Published in final edited form as:

J Public Health Manag Pract. 2010 ; 16(5): 404–410. doi:10.1097/PHH.0b013e3181d52804.

Measuring Physical Activity: Practical Approaches for Program Evaluation in Native American Communities

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Abstract

Promoting physical activity is a high priority in the United States, especially for Native American populations, due to very high rates of inactivity-related chronic diseases. High quality physical activity measures can contribute to achieving health goals. Measuring a sample of the population can identify high risk subgroups and geographic locations that can be targeted for interventions. Outcomes of physical activity interventions should be evaluated because this is the only way to determine whether they are effective. Three types of measures are practical for use in non-research settings, though they still present challenges. First, self-reports are commonly used; they are low-cost, but the least accurate. Second, objective monitors such as pedometers, accelerometers, and heart rate monitors can provide accurate information, but resources and expertise are needed to collect and manage the data. Third, direct observation can be used to evaluate school physical education programs and assess how people are using parks and other physical activity facilities. Studies of Native American populations have used a variety of measures. Good evaluations can lead to program improvements, documenting positive results can attract funding to continue and expand programs, and communicating results can persuade other communities to adopt effective approaches. Program evaluations using quality physical activity measures can contribute to achieving the goal of improved health in Native American communities.

The extraordinarily high rates of obesity and type 2 diabetes in Native American communities are a public health crisis that deserves immediate action. Such action needs to result in improved diets, increased physical activity, and decreased sedentary time among the entire Native American population to prevent obesity and therefore reduce the high rates of type 2 diabetes mellitus and other chronic diseases.¹ Because funding for health programs is always limited, it is essential to make the best use of scarce resources. One of the fundamental principles of public health interventions is to use research and evaluation to maximize the impact and efficiency of interventions.

In this paper my goal is to outline how physical activity measures can be used to plan and evaluate physical activity interventions as part of obesity control and health promotion efforts. Physical activity measures can be used for several purposes. First, they are useful for assessing physical activity in a sample of the population to identify high risk subgroups by demographic characteristics (e.g., age, sex, tribe) and geographic location, which can then be prioritized for targeted interventions. Second, evaluating virtually all physical activity interventions is essential because this is the only way to determine whether they are having the intended effects. Many physical activity interventions are not effective, and because most evidence-based physical activity interventions were evaluated in non-Native populations, it cannot be assumed that interventions implemented in Native American communities will be effective. Spending

some time and money on evaluation provides feedback that can lead to modifying the existing approach or adopting a completely different strategy. For this reason, I strongly recommend that each group sponsoring physical activity and obesity control interventions either identify a staff member who develops expertise in measurement and evaluation or contract with a qualified external group such as university-based researchers who can recommend specific physical activity measures that can be used for intervention planning and evaluation. The present paper focuses on measures which assess physical activity outcomes, but a comprehensive program evaluation would also assess intervention process (e.g., quality of implementation, participant satisfaction), intermediate outcomes (e.g., beliefs, social support), and additional outcomes (e.g., weight, psychological health).

Two recent papers confirm the need for immediate action to increase physical activity among Native Americans. The Strong Heart Family Study of more than 5000 Native American adults used seven days of monitoring with pedometers. Average daily step counts for the youngest to oldest age groups ranged from 5384 to 3768 for men and from 5038 to 3770 for women.² These values are much lower than the recommended 10,000 steps per day and lower than found in studies of the general population of US adults.³ Another large study of over 3600 Native American adults used surveys and came to somewhat different conclusions.⁴ Women (41%) were less likely to report meeting physical activity guidelines than men (56%), but sizeable proportions did not meet guidelines. Only 18% of participants reported no leisure time physical activity, which is less than the 33% of Native Americans and 28% of non-Native adults from a national study.⁵ However, the measures differed across studies so the rates may not be comparable. These two studies of Native American adults illustrate the point that the specific physical activity measure selected can affect conclusions drawn from the results, so measures should be chosen thoughtfully.

Physical Activity Measurement

Three types of physical activity measures are practical for use by non-researchers in Native American communities, but still challenging: self-reports, objective monitors, and direct observation. However, few measures have been validated specifically in Native American populations. I summarize the strengths and weaknesses of each, consider feasibility, and recommend measures in each category that have some evidence of reliability and validity. Reliability means the measure provides similar results on two occasions, assuming the behavior does not change substantially. Validity means the measurement instrument compares favorably with a “gold standard,” usually an objective measure. There is no ideal measure. The selection of measurement instrument depends on the purpose of the assessment and logistic considerations. No single measure can adequately assess all the dimensions of physical activity that are of interest. The most basic dimensions are frequency, intensity, time (duration), and type, often referred to as FITT. Sometimes it is important to assess the location or social context of the physical activity. For more detailed information on physical activity measures, I refer you to books⁶ and journal special issues^{7,8} that were used as sources for this article.

