How Accurate Are Wearable Activity Trackers For Measuring Steps?

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HOW ACCURATE ARE WEARABLE ACTIVITY TRACKERS FOR MEASURING STEPS?

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ABSTRACT

Wearable activity trackers have become popular for tracking individuals’ daily physical activity, but little or no information is available to substantiate the validity of these devices in step counts. PURPOSE: The purpose of this study was to systematically examine the validity of newly developed wearable activity trackers for measuring steps compared to the criterion measure (hand tally) in two different conditions. METHODS: Twenty (28.2±4.8 years) healthy males (n=19) and females (n=17) participated in the study. The participants were fitted with eight wearable activity trackers while walking and running on a treadmill (speeds of 2.5, 3, 3.5, 4, and 5 mph) for 3 minutes at each speed. For overground protocol, participants walked at three self-determined speeds; gradually becoming faster (slow, normal, and fast) for one lap on an indoor track (200 meter track). The number of actual steps taken was manually tallied by researchers using a hand-tally counter. The monitors included the Basis B1 band (BB), Misfit Shine (MS), Polar Loop (PL), and Jawbone UP (UP) worn on the right wrist; the Nike+FuelBand (NF), Garmin VivoFit (GV), and Fitbit Flex (FF) worn on the left wrist; and Withings Pulse (WP) and Fitbit Zip (FZ) worn with a clip on the waist.

RESULTS

PROCEDURES:

• The participants were fitted with eight wearable activity trackers while walking and running on a treadmill (speeds of 2.5, 3, 3.5, 4, and 5 mph) for 3 minutes at each speed.
• For overground protocol, participants walked at three self-determined speeds; gradually becoming faster (slow, normal, and fast) for one lap on an indoor track (200 meter track).
• The number of actual steps taken was manually tallied by researchers using a hand-tally counter.

Data Analyses

• The Mean step scores were calculated for each treadmill walking speed and overground walking speed for all eight pedometers.
• The scores were tested using one-sample t-tests and Bonferroni corrections for multiple comparisons.
• The Mean Absolute Percent Error (MAPE) were calculated to determine accuracy of each device.
• Correlations were be than calculated for each monitors steps recorded and the actual steps counted.
• Bland-Altman plots were used to distinguish similarities between the different measures of steps.

RESULTS (Cont.)

Figure 1. Mean absolute percentage error (± SD) for all monitors with total steps (n = 38).

Figure 2. Results from 95% equivalence testing for agreement in total steps between observed steps and all monitors.

• ANOVA and Post hoc analyses with Bonferroni revealed the MS, WP, FZ, UP, GV, and BB were the devices to give non-significant differences (p > .05) compared to the manual step counts, but significant differences were found with NF, PL, and FF. CONCLUSION: The data demonstrate that the wrist-oriented trackers, FZ and WP, show the most accuracy in measuring steps. However, promising preliminary findings were observed with the wrist-oriented trackers, BB, UP, and GV.

INTRODUCTION

• Wearable activity trackers have become popular for tracking individuals’ daily physical activity, but little or no information is available to substantiate the validity of these devices in step counts.

METHODS

Participants

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Male</th>
<th>Range</th>
<th>Female</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.4 ± 16.6</td>
<td>21.0 - 60.6</td>
<td>26.7 ± 6.9</td>
<td>18.0 - 35.0</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td>177.4 ± 5.9</td>
<td>163.8 - 186.7</td>
<td>156.4 ± 6.5</td>
<td>147.6 - 177.8</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>76.9 ± 12.1</td>
<td>57.0 - 103.9</td>
<td>65.3 ± 7.7</td>
<td>46.0 - 75.3</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.3 ± 2.9</td>
<td>23.0 - 30.9</td>
<td>22.3 ± 2.6</td>
<td>17.0 - 26.4</td>
</tr>
</tbody>
</table>

• Twenty (28.2±4.8 years) healthy males (n=19) and females (n=17) participated in the study.

METHODS (Cont.)

Instruments

• The monitors included the Basis B1 band (BB), Misfit Shine (MS), Polar Loop (PL), and Jawbone UP (UP) worn on the right wrist; the Nike+FuelBand (NF), Garmin VivoFit (GV), and Fitbit Flex (FF) worn on the left wrist; and Withings Pulse (WP) and Fitbit Zip (FZ) worn with a clip on the waist.

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