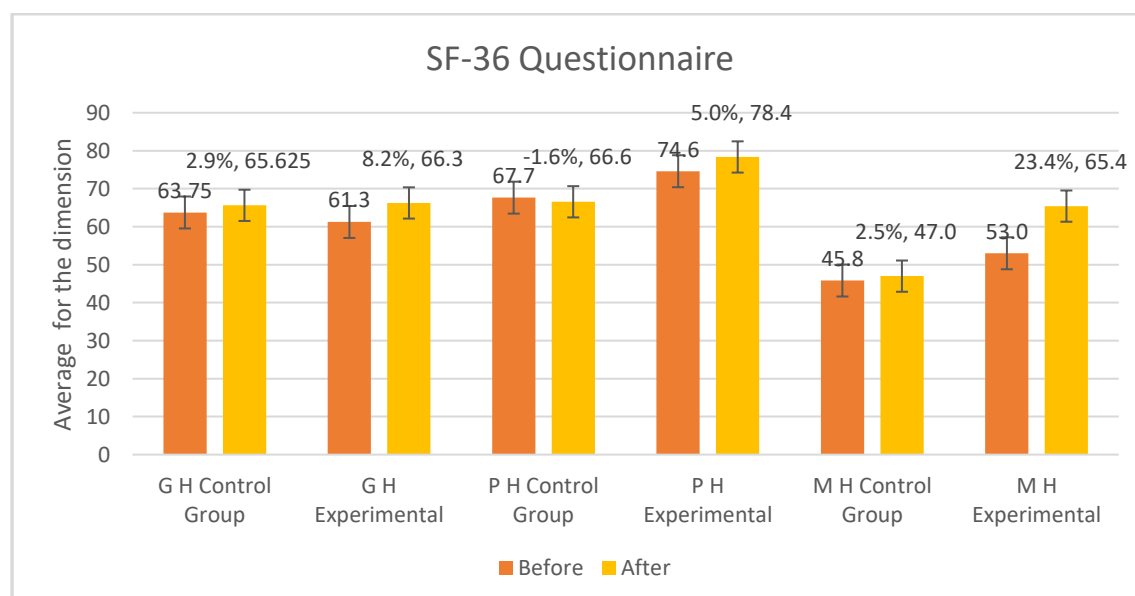


Figure 6 A Graphic Representation of Comparative Mean % Difference Analysis of Three Dimensions of SF-36 Questionnaire of Control and Intervention Group.

Discussion

Summary

This study aimed to examine the impact of sports massage, specifically deep-tissue massage, on functional fitness and overall well-being, which was measured by several functional fitness tests and a standardised well-being questionnaire (SF-36). Given the increase in the use of massage in the athletic world, this research aimed to validate the claims of its effectiveness. The findings indicate a mixed impact, but the medium had a significant effect and significant improvements in several key areas of functional fitness, including muscle strength, endurance, balance, and flexibility following the massage intervention.

Significant findings from the Balance test, particularly on the left leg, showed improvement (*Cohen's d* = -1.042, $p < 0.021$), which suggests an increase in balance and posture control.

The sit-to-stand showed a pronounced improvement (*Cohen's d* = -1.076, $p < 0.019$), which suggests there was an increase in lower body strength. The 2-minute step test results showed significant improvement (*Cohen's d* = -.884, $p < 0.041$), indicating increased aerobic capacity and lower body muscular endurance. Furthermore, the improvement in the Sit and Reach test (*Cohen's d* = -1.409, $p < 0.005$) underscores increased flexibility and range of motion, specifically the hamstring and lower back. The remaining test areas of the balance, the right leg and the stair climb, showed improvement, but the change was not large enough to make a significant difference.

Regarding the overall well-being, the Mental Health component of the SF-36 questionnaire showed significant improvement (*Cohen's d* = -1.142, $p < 0.014$), highlighting enhanced psychological health after having the massage intervention. No significant changes were observed in General health and Physical Health on the SF-36 questionnaire for the remaining two domains. Even though there were improvements in the post-testing, they were not prominent enough to be significant. This suggests that these areas may require a longer intervention period.

The Impact of Deep-tissue Massage on Functional Fitness

Deep-tissue Massage & 30 sec Sit-to-stand test

This study's sit-to-stand test results, which measured lower body strength and strength endurance (Muñoz-Bermejo et al., 2021), have proven that deep-tissue massage interventions were effective. The significant improvement observed during the test performance post-massage suggests that the intervention enhances lower body strength and endurance.

Currently, direct comparison is challenging due to the scarcity of literature exploring the effect of deep-tissue (sports massage) massage and the 30-sec sit-to-stand test. A few studies provide an indirect finding on the effect of strength by using muscle strength results.

Rahiminezhad et al. reported similar findings. They found that in cooperating massage were effective in increasing muscle strength in critically ill ICU patients, indicating a potential benefit of massage in overall strength.