Self-Reports

The most commonly used category of measure asks people to recall their physical activity in recent days, weeks, or months. Self-reports can be self-administered on paper or computer, can be interviewer-administered, or can be completed as daily logs or diaries. Strengths of self-reports include low cost of administration, ability to measure large samples, availability of many instruments with evidence of reliability and validity, and ability to tailor the measure to the population and study goals. Weaknesses include well-documented inaccuracies, the tendency to over-report activity levels, use of unfamiliar terms on surveys (e.g., moderate and vigorous intensity), inability to use with young children, and inability to compare results across

studies due to the large number of measures available. Interviewer-administered surveys are probably needed with low-literacy participants, but they are more expensive to use and require training of interviewers. Physical activity logs are burdensome for participants to complete and for evaluators to score. Self-reports are usually validated by comparing them to objective measures of physical activity such as accelerometers and heart rate monitors.

Self-reports should probably not be used in children below the age of 10 or 11, because these children do not have the required cognitive skills. A further complicating factor shown by several studies⁹ is that parents and teachers cannot accurately recall children's physical activity. Thus objective measures need to be used for measuring physical activity in younger children. Though many self-reports are available for youth that vary greatly in length and complexity, I recommend a simple measure that works as well as much longer ones. This two-item measure assesses how many days per week children age 11 and older meet the guideline of 60 minutes of moderate to vigorous physical activity. Physical activity is defined, then the first question asks about the previous week, and the second question asks about a typical week. The average of the two has proven more reliable and valid than either item by itself.¹⁰ In addition to the initial validity study, the 2-item measure was used in a 34-country study and was shown to be related to obesity level in almost every country.¹¹ Although the 2-item measure does not assess types of activity that might be of interest, one study showed that middle school students were poor reporters of activity type.¹²

One self-report measure has been designed and validated for use with Native American adults, the Modifiable Activity Questionnaire.¹³ Leisure and occupational activities were assessed, and reliability and validity were demonstrated in multiple studies of Pima Indian adults.¹⁴

Until recently, physical activity self-reports mainly assessed leisure or recreational activities, but adults can also be active in their jobs, through the type of transportation they use, and in performing household chores. The International Physical Activity Questionnaire (IPAQ) was developed to assess activities in all these domains among adults aged 18 to 65 and is available in long and short versions (www.ipaq.ki.se). The IPAQ was designed to be adaptable to all cultures and languages and has been shown to be as reliable and valid as other self-reports¹⁵. Participants report the duration and frequency of their activities over the previous week. The IPAQ has been used to assess physical activity prevalence in almost 70 countries,^{16,17} so results with this measure can be compared to a variety of populations. A limitation is that the short IPAQ does not provide summaries by domain; however, the slightly longer Global Physical Activity Questionnaire does summarize activities by recreation, occupation, and transportation domains¹⁸ (www.who.org/gpaq). A further limitation of many self-report measures, including IPAQ,¹⁹ is that they have not been shown to be sensitive to changes in interventions and may be more appropriate for estimating the prevalence of physical activity in the population.

For older adults, the CHAMPS (Community Health Activities Model Program for Seniors) physical activity questionnaire was designed to assess changes in intervention studies.²⁰ CHAMPS assesses the frequency and duration of a wide range of activities that could be adapted for different population groups. CHAMPS has been validated with diverse groups, including African Americans²¹, and it is sensitive to change in interventions.²²

Activity and Heart Rate Monitors

Advances in technology have created small electronic devices – pedometers, accelerometers, and heart rate monitors -- that can be used to record and store minute-by-minute activity levels for weeks at a time. Although all the objective monitors have large advantages over self-reports, each has limitations. Nevertheless, objective monitors are the only option for obtaining quality

measures of young children's activity. Activity monitors are now commonly used in research and are being used more in community and clinical settings.

Pedometers are worn on the waist and count steps. They are often used in physical activity and weight loss interventions because they help participants keep track of their activity levels. Pedometers vary in cost and accuracy,²³ but reasonable units cost as low as \$10, and newer models with 7-day memories cost about \$50. Pedometers are easy to use for participants and evaluators, and they accurately assess walking, which is the most common activity. They are less useful for running, cycling, and water activities, and they work less well for young children who do a variety of activities and for older adults who walk too slowly for accurate measurement. Another disadvantage of pedometers is that it is not usually possible to tell whether low scores mean the person was not active or if the device was removed.

