Assessment of Physical Activity by Self-Report: Status, Limitations, and Future Directions

James F. Sallis and Brian E. Saelens

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Self-report instruments continue to be the most widely used type of physical activity measure. Thus, it is important to identify the strengths and limitations of these measures as well as to continually strive to improve their quality. As more alternatives to self-reports are developed and come into wider use, the role self-reports plays in the mix of measurement options needs to be reconsidered.

In the present review, self-reports are defined as self-administered or interviewer-administered recall questionnaires, activity logs or diaries, and proxy reports (typically used to assess young children). The recognized benefits of self-report (and proxy report) measures are their ability to collect data from a large number of people at low cost. Recalls do not alter the behavior under study, and it is possible to assess all the dimensions of physical activity so patterns of behavior can be examined. Self-reports have been used in a range of ages, and measures can be adapted to fit the needs of a particular population or research question.

Numerous limitations of self-reports have been discussed (Ainsworth, Montoye, & Leon, 1994). Social desirability bias can lead to over-reporting of physical activity (Warnecke, Johnson, Chavez, Sudman, O'Rourke, Lacey, & Horn, 1997). Recalling physical activity is a highly complex cognitive task (Baranowski, 1988), and instruments vary in their cognitive demands. Children and very old adults are likely to have particular memory and recall skill limitations. Respondents and investigators must share understanding of ambiguous terms such as “physical activity,” “moderate intensity,” and “leisure time.” Activity logs and diaries are limited by response rates and the extent to which participants follow instructions. Proxy reports are limited by the reporter’s opportunity to observe the physical activity of the subject. Measures may not assess the primary modes of activity for certain gender, age, cultural, occupational, or income groups.

Because there are several published reviews of physical activity self-reports (Ainsworth, Montoye, & Leon, 1994; Kriska & Caspersen, 1997; Montoye, Kemper, Saris, & Washburn, 1996; Sallis, 1991; Washburn & Montoye, 1986), the present review is not intended to be comprehensive. The goal is to summarize findings on test-retest reliability, criterion-related validity, and content validity for physical activity self-reports that were developed in, or have been used in, the 1990s. Content validity has not been widely discussed related to physical activity measures, but it is critical to examine the extent to which an instrument measures the full range of physical activity characteristics.

Method

Self-report measures of physical activity were included for review if (a) there were published reports of validity testing of the measure using an objective assessment of physical activity, (b) the measure has been used in published studies during the 1990s, and (c) the time frame of recall was within the previous one year. Objective criterion-related validity measures that were considered to directly assess physical activity were doubly labeled water, accelerometers (and other motion sensors), direct observation, and heart rate monitoring. Indirect criterion measures, including physical fitness and body
composition, or diaries, were excluded, but these results
can be found in previous reviews (Ainsworth et al., 1994;
Kriska & Caspersen, 1997; Montoye, et al., 1996; Sallis,

Self-Report measures meeting inclusion criteria are
presented in Table 1 for children and adolescents (up to
about age 18 years), Table 2 for young and middle-aged
adults, and Table 3 for older adults (generally aged
60 years and over). Each entry includes the name of the
measure and primary citation. The assessment format,
administration time (if available), and measurement time
frame are provided. Content validity is indicated by the
(a) dimensions along which physical activity is assessed
(i.e., type, frequency, intensity, duration), (b) ability of
the instrument to produce estimates related to public
health guidelines (i.e., sedentary, moderate, vigorous
activities), and (c) ability to obtain scores for various
contexts or purposes of physical activity (i.e., leisure,
work, household, transportation). Test-retest reliability
is presented as a mean of correlations across studies
(where applicable) weighted by sample size. The validi-
ty criteria are listed along with validity correlations
expressed as weighted means according to the sample size.
Information presented in the tables was consolidated
from (a) the 1997 Medicine and Science in Sports and Exer-
ce supplement on physical activity questionnaires
(Kriska & Caspersen, 1997), (b) the Montoye, Kemper,
Saris, and Washburn (1996) text on physical activity meas-
urement, and (c) articles from 1990 to 1999 obtained
from Medline and PsychINFO database searches. Specific
references used to compute each reliability and criterion
validity mean are available from the first author. Data-
base searches were conducted by entering as a keyword
the name of each questionnaire and also by the keyword
search of “physical activity” and “self-report” or “interview”.

