Validation of the Physical Activity Scale for Individuals With Physical Disabilities

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Objective: To determine the criterion validity of the Physical Activity Scale for Individuals With Physical Disabilities (PASIPD) by means of daily physical activity levels measured by using a validated accelerometry-based activity monitor in a large group of persons with a physical disability.

Design: Cross-sectional.

Setting: Participants’ home environment.

Participants: Ambulatory and nonambulatory persons with cerebral palsy, meningo(myelo)cele, or spinal cord injury (N=124).

Interventions: Not applicable.

Main Outcome Measures: Self-reported physical activity level measured by using the PASIPD, a 2-day recall questionnaire, was correlated to objectively measured physical activity level measured by using a validated accelerometry-based activity monitor.

Results: Significant Spearman correlation coefficients between the PASIPD and activity monitor outcome measures ranged from .22 to .37. The PASIPD overestimated the duration of physical activity measured by using the activity monitor (mean ± SD, 3.9±2.9 vs 1.5±0.9h/d; P<.01). Significant correlation (p = −.74; P<.01) was found between average number of hours of physical activity per day measured by using the 2 methods and difference in hours between methods. This indicates larger overestimation for persons with higher activity levels.

Conclusions: The PASIPD correlated poorly with objective measurements using an accelerometry-based activity monitor in people with a physical disability. However, similar low correlations between objective and subjective activity measurements have been found in the general population. Users of the PASIPD should be cautious about overestimating physical activity levels.

Key Words: Activities of daily living; Cerebral palsy; Meningomyelocele; Rehabilitation; Spinal cord injuries.

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There is increasing interest in the effects of an inactive lifestyle on health. Previous studies in the general population showed an inverse relationship between daily physical activity level and risk for such secondary health problems as coronary heart disease, diabetes, and overweight or obesity.1 Persons with a physical disability often are restricted in their performance of daily physical activities and are more at risk for developing inactive lifestyles compared with the general population. Over time, inactivity may lead to decreased physical capacity and increased body fat, which in turn may lead to further inactivity.2,4 Furthermore, inactive lifestyles may lead to impaired everyday functioning, decreased social participation, and decreased quality of life.1,4

Previous research has focused on instruments to assess daily physical activity in persons with a physical disability. For example, an activity monitor with body-fixed accelerometers has been used to assess body postures and physical activities in persons with bilateral spastic cerebral palsy (CP), meningo(myelo)cele (MMC), and spinal cord injuries (SCIs). These studies showed subnormal daily physical activity levels.5,8 Although the activity monitor provides objective, detailed, and valid data for daily physical activity for ambulatory and wheelchair-dependent persons9,14 and is able to detect differences in daily physical activity levels between groups,2,7 measurements are time consuming and relatively expensive. Therefore, the activity monitor is less useful in large population studies and alternatives are needed.

The Physical Activity Scale for Individuals With Physical Disabilities (PASIPD) is a 7-day physical activity recall questionnaire designed to evaluate physical activity levels in persons with physical disabilities.15 The PASIPD is based on the Physical Activity Scale for the Elderly, which has shown validity in classifying healthy elderly people by level of daily physical activity.16-19

To our knowledge, 3 studies assessed the criterion validity of the PASIPD. van der Ploeg et al20 found weak nonsignificant correlations between the PASIPD and accelerometry-based systems (RT2 and Actigraph, respectively) in ambulatory per-
sons with neurologic disorders, orthopedic disorders, or chronic pain. They concluded that the PASIPD is valid because its criterion validity is similar to well-established self-report physical activity questionnaires from the general population. However, their study had limitations concerning the validity of their criterion and the lack of wheelchair-dependent persons in their study sample. Moreover, their study sample was limited to 45 persons.

Warms et al compared the PASIPD and Actiwatch (wrist-worn actigraph) in adult wheelchair users. They found a weak and nonsignificant correlation between instruments. However, the validity of the Actiwatch, particularly in wheelchair-dependent persons, may be insufficient. Furthermore, their study sample was limited to 50 persons.

Recently, de Groot et al evaluated the validity of the PASIPD in a large sample (n = 139) of ambulatory and wheelchair-dependent persons with SCI using an activity list. In this study, moderate correlations were found between PASIPD score and the activity list. However, no objective activity measure for total daily physical activity was used as a criterion, and validity was assessed in only persons with SCI.

