The Effects of a Progressive Exercise Program on Functional Activity and Quality of Life for Older Overweight Women with Knee Osteoarthritis

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THE EFFECTS OF A PROGRESSIVE EXERCISE PROGRAM ON FUNCTIONAL ACTIVITY
AND QUALITY OF LIFE FOR OLDER OVERWEIGHT WOMEN WITH KNEE
OSTEOARTHRITIS

By
Ty Carlson
Devin Edvalson
Tyler Peck
Brad Robison

A doctoral project submitted in partial fulfillment
of the requirements for the

Doctorate of Physical Therapy

Department of Physical Therapy
School of Allied Health Sciences
The Graduate College

University of Nevada, Las Vegas
May 2014
THE GRADUATE COLLEGE

We recommend the doctoral project prepared under our supervision by

Ty Carlson, Devin Edvalson, Tyler Peck, and Brad Robison

entitled

The Effects of a Progressive Exercise Program on Functional Activity and Quality of Life for Older Overweight Women with Knee Osteoarthritis

is approved in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy
Department of Physical Therapy

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May 2014
ABSTRACT

**Background and Purpose**
Osteoarthritis (OA) is a common symptomatic condition experienced by older adults, especially in the overweight population, that affects the knees in particular. This study compares the effectiveness of two progressive exercise protocols (walking and stepping) on function and quality of life in older, overweight women with OA. This study includes self-management training and assesses participant self-perceived efficacy in managing OA.

**Subjects**
This is a quasi-experimental design utilizing 16 women ≥ 50 years of age (60.44 ± 6.04) with a BMI > 25 (34.21 ± 7.28) and radiographic diagnosis of OA in at least one knee.

**Methods and Measures**
Subjects were randomly assigned to a protocol group and followed exercises twice per week with supervision and once per week independently during the 10-week study. Pre and post-tests were performed using NeuroCom Smart Equitest, Dual-energy X-ray Absorptiometry (DEXA) scan, pain visual analog scale, isometric strength, and self-reported outcome measures including; Knee Osteoarthritis Outcomes Score (KOOS), CDC HRQOL-14 “Healthy Days Measure” - Quality of Life (QOL), and the Patient Activity Measure (PAM).

**Results**
The walking group showed significant improvement in the KOOS -QOL (p=0.026) and function (p=0.027) subscales as well as the NeuroCom Sensory Organization Test (SOT) (p=0.022). No significant results were found within the stepping group. Groups were combined and significant results were found in the KOOS - QOL (p=0.022), NeuroCom SOT (0.001), and NeuroCom Limits of Stability (LOS) (p=0.024).

**Conclusion**
A simple 10 week walking exercise incorporating self-management is shown to improve function, quality of life, and balance. The stepping exercise did not show any significant improvement. However, when the 2 groups are combined, we observed similar improvement in the 3 aforementioned domains. The results from this research provide important insights into exercise intervention in older overweight women with knee OA.

KEY WORDS: Knee Osteoarthritis, Balance, Function, Quality of Life

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i. UNLV IRB protocol number 1006 3496
ACKNOWLEDGEMENTS

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INTRODUCTION

Osteoarthritis (OA), in some form, affects nearly 27 million adults in the United States.\(^1\) Largely considered a condition affecting older adults, it is estimated that almost one third of persons older than 65 are living with OA.\(^1\) In fact, OA is considered to be one of the most common symptomatic health conditions experienced by older adults.\(^2\)

Clinically, the knee has been established as the joint most affected by OA.\(^2\) Knee OA has been recognized as a major cause of disability, reducing the performance of daily tasks such as walking and climbing stairs as well as decreasing quality of life and limiting the ability to live independently.\(^1\) The Centers for Disease Control and Prevention (CDC) reported that 13.6\% of females and 10\% of males over the age of 60 experienced symptomatic knee OA, affecting 4.3 million adults.\(^3\) It has been documented that women are more susceptible to knee OA, and tend to encounter more severe knee OA than men. This is thought to be associated with the onset of menopause and other possible hormonal factors.\(^4,5\)

Zhang and Jordan\(^4\) established that obesity and being overweight are significant risk factors for the development of OA, particularly knee OA. Obesity has recently become a global epidemic with an estimated 1.4 billion adults (20 years and older) being overweight, and obesity affecting over 200 million men and 300 million women.\(^2,6\) Recently, obesity has become a major focus of research due to its modifiability, preventability, and its link to OA. Obesity is linked to altered knee joint loading and malalignment, particularly when OA is present.\(^2,7\) A recent systematic review and meta-analysis of Body Mass Index (BMI) and knee OA
susceptibility revealed that the risk of OA significantly increased with increased BMI.\textsuperscript{2} It was shown that a five-unit increase in BMI is associated with a 35% increased risk of knee OA.\textsuperscript{2} In addition, women with a BMI between 30 and 35 kg/m\textsuperscript{2} were shown to have four times the risk of developing knee OA compared to women with a BMI under 25.\textsuperscript{8}

Many strategies have been developed to combat the progression and reduce the symptoms of OA. In general, physical activity has exhibited numerous benefits including counteracting age related declines in fitness, muscular strength, and endurance. These attributes of physical activity with regard to OA have shown to decrease bone loss, improve physical function, reduce pain, and promote healthy joint cartilage.\textsuperscript{1} A common impairment experienced by older adults is weakness of the lower extremity musculature, particularly the quadriceps.\textsuperscript{9} This weakness can lead to instability in the knee joint leading to further degenerative changes, pain, decreased balance and a reduction in physical activity.\textsuperscript{9} Strength training of the knee extensors has not been shown to reduce the incidence of radiographic tibiofemoral OA. However, increasing knee extensor strength was found to protect against the onset of symptomatic knee OA.\textsuperscript{10}