Results

Measures for Youth

Seventeen instruments for assessing child and ado-
lescent physical activity were reviewed. Seven measures
used interview only, or in combination with diary or self-
administered survey. There were eight self-administered
measures and two proxy reports. Self-administered and
interview-based recalls were tested only on children aged
9 years and above. Recall time frames varied from one
day to three months. One measure (Garcia et al., 1997)
assessed all four dimensions of physical activity, six mea-
sures assessed three of the dimensions, and three did not
allow assessment of any of the dimensions. Most of the
youth measures included separate scoring for moderate
and vigorous physical activity. Intervals between retests
varied considerably, and some reliability correlations re-
lected both measurement error and true behavioral
variation because recall time frames did not overlap.
However, all reliabilities were acceptable (range=.60 to
.98). All measures showed some evidence of validity.
However, almost none of the youth measures were vali-
dated in more than one study. Although some of the va-
idity correlations were nonsignificant or low (i.e., less
than .20), 13 of the 27 correlations were .50 or above.
Validity correlations ranged from .07 to .88 for self-ad-
ministered surveys, from .17 to .72 for interviews, and
from .40 to .77 for the two proxy reports.

Measures for Adults

Seven instruments were reviewed that were validated
with young- to middle-aged adults. As shown in Table 2,
the measures for adults had relatively high test-retest re-
liabilities, especially when intervals between tests were
one month or less. Many reliability correlations reflected
both measurement error and true variation in physical
activity. Total and vigorous physical activity scores tended
to have higher reliabilities than moderate physical activ-
ity scores.

Most measures for adults assessed the dimensions of
frequency and intensity, but less commonly assessed type
and duration. Moderate and vigorous physical activity
scores were obtainable from most adult measures, but the
assessment of sedentary behavior was rare. The assess-
ment of “traditional” leisure time physical activities (e.g.,
biking, sports) was ubiquitous, but less common were
assessments of activities in household and transportation
contexts. Measurement of physical activity during work
was also less common, perhaps due to the existence of
specialized measures (e.g., Reiff et al., 1967).

Validity correlations for summary measures of adults’
habitual or global physical activity were generally low,
ranging from .14 to .36. However, possibly due to their
short and specific recall timeframe, the Seven-Day Physi-
cal Activity Recall (PAR) had validity correlations of .50
and .53 with accelerometers, and the Modifiable Activity
Questionnaire (MAQ) had high correlations with
Caltrac accelerometer and doubly labeled water.
Subscales assessing vigorous physical activity had higher
validity correlations than those summarizing moderate
physical activity.

Measures for Older Adults

Of the four measures developed for older adults, two
were self-administered and two were interviews. Three
of the instruments assessed all four dimensions of physi-
cal activity. All allowed scoring of moderate and vigor-
ous physical activity, and coverage of activity contexts was
generally good. Recall time frames were usual, typical
week, past seven days, and past year. One measure (DiPietro et al., 1993) had a reliability less than .60, but the rest were .75 and above. Correlations with doubly labeled water were high ($r=.58$ and $.62$), but correlations with Caltrac accelerometers were much lower. Only the Modified Baecke Questionnaire was validated in more than one study.

**Discussion**

There is a profusion of self- or proxy-report measures of physical activity for young people, adults, and older adults, most of which have some evidence of validity. Thus, investigators can often choose an existing measure that is appropriate for particular studies. The disadvantage of multiple available measures is that it is difficult or impossible to compare results across studies. There may be benefits of coming to a consensus on a small number of well-studied measures for each age group that can be used for a variety of research purposes.