Accelerometers are more sophisticated than pedometers and measure the intensity of body movement each minute, though they should be set to record every 15 or 30 seconds with children. Accelerometers can be used to determine whether participants are meeting moderate-to-vigorous physical activity guidelines. Although accelerometers can be used with participants of any age, interpretation of results varies by age. Because they are so small, it is common to wear them one week or more.²⁴ An advantage of accelerometers is they can also assess sedentary time by counting minutes with very little movement. This is important because sedentary time is a risk factor for obesity and diabetes even among people who are active.²⁵ Perhaps the biggest disadvantage is that accelerometers are not accurate in assessing such activities as bicycling, swimming, weight lifting, and many household chores. However, they can be used with people of all ages.

Accelerometers are easy for participants to use, but challenging for researchers and evaluators because a large volume of data is generated that must be checked, cleaned, scored, and summarized. There is no consensus on how to define valid wearing days or how to score the data. Different “cut-points” are needed to define intensity levels for each age group.²⁶ The most-used accelerometers are the Actigraph (www.theactigraph.com) and the Actical (www.respironics.com), with costs starting about \$350. National US physical activity prevalence data based on accelerometers is now available,²⁷ so results with Native American samples can be compared to national data if similar methods are used.

Physical activity causes increases in heart rate, so heart rate can be used to estimate the intensity of physical activity for people across the age range. The most common heart rate monitors require a sensor attached to the chest with adhesive patches or a strap, plus a receiver that records and stores the data that is worn on the wrist. Heart rate monitors can detect just about any type of activity, and they can even be used for activities in the water. However, moderate elevations in heart rate can be caused by physical activity or by emotions, so these monitors are most useful for identifying vigorous physical activities. Disadvantages include the need to manage large amounts of data and the difficulty of monitoring over several days because chest electrodes become uncomfortable over time.²⁸ Men's chest hair may need to be shaved to create a strong connection between sensor and skin. Heart rate monitors with memories cost as little as \$100, and they are rarely used to evaluate community or clinical programs except rehabilitation after heart attacks or surgery. Some physical education teachers use heart rate monitors in their classes. They may be best suited to educate participants what it feels like to exercise at varying intensity levels. The main supplier of heart rate monitors is Polar (www.polarusa.com).

Combining heart rate and movement (HR+M) monitors is a relatively new approach that is more accurate than either method alone.²⁹ Both of the main accelerometer makers have combined monitors. The HR+M monitors compensate for the limitations of separate devices

so that all types of activities can be assessed throughout the range of intensities, including sedentary behaviors. The HR+M monitors retain the difficulties of assessing heart rates over several days, and they are only feasible for research groups because of the challenges of analyzing the data.

Some users are concerned about the monitors creating reactivity among participants, or changes in behavior caused by the measurement. Most studies indicate activity monitoring does not create much reactivity.³⁰ However, it may depend on the specific monitor. Pedometers and heart rate monitors are used in intervention programs because they provide ongoing feedback about activity levels that may motivate change. This is a benefit of the technology. But if the purpose is to obtain an accurate assessment of habitual activity levels, then feedback and reactivity become a problem. Most accelerometers used in research provide no feedback to participants, so reactivity should be minimized. When using pedometers and heart rate monitors that provide feedback for measurement purposes, the displays can be covered with tape or other simple materials.

Direct Observation

Direct observation is used most often for assessing physical activity of groups in specific settings, such as physical education classes, school recess, and parks. Observation methods can be used to count people on trails, sidewalks, and stairs, though electronic (e.g., infrared) monitors are available for the same purposes. Human observers can record specific types of activities and aspects of physical and social environments, such as weather, equipment, type of setting, and presence and behavior of leaders or teachers. Observers must be trained to use specific definitions and observation methods, and quality is indicated when there is a high agreement among observers.

Advantages of direct observation include high quality data, ability to record numerous dimensions of physical activity (i.e., FITT), and flexible scoring of results. Disadvantages are the expense of human observers, need for training, difficulties of managing and scoring the data, and possible reactivity effects of the observations on participant behavior.³¹

Two widely used observation measures illustrate the method's use. The System for Observing Fitness Instruction Time (SOFIT) was developed to evaluate physical education classes.³² Student Activity is coded into five categories: lying, sitting, standing, walking, and very active. One student is randomly selected, behavior is coded every 30 seconds for five minutes, then another student is selected. Teacher Behavior within each 30-second period is coded into categories such as fitness instruction, demonstration, general knowledge, and off-task. Lesson Context is used to determine how the class is structured, and codes include management, fitness, and skill practice. Trained observers obtain highly reliable results, and SOFIT has been used to evaluate numerous physical education programs for research and non-research purposes.

The System for Observing Play And Recreation in Communities (SOPARC) was designed to evaluate how parks and other recreation settings are being used.³³ First, the park is divided into activity zones. Then trained observers go to each zone in turn and “scan” the zone from left to right, coding the activity level of each person at the moment they are observed. Separate scans can be done for females, males, children, older adults, and racial/ethnic minorities. Activity level is coded as sedentary, walking, or very active. Thus SOPARC measures both number of people in each zone and their activity levels. Results can be used to compare activity levels across different parts of the park, various population subgroups, and different times of the day or week. The context of the physical and social environment can be coded, including main type of activity, supervision, equipment, and weather. Details about SOFIT, SOPARC, and other observational measures are available at www.activelivingresearch.org.