Studies from a recent meta-analysis of exercise programs for knee OA incorporated flexibility, muscle strengthening, and balance exercises.\textsuperscript{11} Of the 32 studies included in this meta-analysis, four of them integrated functional stepping and mini-squat exercises into their protocol; however, these studies failed to isolate functional strengthening of the lower extremities from other interventions such as isometrics, theraband strengthening, and taping.\textsuperscript{12-15} Furthermore, little evidence
was shown to support exercise protocols that allow the participant to self-select the pace and number of repetitions for each exercise.

Another important finding in this meta-analysis was the functional outcome benefits for land based exercise programs and their strong association with the number of directly supervised treatment sessions. Decreased pain and improved functional outcomes were noted in studies that had at least 12 supervised treatment sessions in contrast to home based exercise sessions performed without direct supervision in which participants had no significant improvement. In other words, the magnitude of the treatment effect was not found to be significant in participants that did not receive supervised treatment sessions.

The results of these studies suggest that supervised exercise sessions may have superior outcomes, although, consistently attending supervised treatment sessions may place an undo financial and scheduling burden on the participant. A combined protocol of supervised treatment sessions and a self-managed home exercise program that is tapered to a self-managed independent exercise program alone may be most effective in promoting long term adherence and improved quality of life. To our knowledge, this treatment strategy has not been studied.

Thus, the aim of the present study was to compare the effectiveness of two different, low to moderate progressive exercise protocols, walking and stepping, on pain, body composition, knee and hip strength, activity as measured in steps, balance, physical function, and quality of life. Additionally, the present study sought to evaluate the subjects' adherence to the exercise protocol after being provided with instruction to continue it independently at home following the study. Subjects'
level of self-management before and after an educational program in overweight women with knee OA was evaluated.

**MATERIALS AND METHODS**

*Subjects:*

Sixteen women ≥ 50 years of age (60.44 ± 6.04) with a BMI > 25 (34.21 ± 7.28) and radiographical evidence (x-ray) of bilateral knee joints (anterior-posterior and lateral views) to confirm presence of osteoarthritis indications in at least one knee were recruited as a sample of convenience using email notifications to the UNLV employee community, all members of the UNLV Osher Lifelong Learning Institute (OLLI) Community, and with flyers posted at various senior centers throughout Clark County. Exclusion criteria included joint arthroplasty, major trauma including lower extremity fracture, rheumatoid arthritis, osteoporosis, uncontrolled heart rate or blood pressure, and recipients of opioid-based pain medications or corticosteroid injections within the last 30 days of initiation of the study. Participants were disallowed from beginning new exercise programs throughout the study. Women were used instead of both sexes due to the higher incidence of OA in women.

*Instrumentation:*

Pre, mid, and post-exercise testing measurements administered are listed below in Table 1. Treatment instrumentation included aerobic steps (The Step, Step Fitness & Recreation, Inc., Marietta GA), personal pedometers (Sportline WR 50M Women's 955 Total Fitness Pedometers, Elmsford, NY), and automatic blood pressure cuffs (Omron BP629 3 Series Wrist Blood Pressure Monitor, Bannockburn, IL). Pre and post-testing instrumentation included hand held dynamometry
(microFET2, Hoggan Health Industries, Salt Lake City, UT), DEXA (GE Lunar Prodigy, GE Healthcare, Madison, WI), and the NeuroCom Smart Equitest (Neurocom, Clackamas, OR, USA).

Procedure:

Pre-participation

Subjects were randomly assigned to intervention groups consisting of either 1) progressive 10-week walking or 2) progressive 10-week stepping on aerobic steps. All subjects were issued a pedometer and instructed to wear it during the daytime. Each subject was given a log to document their steps per day each day for one week prior to initiation of the intervention stage of the study to establish a baseline measurement. All subjects were instructed to continue to document their steps throughout the entirety of the study. All subjects were asked to register for the Arthritis Self-Management Program (ASMP)\textsuperscript{16} to receive emails regarding the workshop. The purpose of including this program was to provide additional education about how to self-treat arthritis symptoms including information on coping, exercise, communication, and diet. Subjects were provided with a supplemental text called “The Arthritis Helpbook”\textsuperscript{16} to improve coping strategies for improvement in functional living. This program required about two hours per week online for the first six weeks of the study.

Walking group

Individuals in the walking group performed the intervention biweekly outdoors under the supervision of trainers. Each participant was asked to perform the exercise at a level that allowed comfortable talking (“talk test”). This stipulation
was to ensure the participants were not overexerting themselves to the point of breathlessness for safety reasons. The subjects in the walking group were asked to perform an additional routine once weekly at home with the same current parameters as their on-site program. Walking duration was progressed both on-site and at home from 15 minutes for Weeks 1 and 2, 30 minutes for weeks 3-5, and 45 minutes for Weeks 6-10 if subjects met the following criteria: 1) ability to complete the exercise protocol without pain > 4/10 on VAS during or within 1 hour after exercise; 2) choosing to remain in the study.

