Assessment of Walking Activity Using a Pedometer and Survey in Adults With Mental Retardation

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This study measured walking activity in 103 adults (65 males, 38 females) with mental retardation (MR) using two instruments. Participants wore a pedometer for seven consecutive days and were administered the NHANES III Physical Activity Survey. The mean weekly step count was 58,321 ± 26,896 and only 21.4% of the participants recorded 10,000 steps/day. There was no association between weekly step counts and walking bouts per week (r = .01) or walking min per week (r = -.01). Only 17.5% of the participants reported engaging in five bouts of MVPA per week totaling 30 min per bout. The percent agreement between participants meeting the recommended 10,000 steps/day and those meeting the recommended 30 min of MVPA five days per week was 68.9%.

Various tools have been used to measure the physical activity levels of individuals with mental retardation (MR), and research consistently shows that engagement in physical activity is limited. Beange, McElduff, and Baker (1995) used a questionnaire to gather information from caregivers on the physical activity habits of adults with MR. The majority of participants (72% of males and 75% of females) reported no physical activity that made them breathe heavily in the previous two weeks. Adults with MR were interviewed and reported on participation in physical activity during a one-week period preceding the interview (Messent, Cooke, & Long, 1998). Half of the participants did not engage in any moderate or vigorous physical activity on a weekly basis and 93% were considered sedentary. Direct observation and accelerometers were used to measure daily energy expenditure and to categorize physical activity levels of six adults with MR (Temple, Anderson, & Walkley, 2000). None of the participants engaged in any activities classified as moderate sport or intense manual work, and much of the day was
spent lying down or sitting. Some participants did accumulate enough moderate intensity physical activity to meet recommended guidelines in Australia. Draheim, Williams, and McCubbin (2002a) examined the prevalence of physical inactivity and recommended physical activity in adults with MR using the National Health and Nutrition Examination Survey III, Physical Activity Survey (NHANES III; National Center for Health Statistics, 1994). They found that 13% of participants performed no leisure time physical activity, while 49% participated in moderate to vigorous leisure time physical activity less than 3 times per week. Less than 46% of the participants achieved current U.S. physical activity recommendations (U.S. Department of Health and Human Services, 1996).

Despite limited participation in physical activity, walking is one of the most commonly reported physical activities by individuals with MR (Draheim et al., 2002a; Temple et al., 2000). Public health initiatives often emphasize walking (Pate et al., 1995; U.S. Department of Health and Human Services, 1996) and the publicized 10,000 steps/day target has received significant attention by researchers (LeMasurier, Sidman, & Corbin, 2003; Wilde, Sidman, & Corbin, 2001; Yamanouchi et al., 1995). Only one published report aimed to measure the accuracy of pedometers and to quantify the walking activity of adults with MR (Stanish, 2004). Results indicated that pedometers are accurate in recording step counts in adults with MR. Male participants accumulated an average of 7,863 steps/day and females accumulated 10,811 steps/day. On average, participants walked more on weekdays compared to weekends.

Since walking appears to be a primary activity in people with MR, it should be targeted in physical activity interventions. However, an initial step is to quantify walking activity using various measurement tools including pedometers and surveys. Since no physical activity assessment tool is known to be truly accurate, there is a strong rationale to employ more than one tool and to compare results. As previously noted, the NHANES III survey has been used to measure the physical activity levels of people with MR (Draheim, Williams, & McCubbin, 2002b; Draheim, Williams, & McCubbin, 2003). Since there was an association between cardiovascular disease risk and physical activity levels, there is some evidence for the accuracy of the survey (Draheim et al., 2002b, 2003; Draheim, McCubbin, & Williams, 2002). It is of interest to determine if a relationship exists among pedometer-determined walking activity and NHANES III survey-determined walking activity and physical activity in adults with MR.