Self-report instruments appear to be at different stages of development for the three age groups. There is substantial interest in physical activity measurement for young people, as indicated by the existence of 17 validated measures. However, the relatively large literature is merely producing additional measures rather than systematically exploring principles for measuring youth physical activity. For example, few studies have assessed the performance of measures in various age groups of young people (Crocker et al., 1997; Kowalski, Crocker, & Faulkner, 1997; Kowalski, Crocker, & Kowalski, 1997; Sallis, Buono et al., 1993). Validity appeared to be stronger for interview measures, because about 2/3 of validity correlations for interview measures were above .50, compared to 1/3 of validity correlations for self-administered instruments. Although no validated parent recalls could be located, the two proxy reports that relied on daily logging showed consistent evidence of validity. Knowledge in the field is most likely to be advanced by studies that compare different measures (Janz et al., 1995; Sallis, Condon, et al., 1993) or different formats of similar measures (Sallis, Condon et al., 1993; Sallis et al., 1996), because such studies could lead to empirically-based principles for survey design.

The literature on adult self-report measures showed signs of greater maturity. Despite the development of many measures over several decades (Kriska & Caspersen, 1997; Montoye et al., 1996), a consensus seems to be developing based on the recent use of a smaller number of measures. Only seven validated measures have been used with some frequency in the past decade, and all but one of the measures was developed before the 1990s. In contrast to the youth literature, most of the adult measures have been evaluated in multiple studies. This literature has benefited from key studies that evaluated multiple measures simultaneously (Jacobs, Ainsworth, Hartman, & Leon, 1993).

The literature on physical activity self-reports for older adults is the newest and most limited. Four validated measures were identified, and three of them were developed or modified during the 1990s. All measures were specifically developed to be sensitive to physical activities common among older adults, and three of the four showed good evidence of reliability and validity.

It was notable that none of the measures used to collect U.S. national data on prevalence of physical activity for young people and adults (USDHHS, 1996) met the criteria for inclusion in this review, because they have not been validated. Although problems with U.S. national prevalence estimates were identified years ago (Slater, Green, Vernon, & Keith, 1987), measures remain unvalidated.

**Requirements for Reliability Studies**

Reliability is hampered by imprecise cognitive processing, memory errors (Baranowski, 1988), variability in levels of physical activity over time (Washburn & Montoye, 1986), and individual differences that predict recall biases (Buchowski, Townsend, Chen, Acra, & Sun, 1999; Jakicic, Polley, & Wing, 1998). A more thorough examination of the cognitive processes involved in recall is needed, with subsequent integration into recall formats and procedures that improve recall accuracy (Durante & Ainsworth, 1996).

Many test-retest reliability estimates for recalled physical activity reflect both measurement error and true variability in the behavior. Because types and amounts of physical activity are highly variable, retests need to cover the same time period as the initial test. Thus, one-day recalls must be repeated on the same day, and one week recalls should be repeated within one week. Recalls of "usual" physical activity should be less sensitive to the interval between tests. Booth, Owen, Bauman, and Gore (1996) argue that inclusion of many participants with no physical activity in analyses inflates reliability indices.

The relatively low reliability of recalls of moderate intensity activities, as compared to vigorous intensity activities, may be best explained by the low salience of moderate intensity activities (Durante & Ainsworth, 1996). It is unclear whether this problem can be overcome by improved recall procedures.

**Content Validity**

The importance of assessing various intensity levels has been increased by mounting evidence that sedentary behaviors (Andersen, Crespo, Bartlett, Cheskin, & Pratt,
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cising days, participants over-reported high-moderate intensity activities (>4.5 METs) by about 90%, but low-moderate activities (2.5-4.4 METs) were reported accurately. Amount of over-reporting was positively correlated with percent body fat.

The weight of the current evidence supports a conclusion that young people and adults overestimate their physical activity, particularly vigorous intensity activities. These results suggest that prevalence estimates may be inaccurate, even at the national level, because prevalence data are virtually always based on self-reports (e.g., USDHHS, 1996). Self-reports may not be acceptable measures when absolute amounts of physical activity need to be assessed. A high research priority is to determine whether self-reports can be improved to yield more accurate estimates of absolute amount of physical activity.

