# Reliability and Convergent Validity of the National College Health Risk Behavior Survey Physical Activity Items

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**ABSTRACT**

*This study examined the reliability and validity of the National College Health Risk Behavior Survey (NCHRBS) vigorous physical activity (VPA), moderate physical activity (MPA), flexibility (FLEX), and muscular strength and/or endurance (MSE) questions. Twenty college students completed the four items twice during the same day. During the next 7 days they wore an accelerometer and a pedometer during all waking hours. They also recorded their daily activity in a log. At the end of the week, subjects completed the NCHRBS physical activity items again. The intraclass correlation coefficients ranged from .94–.99 for the four items. The vigorous item was highly correlated with log VPA (r=.82) and number of days with ≥20 minutes of VPA from the accelerometer (r=.60). The flexibility item was moderately correlated (r=.57) and the muscular strength and/or endurance item was highly correlated (r=.89) with corresponding log activities. The moderate item was highly correlated with log MPA (r=.66) and number of days with ≥30 minutes of MPA from the accelerometer (r=.61). In conclusion, the NCHRBS physical activity items have excellent test-retest reliability and validity indices similar to other self-report physical activity questions.*

When young adults attend college, they gain increased control over their lifestyles and develop a foundation of behaviors that may last throughout their lives. Researchers have determined that physical inactivity increases with age and the most rapid increase occurs in late adolescence and early adulthood (Stephens, Jacobs, & White, 1985). Many young adults on college campuses are not meeting current physical activity recommendations (Centers for Disease Control and Prevention, 1997; Dinger, 1999; Dinger & Waigandt, 1997), and a substantial proportion are leading a sedentary lifestyle (Pinto & Marcus, 1995). Because physical inactivity is a major risk factor for coronary heart disease and is also associated with increasing risk for adult-onset diabetes, hypertension, colon cancer, osteoporosis, anxiety, and depression (Pate et al., 1995), it is important that we have valid and reliable physical activity assessment tools that are specific to the college student population.

In many settings, surveys are the most appropriate measure of physical activity because they are simple, inexpensive, unobtrusive, and generally do not require much effort on the part of the respondent (Ainsworth, 2000). A widely used survey with the college student population is the National College Health Risk Behavior Survey (NCHRBS) (Centers for Disease Control and Prevention, 1997). The NCHRBS is the college student version of the Youth Risk Behavior Survey (Kolbe, Kann, & Collins, 1993). The NCHRBS was developed by the Centers for Disease Control and Prevention to assess health-risk behaviors that are often established during youth and extend into adulthood. Six behavior categories are assessed by the

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survey: physical inactivity, tobacco use, alcohol and other drug use, high-risk sexual activity, dietary consumption, and unintentional and intentional injuries (Kolbe et al., 1993).

The physical activity questions from the NCHRBS have been used widely to describe physical activity among college students (Centers for Disease Control and Prevention, 1997; Dinger, 1999; Dinger & Waigandt, 1997), but the reliability and validity of these questions have not been determined (Brener, Collins, Kann, Warren, & Williams, 1995). The purpose of this study was to examine the reliability and validity of the NCHRBS vigorous physical activity (VPA), moderate physical activity (MPA), flexibility activity (FLEX), and muscular strength and/or endurance activity (MSE) items.

## METHODS

### *Subjects*

A power calculation was conducted before the study began to determine the necessary number of subjects. The researcher reviewed the literature and determined that a Pearson correlation coefficient of .55 between the physical activity questions and direct measures of physical activity would be meaningful. According to Kraemer and Thiemann (1987) at least 19 subjects were needed (80% power, one-tailed test, alpha=.05).

Twenty college students were recruited and volunteered to participate in the study. There were 9 women (age: 24.1±3.5 years, body mass index (BMI): 27.9±6.4) and 11 men (age: 24.0±3.2 years, BMI: 26.4±3.9). All subjects were academically classified as seniors.

### *Design*

A correlational design was employed. Student responses to the four physical activity items were correlated with number of days of VPA, number of days of MPA, number of steps, and activity log data to examine the validity of the items.

### *Measures*

Physical activity can be assessed using indirect or direct methods. Indirect methods are surrogate markers of physical activity, and direct methods reflect actual movement and/or energy expenditure (Ainsworth, 2000). Whereas surveys are indirect measures of physical activity, accelerometers, pedometers, and activity logs are considered to be direct, quantitative measures of physical activity. Therefore, these measures are used to validate physical activity surveys and other subjective physical activity measures (Ainsworth, 2000). To triangulate the findings, three direct measures of physical activity (accelerometers, pedometers, and activity logs) were used as direct criterion measures in this study.

*NCHRBS Physical Activity Items*. These items require subjects to report their participation in VPA, MPA, FLEX, and MSE during the previous 7 days. The original MPA question from the 1995 NCHRBS was assessed along with the revised MPA item from the 2000 Youth Risk Behavior Survey. These items are presented in Figure 1.