At least two studies have compared step counts to reported walking activity in the nondisabled population. One study compared daily walking distance as measured by a questionnaire and pedometer in adult men and women (Bassett, Cureton, & Ainsworth, 2000). It was found that both men and women underreported their walking distance on the questionnaire compared to the pedometer recordings. The correlation coefficients between the two measurement tools was $r = .346$ (p = .02) for men and $r = .481$ (p = .001) for women. Tudor-Locke (2001) found that a valid and reliable physical activity log was less sensitive than a pedometer for detecting changes in physical activity. Energy expenditure calculated from the activity log did not reflect an increase in physical activity after a one-month walking intervention. Step counts measured by the pedometer increased significantly. There is no comparison of instruments to quantify walking activity in adults with MR in the published literature. Insight into this area is needed prior to the development and assessment of walking interventions.
This study had three purposes: (a) to assess the walking activity of adults with MR using a valid and reliable pedometer and the NHANES III Physical Activity Survey, (b) to interpret the relationship between pedometer-determined walking activity and survey-determined walking activity and overall physical activity, and (c) to determine the most common physical activities reported by adults with MR within the NHANES evaluation.

Method

Participants

One hundred and three adults (38 females, 65 males) with mild and moderate MR (Luckasson et al., 1992), aged 19-65 years (females age, $M = 39.7$, $SD = 9.5$; males age, $M = 35.9$, $SD = 11.2$) participated in the study. Nineteen of the participants had Down syndrome (DS; 9 females, 10 males). All participants were volunteers from Eastern Canada and recruited through organizations and service providers associated with people with MR (e.g., residential services, community workshops, Special Olympics). The organizations and agencies identified interested individuals and forwarded names and contact information to the first author.

Participants signed a simply worded consent form that was read aloud to them if they were unable to read. A caregiver signed the form if a participant was unable to provide their own consent. The consent form and all procedures were approved by a University Ethical Review Board for the Protection of Human Subjects prior to data collection.

Walking Activity Assessment Using Pedometer

Yamax Digiwalkers (SW-500 and SW-700) were used to record step counts. The accuracy of pedometers for recording steps has been repeatedly established (Bassey, Dallosso, Fentem, Irving, & Patrick, 1987; Tryon, Pinto, & Morrison, 1991; Tudor-Locke, 2001; Tudor-Locke, Williams, Reis, & Pluto, 2002; Welk et al., 2000) and evidence supports the Yamax Digiwalker as one of the most accurate models (Bassett et al., 1996). Further, Yamax Digiwalkers have shown to be accurate reliable for counting steps in people with MR (Stanish, 2004).

Depending on the intellectual capacity of the participant, either the participant or a caregiver was instructed how to use the pedometer. In most cases, participants were assisted by caregivers. Pedometers were attached to a belt or waistband and placed approximately in line with the middle of the thigh according to the manufacturer’s instructions. They were asked to reset the pedometer in the morning and to record step counts and distance at the end of the night. Participants were instructed to wear the pedometer from the time that they got up in the morning until bedtime for seven consecutive days, except during swimming or showering. All participants were informed that the pedometer counted steps and were asked not to tamper with the device so as not to inflate step counts or accidentally reset the counter. Caregivers and employment supervisors were asked to discourage tampering whenever possible. The pedometers were worn for one week during the summer months. All data was collected within three months when the weather remained warm.
Walking Activity and Physical Activity Assessment Using Questionnaire

The NHANES III Physical Activity Survey was used to assess the participants’ regular physical activity habits, which included assessing walking activity (National Center for Health Statistics, 1994). A reliability study of 3 women and 9 men with mild to moderate MR (age, $M = 43.3$, $SD = 6.2$) indicated that assessing the total number of physical activity bouts per week and total min of physical activity per week via the NHANES III Physical Activity Survey were highly reliable ($r = .87$ and $r = .89$, respectively). Assessing the total number of walking bouts per week and total min of walking per week via the NHANES III Physical Activity Survey were less reliable ($r = .60$ and $r = .61$, respectively). For the reliability study the NHANES III Physical Activity Survey was given to the 12 participants twice, separated by approximately two weeks. In addition to recording the frequency of participation in physical activities, the average duration of each bout of activity was also recorded. The first author or a research assistant administered the physical activity survey through an interview with the participant and the participant’s direct caregiver who assisted with the questions as needed. All caregivers were close to the participant and directly involved in their day-to-day lives. The interviewer answered any questions posed by participants and caregivers and provided clarification on any points of confusion. Participants were also asked if they participated in Special Olympics programs and if so, how frequently and in what events they participated. The intensity of each activity was estimated by the second author using the Ainsworth Compendium for Physical Activities (Ainsworth et al., 1993). Moderate to vigorous physical activity (MVPA) was defined as a physical activity > 3.5 metabolic equivalents (METS; Crespo, Keteyian, Heath, & Semies, 1996).