**Developing Self-Report Measures**

Few studies cited in the present review described the rationale for the design of the self-report measure or the process of instrument development. Thus, the systematic procedures reported by a few investigators are instructive (Bernstein et al., 1998; Sallis et al., 1996; Washburn et al., 1995). Content validity was enhanced through consultation with experts, interviews with potential respondents, and statistical methods to identify types of activities to include. Extensive pilot testing of draft instruments was carried out, and revisions were made before formal psychometric evaluation. Different administration formats were evaluated. When new measures are developed, the rationale and procedures used to develop the instrument should be described.

More than 10 years ago Baranowski (1988) described the cognitive complexity of recalling physical activity and proposed a research agenda that would lead to improved measures. However, little if any progress has been made in conducting the proposed research, so the empirical basis for improving the accuracy of recalls is still absent.

**Adaptation and Evaluation in Specific Demographic and Cultural Groups**

There is a growing interest in examining the level of physical activity among diverse demographic, cultural, and ethnic populations (e.g., Sternfeld, Ainsworth, & Quenesberry, 1999). Investigators should be sensitive to such factors as differences in the range of physical activity performed within and between different populations (Ainsworth, Irwin, Addy, Whitt, Stolarczyk, 1999). Further studies are needed to understand cultural, demographic, and ethnic differences in reactivity to assessment methodologies (Warnecke, Johnson, Chavez, Sudman, O'Rourke, Lacey, & Horn, 1997).

Although some measures appear to perform adequately in specific cultural groups (Rauh, Hovell, Hofstetter, Sallis, & Gleghorn, 1992), there is considerable variability in the response of ethnically distinct groups to various measurement approaches. Ainsworth et al. (1999) found higher prevalence rates for meeting moderate physical activity guidelines among Native American and African American women when using 4-day activity diaries than when more structured assessments were used. Young, Miller, Wilder, Yanek, and Becker (1998) obtained higher prevalence rates among urban African Americans when including assessments of physical activity for transportation and work. Ainsworth et al. (1999) suggested that discrepancies were explained by self-report measures lacking physical activity content validity for a given population, so steps should be taken to ensure content validity of measures in target populations.

Warnecke et al. (1997) suggest the need to be aware of the differential impact of question wording on different populations. In an effort to develop a standardized approach to physical activity self-reports that can be used internationally, a group is developing and evaluating a format that is flexible enough to be tailored for individual countries yet still provides relatively comparable data (Pratt, Ainsworth, Booth, & Craig, 1999).

**Conclusions**

There are multiple self-report physical activity measures with adequate reliability, content validity, and relative criterion validity that can be used with youth, adults, and older adults. New measures should be developed only if they improve substantially on existing measures. Among adults, relative validity was higher for reports of vigorous physical activity than for reports of moderate intensity activities.

Validated self-reports were not located that assessed strengthening exercises, flexibility exercises, weight-bearing activities, sedentary behavior, or other activity dimensions that are proposed to be related to health outcomes.

In general, interview measures had stronger psychometric characteristics than self-administered measures. The literature provided few empirically-based principles for designing physical activity self-reports or selecting recall formats and strategies.

Most studies showed self-reports do not provide accurate estimates of the absolute amount of physical activity, so when absolute amounts of physical activity need to be estimated, objective measures should be used.

Few self-report measures have been developed for, or validated in, distinct demographic, ethnic, or cultural groups.

When used in combination with objective measures, the unique role of self-reports may be to assess the context and type of physical activities.
References


