An Analysis of Discrete Biomechanical Loading Outcomes and Steps per Day in Knee Osteoarthritis Patients

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BACKGROUND

• Symptomatic knee osteoarthritis (OA) affects 14 million individuals in the United States alone.

• Individuals with knee OA often exhibit irregular gait biomechanics and specifically display altered loading patterns.

• Vertical ground reaction force (vGRF) can be used as a measure of force exerted on the lower extremity in the vertical direction.

• External knee adduction moment (KAM) is a measure of compartmental loading, and individuals with knee OA often exhibit greater external KAM values indicating greater degree of medial compartment loading in comparison to healthy controls.

• Both excessive loading and underloading have been associated with cartilage breakdown suggesting an optimal loading magnitude may exist.

• A 6000 step per day cut-off has been previously recognized as a preventative measure against functional limitation.

• It is unknown whether individuals with differing activity levels exhibit differences in biomechanical peak loading outcomes.

PURPOSE

Purpose: To compare peak values of vertical ground reaction force and external knee adduction moment between individuals with knee OA who met or did not meet 6000 steps per day.

Hypothesis 1: We hypothesized that both vGRF peak 1 and peak 2 will be higher in individuals who meet the 6000 steps per day in comparison to those who do not meet the step threshold.

Hypothesis 2: We hypothesized that peak KAM values will be lower in individuals who meet the 6000 steps per day in comparison to those who do not meet the step threshold.

METHODS

• Subjects were instructed to wear a GAIT Link Actigraphy activity monitor for 7 days, where daily step values were averaged across the wear period.

• We utilized cutpoints from The National Health and Nutrition Examination Survey (vigorous activity ≥ 9999, moderate activity ≥ 200-5998, light activity ≥ 100-200 counts/minute).

• We defined individuals having a functional limitation as those accumulating less than 6000 steps per day.

• Between group comparisons were conducted using t-tests for vGRF peak 1, vGRF peak 2, and peak KAM. Hedge’s g effect sizes were calculated (.20 = small, .50 = medium, .80 = large).

RESULTS

Table 1. Demographic Characteristics of Participants N=19 (Mean ± SD)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Steps Met n=9</th>
<th>Steps Not Met n=11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>64.82 ± 8.83</td>
<td>59.63 ± 8.62</td>
</tr>
<tr>
<td>BMI</td>
<td>28.93 ± 4.15</td>
<td>29.02 ± 2.75</td>
</tr>
<tr>
<td>Average Gait Speed (m/s)</td>
<td>1.24 ± 0.18</td>
<td>1.34 ± 0.23</td>
</tr>
<tr>
<td>Womac Pain</td>
<td>7.09 ± 3.14</td>
<td>7.38 ± 1.51</td>
</tr>
<tr>
<td>Womac Stiffness</td>
<td>3.73 ± 1.10</td>
<td>4.13 ± 1.36</td>
</tr>
<tr>
<td>Womac Function</td>
<td>27.36 ± 9.35</td>
<td>27.88 ± 7.74</td>
</tr>
<tr>
<td>Average Daily Steps</td>
<td>7736.17 ± 1543.70</td>
<td>4055.54 ± 902.77</td>
</tr>
</tbody>
</table>

Table 2. Between Group Differences for Peak Biomechanical Outcomes

<table>
<thead>
<tr>
<th>Steps Met</th>
<th>Steps Not Met</th>
<th>p</th>
<th>Hedge's g</th>
</tr>
</thead>
<tbody>
<tr>
<td>vGRF Peak 1</td>
<td>1.046±.0909</td>
<td>1.058±.0839</td>
<td>0.2462</td>
</tr>
<tr>
<td>vGRF Peak 2</td>
<td>1.004±.0821</td>
<td>1.034±.1001</td>
<td>0.4735</td>
</tr>
<tr>
<td>Peak KAM</td>
<td>0.028±.0155</td>
<td>0.029±.00814</td>
<td>0.9692</td>
</tr>
</tbody>
</table>

8 individuals were classified as meeting the step goal and 11 did not (Table 1).

REFERENCES

1. Arthritis Foundation. 2019; v3; 4100.17.10445
7. White, D. K. et al. (2014). Arthritis Care & Research, 66(9), 1328-1336
8. Ellis PD. Cambridge University Press; 2010