Stepping group

Participants in the stepping group completed the stepping intervention under the supervision of two trainers biweekly in the racquetball court. The step protocol involves a 10 minute warm up walk, three cycles of two minutes forward step ups, one minute mini squats, two minutes side stepping and one minute calf raises. Each step exercise session finished with 2 minutes forward stepping and a 10 minute cool down walk. If the subjects met the criteria to advance exercise parameters indicated above, subjects were progressed from a 4 inch step to a 6 inch step at the beginning of Week 3 and to an 8 inch step at the beginning of Week 5 (Fig.1). Exercise sessions for steppers at home involved the same warm-up and cool down protocol and the same stepping protocol as performed on-site. Step height was also progressed at home as on-site moving from the 4 inch step to the 6 inch step on Week 3 and to the 8 inch step on Week 6. The Stepping Group subjects were only progressed at Week 3 and Week 6 if they met the following criteria: 1) ability to complete the exercise protocol without pain > 4/10 on VAS during or within 1 hour after exercise.
after exercise; 2) choosing to remain in the study. This progression is also demonstrated in Figure 1.

Data collection

The following measures were performed pre-intervention and post-intervention: body composition (BMI, lean mass in grams, fat mass in grams) via the DEXA; balance with the SOT and Limits of Stability (LOS) tests on the NeuroCom Smart Equitest; ability to self-manage using the Patient Activation Measure or PAM (licensed by Insignia Health); quality of life on the Function, Sport and Recreation, and Quality of Life subscales of the KOOS; quality of life on the CDC HRQOL-14 “Healthy Days Measure”; pain via the Visual Analogue Scale (VAS); isometric strength of the knee extensors, hip extensors, and hip abductors via hand held dynamometry, and extension and flexion range of motion via goniometry. In addition, pain, strength, the KOOS subscales, the CDC HRQOL-14, and range of motion were also measured at the end of Week 2 and Week 5. Please see Figure 1.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences for Windows, Version 18.0 (SPSS, Chicago, IL). Data was analyzed using 2-tailed paired samples t-tests. For all tests, $\alpha$ was set to .05.

RESULTS

Lower extremity strength:

A 2-tailed paired samples t-test was used to determine if there was a significant difference in strength from beginning of the treatment to end in both
groups. No significant differences were found in any measurement of either group from beginning until the end. (Figure 2, Table 1)

*Knee Osteoarthritis Outcomes Score (KOOS):*

Similarly, a 2-tailed paired samples t-test was used to determine differences in the Function, Sport & Recreation, and Quality of Life subscales of the KOOS. Participants’ reported pre-, at the end of Week 2, at the end of Week 5, and post-treatment. A statistically significant pre-post correlation was found from the Functional section of the KOOS for the walking group with a negative correlation of .909 and a p value of .002 indicating a trend toward improvement of symptoms and increased function. The walking group also had significant decreases in scores for the Functional section and the Quality of Life (QoL) sections with p values of .027 and .026 respectively indicating improvement of symptoms. For the walking and stepping groups combined, there were significant correlations for the Functional section and QoL sections with results of .574 correlation and p=.020 and .638 correlation and p=.008 respectively with post-test scores decreased indicating improvement in the outcome. Post-QoL scores decreased significantly from the pre-QoL scores suggesting improvement in QoL outcomes for the combined groups with a p value of .022. (Figures 3 & 4, Table 2)

*Body composition:*

Using the data from the DEXA scan, analysis was performed using a 2-tailed paired samples t-tests and no significant differences found for BMI, fat mass, or lean mass from beginning to end of the study for either group. (Figure 5, Table 3)
Balance:

SOT and LOS test results were also analyzed using a 2-tailed paired samples t-test. Significant positive correlations indicating improvement were found for the combined groups (SOTcomp, LOScomp1, LOScomp2) with correlations of .594 p = .015, .801 p < .001, and .813 p < .001 respectively. The walking group demonstrated significant positive correlation indicating improvement for SOTcomp, LOScomp1, and LOScomp2, and stepping LOScomp1 and LOScomp2 with correlations and p values respectively; .836 p=.010, .832 p=.010, .931 p=.001, .737 p=.037, and .740 p=.036. Significant improvement was found within the walking group for the SOTcomp (p=.004). The stepping group showed a trend for the same measure with p=.074. There was also significant improvement in combined groups for the SOTcomp (p=.001) and LOScomp1 (p=.024). (Figure 6, Table 4)

Pain:

Pain, as reported through Visual Analog Scale, was recorded and analyzed, again using the 2-tailed paired samples t-test. There were no significant differences found between pre- and post-testing. (Figure 7, Table 5)

CDC HRQOL-14 “Healthy Days Measure” - Quality of Life (QOL):

Upon analysis, it became apparent that subjects didn’t understand the instructions for completing this QOL instrument. As a result, the data was not analyzed.
Activity (as measured in steps per week):

By week 2 of the study all but 3 of the subjects had stopped using the pedometer, as it was too complicated for them to use. As a result, no activity data was reported or analyzed.

Range of Motion (ROM):

Upon analysis, it was observed that the knee extension and flexion ROM was not measured consistently from tester to tester and was not reported consistently. As a result, this data was not analyzed.

Patient Activity Measure (PAM – licensed by Insignia Health):

The PAM was used pre- and post-test to assess the subjects’ ability to self-manage their chronic condition after completion of the 6 week Arthritis Self-Management Program. This data was analyzed and reported separately and has been submitted for publication.