Direct observations have been used most often in physical activity research, but they are only feasible for evaluating community programs if sufficient expertise and resources are available for training observers and managing the data. The results can be considered objective measures and can be used to evaluate both programs and environmental interventions.

Examples of Measures Used With Native Americans

It is instructive to consider some examples of physical activity measures used in major studies with Native American populations. In the Pathways obesity prevention program with Native American school children, a systematic process was undertaken to select or develop appropriate physical activity measures.³⁴ The decision was made to use both self-report and accelerometer methods. The self-report was a 24-hour recall, which minimized the recall time, adapted from a validated measure. Based on interviews and observations with Native American children, a list of physical activities and sedentary behaviors was created, and children indicated their level of participation on a simple scale (none, a little, a lot). An accelerometer was selected to provide an objective measure of physical activity. A pilot study in six Native American communities indicated the methods were feasible to implement and acceptable to children and school officials.³⁴

Studies of Native American adults illustrate different approaches that can be taken. In a very large study of over 5000 adults in three geographic areas, a self-report questionnaire was used.⁴ The measure was based on a survey developed for racial and ethnic minority women³⁵ that was modified to reflect major sources of activity and sedentary behavior by Native Americans, including activities during leisure time and paid work. Part of the survey required a 7-day recall and part required recall over the previous year. The questionnaire was validated by pedometer.⁴

In the Strong Heart Family Study conducted in 13 Native American communities, seven days of monitoring with pedometers was conducted.² This study of over 3600 adults was the first to assess physical activity objectively in a large sample of Native Americans. The pedometer recorded steps for each day in its memory, and special procedures were used to ensure proper placement on severely obese individuals. Steps per day were significantly related to body mass index in both women and men, with leaner participants taking more steps.²

Summary and Conclusions

The physical activity measures described here can be used to define the problem of inactivity, identify high risk subgroups, pinpoint opportunities for intervention, and evaluate the outcomes of interventions. Using high quality data as part of program planning and evaluation can help public health professionals make the greatest possible impact with limited resources. The high rates of obesity, diabetes, and other chronic diseases in Indian Country make it especially critical to use resources as efficiently as possible.

There are multiple options for measuring physical activity. Self-reports initially seem like the obvious choice in many situations, but this method cannot be used with children younger than 10 or 11 years, and the results can be misleading. For example, national data from the Youth Risk Behavior Survey indicated that about 35% of high schools met physical activity guidelines,³⁶ but based on accelerometer data, only 3-10% were meeting guidelines.²⁷ This is a huge difference and would affect perceptions of the urgency of the problem of inactivity. Thus I recommend using objective measures if at all possible.

For many practitioners in the isolated and inadequately-staffed clinical and community settings so common in Indian Country, pedometers are a reasonable option. Pedometers are low cost, and the data are easy to manage and interpret. The models with 7-day memory could be used

to evaluate programs, and they can be motivating for participants when used as part of the intervention. Simple and low-cost pedometers can be used to evaluate activity levels in physical education classes, recess, after school programs, youth sports, and senior recreation classes. It is not necessary to monitor every participant every day. Even monitoring 5-10 participants every week could give ongoing feedback about how much physical activity is being provided by programs.

Intervention staff should consider using accelerometers or direct observation to formally evaluate new initiatives, whether they are programs or environmental changes such as building trails or adding playground equipment in parks. Most community or clinic groups would need to add staff with specialized training or collaborate with academic researchers already skilled in using objective measures and managing the complex data that are generated. There are measures in all three categories described in this paper that are challenging to use and produce data that are difficult to manage and interpret. Developing collaborations with researchers who have experience in physical activity measurement could be valuable in selecting the measures and building the capacity of practitioner groups to use high-quality measures. Especially for self-reports, it may be useful to adapt the instrument to reflect the situation in the Native American community. For adults, it is possible to use measures developed for and validated in Native American populations.^{4,13} All candidate measures should be pretested with the target population before making final decisions. In some situations, it may be advantageous to employ multiple measures, such as accelerometers to quantify total physical activity, self-reports to assess types of activity, and direct observation to evaluate use of new physical activity facilities.

Good evaluations do more than satisfy curiosity. Good evaluations can lead to program improvements, documenting positive results can attract funding to continue and expand programs, and communicating results can persuade other communities to adopt effective approaches. Program evaluations using quality physical activity measures can contribute to achieving our shared goal of improved health in Native American communities.

Acknowledgments

This work was supported by Active Living Research, a national program of The Robert Wood Johnson Foundation, and NIH grant HL083454.

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Biography

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