**The Physical Activity Vital Sign: A Primary Care Tool to Guide Counseling for Obesity**

Jessica L.J. Greenwood, Elizabeth A. Joy, and Joseph B. Stanford

**Background:** Only 25% of US adults achieve adequate physical activity (PA). Obtaining a PA history is an appropriate first step when evaluating this behavior. The Physical Activity Vital Sign (PAVS) is a clinical tool designed to screen for PA in adults.  

**Methods:** To determine how responses to the PAVS questions associate with BMI, overweight, and obesity, we performed a cross-sectional study utilizing the PAVS, and measured height and weight. Data were collected from adults at 2 clinics within the Utah Health Research Network.

**Results:** Adjusting for demographic factors, BMI decreased 0.91 units for every reported day of PA during a typical week ($P < .001$), and the odds of obesity was significantly decreased by 0.73 for every day of PA reported in a typical week, ($P = .001$). **Conclusion:** Response to the PAVS question of typical behavior is highly correlated with BMI. Although response to the PAVS question of behavior last week is not correlated, this question may prompt accurate recall to the typical week question and help guide patient counseling. Our results support the construct validity for the use of the PAVS as a clinical screening tool and suggest the need for additional research to characterize the properties of the PAVS.

**Keywords:** exercise, physical activity, screening, overweight, weight

“Physical inactivity is one of the most important public health problems of the 21st century, and may even be the most important.”¹ A conservatively estimated 400,000 deaths were attributed to poor diet and inactivity in 2000.² Fitness and exercise have significant positive prognostic value for all cause mortality, including a clear dose-response association with health outcomes.³ Physical inactivity contributes to excess weight and the development of chronic diseases including cardiovascular disease, type 2 diabetes mellitus, gallbladder disease, and osteoarthritis.⁴

In October 2008, the United States Department of Human and Health Services (USDHHS) published official physical activity guidelines for Americans. For health benefits, the USDHHS recommends that adults should

- Avoid inactivity
- Do at least 150 minutes (2 hours and 30 minutes) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity
- Increase their aerobic physical activity to 300 minutes (5 hours) a week of moderate-intensity, or 150 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity activity
- Do muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on 2 or more days a week.⁵

The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) recommendation for physical activity states

To promote and maintain health, all healthy adults aged 18-65 yr need moderate-intensity aerobic (endurance) physical activity of a minimum of 30 min on 5 days each week or vigorous-intensity aerobic physical activity for a minimum of 20 min on 3 days each week.⁶

Previous recommendations encouraged moderate-intensity exercise on most days of the week.⁷,⁸ Unfortunately, the majority of adults (>50%) in the United States do not achieve the recommended physical activity.⁹,¹⁰ and approximately 15% are inactive, participating in no moderate- or vigorous-intensity physical activity of at least 10 minutes per day.¹⁰

Over 65% of adults in the United States are overweight or obese, and greater than 30% are obese.¹¹ Clinicians have an opportunity to encourage behavior change in regard to physical activity and obesity. However, only 30% and 42% of those who are overweight or obese, respectively, reported that their clinician advised them to lose weight within the past year.¹²,¹³ A recent Cochrane meta-analysis by Shaw et al indicated that exercise alone can decrease weight 0.5 to 4.0 kg and BMI 0.3 to 0.7 kg/m² compared with a weight and BMI change

The authors are with the Dept of Family and Preventive Medicine, University of Utah, Salt Lake City, UT.
Physician-based Assessment and Counseling (PACE) is a program that utilizes an 11-item physical activity assessment tool (ie, 7-day Physical activity recall and 3 walking scales), and an intervention with a physician and a health educator. The Physical Activity for Life (PAL) program utilizes the Physical Activity Scale for the Elderly (PACE) and a physician counseling intervention to increase this behavior in older adults. The Physical Activity Counseling Trial (PAC) included brief physician counseling, a physical activity intervention and self reported physical activity to determine how self-efficacy was associated with this behavior. The Activity Counseling Trial (ACT) used a 7-day physical activity recall to compare the effects of 2 specific counseling interventions. These endeavors focus on counseling interventions rather than utilizing and effective physical activity assessment tool.