DISCUSSION

Our study is the first study to determine the effects of two different functional exercises (walking, stepping) using a hybrid intervention program (i.e., supervised- and self-driven exercises) on pain, body composition, knee and hip strength, activity, balance, physical function, and quality of life in older overweight women with knee OA. Based upon previous evidence using similar functional exercises, it was hypothesized that as each intervention progressed subjects would demonstrate improvements in each of the above stated categories. In this study, a simple walking protocol incorporating self-management is shown to improve function, quality of life, and balance. The stepping exercise did not show the same
improvement on those outcome variables. However, when the 2 groups were combined, similar improvements were observed in the 3 measurement domains. Neither walking exercise nor stepping exercise is shown to alter pain, body composition and muscle strength after 10 weeks of exercise intervention.

It was expected that pain would decrease as the study progressed. The results indicated that there was no significant difference in pain as determined by the VAS. Consideration should be given to the subjective nature of the VAS for the measurement of pain as there may be variability in self-reported scores based upon patient perception. Furthermore, subjects' pain may have been inconsistently modulated by the use of other, non-excluded medications or modalities.

Measurement of functional activity and quality of life were obtained using the KOOS and Healthy Days Quality of Life questionnaires. Significant differences were found in the Function and Quality of Life sections of the KOOS for those in the walking group alone, while combined walkers and steppers demonstrated significance only in the Quality of Life category. These findings indicate that improvement in function for those with knee OA may be linked to participation in a walking program, while quality of life may be improved by the use of either walking alone or a combination of walking and stepping activities as part of a course of treatment. Significant findings for the walking group may be associated with a greater number of questions being related to walking as opposed to stepping in the Functional section of the KOOS. Though strength and pain did not show significant results, these findings suggest that an exercise regimen of walking may have a more
positive effect on subjects’ function and quality of life than either stepping alone or a combined stepping and walking protocol.

As suggested in the pilot study to this project, it was anticipated that a progressive exercise protocol would improve balance as seen in the SOT and LOS tests\textsuperscript{16}. For the combined groups a statistical significant improvement was found indicating that the progressive exercises performed in this study had a positive relationship to balance. With these results, it may be inferred that elderly, overweight women with knee OA may gain improved balance with a progressive exercise program. This could potentially lead to decreased falls and injury, saving both the health care system and the individuals involved unnecessary burden and hardship.

In an attempt to analyze the impact a progressive exercise program would have on the quality of life of the subjects, the CDC HRQOL-14 “Healthy Days Measure” quality of life questionnaire was selected. However, the questionnaire was difficult to understand and subsequently became unrepresentative of the participants. For example, in the Activity Limitations Module, Question 1 requests a yes or no answer. If no is selected, subjects are to proceed to Question 1 of the Healthy Days Symptoms module. However, many subjects proceeded to complete the additional section of Question 1. In addition, Question 2 in the Activity Limitations Module asks subjects to select the major impairment or health problem that limits their activities (only 1 category). However, many subjects selected several categories. To obtain more reliable and valid results, future studies may find
it beneficial to utilize a proctor with a thorough understanding in administering this specific assessment tool.

An additional component of the current study was to evaluate the subjects’ adherence to a walking or stepping exercise protocol to be performed at home after receiving instruction during supervised treatment sessions. Data was collected not only for the current study, but also for a supplemental study with its primary focus being on adherence. For this reason, specific data analysis and results are being reported separately and are not included in the current study.

This study demonstrated limitations in sample size and selection. The sample size was small (n=16), and was not randomly selected, but was rather a sample of convenience. Generalizability may be improved in future studies by taking a larger sample size of both genders with no exclusions of age or weight. In addition, inter-rater reliability failed to be established for assessment of strength. Although, each data collector was properly trained, no data collector was specifically established to measure strength during data collection periods. Also the measurement team was changed during the course of the study further affecting reliability. Furthermore, the learning and maturation effects of the patients, which variables are difficult to control, may have influenced the findings in this study. An additional limitation to this study was the inability to use pedometer data due to the complicated nature of its function and the discontinued use by subjects over the course of the study.

**CONCLUSION**

Our results indicate that a simple 10-week walking exercise program incorporating self-management can improve function, quality of life, and balance.
The 10-week stepping exercise did not show the same improvement on those outcome variables. However, when the 2 groups were combined, we observed similar improvement in the 3 measurement domains. The results gained in this research provide important insights into the exercise interventions for persons with knee OA.
Figure 1: Research methods and measures flow chart

Recruited Convenience Sample of 17 Subjects

Screening for Inclusion / Exclusion Criteria

Randomization between Walking and Stepping

2 Week 4 inch step

3 Week 6 inch step

5 Week 8 inch step

7 Day Pedometer and ASMP

Measurements: SOT, LOS, KOOS, Strength, CDC-HRQOL14, DEXA, ROM, PAM

2 Week 15 min walk

3 Week 30 min walk

5 Week 45 min walk

Measurements: KOOS, Strength, CDC-HRQOL14, ROM

Measurement KOOS, Strength, CDC-HRQOL14, ROM

Measurement KOOS, Strength, CDC-HRQOL14, ROM

Measurements: SOT, LOS, KOOS, Strength, CDC-HRQOL14, DEXA, ROM, PAM

Data Analysis

HR, BP, and VAS were taken prior to and following exercise session at each on-site workout
Figure 2: Lower extremity strength

Lower Extremity Strength

Weight in lbs

0.00 5.00 10.00 15.00 20.00 25.00 30.00

Pre 2 weeks 5 weeks Post

Walkers Knee Ext
Steppers Knee Ext
Walkers Hip Ext
Steppers Hip Ext
Walkers Hip Abd
Steppers Hip Abd
Figure 3: Knee Osteoarthritis Outcomes Scale

