The Physical Activity Scale for Individuals With Physical Disabilities: Development and Evaluation

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Objective: To evaluate the construct validity of a new 13-item physical activity survey designed to assess physical activity in individuals with physical disabilities.

Design: Mail survey requesting information on physical activity, basic demographic characteristics, self-rated health, and self-rated physical activity.

Setting: In February 2000, surveys were sent to 1176 individuals who had used rehabilitative services at a major midwestern university between 1950 and 1999.

Participants: Two hundred twenty-seven men and 145 women with disabilities responded to the mail survey (80%, spinal cord or other locomotor injuries; 13%, visual and auditory injuries; 7%, other; 92%, white; mean age ± standard deviation, 49.8 ± 12.9y; mean length of disability, 36.9 ± 14.9y).

Interventions: Not applicable.

Main Outcome Measures: Physical activity was assessed with the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD). The PASIPD requests the number of days a week and hours daily (categories) of participation in recreational, household, and occupational activities over the past 7 days. Total scores were calculated as the average hours daily times a metabolic equivalent value and summed over items.

Results: Pearson correlations between each survey item and the total PASIPD score were all statistically significant ($P < .05$) and ≥ .20 (range, .20–.67). Factor analysis with principal component extraction and varimax orthogonal rotations revealed 5 latent factors (eigenvalues ≥ 1, factor loadings ≥ .40): home repair and lawn and garden, housework, vigorous sport and recreation, light sport and recreation, and occupation and transportation. These 5 factors accounted for 63% of the total variance. Cronbach α coefficients ranged from .37 to .65, indicating low-to-moderate internal consistency within factors. Those who reported being "active/highly active" had higher total and subcategory scores compared with those "not active at all." Those in "excellent" health had higher total, vigorous sport and recreation, and occupation and transportation subcategory scores compared with those who rated their health "fair/poor" (all $P < .05$).

Conclusion: These results provide preliminary support for the construct validity of the PASIPD. Additional validation studies using an external criterion and in more generalizable samples are warranted.

Key Words: Disabled persons; Exercise; Rehabilitation.

THE EXTENT TO WHICH the long-term effects of inactivity interact with the normal aging process to affect the health, functional ability, and independence of persons with permanent physical disabilities, such as spinal cord injury (SCI), amputation, postpoliomyelitis, spina bifida, and blindness, are important public health issues that have received little research attention. To date, limited information exists on the physical activity habits of the approximately 49 million Americans with disabilities, 24.1 million of whom are classified as having severe disabilities.[1] The past decade has witnessed an increased interest in the association between physical activity and health in the able-bodied population. Considerable evidence has accumulated to support the hypothesis that moderate levels of physical activity (3–6 metabolic equivalents [METs]) are important in reducing the risks of coronary heart disease and all-cause mortality.[2-7] The American Heart Association has named physical inactivity a major risk factor for coronary heart disease, joining the more established risk factors of hypertension, smoking, and dyslipidemia.[8] Evidence has also accumulated linking physical inactivity to an increased risk for other chronic conditions such as stroke,[9-12] cancer,[13-16] non-insulin-dependent diabetes,[17-19] and osteoporosis.[20-22] The 1993 joint recommendation from the Centers for Disease Control and Prevention and American College of Sports Medicine, the 1996 Surgeon General's *Report on Physical Activity and Health*,[23] and the 1995 National Institutes of Health Consensus Development Conference on Physical Activity and Cardiovascular Health[24] identified physical activity as an important aspect of health promotion and disease prevention and recommended that every adult in the United States accumulate 30 minutes or more of moderate-intensity exercise on most, preferably all, days of the week.[25] These documents also highlighted the need to target populations in which physical inactivity is particularly prevalent, such as those with physical disabilities.

Low levels of physical activity in persons with physical disabilities may decrease their aerobic capacity, muscular strength and endurance, and flexibility, all of which have the potential for restricting functional independence and increasing the risk for chronic disease and secondary complications. However, the association between physical activity and morbidity and mortality from chronic diseases such as coronary heart disease, cancer, diabetes, obesity, or osteoporosis are largely unexplored in individuals with disabilities. The epidemiologic studies that provide data about the type and amount of physical activity related to health benefits have not included people with

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physical disabilities in their samples. The long-term benefits or risks of participation in physical activity by persons with disabilities is not known and should be a national research priority.[26] A major limitation in determining the potential health and functional benefits of a physically active lifestyle in this population is the lack of a valid and reliable physical activity assessment instrument that is suitable for use in population-based research. Because the existing physical activity surveys, which were developed and validated with able-bodied samples, generally focus on participation in more intense leisure time sport and recreational activities, they are not appropriate for populations with physical disabilities. In these populations, the level of activity is generally low and the prevalence of wheelchair use is high. Before the effectiveness of interventions to increase physical activity and the health and functional benefits of physical activity participation can be adequately investigated in persons with physical disabilities, a standardized, valid, and reliable survey instrument for assessing physical activity in this population must be developed.

