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Validity of wearable fitness trackers on sleep measure

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Validity of wearable fitness trackers on sleep measure

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ABSTRACT

We compiled a database of fitness trackers to evaluate their accuracy in measuring sleep. Our study compared the Actigraph GT3X, SenseWear Armband SW, Basis Peak (BP), Fitbit Charge HR (FB), Jawbone UP3 (JU), and Garmin Vivosmart (GV) for estimating sleep variables as compared with a sleep diary. METHODS: 78 healthy individuals participated in the study. Group 1 (n = 38) wore the AG, SW, BP, and FB or Group 2 (n = 40) wore the AG, JU, and GV. Monitors were worn for 3 nights and a sleep log was completed. Sleep variables were total sleep time (TST), time in bed (TIB), sleep efficiency (SE), and wake after sleep onset (WASO). RESULTS: Overall, monitors showed strong correlation with the diaries; all devices were better at measuring TST and TIB, SE, and WASO. Measures of equivalence confirmed the success of the devices in measuring TST and TIB. CONCLUSION: The devices can be used to measure TST and TIB, SE, and WASO. Further research is needed to validate these monitors with polysomnography.

METHODS, cont.

Purposes
- To evaluate the accuracy of fitness trackers in measuring sleep variables
- To determine the effectiveness of different fitness trackers in estimating sleep

Participants
- Participants were healthy adults with no sleep disorders
- Participants were instructed on how to wear their respective activity monitors

Procedures
- Participants were provided with instruction manuals and were encouraged to use the devices
- Participants were monitored for 3 nights with a sleep log

Inspection
- Sleep variables were compared with the diary
- Pearson correlation was used to determine the correlation between the devices and the diary
- Measures of equivalence were used to confirm the success of the devices

RESULTS

The results showed strong correlation between the devices and the diary for all sleep variables. The devices were better at measuring TST and TIB, SE, and WASO. Measures of equivalence confirmed the success of the devices in measuring TST and TIB. CONCLUSION: The devices can be used to measure TST and TIB, SE, and WASO. Further research is needed to validate these monitors with polysomnography.

RESULTS (Cont.)

Table 2. Mean Values for Sleep Variables (Minutes)

<table>
<thead>
<tr>
<th>Variable</th>
<th>TST</th>
<th>TIB</th>
<th>SE (%)</th>
<th>WASO</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG</td>
<td>195</td>
<td>439</td>
<td>± 54.6</td>
<td>492.4</td>
</tr>
<tr>
<td>SW</td>
<td>99</td>
<td>403</td>
<td>± 70.6</td>
<td>482.8</td>
</tr>
<tr>
<td>BP</td>
<td>98</td>
<td>417</td>
<td>± 73.1</td>
<td>449.7</td>
</tr>
<tr>
<td>GV</td>
<td>93</td>
<td>388</td>
<td>± 116.9</td>
<td>417.2</td>
</tr>
</tbody>
</table>

Table 3. Correlation Matrix and Effect Size: Total Sleep Time

<table>
<thead>
<tr>
<th>Basis Peak</th>
<th>Fitbit Charge HR</th>
<th>Actigraph (Sadeh)</th>
<th>Actigraph (Cole-Kripke)</th>
<th>Garmin Vivosmart</th>
<th>Jawbone UP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SenseWear Mini</td>
<td>0.57**</td>
<td>0.59**</td>
<td>0.28**</td>
<td>0.27**</td>
<td>0.41**</td>
</tr>
<tr>
<td>ACTigraph</td>
<td>0.39</td>
<td>0.23</td>
<td>0.54</td>
<td>1.23</td>
<td>0.79</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

CONCLUSION

- The devices can be used to measure TST and TIB, SE, and WASO
- Further research is needed to validate these monitors with polysomnography
- More research is needed to explore the differences between the devices in measuring sleep variables

Table 4. Proportion Matrix and Effect Size: Time in Bed

<table>
<thead>
<tr>
<th>Basis Peak</th>
<th>Fitbit Charge HR</th>
<th>Actigraph (Sadeh)</th>
<th>Actigraph (Cole-Kripke)</th>
<th>Garmin Vivosmart</th>
<th>Jawbone UP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SenseWear Mini</td>
<td>0.66**</td>
<td>0.85**</td>
<td>0.56**</td>
<td>0.32**</td>
<td>0.29**</td>
</tr>
<tr>
<td>ACTigraph</td>
<td>0.09</td>
<td>0.42</td>
<td>0.74</td>
<td>1.22</td>
<td>0.69</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).