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<th>Measure &amp; Original Ref.</th>
<th>Assessment Format</th>
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<td>2-6 days .77</td>
<td>Heart rate (vigorous) observation</td>
<td>53; agreement on type = 46%; agreement on intensity = 75% (Wallace, 85)</td>
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<td>Parent &amp; teacher logs for 3-5 days</td>
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<td>x</td>
<td>x</td>
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<tr>
<td>Measure &amp; Original ref.</td>
<td>Assessment Format</td>
<td>Type</td>
<td>Frequency</td>
<td>Intensity</td>
<td>Duration</td>
<td>Sedentary</td>
<td>Moderate</td>
<td>Vigorous</td>
<td>Leisure</td>
<td>Work</td>
<td>Household</td>
<td>Transport</td>
<td>Re-test reliability, Weighted mean</td>
<td>Validity criterion</td>
<td>Validity, weighted mean</td>
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<tr>
<td>Minnesota Leisure-Time Physical Activity Questionnaire (Taylor, Jacobs, et al., 1975)</td>
<td>Interviewer Administered; Past 12 months</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>1 month</td>
<td>Total .89; Mod. .84; Vig. .87</td>
<td>Energy Intake-REE</td>
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<tr>
<td>Paffenbarger Physical Activity Questionnaire (Paffenbarger, Wind, &amp; Hyde, 1978)</td>
<td>Self- or interviewer administered; Past week or year</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 wks .34</td>
<td>1 mo .72</td>
<td>2 wks .58; 1 yr .73</td>
</tr>
<tr>
<td>Seven-Day Physical Activity Recall (Sallis, Haskell, et al., 1985)</td>
<td>Interviewer administered; Past week</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Same day</td>
<td>Total .86</td>
<td>2 week</td>
</tr>
<tr>
<td>CARDIA Physical Activity History (Jacobs, Hahn, et al., 1989)</td>
<td>Interviewer administered; Past year</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
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<td></td>
<td>2 weeks</td>
<td>Total .84</td>
<td>Mod .77</td>
</tr>
<tr>
<td>Baecke Questionnaire of Habitual Physical Activity (Baecke, Burema, &amp; Frijters, 1982)</td>
<td>Self-administered; Habitual activity with no time frame</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td></td>
<td>1 month</td>
<td>Total .89</td>
<td>Leisure .87; Sports .92</td>
</tr>
<tr>
<td>Measure &amp; Original ref.</td>
<td>Assessment Format</td>
<td>Type</td>
<td>Frequency</td>
<td>Intensity</td>
<td>Duration</td>
<td>Sedentary</td>
<td>Moderate</td>
<td>Vigorous</td>
<td>Leisure</td>
<td>Work</td>
<td>Household</td>
<td>Transport</td>
<td>Re-test reliability, Weighted mean</td>
<td>Validity criterion</td>
<td>Validity, weighted mean</td>
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<td>Baecke et al., continued</td>
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<td>11 months Total .79 Leisure .76 Sports .73</td>
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<tr>
<td>Godin Leisure-Time Exercise Questionnaire (Godin &amp; Shephard, 1985)</td>
<td>Self-administered; Habitual weekly</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td></td>
<td>2 weeks Total .74 Mod .46 Strenuous .94 1 month Total .62 Mod .36 Strenuous .84</td>
<td>Caltrac</td>
<td>.36</td>
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<td>Measure &amp; origin-</td>
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<td>Type</td>
<td>Freq</td>
<td>Intensity</td>
<td>Duration</td>
<td>Sed</td>
<td>Mod</td>
<td>Vig</td>
<td>leisure</td>
<td>work</td>
<td>household</td>
<td>transport</td>
<td>Ret-est reliability; weighted mean</td>
<td>Validity Criterion</td>
<td>Validity, weighted mean</td>
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<tr>
<td>Modified Baecke Q. for Older Adults (Voorrips et al., 1991)</td>
<td>Interview; 30 min; past year</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>2.0 days</td>
<td>pedometer; .72 (Voorips) Caltrac .22 (Pols)</td>
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<tr>
<td>Physical Activity Scale for the Elderly (PASE) (Washburn et al., 1993)</td>
<td>Self-administer; 7 days</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>3-7 weeks</td>
<td>doubly labeled water .58 (Schuit)</td>
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<tr>
<td>Yale Physical Activity Survey (YPAS) (DiPietro et al., 1993)</td>
<td>Interview; 20 min; typical in past month</td>
<td>x</td>
<td>partial</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>2 weeks</td>
<td>Caltrac overall .56 vigor = .20;</td>
<td></td>
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<tr>
<td>Zutphen Physical Activity Q. (Caspersen et al., 1985)</td>
<td>Survey; 15 min; usual</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>3 months</td>
<td>doubly labeled water .93</td>
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