The goal of our research was to develop and evaluate the construct validity of a practical physical activity assessment instrument for persons with physical disabilities for use in epidemiologic research. Our intent was to develop an instrument appropriate for both self- and interview administration and requires 5 minutes or less to complete. This instrument should be useful for comparing physical activity across disability types, as well as between disabled and nondisabled groups. It should also be useful for evaluating the associations between physical activity and chronic disease and functional outcomes and for evaluating the effectiveness of interventions to increase physical activity in persons with disabilities.

METHODS

Instrument Development

We developed a physical activity questionnaire, the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD), specifically for use in epidemiologic studies of physical activity, health, and function of individuals with physical disabilities. The PASIPD is a modification of the Physical Activity Scale for the Elderly (PASE) that we developed and validated earlier.[27] The original PASE is a short (10-item) instrument, suitable for telephone or self-administration, that requests information about leisure, household, and occupational physical activity over the preceding 7 days. Our group, as well as others,[27-31] have shown the validity and reliability of the PASE.

Modifications to the PASE to make the instrument suitable for individuals with physical disabilities were made by conducting qualitative interviews with 15 individuals with physical disabilities and 4 individuals who work directly with this population at the Division of Rehabilitation Education Services at the University of Illinois at Urbana-Champaign. Respondents were asked to read the PASE to identify items that they felt should be added or deleted and to suggest examples of physical activities that would be appropriate for individuals with physical disabilities. Results from these interviews were used to prepare a draft version of the PASIPD, which was again reviewed by the same group of rehabilitation professionals and an additional group of 5 individuals with physical disabilities. These reviewers were asked to evaluate the draft PASIPD for appropriateness and comprehensibility of the items for the target population. The final version of the PASIPD that was evaluated in the present study consisted of 13 items: 6 leisure time, 6 household, and 1 occupational activity item.

Similar to the PASE, the PASIPD requests information on leisure activities, including walking and wheeling outside the home other than specifically for exercise; light, moderate, and strenuous sport and recreation; exercise to increase muscle strength and endurance; household activity including light and heavy housework; home repair; lawn work; outdoor gardening; caring for another person; and occupational activity other than office work. Respondents were asked to recall the number of days in the past 7 days that they participated in these activities as never, seldom (1–2d/wk), sometimes (3–4d/wk), or often (5–7d/wk) and on average how many hours a day they participated ($<$1hr, 1 but $<$2hr, 2–4hr, $>$4hr). The response categories for hours a day for the occupational item were ($<$1hr, 1 but $<$4hr, 5 but $<$8hr, $\geq$8hr). The score for the PASIPD was created by multiplying the average hours per day for each item by a MET value associated with the intensity of the activity and summing over items 2 through 13.[32] Empirical evidence is not available to support the absolute accuracy of the assigned MET values; however, they are logical constants that serve to rank order the intensity of physical activity. The first item, which requests information on sedentary activities, was included only to familiarize respondents with the item format and was not scored. By using this scoring procedure, the mathematically maximum possible score is 199.5 MET hr/d. An individual who walked or wheeled or pushed outside the home 5 to 7 days a week for 2 to 4 hours daily, performed light housework 3 to 4 days a week for at least 1 hour (but $<$2hr) daily, performed heavy housework 1 to 2 days a week for at least 1 hour (but $<$2hr) daily, and worked 5 to 7 days a week for at least 5 hours, (but $<$8hr) daily would receive a PASIPD score of 22.74 MET hr/d. A copy of the PASIPD instrument and its scoring instructions are in Appendix 1.

Participants and Survey

In February 2000, an 18-page survey designed to evaluate the PASIPD and to assess factors and barriers associated with participation in physical activity was mailed to 1176 individuals who had used the services of the Division of Rehabilitation Education Services at the University of Illinois at Urbana-Champaign during the period 1950 to 1999. Survey methodology and content were approved by the Human Subjects Review Committee, Department of Kinesiology, University of Illinois at Urbana-Champaign. Four weeks before mailing the survey, we sent all potential participants a postcard describing the survey and requesting their participation. Reminder postcards were sent to those who had not returned the survey within 6 weeks of the initial mailing. In addition to physical activity, the survey also requested information regarding age, gender, height, weight, ethnicity, education, annual household income, and self-rated health and self-rated physical activity.

Data Analysis

The goal of the analysis was to determine the construct validity of the PASIPD instrument. A construct is a product of informed scientific imagination, an idea developed to permit categorization and description of a directly observable behavior. In this case, physical activity is the construct of interest. Multiple lines of evidence are required to verify the construct validity of a measure. Four approaches are commonly used for this purpose. These include correlations between the proposed measure and a more accurate and usually more expensive and time-consuming measure of the construct, differentiation between groups, factor analysis, and the multitrait-multimethod matrix.[33] Factor analysis and differentiation between groups were the approaches used in the present study.