The aim of this study was to determine the criterion validity of the PASIPD by using daily physical activity levels measured with a validated accelerometer-based activity monitor in a large group of persons with a physical disability, including wheelchair-dependent persons.

METHODS

Participants
A total of 124 subjects participated in this study, including 51 (41%) wheelchair-dependent persons. Participants were aged 16 to 65 years and had a diagnosis of spastic bilateral CP (n = 56), MMC (n = 47), or SCI (n = 21) (Table 1). Participants were identified from 3 studies focusing on daily physical activity. We used the Dutch version of the PASIPD, which integrates lawn work and outdoor gardening into 1 item about gardening. Respondents were asked to recall the number of days during the past 7 days that they participated in the mentioned activities and how many hours on average were spent on those activities.

**Table 1: Descriptive Characteristics of Study Sample**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total</th>
<th>CP</th>
<th>MMC</th>
<th>SCI</th>
</tr>
</thead>
<tbody>
<tr>
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<td>56</td>
<td>47</td>
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</tr>
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<td>Sex</td>
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</tr>
<tr>
<td>Men</td>
<td>72</td>
<td>35</td>
<td>23</td>
<td>14</td>
</tr>
<tr>
<td>Women</td>
<td>52</td>
<td>21</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>Mean age (y)</td>
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<td>36.3±5.8</td>
<td>20.9±4.6</td>
<td>40.7±14.3</td>
</tr>
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<td>6</td>
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<td>1</td>
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<tr>
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<td>54</td>
<td>40</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>12</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>31</td>
<td>0</td>
<td>26</td>
<td>5</td>
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<tr>
<td>4</td>
<td>20</td>
<td>4</td>
<td>0</td>
<td>16</td>
</tr>
</tbody>
</table>

*Ambulatory status was determined according to the classification of Hoffer et al: (1) community ambulator, walking indoors and outdoors; (2) household ambulator, walking indoors only; (3) nonfunctional ambulator, walking during therapy sessions only; and (4) nonambulator, being completely wheelchair dependent.

evaluated maximal exercise tests for other purposes; (3) inability to understand instructions given during the study; (4) complete dependence on an electric wheelchair; or (5) for persons with SCI, the presence of progressive disease. Age limits were 25 to 45 years for those with CP, 16 to 30 years for those with MMC, and 18 to 65 years for those with SCIs.

We obtained written informed consent from all study participants. The medical ethics committee of Erasmus Medical Center approved the study.

**Instruments**

**Physical Activity Scale for Individuals with Physical Disabilities.** The PASIPD is a 13-item 7-day recall questionnaire that solicits information about leisure activities performed for purposes other than exercise (including walking and wheeling outside the home); light, moderate, and strenuous sports and recreation; exercise to increase muscle strength and endurance; light and heavy household activity; home repair; lawn work; outdoor gardening; caring for another person; and occupational activity. We used the Dutch version of the PASIPD, which integrates lawn work and outdoor gardening into 1 item about gardening. Respondents were asked to recall the number of days during the past 7 days that they participated in the mentioned activities and how many hours on average were spent on those activities.

**Activity monitor.** We used an activity monitor as criterion (fig 1), an instrument that uses long-term (>24h) ambulatory accelerometry to measure body postures and physical activities. For the measurement, a small portable data recorder was worn on a belt around the waist and connected to 4 accelerometers that were fixed at the upper legs and trunk. In wheelchair-dependent subjects, an additional sensor was attached to each wrist. Accelerometer signals were stored digitally on a Personal Computer Memory Card International Classification flash card with a sampling frequency of 32Hz. Accelerometer signals were used to detect duration, rate, and moment of occurrence of body postures and physical activities and transitions between postures. Measured body postures include lying, sitting, and standing. Measured physical activities include walking (including running and climbing stairs), cycling, wheelchair driving (including handcycling), and general noncyclic movement. Furthermore, sensors allowed for detec-
Statistical Analysis

Statistical analysis was performed using SPSS. Level of significance was set at \( P < 0.05 \). Nonparametric tests were used because data were skewed.