Two validated and reliable questionnaires exist to assess physical activity in adults: the Rapid Assessment of Physical Activity (RAPA) and the Physical Activity Assessment Tool 3 (PAAT). The RAPA is a 2 page questionnaire, including 9 questions and scoring instructions. The PAAT is a 2 page survey with more than 20 questions. Because of the length and complexity of these questionnaires, it would be difficult to routinely use these tools during a 15 to 20 minute clinical visit. After analyzing several physical activity assessment tools, Glasgow et al recommended the RAPA as a primary measure for this activity in adults, though they recognized the assessment tools considered in their study would be difficult to implement in practice.

Therefore, we have developed the Physical Activity Vital Sign (PAVS) as a clinical assessment tool designed to gauge adult moderate to vigorous physical activity levels. The PAVS asks 2 questions: 1. How many days during the past week have you performed physical activity where your heart beats faster and your breathing is harder than normal for 30 minutes or more? 2. How many days in a typical week do you perform activity such as this? The responses are reported in a format similar to blood pressure (ie, days during past week over days in typical week). The responses yield a PAVS score ranging from a minimum of 0/0 to a maximum of 7/7. Review of these responses by a clinician prompts and initiates the process of patient evaluation with respect to physical activity. The PAVS can take less than 30 seconds to administer and score, and, if administered routinely, provides valuable information regarding physical activity for every outpatient encounter.

To explore the validity of the PAVS as a clinical screening tool, we performed a cross-sectional study to associate responses to the PAVS questions with BMI, overweight, and obesity. The study also included an assessment of eating behaviors as reported previously. This paper includes analyses of only the PAVS and BMI data.

**Methods**

Before data collection, the University of Utah Institutional Review Board approved this study. From May through August 2007, we recruited English speaking adults (age 21 to 65 years) who came to 2 university-based family medicine clinics in the Utah Health Research Network (referred to as Clinic 1 and Clinic 2). Adult patients presenting for any chief complaint were invited to participate, with the following exceptions. We excluded pregnant women, those who had undergone bariatric or cardiac surgery, and those with a known eating disorder, kidney failure, or uncontrolled thyroid disorder. We also excluded those who could not read English. Demographic information collected included age, gender/sex, race/ethnicity, and number of years completed in school.

We used one of the 2 clinic sites for data collection each day of the study; the clinic site for the day was selected randomly by coin toss. After we obtained informed consent, the subjects from each clinic completed the PAVS questions in a written questionnaire. A medical assistant measured and recorded height and weight at the same visit. We calculated BMI using the following equation: BMI = [weight (pounds)] / [height (inches) × 703]. We defined normal weight as BMI 18.9 to 24.9 kg/m², overweight as 24.9 to 29.9 kg/m², and obese as greater than 29.9 kg/m². The distribution of BMI and demographic characteristics for the participants from Clinic 1 and Clinic 2 were very similar; therefore, we combined the data from each clinic for all analyses.

Utilizing Stata 10 statistical software, we assessed linear and logistic regression models for the outcomes of BMI, and overweight or obese, respectively. The primary predictor variable in the model was the response to the PAVS questions. We assessed unadjusted models and models adjusted for the demographic variables age, sex/gender, race/ethnicity, and years of education. We conducted analyses with and without persons that had missing demographic data. We also created new variables to categorize physical activity as greater than or equal to 5 times per week, and repeated the regression models. We dichotomized the frequency of physical activity based on the ACSM and AHA recommendation for adults to achieve moderate-intensity physical activity on at least 5 days of the week.

Finally we used Spearman’s correlation to determine the colinearity between the 2 PAVS questions.

**Results**

Two hundred fifty-four clinic patients were enrolled as study participants and 7 additional persons who accompanied the clinic patients and met other eligibility criteria requested to take part in the study (71% participation rate). A total of 137 subjects were from Clinic 1 and 124 subjects were from Clinic 2. The gender, age distribution, and race/ethnicity were similar for participants from each clinic. Furthermore, the mean BMI at each clinic was equal at 28 kg/m² (SD 7, min 17, max 69). Participants...
were 58% female, had a mean age of 38.4 years ± 11.7 years, and were 80% white/Caucasian, 2% black, 5% Asian, 5% Latino, and 9% Other. See Table 1 for details of the demographic data. Full details on sample recruitment have been published previously.22

Utilizing linear regression, we created multiple models to associate BMI with the PAVS questions. With univariate regression models, we found that BMI was significantly decreased by 0.83 units for every day reported physical activity in a typical week ($P < .001$), and BMI was significantly decreased by 2.42 units for reported exercise 5 or more times in a typical week ($P = .01$). In separate models, we used the responses to the individual PAVS questions as the predictor variable and adjusted for demographic characteristics (ie, age, gender/sex, race/ethnicity, and years of education). We found that BMI decreased 0.91 units for every day of moderate-intensity physical activity during a typically week ($P < .001$). Furthermore, while adjusting for demographic factors, BMI was significantly decreased 2.90 units for those who reported physical activity 5 or more times in a typical week ($P < .01$) (see Table 2).