Table 1: Descriptive Characteristics by Gender

Variable	Men (n = 227)	Women (n = 145)
Age (y)	50.7 ± 12.9	48.4 ± 12.6
Height (cm)	176.2 ± 10.8	161.3 ± 9.6
Weight (kg)	78.2 ± 16.3	64.2 ± 16.0
Body mass index (kg/m^2)	25.3 ± 5.4	24.7 ± 5.6
Education (%)		
College graduate	36.9	29.0
Graduate school	63.1	71.0
Working for pay or volunteer (%)	72.1	71.7
Annual household income (%)		
<$34,999	14.7	26.6
$35,000–$74,999	45.1	35.7
>$75,000	33.0	28.7
Don't know/no response	7.1	9.1
Marital status (%)		
Married	65.8	50.3
Never married	24.4	37.2
Separated/divorced/widowed	9.8	12.4
Disability type (%)		
Visual/auditory	18.1	22.8
Locomotor/SCI	81.9	77.2
Receive attendant care (%)	16.0	16.9
Self-rated health status (%)		
Excellent	68.8	74.5
Good	25.4	19.9
Fair/poor	5.8	5.7
Self-rated physical activity status (%)		
Not active at all	35.9	38.3
Moderately active	33.6	38.3
Active/extremely active	30.5	23.4

NOTE. Values are mean ± SD or percentage.

Factor analysis. In light of the theoretic nature of the construct (ie, physical activity behaviors), we used factor analysis to determine whether item responses "cluster" in reasonable and predictable patterns. We computed a 12-item intercorrelation matrix that we then used for a factor analysis with principal component extraction and varimax orthogonal rotations. Factor determination was based on 2 criteria: an eigenvalue ≥ 1 and a factor loading $\geq .40$, without loading on more than 1 factor. In addition, scree plots were created and examined to assist with factor identification. Cronbach α values were calculated for each factor identified to examine the internal consistency of items within the factor. Finally, individual subcategory scores, based on the identified factors, were calculated and used in the group differentiation analysis.

Group differentiation. To assess further the construct validity of the PASIPD, we compared total PASIPD scores and subcategory scores by participant behavioral and health characteristics that one would expect to be associated with differences in physical activity. More specifically, group differentiation analysis was used to determine if differences existed in physical activity scores by age, self-rated health status, and self-rated physical activity level. Self-rated health status was determined by subjects' responses to the question "How would you rate your overall health status?" (1 = excellent, 5 = poor), whereas self-rated physical activity level was determined from the response to "How would you rate your overall level of physical activity?" (1 = not active at all, 5 = extremely active). We hypothesized that younger persons and those with higher self-rated health and physical activity would have higher scores on the PASIPD. We also evaluated differences in PASIPD scores by gender, annual family income, the presence or absence of attendant care, and type of disability. Analysis of variance (ANOVA) and Student *t* tests for independent samples were used to determine the statistical significance of differences in both PASIPD total and subcategory scores among the groups. Scheffé post hoc comparisons were used to determine the exact group difference when significant ANOVA results were obtained. All statistical analyses were completed using SPSS for Windows, version 10,[a] and type I error rate was set at .05.

RESULTS

Sample Description

Of the 1176 potential respondents, 412 returned surveys for an overall response rate of 35%. Forty surveys were unusable for the analysis: 12 respondents did not include information on disability type and 28 did not report a physical disability. Of the remaining 372 surveys, the following disabling conditions were reported: postpolio (n = 77); paraplegia (n = 56); quadriplegia (n = 38); cerebral palsy (n = 30); SCI, level unspecified (n = 21); other locomotor disabilities including amputation, muscular dystrophy, and spina bifida (n = 77); visual impairment (n = 35); auditory impairment (n = 13); and miscellaneous physical conditions including diabetes, epilepsy, hemophilia, arm amputation, and Crohn's disease (n = 25). The average length of reported disability was 36.9 ± 14.9 years.

The descriptive characteristics of the study sample, which included 227 men and 145 women, are in table 1. Respondents were highly educated, predominantly white, healthy, and of high annual family income. Approximately 92% of respondents were white, 3% were black, and 5% were other (including Hispanic, Asian, Pacific Islander, Native American). Over 60% of men and 70% of women had completed graduate degrees, and all disabling conditions were present when participants attended college. Approximately 30% of respondents reported annual household income greater than $75,000, whereas 72% rated their general level of health to be excellent. The distribution of scores on the PASIPD are presented in figure 1. The mean score was 20.2 with a standard deviation (SD) of 14.5 MET hr/d. Scores ranged from 0.0 to 67.9 MET hr/d.