The study was a single blinded which reduces the risk of performance bias in the study but there is still a risk for preferential treatment for intervention group. It is important to note that the participants in the massage group received massage once per day for 7 days for 30 - 60 minutes using Swedish massage. The study massage duration, areas massaged, and techniques used were like that used in the current study. Similarly, Toskić et al. findings in the systematic review highlighted there may be improvement on muscle strength, but it occurs 48 hours post-massage [2]. In addition,

Yu et al. observed positive effects of a massage program on muscle strength in children with spastic cerebral palsy, after they have received massage for 40 minutes twice per week. The muscle strength was test conducted using s scale. Both students massage consisted of the same techniques and had a long duration of massage duration suggesting that conducting a long-term program is effective on muscle strength

In summary, while direct improvements in strength from massage are not consistently demonstrated across all studies, there is evidence to suggest that massage can indirectly benefit muscle strength.

Deep-tissue Massage & 2-Minute Step Test

The results from the study highlights sports massage specifically, deep-tissue massage can positively affect endurance. The current findings from the study contradicts the literature found that massage does not enhance endurance performance. This is supported by

systematic review and meta-analysis evidence which pooled together data from several high-powered, well-designed studies with little heterogeneity found Miloš Dakić ,2023.

This is echoed by another review which suggests that while sports massage is widely used by athletes for recovery and injury prevention, its effect on endurance is not present indicating.

This is echoed by another review, which suggests that while sports massage is widely used by athletes for recovery and injury prevention, its effect on endurance is not present, indicating a lack of strong scientific evidence supporting its efficacy in enhancing endurance directly

Ramazan Bayer 2023. Although Bayer's 2023 experimental research is promising, it has limited generalisability to gender as the population studied were only males. Additionally, for this study, participants received only 15 minutes of massage, which could have led to no significant

However, two studies have shown positive outcomes in an indirect context. Rajum Satria Patra,2023 highlighted that sports massage was effective in reducing athletes' lactic acid levels, which contributes indirectly to the enhancement of endurance y from high-intensity activities. However, this uncontrolled, non-randomised study provides weak evidence due to the risk of several biases.

additionally, Holly Louisa Davis 2020 meta-analysis cardiovascular endurance among basketball players, sports massage, when combined with passive stretching, showed a significant improvement, proving there can be beneficial effect on endurance-related performance. However, this is possible when paired with another intervention

Deep-tissue Massage & Flexibility: Sit and Reach Test

Another finding from this study is that massage positively influences flexibility. The findings are consistent with Kaur & Sinha 2020 randomised control trial and highlighted massage significantly increased flexibility scores. The massage techniques used in present study were similar to current literature. The study found that after five consecutive days of massage, 7 minutes on each leg, there was a notable increase in hamstring flexibility, and the effect lasted five days post-massage. Most studies had a longer duration to see results, highlighting that a short duration can also have an impact on flexibility. Additionally, the test was single-blinded and had a risk of performance bias from the participants since they were aware of the group they belonged to.

A systematic review and meta-analysis by Davis et al. and Toskić et al., who found that massage of all durations, long and short, was associated with statistically significant improvements in flexibility and delayed onset muscle soreness (DOMS). (Bezuglov et al. (2021) and Pearcey et al. (2015) also supported the current literature findings. Other

research by Sloman and Annetts investigated the effects of compression massage on hamstring flexibility and revealed that compression massage had a greater impact on enhancing flexibility than static stretching using participants similar to those in the current study. Most existing literature agrees with these findings. However, research indicates that sports massage may not significantly enhance flexibility or cardiorespiratory endurance in college students participating in intermittent exercise programs (Shen et al., 2021). suggesting results can differ based on population group.

Deep-tissue Massage & Stair Climb

This study found that massage had no significant impact on the domains of stair climb. However, the results showed that there were improvements. Literature to directly compare the results with remains limited. This result falls into line with (Davis 2020) A systematic review and meta-analysis found that massage does not improve measures of strength or endurance. But, a cross over randomized control trial highlighted positively impact muscle force and strength which can influence functional fitness thus resulting in improvement (mine, 2017)

Deep-tissue Massage & Balance: Single Leg stance test

The present study was designed to determine the effect of deep-tissue massage on balance and posture control and found that performing massage produced mixed result as one leg significantly improved while the other did not. The significant results align with a single-blinded experimental study (stefon P,2012) study where 60 minutes massage therapy improved balance. The study mirrored a similar study design but had an older population group. Additionally, the study conducted by Farzaneh Gandomi in 2023 revealed that the immediate effects of Swedish relaxation massage on collegiate female athletes who were experiencing mental fatigue resulted in significant improvements in both dynamic and semi-dynamic balance, as well as lower extremity function. This suggests that Swedish relaxation massage may play a role in enhancing balance. The study by Espi-lopez in 2023 confirms results, as their study highlighted massage therapy not being effective on dynamic balance.