Data Analysis

Only participants with seven days of pedometer data were included in the statistical analyses. Since previous research (Draheim et al., 2002) and preliminary analysis on this sample (Stanish & Draheim, 2004) has indicated that weekly steps and physical activity levels between men and women and between persons with and without Down syndrome are similar, all analyses included the total sample. Means and standard deviations were calculated for physical descriptors, dependent variables from the pedometer (steps), and dependent variables from the NHANES III Physical Activity Survey (frequency, duration of walking activity, and other MVPA). The median number of min per bout of each physical activity was also calculated because of the high variability (standard deviations) of the activities.

Pearson Product Moment correlation coefficients were calculated to examine the association between pedometer and survey variables. The prevalence of participants walking 10,000 steps per day (Yamanouchi et al., 1995), participating in MVPA five or more times per week (Pate et al., 1995; U.S. Department of Health and Human Services, 1996), and accumulating 30 min of MVPA five or more days per week (Health Canada, 2002) were also calculated. Percent agreement was calculated among participants that met the following physical activity recommendations: (a) 10,000 steps/day, (b) five or more bouts of MVPA, and (c) 30 min of MVPA five days per week. The most commonly reported physical activities were ranked
according to percentage of sample, frequency (bouts/week), and duration (min/bout). Significance was set at \( p < .05 \) for all statistical comparisons.

**Results**

Table 1 includes physical descriptors of the participants. The frequency and duration of reported walking activity and reported MVPA are presented in Table 2. The mean number of steps walked per week is also presented in Table 2.

There were no significant correlations between pedometer step counts and any of the NHANES survey variables. The correlation coefficients between steps per week and reported walking bouts and reported walking min per week were .01 and −.01, respectively. The correlation coefficients between steps per week and reported MVPA bouts and reported MVPA min per week were .06 and .10, respectively. Of the participants, 21% achieved 10,000 steps per day, 64.1% achieved five bouts of MVPA per week, and 17.5% achieved 30 min of MVPA five or more days per week.

The percent agreement between the participants meeting the recommended 10,000 steps per day and those meeting the recommended five or more bouts of MVPA

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Physical Descriptors of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men ((N = 65))</td>
</tr>
<tr>
<td>Age (years)</td>
<td>35.9 ± 11.2</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168.0 ± 10.6</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>82.0 ± 20.9</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>28.8 ± 6.0</td>
</tr>
</tbody>
</table>

\( M \pm SD \)

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Description of Step Counts, Reported Walking Activity, and Reported MVPA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M )</td>
</tr>
<tr>
<td>Step count</td>
<td></td>
</tr>
<tr>
<td>Total steps per week</td>
<td>54,821</td>
</tr>
<tr>
<td>Reported walking activity</td>
<td></td>
</tr>
<tr>
<td>Bouts per week</td>
<td>5.0</td>
</tr>
<tr>
<td>Min per bout</td>
<td>10.3</td>
</tr>
<tr>
<td>Total min per week</td>
<td>55.4</td>
</tr>
<tr>
<td>Reported MVPA</td>
<td></td>
</tr>
<tr>
<td>Bouts per week</td>
<td>8.9</td>
</tr>
<tr>
<td>Min per bout</td>
<td>26.4</td>
</tr>
<tr>
<td>Total min per week</td>
<td>209.2</td>
</tr>
</tbody>
</table>
per week was 60.9%. The percent agreement between the participants meeting the recommended 10,000 steps per day and those meeting the recommended 30 min of MVPA five or more days per week was 68.9%.

Walking was the most frequently reported physical activity followed by dancing, yard work, swimming, cycling, and bowling. The percent of participants reporting each activity and a description of frequency and duration are presented in Table 3.