Factor Analysis

Table 2 presents the mean scores for each of the 12 items on the PASIPD, correlations between each item and the total

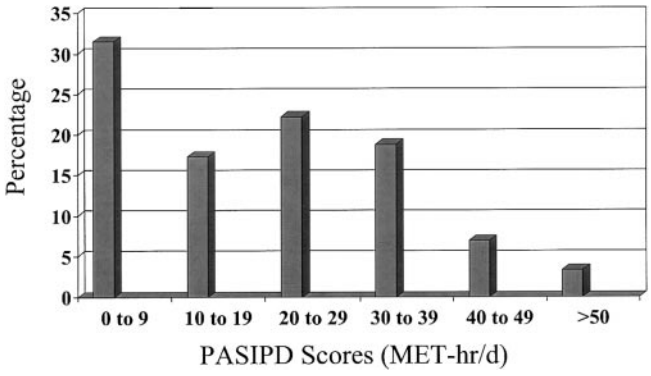

Fig 1. Distribution of PASIPD scores in 372 men and women with physical disabilities.

Table 2: Item Correlation With Total Score Factor Loading, Eigenvalues, Percentage of Variance Explained, and Cronbach α for PASIPD

Item	Mean ± SD (MET hr/d)	Correlation With Total Score	Factor Loading				
			Factor 1: Home Repair Lawn & Garden Work	Factor 2: Housework	Factor 3: Vigorous Sport & Recreation	Factor 4: Light/ Moderate Sport & Recreation	Factor 5: Occupation
Home repair	.35 ± 1.2	.27*	.82	—	—	—	—
Lawn work and yard care	.54 ± 1.5	.29*	.81	—	—	—	—
Outdoor garden work	.57 ± 18	.25*	.56	—	—	—	—
Light house work	1.1 ± 1.3	.22*	—	.83	—	—	—
Heavy house work	.66 ± 1.6	.31†	—	.71	—	—	—
Care for another person	.80 ± 1.8	.20*	—	.57	—	—	—
Strenuous sport and recreation	1.94 ± 5.3	.50*	—	—	.85	—	—
Exercise to increase muscular strength	.95 ± .2	.37*	—	—	.84	—	—
Light sport and recreation	.75 ± 1.7	.29*	—	—	—	.78	—
Moderate sport and recreation	.69 ± 1.8	.29*	—	—	—	.78	—
Walk and wheel push outside home (not for exercise)	3.9 ± 3.6	.54*	—	—	—	—	.82
Work for pay/volunteer	8.2 ± 8.8	.67*	—	—	—	—	.70
Eigenvalue	—	—	1.71	1.70	1.52	1.36	1.24
% variance	—	—	14.3	14.2	12.7	11.3	10.4
Cumulative % variance	—	—	14.3	28.5	41.5	52.5	62.9
α	—	—	.59	.55	.65	.48	.37

* $P < .01$.
† $P < .05$.

score, factor loadings, eigenvalues, percentage of variance explained, and Cronbach α coefficients. Approximately 12% of the total score variance was accounted for by walk-wheel-push outside the home other than specifically for exercise, and 40% was accounted for by work-related activity. The correlations between each survey item and the total PASPID score were all statistically significant ($P < .05$) and $\geq .20$ (range, .20–.67). Based on the criterion described earlier, 5 latent factors were identified: factor 1, home repair and lawn and garden work (items 9, 10, 11); factor 2, housework (items 7, 8, 12); factor 3, vigorous sport and recreational activity (items 5, 6); factor 4, light and moderate sport and recreational activity (items 3, 4); and factor 5, occupational and transportation activity (items 2, 13). The variance accounted for by these factors was as follows: home repair and lawn and garden work (14.3%), housework (14.2%), vigorous sport and recreational activity (12.7%), light and moderate sport and recreational activity (11.3%), and occupational and transportation activity (10.4%). Altogether these factors accounted for approximately 63% of the total item variance. Cronbach α for each of the 5 factors ranged from .37 to .65. Considering the small number of items in each factor, low-to-moderate internal consistency was observed.

Group Differentiation

The results of group comparisons are in table 3. Younger respondents reported higher total activity; higher household, vigorous, moderate, and occupational activity; and lower home repair and lawn and garden scores than their older counterparts. Those who rated their health status as "excellent/very good" reported significantly higher total, vigorous sport, and occupational activity compared with respondents who rated their health as "good" or "fair/poor." Total PASIPD scores, as well as the scores for all 5 subcategories, were significantly higher for respondents who rated their level of physical activity as "active/extremely active" compared with respondents who considered themselves to be "not active at all." Respondents who received attendant care had significantly lower total PASIPD scores and lower scores for all 5 subcategories. Men reported significantly higher scores for home repair and lawn and garden activity, whereas women reported significantly higher household activity scores. No differences in either total or PASIPD subcategory scores were noted by level of annual household income. Individuals with visual or hearing impairments reported significantly higher scores for vigorous sport and recreational activity compared with persons with SCI or other locomotor disabilities.