Subsequently, we created logistic regression models to associate the odds of overweight or obesity with the responses to the PAVS questions. The unadjusted odds of being overweight was significantly decreased by 0.44 units for those who reported exercising 5 or more times weekly ($P = .01$). However, this decreased odds of being overweight lost significance when adjusting for demographic factors. Without adjusting for demographic factors, we found that the odds of being obese are 0.73 times less for each day of reported physical activity in a typical week ($P < .001$). Adjusting for demographic factors, the odds of obesity continued to be significantly decreased by 0.73 for every day of physical activity reported in a typical week, ($P < .01$). Concurrently, the odds of being obese was significantly decreased for those who reported exercising 5 or more times in a typical week (OR –0.44, $P < .01$) (see Table 3).

Spearman’s correlation determined that the questions of past week recall versus typical week recall were substantially collinear for physical activity ($r = .78$).

Table 1  Demographic Characteristics and BMI

<table>
<thead>
<tr>
<th>Characteristic*</th>
<th>N (Prevalence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants (N = 261)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>152 (58%)</td>
</tr>
<tr>
<td>Male</td>
<td>109 (42%)</td>
</tr>
<tr>
<td>Age (mean = 38.4 ± 11.7 years)</td>
<td></td>
</tr>
<tr>
<td>21–29 years old</td>
<td>77 (30%)</td>
</tr>
<tr>
<td>30–39 years old</td>
<td>74 (28%)</td>
</tr>
<tr>
<td>40–49 years old</td>
<td>49 (19%)</td>
</tr>
<tr>
<td>50–59 years old</td>
<td>50 (19%)</td>
</tr>
<tr>
<td>60–65 years old</td>
<td>11 (4%)</td>
</tr>
<tr>
<td>Clinic 1</td>
<td>137 (52%)</td>
</tr>
<tr>
<td>Clinic 2</td>
<td></td>
</tr>
<tr>
<td>Race/ethnicity (N = 259)</td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>208 (80%)</td>
</tr>
<tr>
<td>Black</td>
<td>5 (2%)</td>
</tr>
<tr>
<td>Asian</td>
<td>12 (5%)</td>
</tr>
<tr>
<td>Latino/Hispanic</td>
<td>12 (5%)</td>
</tr>
<tr>
<td>Other</td>
<td>19 (9%)</td>
</tr>
<tr>
<td>Years of schooling (mean= 15.7 ± 3.4)</td>
<td></td>
</tr>
<tr>
<td>BMI† (N = 261)</td>
<td></td>
</tr>
<tr>
<td>Mean BMI= 27.7 ± 7.2</td>
<td></td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
</tr>
<tr>
<td>Underweight (less than 18.5)</td>
<td>7 (3%)</td>
</tr>
<tr>
<td>Normal Weight (18.5–24.49)</td>
<td>91 (35%)</td>
</tr>
<tr>
<td>Overweight (24.5–29.49)</td>
<td>85 (33%)</td>
</tr>
<tr>
<td>Obese (29.5 or greater)</td>
<td>78 (30%)</td>
</tr>
</tbody>
</table>

* Combined data from Clinic 1 and Clinic 2.
† BMI = Body mass index calculated from height and weight measurements taken on the same day as the survey. All measurements were recorded in inches and pounds (BMI = (height²/ weight) × 703).

Discussion

The Physical Activity Vital Sign is a novel clinical screening tool to assess moderate- to vigorous-intensity physical activity in adults. This is the first study utilizing the PAVS questions to associate this behavior with weight. We found that responses to both PAVS questions were associated with decreased BMI and odds of obesity. We found that the typical week question was the more potent predictor. Furthermore, the responses to the 2 questions were highly correlated.