The Impact of Deep-tissue Massage on Overall Wellbeing

Deep-tissue Massage & General, Physical & Mental Health

The current investigation found that there were improvements in all three (3) dimension of the wellbeing questionnaire however only one dimension had a significant improvement which was Mental health. The study is consistent with that of, (shen,2021) whose study saw an improvement in Mental Health by lifting mood state and improved confidence. similarly, Lazar Toskić, meta-analysis highlighted that receiving sports massage can have a positive effect on your mood and mental well-being since it helps to reduce feelings of depression, stress, sadness and anxiety. The study concluded that in its analysis, people often feel less tired which differs from the finding which highlighted no significant effect on physical health. The study further stated there was attainment of feeling more relax. The relaxation and reduction in fatigue can indirectly support better mental health. Other studies such as (weerapong,2005), & (shamsi 2022) in their review studies and (Hohl 2019) supports further claims on the mental health benefits massage. Reichert (2020) study highlighted all the mental health benefits suggesting that faactor such as the gender of the sports massage therapist cannot change the positive psychological effect (Reichert,2020).

Future Outlook

In the future research should investigate the effects of the different massage techniques to determine the right protocols for the different domains of functional fitness as much research is needed. Technillogy should be incooperated into this research to sort the effects it would give to functional fitness. As the outcome looks promising.

Conclusion

In summary, the study demonstrated that deep-tissue (sports) massage significantly enhance several areas of functional fitness. It enhances some aspect of balance, lower body strength, endurance and flexibility which is evidently shown by performing the balance;single leg stance, 30 second sit-to-stand, 2 minute step test and the sit and reach test. Additionally, the wellbeing aspect was tested and deep-tissue massage significantly improve Mental Health. Highlighting the physiological and mental advantage of incoropating sports massage therapy into our daily lives. Future research is needed to futher explore its holistic impact on functional fitness and overall wellbeing.

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Abbreviation

HRQoL	Health Related Quality of Life
PAR-Q	Physical Activity Readiness Questionnaire
QoL	Quality of Life
SPSS	Statistical Package for Social Science
UWTSD	University of Wales Trinity Saint David

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Appendix

Par-q and Consent form

Prifysgol Cymru
Y Ddwydd Dewi Sant
University of Wales
Trinity Saint David

PAR-Q and Informed Consent Form

Personal Details	
First Name	[REDACTED]
Last Name	[REDACTED]
Student Number	[REDACTED]
Course	[REDACTED]
Year	[REDACTED]

Please answer the following questions fully and truthfully as it may affect your safety whilst exercising.

- Has a doctor told you that you have a heart condition AND must seek medical advice before participating in regular exercise? YES / NO
- Do you feel a pain in your chest when you perform physical activity? YES / NO
- Have you ever had a chest pain when not doing physical activity? YES / NO
- Do you lose your balance due to dizziness or do you ever lose consciousness? YES / NO
- Do you have a bone or joint condition that could be made worse through physical activity? YES / NO
- Are you currently taking any medication for high blood pressure? YES / NO
- Are you currently taking any medication for a heart problem? YES / NO
- Do you take any other medications on a regular basis? YES / NO
- Have you had any recent surgery? YES / NO
- Do you have any chronic health conditions such as asthma, diabetes? YES / NO
- Women Only:** Are you pregnant or have you given birth in the last 6 months? YES / NO

If you have answered YES to any of these then please give details below.

If you have answered YES to one or more of these questions then it would be advisable to talk to your doctor before starting exercise.

Please comment below if you have any further information regarding your health, physical or otherwise, that has not been covered by the above questions (i.e. past or present injuries):

Possible knee injury in the past however it was never checked by a breast physician

Declaration, Terms & Conditions

I have read, understood and completed this questionnaire to the best of my knowledge and can confirm that the information I have provided is correct.

I understand that I am expected to participate in physical activity and exercise as this is a necessary element of this degree. This may include exercise to exhaustion and maximal efforts. I am aware that participation in these activities involves the risk of injury.

I agree to work with in the guidelines of the laboratory and the parameters of any test protocol when present in the laboratory.

I understand that unacceptable or dangerous behaviour may result in my removal from the facilities.

I agree to inform a member of staff in the event of any change to either my personal or medical details.

Signature: [REDACTED] Date: 5/01/2024

Sports Massage Form

Client Assessment

Personal Information	
Title	D.O.B.
Surname	Gender
Forename	GP Name
Address	GP Address
Telephone Number	GP Number
Occupation	Consultant
Other Healthcare Practitioners	
Reason for Visit	

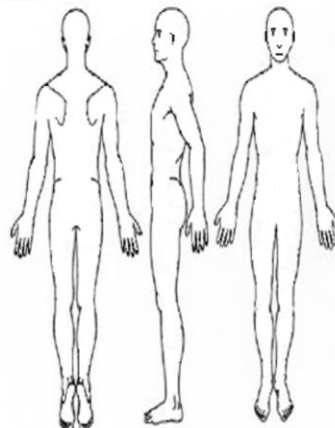
Contraindications

- Is your general health ok?
- Have you had your BP taken?
- Are you taking any medications?
- Have you had any surgery?
- Are you subject to any medical conditions?
- Do you have any allergies?
- Anything else of relevance that I should be aware of?

Current Medical History

- Is this the first episode of the particular problem?
- How, when, what (Details)?
- Symptoms?