DISCUSSION

We developed a physical activity survey for use in individuals with physical disabilities that is brief (13 items), easily scored, and suitable for administration by mail, telephone, or in person. To date, an instrument appropriate for use in studies of physical activity and health or to document change in physical activity over time in this population has not been available. The brevity of our survey makes it feasible for inclusion in large-scale studies in which limited time and resources may be available for physical activity assessment.

Factor analysis showed that the PASIPD assesses 5 distinct dimensions of physical activity, which can be described as home repair and lawn and garden work, housework, vigorous

Table 3: Total and Subcategory Scores for the PASIPD by Descriptive Characteristics

Variable	n	Total Score	n	Home Repair/Gardening	n	Housework	n	Vigorous Sport	n	Moderate Sport	n	Occupation
Age group (y)												
≤51	143	24.6 ± 14.6*	169	1.1 ± 2.2†	169	2.9 ± 3.6†	166	4.1 ± 7.8*	164	1.8 ± 3.3†	161	14.7 ± 10.2*
>51	163	16.5 ± 13.4	179	1.8 ± 4.0	174	2.2 ± 3.1	180	1.8 ± 5.1	181	1.1 ± 2.4	179	9.8 ± 9.8
Gender												
Men	193	20.5 ± 15.1	220	1.8 ± 3.7†	218	1.9 ± 2.9*	218	2.9 ± 6.6	215	1.4 ± 2.8	216	12.6 ± 10.7
Women	123	19.9 ± 13.5	138	.9 ± 2.2	135	3.6 ± 3.8	138	2.7 ± 6.7	140	1.4 ± 2.9	134	11.4 ± 9.5
Self-rated health												
Excellent	216	22.5 ± 14.8*‡	250	1.5 ± 3.2	246	2.6 ± 3.5	249	3.5 ± 7.5†‡	248	1.4 ± 2.4	243	13.2 ± 10.4†‡
Good	76	16.3 ± 13.0‡	82	1.6 ± 3.9	82	2.4 ± 3.4	81	1.3 ± 2.9‡	82	1.8 ± 4.2	81	9.9 ± 9.4‡
Fair/poor	20	10.6 ± 9.6‡	21	0.5 ± 1.4	20	1.9 ± 2.5	21	1.3 ± 1.8‡	21	0.4 ± 0.9	21	6.9 ± 9.1‡
Self-rated physical activity												
Not active at all	119	13.2 ± 12.1†‡	130	0.9 ± 3.3†‡	128	1.9 ± 2.8*‡	129	0.6 ± 2.0*‡	131	0.6 ± 1.7*‡	128	9.1 ± 9.7*‡
Moderately active	108	19.8 ± 12.7‡	124	1.5 ± 2.5	124	2.9 ± 3.8‡	124	1.7 ± 3.1‡	124	1.7 ± 3.4‡	125	12.3 ± 10.1‡
Active extremely active	84	30.7 ± 14.0‡	98	2.1 ± 4.1‡	95	2.9 ± 3.5‡	97	7.4 ± 10.5‡	95	2.42 ± 3.2‡	91	15.8 ± 10.0‡
Disability type												
Visual/ auditory	57	22.1 ± 4.6	68	1.5 ± 2.4	69	3.0 ± 3.9	71	4.6 ± 9.3†	66	1.5 ± 2.6	67	12.8 ± 10.2
Locomotor/SCI	260	19.8 ± 14.4	291	1.5 ± 3.4	285	2.5 ± 3.2	286	2.4 ± 5.6	290	1.4 ± 2.9	284	11.9 ± 10.2
Receive attendant care												
Yes	51	10.0 ± 11.1*	59	0.3 ± 0.9†	57	1.1 ± 2.2*	58	0.7 ± 1.3†	59	0.9 ± 2.0†	54	9.2 ± 1.3*
No	259	21.9 ± 14.1	291	1.7 ± 3.5	289	2.9 ± 3.5	290	3.2 ± 6.9	289	1.6 ± 3.0	288	10.1 ± 0.6
Annual household income												
<$34.999	65	20.8 ± 14.2	68	0.9 ± 3.5	70	3.3 ± 4.4	68	4.0 ± 8.1	71	2.3 ± 4.3	70	10.0 ± 8.8
$35,000–$74,999	134	21.3 ± 15.5	146	1.6 ± 3.3	145	2.6 ± 3.3	147	3.1 ± 7.2	148	1.3 ± 2.6	144	12.6 ± 10.3
≥$75,000	88	21.1 ± 13.2	111	1.8 ± 3.4	106	2.2 ± 2.9	108	2.4 ± 5.2	106	1.2 ± 2.1	103	14.4 ± 10.7

NOTE. Values are mean ± SD MET hr/d.

* $P < .001$.

† $P < .05$.