KOOS

Mean KOOS Score

- Walkers (Function)
- Steppers (Function)
- Walkers (Sport and Recreation Function)
- Steppers (Sport and Recreation Function)
- Walkers (Quality of Life)
- Steppers (Quality of Life)

Pre  2 weeks  5 weeks  Post
Figure 4: KOOS significant correlations pre and post Intervention

KOOS Significant Correlations

- Walking Group (Function Subscale)
- Combined Group (Function Subscale)
- Combined Group (QOL Subscale)
Figure 5: Dual Energy X-ray Absorptiometry scan pre- and post-intervention.
Figure 6: Balance pre- and post-intervention

![Graph showing balance pre- and post-intervention](image)
Figure 7: Pain pre- and post- intervention

![Graph showing pain levels on VAS scale (0-10) pre, 2 weeks, 5 weeks, and post intervention for Walkers and Steppers. Graph indicates a decrease in pain levels post-intervention.]
Table 1: Lower extremity strength

<table>
<thead>
<tr>
<th>LE Strength in lbs</th>
<th>N</th>
<th>Pre Mean</th>
<th>Pre SD</th>
<th>Post Mean</th>
<th>Post SD</th>
<th>Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee Ext. Right</td>
<td>16</td>
<td>20.73</td>
<td>6.56</td>
<td>19.44</td>
<td>11.41</td>
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<td>16</td>
<td>20.7</td>
<td>7.64</td>
<td>20.02</td>
<td>12.94</td>
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<tr>
<td>Hip Ext. Right</td>
<td>16</td>
<td>16.68</td>
<td>7.15</td>
<td>17.16</td>
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<tr>
<td>HIP Ext. Left</td>
<td>16</td>
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<td>Hip Abd. Right</td>
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<tr>
<td>Hip Abd. Left</td>
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Table 2: Knee Osteoarthritis Outcome Score

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<th>Pre SD</th>
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<th>Post SD</th>
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<td>Walking</td>
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<tr>
<td>Function (A totals)</td>
<td>8</td>
<td>13.88</td>
<td>8.07</td>
<td>10.38</td>
<td>8.47</td>
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<td>Sport and Recreation (SP totals)</td>
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<td>Quality of Life (Q totals)</td>
<td>8</td>
<td>7.88</td>
<td>2.8</td>
<td>5.5</td>
<td>2</td>
<td>0.548</td>
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<td>Stepping</td>
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<td>Function (A totals)</td>
<td>8</td>
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<td>9.61</td>
<td>10.5</td>
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<td>0.635</td>
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<td>Sport and Recreation (SP totals)</td>
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<td></td>
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<td>Quality of Life (Q totals)</td>
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<td>5.75</td>
<td>3.54</td>
<td>4.88</td>
<td>3.04</td>
<td>0.687</td>
<td>0.38</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function (A totals)</td>
<td>16</td>
<td>13.13</td>
<td>8.61</td>
<td>10.44</td>
<td>8.15</td>
<td>0.574</td>
<td>0.185</td>
</tr>
<tr>
<td>Sport and Recreation (SP totals)</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Quality of Life (Q totals)</td>
<td>16</td>
<td>6.81</td>
<td>3.27</td>
<td>5.19</td>
<td>2.51</td>
<td>0.638</td>
<td>0.022</td>
</tr>
</tbody>
</table>
Table 3: Dual Energy X-ray Absorptiometry

<table>
<thead>
<tr>
<th>DEXA Scan and BMI</th>
<th>N</th>
<th>Pre Mean</th>
<th>Pre SD</th>
<th>Post Mean</th>
<th>Post SD</th>
<th>Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking BMI</td>
<td>8</td>
<td>34.31</td>
<td>9.29</td>
<td>34.27</td>
<td>9.57</td>
<td>0.999</td>
<td>0.822</td>
</tr>
<tr>
<td>Total Fat Mass (g)</td>
<td>8</td>
<td>40432</td>
<td>12347.57</td>
<td>40270.25</td>
<td>12816</td>
<td>0.999</td>
<td>0.557</td>
</tr>
<tr>
<td>Total Lean Mass (g)</td>
<td>8</td>
<td>42409.38</td>
<td>8539.15</td>
<td>42806.25</td>
<td>8168.81</td>
<td>0.997</td>
<td>0.184</td>
</tr>
<tr>
<td>Stepping BMI</td>
<td>8</td>
<td>34.11</td>
<td>6.33</td>
<td>34.44</td>
<td>6.48</td>
<td>0.996</td>
<td>0.136</td>
</tr>
<tr>
<td>Total Fat Mass (g)</td>
<td>8</td>
<td>40170.13</td>
<td>11649.75</td>
<td>40116.88</td>
<td>12227.38</td>
<td>0.997</td>
<td>0.897</td>
</tr>
<tr>
<td>Total Lean Mass (g)</td>
<td>8</td>
<td>44263.75</td>
<td>8071.16</td>
<td>44639.13</td>
<td>8141.08</td>
<td>0.977</td>
<td>0.562</td>
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</tbody>
</table>