Body Chart



Previous Medical History (if applicable)

- What happened & how long ago did problem occur?
- What was done & by whom?
- Results previously?
- Were any investigations carried out? (x-ray, MRI)?

Observations

Symmetry, Ease of undressing, Left/Right comparison, Inflammation, Lump/bumps/scars, Comparison of previous visit.

Palpation

Skin temp/circulation, Muscle Tone, Swelling/Inflammation, Muscle Spasm, Limb comparison.

Movement

Joint mobility, Soreness/tenderness, hypomobile, Stiffness, Active/Passive/Resisted.

Raw Testing Scores and Questionnaire scores

Testing Control Group

Client	Before						After					
	Single leg stance R	Single leg stance L	Sit to stand (30 sec)	2 mins step test	Stair climb	Sit and reach	Single leg stance R	Single leg stance L	Sit to stand (30 sec)	2 mins step test	Stair climb	Sit and reach
Obz	0:35:87	01:41:63	19	156	0:03:78	26	01:37:28	02:11:81	18	197	03:97	26
Anch	0:32:12	0:28:94	15	208	0:05:19	8	1:04:03	0:48:47	15	200	0:04:91	15
SD	0:28:50	0:55:12	16	165	0:04:13	23	1:47:91	0:23:34	15	159	0:04:27	23
Mich	4:08:66	1:51:28	14	116	0:04:78	22	04:00:20	3:21:06	17	125	0:04:78	20
ash	2:46:87	1:36:84	19	162	0:05:56	19	2:06:17	1:46:84	17	155	0:05:00	18
XB2	01:16:22	0:43:81	10	122	0:05:69	22	1:25:50	1:22:72	10	108	0:05:78	21
TS1	-	-	-	-	-		-	-	-	-	-	-
Xi45	0:17:69	0:15:57	19	163	0:04:46	10	0:10:22	0:15:96	18	210	0:04:50	10

Testing Experimental group

Client	Before						After					
	Single leg stance R	Single leg stance L	Sit to stand (30 sec)	2 mins step test	Stair climb	Sit and reach	Single leg stance R	Single leg stance L	Sit to stand (30 sec)	2 mins step test	Stair climb	Sit and reach
JC1	01:59:28	01:28:50	17	173	00:04:00	33	02:09:59	02:18:40	20	193	00:03:66	38
OJ2	05:03:50	04:01:53	16	180	00:04:16	31	05:00:17	4:39:42	18	188	00:03:94	33
AG3	0:48:45	01:04:69	15	198	00:04:32	23	02:37:18	01:44:59	19	205	0:04:02	26
SP4	05:05:35	02:59:40	20	124	0:03:75	22	03:14:56	03:53:28	24	152	00:03:65	24
SL5	00:24:15	00:24:57	16	160	00:05:28	21	00:08:28	00:12:94	17	184	00:05:15	24
SB6	02:05:96	01:13:63	11	192	00:04:40	22	01:51:19	01:29:63	12	200	00:04:50	24
KA7	0:35:50	01:40:69	13	133	00:04:32	26	02:27:16	02:24:59	24	211	0:03:66	25
KF8	0:40:28	0:43:14	14	135	00:05:02	23	1:03:12	0:32:16	16	136	00:04:49	26

Questionnaire Control group																
	Physical functioning		Role limitation(physical)		Role limitation (emotional problem)		Energy/fatigue		Emotional well-being		Social functioning		pain		General Health	
Client	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Xi45	800	800	400	400	100	100	160	180	360	360	175	175	135	115	325	375
SD	950	950	200	300	100	100	60	60	240	240	25	25	175	175	400	425
Ash	1000	1000	400	400	100	100	200	200	240	240	175	175	180	180	275	275
Anch	750	750	200	200	100	100	240	240	380	380	125	125	155	155	375	375
XB2	950	950	300	300	0	0	200	200	420	420	125	125	155	155	425	425
Mich	1000	1000	400	400	300	300	240	240	480	480	175	175	180	180	375	375
Obz	250	100	200	100	100	100	80	140	280	240	50	100	140	90	375	375
TS1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Questionnaire Experimental group																
	Physical functioning		Role limitation(physical)		Role limitation (emotional problem)		Energy/fatigue		Emotional well-being		Social functioning		pain		General health	
Client	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
JC1	850	900	300	300	100	100	80	140	220	280	100	100	115	115	325	325
OJ2	1000	1000	400	400	0	0	80	80	220	280	125	125	155	200	450	450
AG3	1000	1000	200	200	100	100	200	260	360	400	360	400	200	200	475	475
SP4	850	900	300	300	200	300	180	280	240	360	75	95	135	135	300	325
SL5	750	800	400	400	200	200	80	160	160	260	50	75	90	30	175	200
SB6	700	850	100	300	100	300	100	220	320	300	125	150	140	135	100	125
KA7	950	1000	400	400	300	300	320	300	500	420	175	175	180	180	325	425
KF8	900	950	300	300	100	200	200	280	240	280	125	175	180	180	300	325