Validity of the PASIPD was assessed by calculating Spearman correlation coefficients between outcome measures of the PASIPD and the activity monitor. We chose a correlation coefficient of .50 or greater between PASIPD and activity monitor outcomes as a cutoff for PASIPD validity to quantify daily physical activity levels. We chose this moderate threshold level because the PASIPD and activity monitor measure the same construct: physical activity level, defined as "any bodily movement produced by skeletal muscles that results in energy expenditure." However, there are some differences between the PASIPD and activity monitor. The first difference is that the PASIPD measures activity over a 7-day period (including weekend days), whereas the activity monitor measures activity over 2 randomly selected consecutive weekdays. Second, there are some differences in physical activity definitions between the activity monitor and PASIPD. For example, fishing or dishwashing are detected as postures by the activity monitor, but as physical activities by the PASIPD. This discrepancy in definitions possibly affects the relationship between PASIPD duration and activity monitor duration.

For the relationship between PASIPD outcomes and activity monitor duration, we calculated Spearman correlation coefficients for the total group \( (N = 124) \) and each patient group \( (CP, n = 56; MMC, n = 47; SCI, n = 21) \). For the relationship with activity monitor intensity, Spearman correlation coefficients were calculated separately for ambulatory and nonambulatory participants because motility values for ambulatory and nonambulatory persons cannot be compared directly.

In addition, we compared PASIPD duration with activity monitor duration by using Wilcoxon signed rank test and made a Bland-Altman plot using these measures. Moreover, the relationship (Spearman correlation) between number of hours per day spent on physical activities (assessed as the average of PASIPD duration and activity monitor duration) and difference in number of hours between methods was determined.

RESULTS

PASIPD intensity scores were \( 11.3 \pm 9.1 \) MET-hours per day for the total group, \( 11.8 \pm 9.1 \) MET-hours per day for subjects with CP, \( 10.8 \pm 7.6 \) MET-hours per day for subjects with MMC, \( 10.9 \pm 12.0 \) MET-hours per day for subjects with SCI, \( 11.3 \pm 8.6 \) MET-hours per day for ambulatory subjects, and \( 11.1 \pm 9.8 \) MET-hours per day for nonambulatory subjects.

Table 2 lists correlation coefficients for PASIPD outcome measures and activity monitor duration. Spearman correlations ranged from \( 0.10 \) to \( 0.37 \). The highest correlation coefficients were found in persons with CP \( (0.37, 0.33) \). The CP patient group and total group had the only statistically significant \( (P = 0.01) \) correlations. Correlation coefficients between PASIPD outcome measures and activity monitor intensity are listed in Table 3. Spearman correlations ranged from \( 0.19 \) to \( 0.24 \). Only the correlation coefficient between PASIPD intensity and activity monitor intensity in ambulatory persons was statistically significant \( (r = 0.23; P = 0.047) \).

Overall, the PASIPD showed significantly longer durations of physical activity than the activity monitor. For the total
group, PASIPD duration was 3.9 ± 2.9 hours per day compared with activity monitor duration of 1.5 ± 0.9 hours per day (P < .01). This difference also was shown for each patient group: CP, 3.8 ± 2.9 hours PASIPD versus 1.9 ± 0.9 hours activity monitor (P < .0001); MMC, 4.1 ± 2.8 hours PASIPD versus 1.3 ± 0.8 hours activity monitor (P < .01); and SCI, 3.5 ± 3.4 hours PASIPD versus 0.8 ± 0.5 hours activity monitor (P < .01). A significant correlation (r = −.74; P < .01) was found between average number of hours of physical activity per day (measured by using the PASIPD and activity monitor) and difference in hours between both methods (fig 2).

**DISCUSSION**

In this study, an extensively validated activity monitor was used to assess the criterion validity of the PASIPD for measuring daily physical activity levels. The study assessed subjects with various physical disabilities (CP, MMC, SCI), and varying ambulation and educational levels. Therefore, we believe our results contribute to understanding the validity of the PASIPD for quantification of daily physical activity in persons with a physical disability.

Study results did not support the criterion validity of the PASIPD. Correlation coefficients between PASIPD and activity monitor outcome measures suggested poor validity for the total group and patient subgroups.

This finding of low correlations between PASIPD and activity monitor is consistent with previous studies of people with a disability. However, similar correlation coefficients were found in validity studies of questionnaires in the general public population, including the International Physical Activity Questionnaire and Stanford 7-Day Recall (correlation coefficient range, .18–.35). For practical or financial reasons, it is not always possible to use an activity monitor device to assess physical activity level. However, users of the PASIPD should be cautious about overestimating physical activity levels.

Correlation coefficients were higher in the subgroup of patients with CP (.33–.37) compared with other patient groups. However, the .50 threshold was not reached, indicating poor validity. The higher correlation coefficients in persons with CP may be explained by the higher educational level of this subgroup. Higher educational levels may favor improved recall for completing questionnaires, such as the PASIPD.