### Discussion

Regardless of the instrument used to measure walking activity and overall physical activity, the number of persons with MR who achieved the recommended activity levels was very low. Only 21.4% of the participants accumulated 10,000 steps per day, and only 17.5% of the participants reported at least five bouts of MVPA, totaling 30 min per day. Current recommendations indicate that *every* person should engage in five or more bouts of physical activity per week to lower their risk for coronary heart disease, stroke, and obesity (Pate et al., 1995; U.S. Department of Health and Human Services, 1996). Despite the agreement among instruments in regard to activity levels, there was considerable interindividual variability in step counts and survey results. The sample included participants who lived in various residential settings, were employed by different organizations that required many job tasks, used various modes of transportation, and participated in a variety of activities including Special Olympics. While all of these variables contributed to the high variability in results, the heterogeneous nature of the sample makes it more representative of people with MR in general. Further research should examine the influence of similar variables to physical activity levels in people with MR.

<table>
<thead>
<tr>
<th>Physical Activity</th>
<th>Intensity</th>
<th>Rank</th>
<th>% of all participants</th>
<th>Frequency</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>Low/moderate</td>
<td>1</td>
<td>60.2</td>
<td>4.2 ± 4.1</td>
<td>32.3 ± 17.9 (30)</td>
</tr>
<tr>
<td>Dance</td>
<td>Moderate</td>
<td>2</td>
<td>40.8</td>
<td>1.1 ± 2.7</td>
<td>55.4 ± 52.9 (30)</td>
</tr>
<tr>
<td>Yardwork</td>
<td>Moderate</td>
<td>3</td>
<td>29.1</td>
<td>1.9 ± 4.1</td>
<td>64.3 ± 94.0 (30)</td>
</tr>
<tr>
<td>Swimming</td>
<td>Moderate</td>
<td>4</td>
<td>27.2</td>
<td>1.1 ± 1.4</td>
<td>37.4 ± 26.9 (30)</td>
</tr>
<tr>
<td>Cycling</td>
<td>Moderate</td>
<td>5</td>
<td>26.2</td>
<td>6.3 ± 9.8</td>
<td>27.8 ± 21.4 (20)</td>
</tr>
<tr>
<td>Bowling</td>
<td>Moderate</td>
<td>6</td>
<td>22.3</td>
<td>0.9 ± 0.6</td>
<td>69.4 ± 23.2 (60)</td>
</tr>
<tr>
<td>Calisthetics</td>
<td>Low/moderate</td>
<td>7</td>
<td>14.6</td>
<td>2.3 ± 2.3</td>
<td>26.1 ± 18.9 (15)</td>
</tr>
<tr>
<td>Jogging/Running</td>
<td>Vigorous</td>
<td>8</td>
<td>12.6</td>
<td>3.7 ± 6.2</td>
<td>22.0 ± 14.5 (20)</td>
</tr>
<tr>
<td>Soccer</td>
<td>Vigorous</td>
<td>9</td>
<td>9.7</td>
<td>1.2 ± 1.4</td>
<td>25.0 ± 7.9 (30)</td>
</tr>
<tr>
<td>Aerobics</td>
<td>Moderate</td>
<td>10</td>
<td>4.9</td>
<td>2.2 ± 2.9</td>
<td>14.6 ± 11.4 (11)</td>
</tr>
</tbody>
</table>

*a% of all participants

*bM ± SD of number of bouts per week

*cM ± SD (median) number of min per bout
The lack of association between pedometer-determined walking activity and survey-determined walking bouts and walking min may be explained a few ways. Although it would be expected that walking activity derived from two accurate measurement instruments would be related, previous work has indicated that physical activity data gathered from independent tools are not strongly associated. Both the survey and the pedometer have measurement issues that could have contributed to the nonsignificant relationship among step counts and reported walking frequency and duration. First, it is likely that imprecise reporting of walking activity partly accounts for the lack of relationship (Ainsworth, Leon, Richardson, Jacobs, & Paffenbarger, 1990). Bassett and colleagues (2000) found that both men and women underreported their walking distance on the College Alumnus Questionnaire compared to a pedometer. Tudor-Locke (2001) reported that an activity log did not detect an increase in walking activity that was detected by the pedometer during a walking program.