Final scoring for SF-36 questionnaire

1	Control Group questionnaire															
2	Physical functioning		Role limitation (Phys)		Role limitation(emo)		Energy/Fatigue		Emotional Wellbeing		Social functioning		Pain		General Health	
3	Before	After	Before	After	Before	After	Before	After	before	after	before	after	Before	After	Before	After
4	80	80	100	100	33.3	33.3	40	45	72	72	87.5	87.5	67.5	57.5	65	75
5	95	95	50	75	33.3	33.3	15	15	48	48	12.5	12.5	87.5	87.5	80	85
6	100	100	100	100	33.3	33.3	50	50	48	48	87.5	87.5	90	90	55	55
7	75	75	50	50	33.3	33.3	60	60	76	76	62.5	62.5	77.5	77.5	75	75
8	95	95	75	75	0.0	0.0	50	50	84	84	62.5	62.5	77.5	77.5	85	85
9	100	100	100	100	100.0	100.0	60	60	96	96	87.5	87.5	90	90	75	75
10	25	10	50	25	33.3	33.3	20	35	56	48	25	50	70	45	75	75
11	0	0	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
12													Av		63.8	65.6
13																
14	Experimental Group questionnaire															
15	Physical functioning		Role limitation (Phys)		Role limitation(emo)		Energy/Fatigue		Emotional Wellbeing		Social functioning		Pain		General Health	
16	Before	After	Before	After	Before	After	Before	After	before	after	before	after	Before	After	Before	After
17	85	90	75	75	33.3	33.3	20	35	44	56	50	50	57.5	57.5	65	65
18	100	100	100	100	0.0	0.0	20	20	44	56	62.5	62.5	77.5	100	90	90
19	100	100	50	50	33.3	33.3	50	65	72	80	180	200	100	100	95	95
20	85	90	75	75	66.7	100.0	45	70	48	72	37.5	47.5	67.5	67.5	60	65
21	75	80	100	100	66.7	66.7	20	40	32	52	25	37.5	45	15	35	40
22	70	85	25	75	33.3	100.0	25	55	64	60	62.5	75	70	67.5	20	25
23	95	100	100	100	100.0	100.0	80	75	100	84	87.5	87.5	90	90	65	85
24	90	95	75	75	33.3	66.7	50	70	48	56	62.5	87.5	90	90	60	65
25													Av		61.3	66.3

SF-36 Final scoring

Control Group						
Participants	Physical Health		Mental Health		General Health	
	Before	After	Before	After	Before	After
1	78.1	78.1	58.2	59.5	65	75
2	78.1	85.6	27.2	27.2	80	85
3	86.3	86.3	54.7	54.7	55	55
4	69.4	69.4	58.0	58.0	75	75
5	83.1	83.1	49.1	49.1	85	85
6	91.3	91.3	85.9	85.9	75	75
7	0.0	0.0	0.0	0.0	75	75
8	55.0	38.8	33.6	41.6	0	0
Average	67.7	66.6	45.8	47.0	63.8	65.6
Experimental group)						
Participants	Physical Health		Mental Health		General Health	
	Before	After	Before	After	Before	After
1	70.6	71.9	36.8	43.6	65	65
2	91.9	97.5	31.6	34.6	90	90
3	86.3	86.3	83.8	94.6	95	95
4	71.9	74.4	49.3	72.4	60	65
5	63.8	58.8	35.9	49.0	35	40
6	46.3	63.1	46.2	72.5	20	25
7	87.5	93.8	91.9	86.6	65	85
8	78.8	81.3	48.5	70.0	60	65
Average	74.6	78.4	53.0	65.4	61.3	66.3

SPSS Paired T-test

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Single leg right Control Group-B	75.75	8	87.169	30.819
	Single leg right Control Group-A	64.25	8	47.692	16.862

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	Single leg right Control Group-B & Single leg right Control Group-A	8	.113	.395	.790

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Single leg right Control Group-B - Single leg right Control Group-A	11.500	94.520	33.418	-67.521 90.521	.344	7	.370	.741

Paired Samples Effect Sizes

				Standardizer ^a	Point Estimate	95% Confidence Interval	
		Cohen's d				Lower	Upper
Pair 1	Single leg right Control Group-B - Single leg right Control Group-A			94.520	.122	-.578	.813
		Hedges' correction		106.417	.108	-.514	.722

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Single leg left Control Group-B	56.63	8	42.274	14.946
	Single leg left Control Group-A	76.25	8	68.389	24.179

Paired Samples Correlations

			Significance	
			One-Sided p	Two-Sided p
	N	Correlation		
Pair 1 Single leg left Control Group-B & Single leg left Control Group-A	8	.897	.001	.002

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	
					Lower	Upper			One-Sided p
									Two-Sided p
Pair 1	Single leg left Control Group-B - Single leg left Control Group-A	-19.625	35.709	12.625	-49.478	10.228	-1.554	7	.082
									.164

Paired Samples Effect Sizes

					95% Confidence Interval		
				Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	Single leg left Control	Cohen's d	35.709	-.550	-1.281	.215	
	Group-B - Single leg left Control Group-A	Hedges' correction	40.204	-.488	-1.138	.191	