BMI= Body Mass Index measured in grams (g)
<table>
<thead>
<tr>
<th>NeuroCom Smart Equitest</th>
<th>N</th>
<th>Pre Mean</th>
<th>Pre SD</th>
<th>Post Mean</th>
<th>Post SD</th>
<th>Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Walking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOT Comp</td>
<td>8</td>
<td>66.25</td>
<td>11.99</td>
<td>75.88</td>
<td>10.37</td>
<td>0.836</td>
<td>0.004</td>
</tr>
<tr>
<td>LOS Comp 1 (EPE)</td>
<td>8</td>
<td>58.25</td>
<td>13.8</td>
<td>63.13</td>
<td>10.11</td>
<td>0.832</td>
<td>0.119</td>
</tr>
<tr>
<td>LOS Comp 2 (MXE)</td>
<td>8</td>
<td>74.5</td>
<td>12.38</td>
<td>73.5</td>
<td>11.5</td>
<td>0.931</td>
<td>0.55</td>
</tr>
<tr>
<td><strong>Stepping</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOT Comp</td>
<td>8</td>
<td>68.25</td>
<td>10.07</td>
<td>76.5</td>
<td>6.39</td>
<td>0.144</td>
<td>0.074</td>
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<tr>
<td>LOS Comp 1 (EPE)</td>
<td>8</td>
<td>62.13</td>
<td>10.67</td>
<td>66.38</td>
<td>8.38</td>
<td>0.737</td>
<td>0.14</td>
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<tr>
<td>LOS Comp 2 (MXE)</td>
<td>8</td>
<td>76.76</td>
<td>11.99</td>
<td>81.13</td>
<td>7.9</td>
<td>0.74</td>
<td>0.171</td>
</tr>
<tr>
<td><strong>Combined</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOT Comp</td>
<td>16</td>
<td>67.25</td>
<td>10.74</td>
<td>76.19</td>
<td>8.33</td>
<td>0.594</td>
<td>0.001</td>
</tr>
<tr>
<td>LOS Comp 1 (EPE)</td>
<td>16</td>
<td>60.19</td>
<td>12.08</td>
<td>64.75</td>
<td>9.13</td>
<td>0.801</td>
<td>0.024</td>
</tr>
<tr>
<td>LOS Comp 2 (MXE)</td>
<td>16</td>
<td>75.63</td>
<td>11.83</td>
<td>77.31</td>
<td>10.31</td>
<td>0.813</td>
<td>0.345</td>
</tr>
</tbody>
</table>

SOT=Sensory Organization Test, LOS=Limits of Stability Test, Comp=Composite Score, EPE=Endpoint Excursion, MXE=Maximum Excursion
### Table 5: Pain

<table>
<thead>
<tr>
<th>Pain VAS</th>
<th>N</th>
<th>Pre Mean</th>
<th>Pre SD</th>
<th>Post Mean</th>
<th>Post SD</th>
<th>Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>8</td>
<td>1.75</td>
<td>1.58</td>
<td>0.75</td>
<td>0.89</td>
<td>-0.459</td>
<td>0.227</td>
</tr>
<tr>
<td>Stepping</td>
<td>8</td>
<td>2.38</td>
<td>2.13</td>
<td>1.13</td>
<td>1.13</td>
<td>0.04</td>
<td>0.16</td>
</tr>
<tr>
<td>Combined</td>
<td>16</td>
<td>2.06</td>
<td>1.77</td>
<td>0.94</td>
<td>1</td>
<td>-0.111</td>
<td>0.051</td>
</tr>
</tbody>
</table>

VAS= Visual Analog Scale
REFERENCES


Curriculum Vitae

Tyler Peck, SPT

Education

**University of Nevada, Las Vegas;** Las Vegas, NV (Degree Expected May 2014)
*Degree: Doctor of Physical Therapy*
- Awarded Graduate Assistant Position

**Brigham Young University;** Provo, UT (April 2011)
*Degree: Bachelor of Exercise Science*

**Southern Utah University;** Cedar City, UT (May 2008)
*Degree: Associate of Arts*
- Awarded Dean’s Scholarship and Athletic Scholarship
- Division 1 Football Team player
- Member of Rural Health Scholars Program and Student Athlete Advisory Committee

Relevant Experience

**Clinical Internships**

*Concentra;* Sandy, UT (1/2014 – 3/2014)
- Examined and evaluated patients efficiently in an outpatient setting
- Managed a full-time physical therapy case load effectively
- Administered human performance examinations for a variety of different occupations

*Jordan Valley Hospital;* West Jordan, UT (10/2013 – 12/2013)
- Demonstrated empathetic care for patients in the acute care setting
- Treated patients who were in life threatening situations while in the ICU
- Motivated patients to actively participate in therapy at times that were difficult for them

*Utah Valley Regional Medical Center;* Provo, UT (7/2013 – 10/2013)
- Provided effective care plans for patients in the neuro-trauma rehabilitation unit
- Collaborated with other health care providers as part of the rehabilitation team
- Educated family members in providing safe assistance for their loved ones preparing for d/c

*Boulder City Hospital;* Boulder City, NV (5/2012 – 8/2012)
- Examined and evaluated patients with musculoskeletal pathology in an outpatient setting
- Demonstrated excellent communication with patients and caregivers
- Provided an in-service on the current concepts of pain and its relevance to physical therapy

**Physical Therapist Aid and Exercise Specialist (12/2009 - 5/2012)**

*Registered Physical Therapists, Inc.;* South Jordan, UT
- Set patients up and took them down from all modalities (e.g.; heat, ultra sound, ice)
• Taught and demonstrated exercises and stretches for all patients