In the present study, an additional consideration is that a care provider assisted in reporting walking activity for an adult with MR. The accuracy of proxy reports for this population has been examined and results vary. Temple and Walkley (2003) examined the agreement between proxy generated estimates of physical activity and physical activity measured with an accelerometer in adults with MR. There was a significant relationship between energy expenditure measured with a three-day activity record and the accelerometer. While the results support proxy reports, it must be noted that the activity record did not involve recall like in the present study. In contrast, Lunsky and Benson (1999) found that using caregivers as a source of information on the social support system of people with MR may not result in a complete representation of actuality. The lack of relationship between survey-determined walking activity and pedometer-determined walking activity in this study may imply that people with MR and their caregivers are not able to accurately recall and report walking frequency and duration.

A second measurement issue that may have contributed to the lack of association between the survey and pedometer is device tampering. Pedometers are sensitive to interference, and step counts could have been inflated if participants shook the device or displayed repetitive behaviors such as rocking. Third, pedometers are known to be less precise when the participant is walking slowly (Washburn, Chin, & Montoye, 1980) and with gait abnormalities, which may have been the case with some participants in the sample.

The lack of relationship between step counts and bouts of physical activity per week and min of physical activity per week suggests that the survey and the pedometer measured different variables and that values may be difficult to compare. Since walking is only one component of overall physical activity, step counts may be inadequate to reflect habitual physical activity.

The percent agreement among participants who met the recommended guidelines of 10,000 steps per day and 30 min of MVPA was 68.9%. It has been suggested that walking 10,000 steps per day would be adequate to meet the recommended 30 min of moderate physical activity five days per week (Yamanouchi et al., 1995), although pedometers are not able to measure the intensity of physical activity. The lack of agreement in approximately 30% of the sample may suggest two things: (a) the 10,000 steps/day target is not equivalent to meeting the current physical activity recommendation or (b) the reporting of physical activity, including
walking, may not have been accurate. A recent study revealed that accumulating 10,000 steps/day does not assure that the activity guidelines are met (LeMasurier, Sidman, & Corbin, 2003). It is also possible that walking was overlooked in the reporting of physical activity, and the participants and care providers underestimated total number of bouts and min per week. Although walking is the most common form of physical activity, it is often not reported accurately in surveys.

The percent of participants who reported five or more bouts of MVPA per week was approximately 65%, while the percent of participants who reported five or more bouts of 30 min of MVPA per week was much lower at approximately 18%. Previous estimates (44.1%) of adults with MR who participated in the recommended five bouts of MVPA (Draheim et al., 2002) were likely overestimated because of the lack of assessing the duration of physical activity bouts. The durations of the activities in the present study were extremely variable with only three activities (bowling, hockey, and football) possessing median durations over 30 min. The low median durations of most reported activities indicates that persons with MR typically participate in physical activity for short periods of time. Failing to assess the duration component of physical activity for persons with MR may result in an overestimation of physical activity.

Similar to previous studies on physical activity participation of persons with MR, walking was the most frequently reported physical activity, with dance, yard work, swimming, and cycling rounding off the top five reported activities (Draheim et al., 2002a). Walking likely represents the primary mode of transportation for this group. Further, since the employment tasks performed by people with MR are often physical in nature, it is likely that considerable walking was done during the workday. The prevalence of reporting vigorous physical activities was very low, which concurs with previous work (Draheim et al., 2002a; Temple et al., 2000). In the present study, only three activities out of the top 15 would be classified as vigorous physical activities. Previous research indicated a high participation in optional, lower intensity (moderate) physical activity programs by adults with MR (Stanish, McCubbin, Draheim, & van der Mars, 2001). It seems that adults with MR may find less intense activities enjoyable compared to activities that require a high level of physical stamina.

As previously stated, the validity of conducting the NHANES III Physical Activity Survey with the assistance of care providers has not been evaluated. Despite the implications that the accuracy of recalling and recording activity was limited, the structured physical activity routines of adults with MR and the input of direct care providers who assisted with daily activities have likely produced the most accurate physical activity information attainable through survey. The results seem to agree with previous work that indicates questionnaires and interviews provide questionable results in people with MR (Lunsky & Benson, 1999; Finlay & Lyons, 2001).

It is evident from the results of this study that more research needs to be conducted on the walking activity patterns of adults with MR. The high variability in scores and the inconsistencies among measurement techniques suggests that more work is necessary in order to make conclusive statements about the activity levels of this segment of the population. Finally, caution should be taken when generalizing results since participants were from Eastern Canada only and data were collected during the summer months.
References


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