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Single leg right Experi Group-B	125.00	8	116.849	41.312
	Single leg right Experi Group-A	138.63	8	87.140	30.809

Paired Samples Correlations

			N	Correlation	Significance	
					One-Sided p	Two-Sided p
Pair 1	Single leg right Experi Group-B & Single leg right Experi Group-A		8	.788	.010	.020

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	
									One-Sided p
									Two-Sided p

Pair 1	Single leg right Experi Group-B - Single leg right Experi Group-A	-13.625	72.091	25.488	-73.895	46.645	-.535	7	.305	.610
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Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Single leg right Experi Group-B - Single leg right Experi Group-A	Cohen's d	72.091	-.189	-.882	.517
		Hedges' correction	81.165	-.168	-.784	.459

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Single leg left Experi Group-B	101.88	8	72.865	25.762
	Single leg left Experi Group-A	129.13	8	91.521	32.358

Paired Samples Correlations

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Single leg left Experi Group-B & Single leg left Experi Group-A	8	.975	<.001	<.001

Paired Samples Test

		Paired Differences			95% Confidence Interval of the Difference		t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			One-Sided p	Two-Sided p
Pair 1	Single leg left Experi Group-B - Single leg left Experi Group-A	-27.250	26.152	9.246	-49.114	-5.386	-2.947	7	.011	.021

Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Single leg left Experi Group-B - Single leg left Experi Group-A	Cohen's d	26.152	-1.042	-1.895	-.144
		Hedges' correction	29.444	-.925	-1.683	-.128

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sit to stand Control Group-B	14.00	8	6.459	2.283
	Sit to stand Control Group-A	13.75	8	6.135	2.169

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	Sit to stand Control Group-B & Sit to stand Control Group-A	8	.973	<.001	<.001

Paired Samples Test

		Paired Differences						Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Sit to stand Control Group-B - Sit to stand Control Group-A	.250	1.488	.526	-.994 1.494	.475	7	.325	.649

Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Sit to stand Control Group-B - Sit to stand Control Group-A	Cohen's d	1.488	.168	-.536	.861
		Hedges' correction	1.675	.149	-.476	.764

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sit to stand Experi Group-B	15.25	8	2.712	.959

Paired Samples Correlations

			Significance	
			One-Sided p	Two-Sided p
	N	Correlation		
Pair 1 Sit to stand Experi Group-B & Sit to stand Experi Group-A	8	.595	.060	.120

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	
					Lower	Upper			
Pair 1	Sit to stand Experi Group-B - Sit to stand Experi Group-A	-3.500	3.251	1.150	-6.218	-.782	-3.045	7	.009
									.019

Paired Samples Effect Sizes

						95% Confidence Interval		
					Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	Sit to stand Experi Group-B	Cohen's d		3.251	-1.076	-1.940	-.168	
	Sit to stand Experi Group-A	Hedges' correction		3.661	-.956	-1.723	-.149	

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Two min step Control group-B	136.50	8	62.014	21.925
	Two min step Control Group-A	144.25	8	68.702	24.290

Paired Samples Correlations

			Significance		
			One-Sided	Two-Sided	
			p	p	
Pair 1	Two min step Control group-B & Two min step Control Group-A	8	.941	<.001	<.001

Paired Samples Test

Paired Differences	t	df	Significance
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		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
					Lower	Upper				
Pair 1	Two min step Control group-B - Two min step Control Group-A	-7.750	23.408	8.276	-27.319	11.819	-.936	7	.190	.380

Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Two min step Control group-B - Two min step Control Group-A	Cohen's d	23.408	-.331	-1.034	.393
		Hedges' correction	26.354	-.294	-.918	.349

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Two min step Experi Group-B	161.88	8	28.433	10.052
	Two min step Experi Group-A	183.63	8	26.322	9.306

Paired Samples Correlations

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Two min step Experi Group-B & Two min step Experi Group-A	8	.599	.058	.117

Paired Samples Test

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Significance	
					Lower	Upper			One-Sided p	Two-Sided p
Pair 1	Two min step Experi Group-B - Two min step Experi Group-A	-21.750	24.604	8.699	-42.319	-1.181	-2.500	7	.020	.041

Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Two min step Experi Group-B - Two min step Experi Group-A	Cohen's d	24.604	-.884	-1.691	-.034
		Hedges' correction	27.701	-.785	-1.502	-.030

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Stair Climb Control Group-B	4.3488	8	1.88597	.66679
	Stair Climb Control Group-A	4.3513	8	1.86447	.65919

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Two-Sided p
Pair 1	Stair Climb Control Group-B & Stair Climb Control Group-A	8	.992	<.001	<.001

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Stair Climb Control Group-B - Stair Climb Control Group-A	-.00250	.23705	.08381	-.20068 .19568	-.030	7	.489	.977

Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval Lower Upper	
Pair 1	Stair Climb Control Group-B - Stair Climb Control Group-A	Cohen's d	.23705	-.011	-.703	.683
		Hedges' correction	.26689	-.009	-.625	.606