We consider this to be a promising pilot investigation in support of the construct validity for the use of the PAVS as a clinical screening tool. As there is no single widely accepted or implemented instrument for measuring physical activity in the clinical setting, this novel instrument could be useful when assessing physical activity for preventing or managing obesity. Associating the responses to the PAVS and objective measurements of physical activity (ie, an accelerometer) would support criterion validity of the PAVS, though a true gold standard for objective physical activity assessment has not been established. The strong correlation between the 2 PAVS questions provides evidence in favor of the content validity and predictive value of self-reported physical activity for excessive weight, as assessed by the PAVS. However, the weaker association between responses to the first PAVS question and BMI does not support this.

Sallis et al suggest that an instrument with construct validity assesses sedentary-, moderate- and vigorous-intensity physical activity and assesses this behavior in multiple contexts (ie, occupational and residential).23
Table 2  Change in BMI Associated With Responses to the Physical Activity Vital Sign Questions*

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted β coefficient</th>
<th>Adjusted β coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(95% CI)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>PA per day last week</td>
<td>–0.33 (–0.77 to 0.10)</td>
<td>–0.37 (–0.82 to 0.07)</td>
</tr>
<tr>
<td>PA per day typical week</td>
<td>–0.82 (–1.28 to –0.37)</td>
<td>–0.91 (–1.40 to –0.44)</td>
</tr>
<tr>
<td>PA ≥ 5 times last week</td>
<td>–1.44 (–3.44 to 0.56)</td>
<td>–1.78 (–3.81 to 0.25)</td>
</tr>
<tr>
<td>PA ≥ 5 times typical week</td>
<td>–2.42 (–4.36 to –0.49)</td>
<td>–2.90 (–4.88 to –0.91)</td>
</tr>
</tbody>
</table>

*Based on univariate and multivariate linear regression analysis. Multivariate regression adjusted for age, gender/sex, race/ethnicity, and schooling. Each cell represents a separate model.

Note. Bold indicates statistical significance.

Abbreviations: CI, confidence interval; PA, reported physical activity.

Table 3  Odds of Overweight and Obesity Associated With Responses to Physical Activity Vital Sign Questions Categorized*

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted odds</th>
<th>Adjusted odds</th>
<th>Unadjusted odds</th>
<th>Adjusted odds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(95% CI)</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>PA per day last week</td>
<td>1.11 (0.95 to 1.30)</td>
<td>1.09 (0.93 to 1.29)</td>
<td>0.87 (0.75 to 1.03)</td>
<td>0.87 (0.74 to 1.03)</td>
</tr>
<tr>
<td>PA per day typical week</td>
<td>1.30 (1.09 to 1.55)</td>
<td>1.27 (1.05 to 1.54)</td>
<td><strong>0.73 (0.61 to 0.88)</strong></td>
<td>0.73 (0.60 0.89)</td>
</tr>
<tr>
<td>PA ≥ 5 times last week</td>
<td><strong>0.44 (0.23 to 0.82)</strong></td>
<td>1.40 (0.63 to 3.09)</td>
<td>2.38 (1.30 to 4.38)</td>
<td>0.62 (0.28 to 1.37)</td>
</tr>
<tr>
<td>PA ≥ 5 times typical week</td>
<td>0.59 (0.32 to 1.08)</td>
<td>1.62 (0.74 to 3.52)</td>
<td>1.67 (0.93 to 3.00)</td>
<td><strong>0.44 (0.20 to 0.98)</strong></td>
</tr>
</tbody>
</table>

Note. Bold indicates statistical significance.

*Based on logistic regression models. Adjusted models control for age, gender/sex, race/ethnicity, and schooling. Each cell represents a distinct model.

Abbreviations: CI, confidence interval; PA, reported physical activity.

Utilizing the PAVS alone would not yield such information. However, we have created the PAVS for use as a screening tool. The questions are to prompt further examination and evaluation of physical activity, during which, in-depth quantitative and contextual information can surface.

Although, the response to the question of physical activity last week was not the more potent predictor of BMI, our experience suggests that it is important to include this question to prompt accurate recall for the typical week question, as well as to individualize patient counseling. The response to the PAVS question regarding activity last week may reflect more contextual detail and acute changes in a patient’s lifestyle, and may guide initial efforts at assessment and counseling regarding physical activity. For example, if a patient traveled on the previous week and got out of their typical routine, reviewing the PAVS questions could initiate a conversation about how to achieve physical activity goals in varying living situations. Future research with the PAVS should compare results with inclusion or exclusion of the questions about physical activity in the past week.

