Practical Guide to Measuring Physical Activity

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RESEARCH HAS DEMONSTRATED THE BENEFITS OF physical activity and the negative consequences of sedentary behavior for physical and mental well-being.[1-5] Thus, physical activity has become increasingly prominent as an intervention tool; however, research is often hindered by the challenge of employing a valid, reliable measure that also adequately satisfies the research question or design.[1,4-7] The doubly labeled water method (DLW) remains the gold standard for assessing total energy expenditure; however, it is not often used for research studies because it is expensive, has high subject burden, is time-intensive, and cannot capture qualitative data.[8,9] The aim of our commentary is to summarize the main methods of measuring physical activity as well as offer examples of their uses in research trials.[10-12]

METHODS OF MEASURING PHYSICAL ACTIVITY

Self-Report Questionnaires

These questionnaires are the most common method of physical activity assessment[13] and rely on participants' recall ability. Questionnaires vary by what they measure (eg, mode, duration, or frequency of physical activity), how data are reported (eg, activity scores, time, or kilocalories), quality of the data (eg, measures of intensity, differentiating between habitual and merely recent activities, and inclusion of leisure and nonleisure activity), and how data are obtained (eg, paper and pencil assessment, computerized questionnaire, or interview).[11,14] Validation studies comparing self-report questionnaires to DLW are inconsistent[9]; however, their advantages include cost-effectiveness, ease of administration, and accuracy in measuring intense activity[15,16]; and the ability to determine discrete categories of activity level (eg, low, moderate, or high),[16] rank individuals or groups by their physical activity,[17] provide details about the physical activity, and show improvement across groups or individuals.[14,18,19] Potential disadvantages are that self-report questionnaires are less robust in measuring light or moderate activity,[14] assessing energy expenditure,[18,19] and may be limited by the dependency on written language (ie, questions)[20] and external factors (ie, social desirability, complexity of the questionnaire, age, and seasonal variation).[21-25] Self-report questionnaires are significantly more reliable at the group level than at the individual level[9,17-19] as well as when the questionnaire is structured chronologically and with discrete periods.[26]

In Figure 1, we provide details on seven well-studied, commonly used self-report questionnaires, the Modifiable Activity Questionnaire,[27] Previous Week Modifiable Activity Questionnaire,[28] Recent Physical Activity Questionnaire,[29] International Physical Activity Questionnaires,[3,30] Previous Day Physical Activity Recall,[31] and 7-day Physical Activity Recall.[2,32]

Self-Report Activity Diaries/Logs

Self-report diaries require participants to record physical activity in real time, which provides the most detailed data[11,26] and can overcome some limitations of questionnaires (ie, less susceptible to recall errors, social desirability bias, and measurement bias).[26,33] For example, Bouchard's Physical Activity Record[34] is a widely used diary in which participants report physical activity for each 15-minute interval over 3 days. Activities are rated on a scale of 1 to 9 (1=sedentary activity and 9=intense manual work or high intensity sports) to yield a total energy expenditure score; however, the diary is burdensome, particularly for individuals with cognitive dysfunction.[30] In addition, questionnaires not completed in real time could be subject to memory bias as well as participant reactivity, the phenomenon of behavior change due to awareness of being observed.[35-37]

Direct Observation

In direct observation, an independent observer monitors and records physical activity.[38,39] This method of assessment is often used when activity is restricted to a delineated space (eg, a classroom).[39-41] It is also a popular method for young children because they have difficulty recalling their physical activity.[42] This flexible method is valuable in gathering contextual information (eg, preferred location, time, and clothing) and details of the physical activity (eg, type of activity and personalized variations to activities). Disadvantages include high cost of time and energy,[30] potential reactivity,[35-37] difficulty obtaining ethical approval,[37] and the lack of objective measures of energy expenditure.[37]

Devices: Accelerometers

In recent decades, accelerometers have gained popularity given their accuracy, ability to capture large amounts of data, and ease of administration, particularly in large studies.[9] Accelerometers measure acceleration (counts) in real time

Measure	Period(s) of interest	Categories of activity included	Input	Output	Special notes
Modifiable Activity Questionnaire[27]	Lifetime, Past year Past week	Leisure Occupation Transport	Duration Frequency	No. of hours (or MET[a] hours) per week of PA	Includes no measure of intensity
Previous Week Modifiable Activity Questionnaire[28]	Past week	Leisure Television Computer use Disability-related inactivity	Duration Frequency	No. of hours (or MET hours) per week of PA	Modified version of the Modifiable Activity Questionnaire[27] Includes no measure of intensity
Recent Physical Activity Questionnaire[29]	Past 4 weeks	Leisure Occupation Transport Home	Duration Frequency	Total energy expenditure PA energy expenditure	Includes no measure of intensity
International Physical Activity Questionnaire (Short Version)[3,30]	Habitual or past week	Vigorous PA Moderate PA Walking Sitting	Duration Frequency	Total PA scores for each category	Designed to be easily adapted in many languages and countries
International Physical Activity Questionnaire (Long Version)[3,30]	Habitual or past week	Leisure Occupation Transport Home Yard and garden Sitting	Duration Frequency	Total PA scores for each category	Versions exist for specific populations (eg, youth, elderly, and foreign language speakers[117,118])
Previous Day Physical Activity Recall[31]	Past day, 3 d, or 7 d 3:00-11:00 PM 30-min intervals	Eating Sleeping/bathing Transport Work/school Spare time Play/recreation Exercise/workout	Primary activity per interval Relative intensity rated on repeated scale (containing verbal and cartoon descriptors)	Daily total energy expenditure Total energy expenditure during specific time periods Total energy expenditure during specific activities	Designed for children and adolescents Contextual cues and prompts intended to enhance memory of PA and intensity
7-Day Physical Activity Recall [2,32]	Past week	Sleep Moderate PA Hard PA Very hard PA	Duration	Total energy expenditure	Calculations assume that the unaccounted for time was spent in light activity

[a]MET=metabolic equivalent of task (1 MET represents 3.5 mL/kg/minute oxygen consumption).[7]

Figure 1. Summary of self-report questionnaires to measure physical activity (PA).