‡ Significantly different from categories with dissimilar alphabet levels.

sport and recreation, moderate sport and recreation, and occupation and transportation. In the past, the validation of physical activity instruments has only focused on the correlation between scores from the instrument and some external criterion such as activity measured by activity diaries, motion sensors, or doubly labeled water, while providing no empirical evidence to support whether the scores actually reflect the construct of interest.[34-36] Understanding the factor structure of a physical activity survey instrument enhances the interpretation of the scores. For example, the PASIPD evaluated in the present study assesses 5 dimensions of physical activity. Therefore, the total score, which is a composite of the 5 subcategory scores based on the identified factors, may not always provide the most useful measure of activity. For example, it may not help researchers who are trying to determine which factors are associated with specific dimensions of activity. It may not be useful for comparing activity level between population subgroups or for assessing the association of physical activity with health outcomes. This issue is shown in the present study in which younger participants had significantly higher total PASIPD scores than the older participants, but the converse was found in scores for home repair and garden activity.

Further support for the validity of the PASIPD was provided by the group difference comparisons. In general, PASIPD scores differed significantly, and in the expected direction, between groups differing by age and levels of self-rated health and self-rated physical activity. Differences also existed in PASIPD total or subcategory scores by gender, type of disability, and presence or absence of attendant care. Additional studies should be conducted to validate the PASIDP by using an external criterion measure such as doubly labeled water, activity diary, or motion sensors. Choosing the best criterion measure for a heterogenous sample of individuals with physical disabilities may be problematic. The validity of doubly labeled water may be lower in individuals with secondary complications affecting total body water content, which may be associated with disability.[37,38] Little information is available regarding the validity of motion sensors in individuals with disabilities.[31] At present, the activity diary may provide the most practical and valid criterion activity measure available for use in this population.

The limitations of the present study must be considered when interpreting the results. These results were obtained from a well educated, relatively affluent sample composed predominantly of white individuals with locomotor disabilities. The degree to which our results can be generalized to samples with other demographic characteristics is not known and should be the object of further study. The response rate in the present study (35%), although reasonable for a mail-administered survey, still may have biased the results. Because we have no information regarding characteristics of the individuals who did not respond to the survey, other than education, the nature of any bias cannot be determined.

CONCLUSION

In summary, we have developed an instrument designed to measure physical activity in individuals with physical disabilities and provided preliminary support for its construct validity. This PASIPD instrument is short (13 items), easily administered and scored, and is suitable for administration either in person or by telephone or mail. Further work is needed to establish the validity of the PASIPD in samples of lower

education and income and with more diverse types of physical disabilities than were available for the present study.

APPENDIX 1: PHYSICAL ACTIVITY SCALE FOR PERSONS WITH PHYSICAL DISABILITIES

Instructions: This questionnaire is about your current level of physical activity and exercise. Please remember there are no right or wrong answers. We simply need to assess your current level of activity.

Leisure Time Activity

1. During the past 7 days how often did you engage in *stationary activities* such as reading, watching TV, computer games, or doing handcrafts?
   1. Never (Go to question #2)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   What were these activities?

   On average, how many hours per day did you spend in these *stationary activities*?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
2. During the past 7 days, how often did you *walk, wheel, push outside* your home *other than specifically for exercise*. For example, getting to work or class, walking the dog shopping, or other errands?
   1. Never (Go to question #3)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend wheeling or pushing outside your home?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
3. During the past 7 days, how often did you engage in *light sport or recreational activities* such as bowling, golf with a cart, hunting or fishing, darts, billiards or pool, therapeutic exercise (physical or occupational therapy, stretching, use of a standing frame) or other similar activities?
   1. Never (Go to question #4)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   What were these activities?

   On average, how many hour per day did you spend in these *light sport or recreational* activities?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
4. During the past 7 days, how often did you engage in *moderate sport and recreational* activities such as doubles tennis, softball, golf without a cart, ballroom dancing, wheeling or pushing for pleasure or other similar activities?
   1. Never (Go to question #5)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   What were these activities?

   On average, how many hours per day did you spend in these *moderate sport and recreational* activities?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
5. During the past 7 days, how often did you engage in *strenuous sport and recreational* activities such as jogging, wheelchair racing (training), off-road pushing, swimming, aerobic dance, arm cranking, cycling (hand or leg), singles tennis, rugby, basketball, walking with crutches and braces, or other similar activities
   1. Never (Go to question #6)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   What were these activities?

   On average, how many hours per day did you spend in these *strenuous sport or recreational* activities?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
6. During the past 7 days, how often did you do any exercise *specifically to increase muscle strength and endurance* such as lifting weights, push-ups, pull-ups, dips, or wheelchair push-ups, etc?
   1. Never (Go to question #7)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   What were these activities?