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Stair Climb Experi Group-A	4.4563	8	.45141	.15960
	Stair Climb Experi Group-A	4.3337	8	.38678	.13675

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	Stair Climb Experi Group-A & Stair Climb Experi Group-A	8	.852	.004	.007

Paired Samples Test

		Paired Differences						Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Stair Climb Experi Group-A - Stair Climb Experi Group-A	.12250	.23645	.08360	-.07517 .32017	1.465	7	.093	.186

Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval Lower Upper	
Pair 1	Stair Climb Experi Group-A	Cohen's d	.23645	.518	-.240	1.245
	- Stair Climb Experi Group-A	Hedges' correction	.26621	.460	-.213	1.106

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sit and Reach Control Group-B	16.25	8	9.146	3.233
	Sit and Reach Control Group-A	16.63	8	8.314	2.939

Paired Samples Correlations

			N	Correlation	Significance	
					One-Sided p	Two-Sided p
Pair 1	Sit and Reach Control Group-B & Sit and Reach Control Group-A		8	.954	<.001	<.001

Paired Samples Test

		Paired Differences						Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	One-Sided p
					Lower	Upper			Two-Sided p
Pair 1	Sit and Reach Control Group-B - Sit and Reach Control Group-A	-.375	2.774	.981	-2.694	1.944	-.382	7	.357

Paired Samples Effect Sizes

					95% Confidence Interval		
				Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	Sit and Reach Control Group-B - Sit and Reach Control Group-A	Cohen's d	2.774	-.135	-.827	.566	
		Hedges' correction	3.123	-.120	-.734	.503	

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Tes

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sit and Reach Eperi Group-B	25.13	8	4.518	1.597
	Sit and reach Experi Group-A	27.50	8	5.182	1.832

Paired Samples Correlations

			Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Sit and Reach Eperi Group-B & Sit and reach Experi Group-A	8	.949	<.001	<.001

Paired Samples Test

		Paired Differences						Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	One-Sided p
					Lower	Upper			Two-Sided p

Pair 1	Sit and Reach Eperi Group-B - Sit and reach Experi Group-A	-2.375	1.685	.596	-3.784	-.966	-3.987	7	.003	.005
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Paired Samples Effect Sizes

					95% Confidence Interval		
				Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	Sit and Reach Eperi Group-B - Sit and reach Experi Group-A	Cohen's d	1.685	-1.409	-2.389		-.386
		Hedges' correction	1.897	-1.252	-2.122		-.342

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Two min step Control group-B	136.50	8	62.014	21.925
	Two min step Control Group-A	144.25	8	68.702	24.290

Paired Samples Correlations

			Significance		
			One-Sided p	Two-Sided p	
	N	Correlation			
Pair 1 Two min step Control group-B & Two min step Control Group-A	8	.941	<.001	<.001	

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	t	df	One-Sided p	Two-Sided p
					Lower				
Pair 1	Two min step Control group-B - Two min step Control Group-A	-7.750	23.408	8.276	-27.319	11.819	-936	.190	.380

Paired Samples Effect Sizes

					95% Confidence Interval		
				Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	Two min step Control group-B - Two min step Control Group-A	Cohen's d	23.408	-.331	-1.034	.393	
		Hedges' correction	26.354	-.294	-.918	.349	

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	P H Questionnaire Control Group-B	67.663	8	29.5293	10.4402
	P H Questionnaire Control Group-A	66.575	8	31.5774	11.1643

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	P H Questionnaire Control Group-B & P H Questionnaire Control Group-A	8	.979	<.001	<.001

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	One-Sided p	Two-Sided p
Pair 1	P H Questionnaire Control Group-B - P H Questionnaire Control Group-A	1.0875	6.6465	2.3499	-4.4691 6.6441	.463	7	.329	.658

Paired Samples Effect Sizes

		Standardizer ^a		Point Estimate	95% Confidence Interval	
		Cohen's d	Hedges' correction		Lower	Upper
Pair 1	P H Questionnaire Control Group-B - P H Questionnaire Control Group-A	6.6465	7.4831	.164	-.540	.856
				.145	-.480	.760

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	M H Questionnaire Control Group-B	45.838	8	25.6157	9.0565
	M H Questionnaire Control Group-A	47.000	8	25.3105	8.9486

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	M H Questionnaire Control Group-B & M H Questionnaire Control Group-A	8	.994	<.001	<.001

Paired Samples Test

		Paired Differences						Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	One-Sided p	Two-Sided p
Pair 1	M H Questionnaire Control Group-B - M H Questionnaire Control Group-A	-1.1625	2.8000	.9899	-3.5033 1.1783	-1.174	7	.139	.279

Paired Samples Effect Sizes

				Standardizer ^a	Point Estimate	95% Confidence Interval	
						Lower	Upper
Pair 1	M H Questionnaire Control Group-B - M H Questionnaire Control Group-A	Cohen's d		2.8000	-.415	-1.127	.323
		Hedges' correction		3.1524	-.369	-1.001	.287