Several factors, limit the inferences that can be made from this study. The measure of physical activity was obtained from self report, and the accuracy of self report can be variable. An objective measurement would be more precise. Our study had a relatively small sample size, and participants were solely recruited from university-based family medicine clinics in Salt Lake City. We collected data for this study during the summer months of 2007; therefore, we could not account for seasonal variations of behavior. The ethnic/racial diversity of our sample was limited, and we did not include people who do not speak or read the English language. We cannot address cause and effect with a cross-sectional study; therefore, we cannot evaluate whether less frequent physical activity causes increased BMI or whether higher BMI limits physical activity.

We did not formally adjust the alpha level for multiple analyses for 2 reasons. First, the sample size was small in our pilot study. Second, our analyses were not independent assessments of multiple dimensions, but rather highly related predictors (recent and typical counts of days of physical activity) and outcomes (BMI continuous, and BMI with different cutoffs). The trends for all related analyses were consistent throughout our results, even for those results that did not achieve statistical significance. This suggests that these results may be robust, but replication research is needed for confirmation.
The responses to the PAVS questions do not reveal the quantitative detail necessary to determine the specific level of intensity or duration of activity by the minute as required by the USDHHS guidelines. However, we feel that the PAVS questions allow for a rapid screening for this behavior, which can then lead to more detailed evaluation as needed. Though the US Preventive Services Task Force (USPSTF) updated their recommendations to reflect the “insufficient evidence to determine whether counseling patients in primary care settings to promote physical activity leads to sustained increases in physical activity among adult patients,” the American College of Sports Medicine (ACSM), and the American Heart Association (AHA) continue to recommend that clinicians advise every patient in the primary care setting to participate in regular physical activity. Discussing the importance of physical activity with a patient can increase the chance of changing the patient’s behavior.

While physicians recognize the importance of physical activity in promoting health and preventing disease, only a minority provide such advice during routine office visits. Wee, et al, found that only 34% of nearly 10,000 patients were counseled about exercise during their last physician visit. Direct observation of exercise counseling in a community family practice setting found that such counseling was provided in only 22% of visits, and the average time spent counseling patients about exercise was a mere 49 seconds. A study of exercise counseling rates in patients at high risk for coronary artery disease (CAD) found that only 1% were advised to increase exercise levels.

Obtaining a physical activity history is a natural and appropriate first step when evaluating this behavior. The Public Health Service (PHS) program on tobacco cessation can be a useful model for physical activity assessment and counseling. In these guidelines, the PHS suggests physicians follow the “5 A’S”: ask, advise, assess, assist, and arrange. Smith et al suggest using a similar approach to assess and promote physical activity. We agree that clinicians should ask every patient about physical activity at every visit, and assess their current physical activity level, asking inactive patients about their readiness to increase their activity. Subsequently, advice, assistance, and arrangements can be offered to the patient. Jaen et al found that due to competing priorities, it is appropriate and reasonable to not discuss behavior change during some clinic visits. However, the investigators agree that just as temperature, weight and height are routinely obtained during a clinic encounter, a clinician can consistently ask and assess the patient’s physical activity at every office visit, even if this behavior is not addressed directly.

Due to its simple and brief nature, the PAVS can provide a systematic approach to physical activity evaluation when collected by a nurse or medical assistant with other standard measurements (ie, pulse, blood pressure, temperature, etc.) at the beginning of the clinical encounter. After obtaining information regarding self-reported physical activity, the clinician can then address physical activity in the context of a patient’s unique health needs. The PAVS can assist with child and adolescent evaluations as well. However, further investigation is warranted to associate the use of the PAVS questions with physician counseling behavior, and to firmly establish the validity and reliability of the PAVS in adults and children. We recognize that weight is a product of energy balance: energy intake versus energy expenditure. However, as Hippocrates taught, “Eating alone will not keep a man well; he must also take exercise.”

Acknowledgments

We are grateful for the time and counsel provided by the following persons: Maureen A. Murtaugh, PhD RD, Steven C. Alder, PhD, and Emily M. Omura, BS.

References