   On average, how many hours per day did you spend in these *exercises to increase muscle strength and endurance*?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr

Household Activity

7. During the past 7 days, how often have you done any *light housework*, such as dusting, sweeping floors or washing dishes?
   1. Never (Go to question #8)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend doing *light housework*?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
8. During the past 7 days, how often have you done any *heavy housework or chores* such as vacuuming, scrubbing floors, washing windows, or walls, etc?
   1. Never (Go to question #9)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend doing *heavy housework or chores*?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr

9. During the past 7 days, how often you done *home repairs* like carpentry, painting, furniture refinishing, electrical work, etc?
   1. Never (Go to question #10)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend doing *home repairs*?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
10. During the past 7 days how often have you done *lawn work or yard care* including mowing, leaf or snow removal, tree or bush trimming, or wood chopping, etc?
   1. Never (Go to question #11)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend doing *lawn work*?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr
11. During the past 7 days, how often have you done *outdoor gardening*?
   1. Never (Go to question #12)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend doing *outdoor gardening*?
   1. Less than 1hr
   2. 1 but less than 2 hr
   3. 2–4hr
   4. More than 4hr
12. During the past 7 days, how often did you *care for another person*, such as children, a dependent spouse, or another adult?
   1. Never (Go to question #13)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend *caring for another person*?
   1. Less than 1hr
   2. 1 but less than 2hr
   3. 2–4hr
   4. More than 4hr

Work-Related Activity

13. During the past 7 days, how often did you *work for pay or as a volunteer*? (Exclude work that mainly involved sitting with slight arm movement such as light office work, computer work, light assembly line work, driving bus or van, etc.)
   1. Never (Go to END)
   2. Seldom (1–2d)
   3. Sometimes (3–4d)
   4. Often (5–7d)

   On average, how many hours per day did you spend *working for pay or as a volunteer*?
   1. Less than 1hr
   2. 1 but less than 4hr
   3. 5 but less than 8hr
   4. 8hr or more

Scoring: PASIPD

Item multipliers

1. Not scored
2. 2.5
3. 3.0
4. 4.0
5. 8.0
6. 5.5
7. 1.5
8. 4.0
9. 4.0
10. 4.0
11 4.0
12. 1.5
13. 2.5

Average Hours Per Day Calculation for Items 2–12

Category	Reported (hr/d)	Average (hr/d)
Seldom (1–2d)	<1	.11
	1–2	.32
	2–4	.64
	>4	1.07
Sometimes (3–4d)	<1	.25
	1–2	.75
	2–4	1.50
	>4	2.50
Often (5–7d)	<1	.43
	1–2	1.29
	2–4	2.57
	>4	4.29

Average Hours Per Day Calculation for Item 13

Category	Reported (hr/d)	Average (hr/d)
Seldom (1–2d)	<1	.12
	1–4	.64
	5–8	1.39
	>8	1.93
Sometimes (3–4d)	<1	.28
	1–4	1.5
	5–8	3.11
	>8	4.5
Often (5–7d)	<1	.49
	1–4	2.57
	5–8	5.57
	>8	7.71

NOTE. PASIPD score = sum of item multiplier × average hours per day over items 2–13.

References

1. NIH Consensus Conference. Physical activity and cardiovascular health. JAMA 1996;276:241-6.
2. Abbott RD, Rodriguez BL, Burchfiel CM, Curb JD. Physical activity in older middle-aged men and reduced risk of stroke: the Honolulu Heart Program. Am J Epidemiol 1994;139:881-93.
3. ACSM position stand on osteoporosis and exercise. American College of Sports Medicine. Med Sci Sports Exerc 1995;27:i-vii.
4. Agnarsson U, Thorgeirsson G, Sigvaldason H, Sigfusson N. Effects of leisure-time physical activity and ventilatory function on risk for stroke in men: the Reykjavik study. Ann Intern Med 1999;130:987-90.