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	P H Questionnaire Experi Group-B	74.638	8	14.9334	5.2797
	P H Questionnaire Experi Group-A	78.388	8	13.8836	4.9086

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Two-Sided p
Pair 1	P H Questionnaire Experi Group-B & P H Questionnaire Experi Group-A	8	.906	<.001	.002

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	One-Sided p	Two-Sided p
Pair 1	P H Questionnaire Experi Group-B - P H Questionnaire Experi Group-A	-3.7500	6.3243	2.2360	-9.0373 1.5373	-1.677	7	.069	.137

Paired Samples Effect Sizes

		Standardizer ^a		Point Estimate	95% Confidence Interval	
		Cohen's d	Hedges' correction		Lower	Upper
Pair 1	P H Questionnaire Experi Group-B - P H Questionnaire Experi Group-A	6.3243	7.1204	-.593	-1.333	.181
				-.527	-1.184	.161

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	M H Questionnaire Experi Group-B	53.000	8	22.5352	7.9674
	M H Questionnaire	65.413	8	21.0967	7.4588

Paired Samples Correlations

			Significance	
			One-Sided p	Two-Sided p
	N	Correlation		
Pair 1 M H Questionnaire Experi Group-B & M H Questionnaire Experi Group-A	8	.878	.002	.004

Paired Samples Test

		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	t	df	One-Sided p	Two-Sided p
					Lower Upper				
Pair 1	M H Questionnaire Experi Group-B - M H Questionnaire Experi Group-A	-12.4125	10.8665	3.8419	-21.4971 -3.3279	-3.231	7	.007	.014

Paired Samples Effect Sizes

					95% Confidence Interval		
				Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	M H Questionnaire Experi Group-B - M H Questionnaire Experi Group-A	Cohen's d	10.8665	-1.142	-2.027	-.212	
		Hedges' correction	12.2343	-1.015	-1.801	-.188	

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	G H Questionnaire Control Group-B	63.750	8	27.3535	9.6709
	G H Questionnaire Control Group-A	65.625	8	28.0863	9.9300

Paired Samples Correlations

			Significance		
			One-Sided p	Two-Sided p	
	N	Correlation			
Pair 1	G H Questionnaire Control Group-B & G H Questionnaire Control Group-A	8	.991	<.001	<.001

Paired Samples Test										
		Paired Differences					Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	One-Sided p	Two-Sided p
					Lower	Upper				
Pair 1	G H Questionnaire Control Group-B - G H Questionnaire Control Group-A	-1.8750	3.7201	1.3153	-4.9851	1.2351	-1.426	7	.099	.197

Paired Samples Effect Sizes						
			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	G H Questionnaire Control	Cohen's d	3.7201	-.504	-1.228	.251
	Group-B - G H Questionnaire Control Group-A	Hedges' correction	4.1884	-.448	-1.091	.223

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

T-Test

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	G H Questionnaire Experi Group- B	61.250	8	25.0357	8.8515
	G H Questionnaire Experi Group-A	66.250	8	24.3120	8.5956

Paired Samples Correlations					
		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	G H Questionnaire Experi Group- B & G H Questionnaire Experi Group-A	8	.965	<.001	<.001

Paired Samples Test										
		Paired Differences								
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Significance	
					Lower	Upper			One-Sided p	Two-Sided p
Pair 1	G H Questionnaire Experi Group- B - G H Questionnaire Experi Group-A	-5.0000	6.5465	2.3146	-10.4730	.4730	-2.160	7	.034	.068

Paired Samples Effect Sizes			
		Standardizer ^a	95% Confidence
		Point Estimate	

Paired Samples Effect Sizes

			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	G H Questionnaire Experi Group- B - G H Questionnaire Experi Group-A	Cohen's d	6.5465	-.764	-1.540	.053
		Hedges' correction	7.3705	-.678	-1.368	.047

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Mean Average and Percentage (%) difference of test

Sit to stand							
Sit to stand	Pre-test	Post-test	% difference				
Control Group	14.0	13.8	-1.8%				
Intervention Group	15.3	18.8	23.0%				
Stair climb	Before	After	% difference				
Control Group	4.3	4.4	0.1%				
Experimental	4.46	3.85	-13.7%				
SF-36							
GH	Before	After	% difference				
Control Group	63.8	65.6	2.9%				
Experimental	61.3	66.3	8.2%				
PH							
Control Group	67.7	66.6	-1.6%				
Experimental	74.6	78.4	5.0%				
MH							
Control Group	45.8	47.0	2.5%				
Experimental	53.0	65.4	23.4%				

Balance			
Balance test	Before	After	% difference
Control Group Right	75.8	64.3	-15.2%
Experimental Group right	125.0	138.6	10.9%
Control Group Left	57	76	34.7%
Experimental Group left	101.9	129.1	26.7%
Sit and reach			
	Before	After	% difference
Control Group	16.3	16.6	1.8%
Experimental Group	25.1	27.5	9.6%
2 min step test			
	Before	After	% difference
Control Group	156	164.9	5.7%
Experimental	161.9	183.6	13.4%