Although PASIPD outcome measures commonly are calculated by considering MET values for each activity, we also calculated the sum of average hours per day that persons participated in activities (PASIPD duration) without taking into account the MET values. Compared with the activity monitor, duration of physical activity a day was overestimated by using the PASIPD, particularly for persons with higher physical activity levels (see fig 2). Overestimation of time spent on activities has been shown previously for recall questionnaires. Possible explanations for this overestimation are social desirability (particularly in interview situations) and recall difficulties. Another possible explanation is that some activities assessed by using the PASIPD may be static and not recorded as activity by the activity monitor (e.g., weightlifting, dishwashing, fishing, certain forms of home repair). Also, activity monitor measurements were performed on weekdays, whereas the PASIPD evaluates a 7-day period. It might be hypothesized that subjects are more physically active on week-

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**Table 2: Spearman Correlation Coefficients Between Outcome Measures of the PASIPD and Activity Monitor Duration**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>CP</th>
<th>MMC</th>
<th>SCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity monitor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>duration × PASIPD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ρ</td>
<td>.22</td>
<td>.33</td>
<td>.10</td>
<td>.31</td>
</tr>
<tr>
<td>P</td>
<td>.01*</td>
<td>.01*</td>
<td>.50</td>
<td>.18</td>
</tr>
<tr>
<td>Activity monitor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>duration × PASIPD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ρ</td>
<td>.28</td>
<td>.37</td>
<td>.18</td>
<td>.28</td>
</tr>
<tr>
<td>P</td>
<td>&lt;.01*</td>
<td>&lt;.01*</td>
<td>.24</td>
<td>.22</td>
</tr>
</tbody>
</table>

*Indicates significant correlation.

**Table 3: Spearman Correlation Coefficients Between Outcome Measures of the PASIPD and Activity Monitor Intensity**

<table>
<thead>
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<th>Variable</th>
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<th>Nonambulatory</th>
</tr>
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<tbody>
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<td>n</td>
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<td>51</td>
</tr>
<tr>
<td>Activity monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>intensity × PASIPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ρ</td>
<td>.23</td>
<td>.24</td>
</tr>
<tr>
<td>P</td>
<td>.047*</td>
<td>.09</td>
</tr>
<tr>
<td>Activity monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>intensity × PASIPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ρ</td>
<td>.19</td>
<td>.22</td>
</tr>
<tr>
<td>P</td>
<td>.11</td>
<td>.12</td>
</tr>
</tbody>
</table>

*Indicates significant correlation.

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**Fig 2. Bland-Altman plot comparing average number of hours per day of physical activity assessed by using the PASIPD and activity monitor (x-axis) to the difference between methods (y-axis).** The score on the PASIPD does not include energy expenditure (MET values) for different activities; the score on the activity monitor indicates dynamic activity measured by using an accelerometry-based activity monitor.
ends. However, because the weekend accounts for only 29% of weekly activity, any weekday or weekend differences would explain only part of the overestimation by using the PASIPD.

Study Limitations

Our study has some limitations. First, the SCI group had a gap of up to 1 month between completing the PASIPD and activity monitor measurements; this may have introduced discrepancies in activity levels. However, it did not seem to have much influence on our results because correlation coefficients for the SCI group did not differ from those for the other patient groups. Second, the PASIPD was completed by an interviewer for persons with CP and MMC, whereas subjects with SCI completed their own questionnaires. Because correlation coefficients did not differ among subgroups, we assumed that method of administration did not affect results. According to Washburn et al., the PASIPD is suitable for administration by mail, telephone, or in person. Third, participant reactivity, the way in which persons adapt their behavior when they know they are being observed or studied, may have influenced mail, telephone, or in person. Fourth, we used specific inclusion and exclusion criteria for the method of administration did not affect results. According to Washburn et al., the PASIPD is suitable for administration by mail, telephone, or in person. However, because the weekend accounts for only 29% of weekly activity, any weekday or weekend differences would explain only part of the overestimation by using the PASIPD. Study Limitations

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CONCLUSIONS

The PASIPD correlated poorly with objective measurements using an accelerometry-based activity monitor in people with a physical disability. However, similar low correlations between objective and subjective activity measurements have been found in the general population. Users of the PASIPD should be cautious of overestimating physical activity levels.

References

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Suppliers

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