5. Ainsworth BE, Haskell WL, Leon AS, et al. Compendium of physical activities: classification of energy costs of human physical activities. Med Sci Sports Exerc 1993;25:71-80.
6. Anson CA, Shepherd C. Incidence of secondary complications in spinal cord injury. Int J Rehabil Res 1996;19:55-66.
7. Blair SN, Kampert JB, Kohl HW, et al. Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. JAMA 1996;276:205-10.
8. Brancati FL, Kao WH, Folsom AR, Watson RL, Szklo M. Incident type 2 diabetes mellitus in African American and white adults: the Atherosclerosis Risk in Communities Study. JAMA 2000;283:2253-9.
9. Burchfiel CM, Sharp DS, Curb JD, et al. Physical activity and incidence of diabetes: the Honolulu Heart Program. Am J Epidemiol 1995;141:360-8.
10. Crocker L, Algina J. Introduction to classical and modern test theory. New York: Harcourt, Brace, Jovanovich; 1986.
11. DiPietro L, Caspersen CJ, Ostfeld AM, Nadel ER. A survey for assessing physical activity among older adults. Med Sci Sports Exerc 1993;25:628-42.
12. Evenson KR, Rosamond WD, Cai J, et al. Physical activity and ischemic stroke risk: the Atherosclerosis Risk in Communities Study. Stroke 2000;30:1333-9.
13. Fletcher GF, Blair SN, Blumenthal J, et al. Statement on exercise: benefits and recommendation for physical activity programs for all Americans: a statement for health professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, American Heart Association. Circulation 1992;86: 340-4.
14. Hu FB, Stampfer MJ, Colditz GA, et al. Physical activity and risk for stroke in women. JAMA 2000;283:2961-7.
15. Inman CL, Warren GL, Hogan HA, Bloomfield SA. Mechanical loading attenuates bone loss due to immobilization and calcium deficiency. J Appl Physiol 1999;87:189-95.
16. Johnson RL, Gerhart KA, McCray J, Menconi JC, Whiteneck GG. Secondary conditions following spinal cord injury in a population-based sample. Spinal Cord 1998;36:45-50.
17. Lee CD, Blair SN, Jackson AS. Cardiorespiratory fitness, body composition, and all-cause and cardiovascular disease mortality in men. Am J Clin Nutr 1999;69:373-80.
18. Lee IM, Paffenbarger RS Jr. Associations of light, moderate, and vigorous intensity physical activity with longevity: the Harvard Alumni Health Study. Am J Epidemiol 2000;151:293-9.
19. Lemaitre RN, Heckbert SR, Psaty BM, Siscovick DS. Leisure-time physical activity and the risk of nonfatal myocardial infarction in postmenopausal women. Arch Intern Med 1995;155:2302-8.
20. Lynch J, Helmrich SP, Lakka TA, Kaplan GG, Cohen RD. Moderately intense physical activities and high levels of cardiorespiratory fitness reduce the risk of non-insulin-dependent diabetes mellitus in middle-aged men. Arch Intern Med 1996;156:1307-14.
21. Manson JE, Hu FB, Rich-Edwards JW, et al. A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. N Engl J Med 1999;341: 650-8.
22. McNeil JM. Americans with disabilities: 1991-1992. Washington (DC): US Department of Commerce, Economics and Statistics Administration, Bureau of the Census; 1993. Current Population Reports No. P70-33.
23. Milgrom C, Finestone A, Simkin A, et al. In vivo strain measurements to evaluate the strengthening potential of exercises on the tibial bone. J Bone Joint Surg Br 2000;82:591-4.
24. Pate RR, Blair SN, Haskell WL, et al. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995;273:402-7.
25. Pereira MA, Fitzgerald SJ, Gregg EW, et al. A collection of physical questionnaires for health-related research. Med Sci Sports Exerc 1997;29:S3-205.
26. Rimmer JH, Braddock D, Pitetti KH. Research on physical activity and disability: an emerging national priority. Med Sci Sports Exerc 1996;28:1366-72.
27. Rockhill B, Willett WC, Hunter DJ, Manson JE, Hankinson SE, Colditz GA. A prospective study of recreational physical activity and breast cancer risk. Arch Intern Med 1999;159:2290-6.
28. Sallis JF, Haskell WL, Wood PD, et al. Physical activity assessment methodology in the five-city project. Am J Epidemiol 1985; 212:91-106.
29. Schuit AJ, Schouten E, Westerterp KR, Saris WH. Validity of the Physical Activity Scale for the Elderly (PASE): according to energy expenditure assessed by the doubly labeled water method. J Clin Epidemiol 1997;50:541-6.
30. US Department of Health and Human Services. Physical activity and health: a report of the Surgeon General. Atlanta (GA): US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996.
31. Sesso HD, Paffenbarger RS, Ha T, Lee IM. Physical activity and cardiovascular disease risk in middle-aged and older women. Am J Epidemiol 1999;150:408-16.
32. Thune I, Brenn T, Lund E, Gaard M. Physical activity and the risk of breast cancer. N Engl J Med 1997;336:1269-15.
33. Verloop J, Rookus RA, van der Kooy K, van Leeuwen FE. Physical activity and breast cancer risk in women aged 20-54 years. J Nat Cancer Inst 2000;92:128-35.
34. Washburn RA, Copay AG. Assessing physical activity in wheelchair users. Validity of a portable accelerometer. Adapt Phys Act Q 1999;16:290-9.
35. Washburn RA, Ficker JL. Physical Activity Scale for the Elderly (PASE): the relationship with activity measured by a portable accelerometer. J Sports Med Phys Fitness 1999;39:336-40.
36. Washburn RA, McAuley E, Katula J, Mihalko SL, Boileau RA. The Physical Activity Scale for the Elderly (PASE): evidence for validity. J Clin Epidemiol 1999;52:643-51.
37. Washburn RA, Smith KW, Jette AM, Janney CA. The physical activity scale for the elderly (PASE): development and evaluation. J Clin Epidemiol 1993;46:153-62.
38. White E, Jacobs EJ, Daling JR. Physical activity in relation to colon cancer in middle-aged men and women. Am J Epidemiol 1996;144:42-50.

Supplier

a. SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.