Rural Health Scholars Volunteer (11/2007 -12/2007)
Southern Utah University; Cedar City, UT
• Prepared and organized medical supplies for distribution
• Spent one week in Hermosillo, Mexico, visiting hospitals and orphanages to deliver supplies, toys, and clothes
• Interacted with hospital patients and staff

Volunteer Representative (10/27/2004 – 01/03/2007)
The Church of Jesus Christ of Latter-day Saints; Montreal, Canada
• Rendered welfare service and taught principles of faith and responsibility to several hundred individuals
• Managed the activities of 20 representatives and cultivated language, cultural, and teaching skills

Research Experience

Mentored Group Research Project (In Progress)
Student Investigator
• The Effects of a Progressive Exercise Program on Functional Activity and Quality of Life For Older Overweight Women With Knee Osteoarthritis

Supplemental Education Experience

Nevada Chapter Meeting
• Introduction to Electrodiagnostics (9/13/2011)
• Fall Risk Assessment & Fall Prevention for Older Nevadans (9/11/2012)

Lou Ruvo Center for Brain Health Medical Education Conference
• Advances in Neurological Therapeutics (9/29/2012)

Combined Sections Meeting
• San Diego California (1/21-24/2013)

Awards/Certificates and Memberships

• Licensed by the State Board of Physical Therapy Examiners; State of Utah (Expected May, 2014)
• Award UNLV PT Scholarship Spring 2012 and Fall 2013
• Member of APTA and NV Chapter since 2011
• Certified in CPR and First Aid
• Certificate for completion of HIPAA training course
• Scholar, Leader, Athlete Award, National Football Foundation (2004)
• Fluent in French
Curriculum Vitae

Devin Edvalson, SPT

Education

University of Nevada Las Vegas - Las Vegas, NV
Degree: Doctorate of Physical Therapy – Pending: May 2014

Brigham Young University - Provo, UT
Degree: Bachelor of Science in Exercise Science – April 2011

Utah Valley University - Orem, UT
Degree: Associate of Science – April 2008

Professional Experience

Clinical Internships

Elevate Fitness and Rehab, Orem, UT
January 2014 – March 2014
• Outpatient orthopedic physical therapy
  o Evaluated and treated patients with a wide variety of orthopedic conditions including joint replacements, ACL repairs, ankle sprains, rotator cuff dysfunction, low back pain, and many others.
  o Provided excellent care while working with a clinical instructor with emphasis in exercise and manual therapy to achieve patient centered goals.
  o Accurately documented patient treatment and progress utilizing appropriate outcome measures.
  o Supervised aides with patient care.
  o Developed treatment care plans
  o Learned proper technique and gained experience using Graston tools for inflammatory conditions such as tendonitis and plantar fasciitis.
  o Collaborated with/mentored another DPT student in clinical internship
  o Interacted with personal trainers, triathlon coaches, chiropractors and health coaches.

Intermountain-Utah Valley Reg Med Ctr Rehab, Provo, UT
October 2013 – December 2013
• Rehabilitation physical therapy
  o Provided physical therapy services for patients with musculoskeletal and complex neurologic conditions including CVA, SCI, and TBI.
  o Assisted in the development and execution of appropriate treatments to facilitate functional recovery and motor learning.
  o Worked in a collaborative effort with other health care professionals to provide the best patient care possible. This included participating in weekly interdisciplinary meetings with physicians, nurses, occupational and speech therapists to provide the most complete and appropriate patient care.
  o Collected outcome measures to evaluate the effectiveness of treatments.
George E. Wahlen  
Department of Veterans Affairs Med Ctr, SLC, UT  
July 2013 – September 2013

- **Inpatient Acute Care physical therapy**
  - Provided physical therapy services to veterans in a specialized acute care hospital.
  - Participated in evaluation and discharge planning for a wide variety of patients including general medicine, cardiac complications, neurologic disorders, post-surgical orthopedic patients, and those in various intensive care units.
  - Evaluated and treated wounds while educating patients in appropriate self care. Learned and developed basic skills in the use of total contact casting for patients with diabetic foot ulcers.

C.O.R.E. Physical Therapy, Henderson, NV  
June 2012 – July 2012

- **Outpatient Orthopedic physical therapy**
  - Evaluated and treated patients with numerous musculoskeletal pathologies.
  - Administered treatment involving modalities, therapeutic exercise, and manual therapy.
  - Provided patient education and instruction in home exercise programs.

Research Experience

**Mentored Group Research Project**  
**In Progress**

- **Student Investigator**
  - The Effects of a Progressive Exercise Program on Functional Activity and Quality of Life for Older Overweight Women with Knee Osteoarthritis

Professional Memberships/Certification

- **APTA Member since 2011**
  - Sports and Orthopaedic sections
- **Health Care Provider CPR and AED Certification since 2012**
  - American Heart Association
  - Expires April 2014

Continuing Education

- CSM 2013 – San Diego, CA
- Neuroscience Education Pain Seminar- Adriaan Louw PT, PhD, GCRM, CSMT
- Attended several NPTA continuing education meetings

References

- Available upon request
Curriculum Vitae

Tyler Carlson, SPT

Education

University of Arizona; Tucson, AZ (May 2010)

Degree: Bachelor of Physiology, Minor: Chemistry, Psychology

University of Nevada Las Vegas; Las Vegas, NV (Pending: May 17th, 2014)

Degree: Doctorate of Physical Therapy GPA 3.9

Experience

Clinical Internship

Maricopa Medical Center, Phoenix, AZ (January 2014 – March 2014)

- Acute Inpatient Physical Therapy
  - Evaluated and treated patients in a variety of wards including ICUs, Pediatrics, and Burn
  - Determined functional capacity of various cases with regard to appropriate discharge location

HealthSouth Valley of the Sun, Glendale, AZ (October 2013 – December 2013)

- Inpatient Rehabilitation Physical Therapy
  - Incorporated evidence based rehabilitative therapy techniques to a wide variety of orthopedic and neurologic patients
  - In conjunction with clinical instructor evaluated, developed plan of care, and treated patients with various conditions

Physiotherapy Associates, Chandler, AZ (July 2013 – September 2013)

- Orthopedic Outpatient Physical Therapy
  - Evaluated and treated patients with various simple and complex orthopedic musculoskeletal and neuromuscular conditions
  - Developed comprehensive plans of care to facilitate extremely high functioning athletes return to sport safely

Willmore Wellness Center, Bullhead City, AZ (June 2012 – July 2012)

- Orthopedic Outpatient Physical Therapy
  - Evaluated and developed plans of care for various orthopedic and neuromuscular conditions
  - Designed treatment plans with the use of manual techniques, therapeutic exercise, and modalities to reduce impairments and increase function

Physical Therapy Technician


- Orthopedic Outpatient Physical Therapy
  - Assisted physical therapy staff in administration of treatments and plan of care
  - Managed work environment to provide quality experience to patients

Research Experience

Mentored Group Research Project

- Student Investigator

In Progress
The Effects of a Progressive Exercise Program on Functional Activity and Quality of Life for Older Overweight Women with Knee Osteoarthritis

Positions and Awards

School of Allied Health Graduate Assistant
- Discussion Section Instructor
  - Led discussion sections for a freshmen level course introducing students to critical appraisal of research articles

Scholarships
- UNLVPT Department Scholarship (Spring 2012, Fall 2013)
  - Selected for academic merit and demonstration of UNLVPT generic abilities

Professional Licenses/Memberships/Certification
- AZPTA License: Application pending NPTE scheduled April 30th, 2014, all other requirements met
- APTA Member since 2012
  - Research section and Sports section
- Health Care Provider CPR and AED Certification since 2012
  - American Heart Association

Continuing Education
- CSM 2013 – San Diego, CA
- Neuroscience Education Pain Seminar- Adriaan Louw PT, PhD, GCRM, CSMT
- Attended several NPTA continuing education meetings
Curriculum Vitae

Brad Robison, SPT

Education

University of Nevada Las Vegas; Las Vegas, NV (May 2011)
Degree: Bachelor of Science in Kinesiological Science

University of Nevada Las Vegas; Las Vegas, NV (Pending: May 2014)
Degree: Doctorate of Physical Therapy

Experience

Clinical Internship

Fit Physical Therapy, Mesquite, NV (December 2013 – February 2014)
- Orthopaedic Outpatient Physical Therapy
  - Evaluated, treated and managed patients with a variety of conditions and injuries
  - Organized and participated in community education events
  - Accurately documented patient treatment and progress
  - Implemented therapeutic and home exercise plans for a variety of pathologies

Mesa View Physical Therapy, Mesquite, NV (September 2013 – November 2013)
- Orthopaedic Outpatient, Home Health, Rehab, and Skilled Nursing
  - Evaluated, treated and managed patients with a wide variety of conditions and injuries through different phases of rehab.
  - Provided specialized care including hand therapy and aquatic therapy
  - Participated in multi-disciplinary patient care for diverse patient populations

Mountain View Hospital, Las Vegas, NV (July 2013 – September 2013)
- Inpatient Acute Care Physical Therapy
  - Managed care of patients in the intensive care unit, inpatient care, and provided specialized wound care.
  - Designed rehab programs for medically complex patients and worked with occupational, speech and respiratory therapists as well as nursing in total patient care
  - Worked with case managers to direct patient referrals to appropriate care facilities

Southern Utah Physical Therapy and Rehab, Cedar City, UT (June 2012 – July 2012)
- Orthopaedic Outpatient Physical Therapy
  - Evaluation and treatment of patients with a variety of injuries including primary access patients and post-op or physician referred patients
  - Documentation and billing for all treatments provided
  - Observed and shadowed a referring orthopaedic surgeon including observing a variety of orthopaedic surgeries

Physical Therapy Tech
Healthsouth Rehab Hospital, Las Vegas, NV (Nov 2010- June 2011)
- **Acute Rehab Physical Therapy**
  - Transferred patients to and from therapy gym
  - Assisted with PT interventions and guarding patients
  - Led group therapy sessions and group activities
  - Collected and submitted PT charges and organized patients charts

**Research Experience**

**Mentored Group Research Project**
- Student Investigator
  - The Effect of a Progressive Exercise Program on Functional Activity and Quality of Life for Older Overweight Women with Knee Osteoarthritis

**Scholarships**
- Nevada WICHE Scholarship for Physical Therapy (2011-2014)
- UNLV Department of Physical Therapy (Fall 2013)

**Professional Memberships/Certifications/Skills**
- Licensed by the State Board of Physical Therapy Examiners, State of Nevada
  - Expected May 2014
- APTA and NPTA Member since 2011
  - Research section and Orthopaedic section
- Health Care Provider CPR and AED Certification since 2007
  - American Heart Association
- Oral and Written Fluency in Spanish
  - Volunteer service missionary for the Church of Jesus Christ of Latter Day Saints (2004-2006)