*Computer Science and Applications Actigraph Accelerometer*. The Actigraph (model 7164) accelerometer is a small, lightweight, personal physical activity measurement and recording system (Computer Science and Applications, 1999) that was used as one direct criterion measure of subjects' ambulatory physical activity in this study. Accelerometers detect motion produced by a change in the speed or pattern of bodily movements. The Actigraph allows for continuous collection (1-minute intervals) and storage of data for up to 22 days. The stored data can be downloaded via interface to a personal computer for analysis. Actigraph data are in counts per unit time and represent the level or intensity of the activity during each time period. Several studies have reported that Actigraph counts are significantly correlated with energy expenditure and relative oxygen consumption (Hendelman, Miller, Baggett, Debold, & Freedson, 2000; Melanson & Freedson, 1995; Welk, Blair, Wood, Jones, & Thompson, 2000). The Actigraphs used in this study were approximately 1 month old and had calibration checks completed prior to being shipped from the manufacturer.

*Yamax Digiwalker Pedometer*. The Yamax Digiwalker (DW; model 200) was the pedometer used as the second direct criterion measure of ambulatory physical activity. This pedometer is the most accurate pedometer available to assess ambulatory physical activity (Bassett et al., 1996). The DW counts the number of steps an individual takes by vertically displacing a lever arm inside the unit that rotates a counting device (Ainsworth, 2000).

*Physical Activity Log*. A physical activity log was the third direct criterion measure of physical activity in this study. The physical activity log required subjects to record their participation in VPA, MPA, MSE, and FLEX each day. Subjects recorded whether they participated in each of the four types of activities and identified the specific activity and duration.

### *Procedures*

Following approval by the Institutional Review Board, undergraduate college students were recruited to participate in the study. Fliers were posted at high-traffic areas around campus, an advertisement was placed on the campus television station, and the researcher announced the opportunity in several undergraduate classes. Interested students were instructed to call the researcher for an appointment. An appointment time was established for each subject to come to the laboratory for an orientation session.

At the beginning of the orientation session subjects completed an informed consent, a short demographic questionnaire, and the NCHRBS physical activity items. Next, the researcher weighed each subject using a physician's beam scale and assessed each subjects' height using a wall mounted stadiometer.

During the middle portion of the orientation session, each subject was fitted with a cotton belt that fit closely around his or her waist. The belts were used to attach the Actigraph (which was in the nylon pouch available from the manufacturer) to the body, so that the Actigraph could be worn under clothing and fit snugly against

**Figure 1. National College Health Risk Behavior Survey (NCHRBS) Physical Activity Items**

Vigorous Item – "On how many of the past 7 days did you exercise or participate in physical activity for at least 20 minutes that made you sweat and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic activities?"

Flexibility Item – "On how many of the past 7 days did you do stretching exercises, such as toe touching, knee bending, or leg stretching?"

Muscular Strength/Endurance Item – "On how many of the past 7 days did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or weight lifting?"

Moderate Item 2000 – "On how many of the past 7 days did you participate in physical activity for at least 30 minutes that did NOT make you sweat or breathe hard, such as fast walking, slow bicycling, skating, pushing a lawn mower, or mopping floors?"

Moderate Item 1995 – "On how many of the past 7 days did you walk or bicycle for at least 30 minutes at a time? (Include walking or bicycling to and from class or work.)"

Note: Possible responses for each item are 0 days – 7 days.

the skin. Subjects were instructed to keep the Actigraph in the pouch and to make sure that the pouch was oriented properly (fastening flap pointed downward and away from the body) when putting on the Actigraph each morning. Subjects wore the Actigraph monitor over the right hip during all waking hours for 7 consecutive days, except when showering, bathing, or swimming. Subjects removed the Actigraph when going to bed at night.

Subjects also wore a DW attached to their waistbands or belts at the anterior midline of the right leg during all waking hours for the same 7 consecutive days. In addition, they recorded the number of steps from the DW onto their DW record before going to bed at night and pressed the reset button so that the DW was ready to collect data the next day. Subjects removed the DW when showering, bathing, swimming, or sleeping.

In addition to wearing the Actigraph and DW, subjects recorded their participation in VPA, MPA, MSE, and FLEX into their activity log each day for the same 7 consecutive days. They were given a different color log sheet for each of the 7 days.

At the end of the orientation session (approximately 2 hours later) subjects completed the NCHRBS physical activity items again. After the 7 days subjects returned to the lab to hand in their DW records, activity logs, and equipment. They also completed the NCHRBS physical activity items. All data were collected during the months of June and July.

### *Actigraph Data Reduction*

Actigraph data were reduced using SAS Release 8.1 (SAS Institute Inc., 2000). One-minute epoch periods were used in this study. Counts per minute were summed across 60 minutes to obtain total counts per hour for each day. The number of hours during each 24-hour period with total counts per hour greater than zero was determined. It was decided *a priori* that subjects must have at least 12 hours per day with total counts per hour greater than zero on at least 5 of the 7 days to be included in the analyses. Data from all 20 subjects met these criteria. Cut-points were used to determine the number of days with ≥20 minutes of VPA and the number of days with ≥30 minutes of MPA from the Actigraph data (Freedson, Melanson, & Sirard, 1998).

### *Statistical Analyses*

All statistical analyses were completed using SAS Release 8.1 (SAS Institute Inc., 2000). Descriptive statistics were calculated. The students' responses to the physical activity items at the beginning and end of the orientation session were used to determine intraclass correlation coefficients (ICC) using one-way analysis of variance models (Patterson, 2000). Pearson correlation coefficients were calculated to examine the relationship between the students' responses to the physical activity items at the end of the week and Actigraph, DW, and activity log data.

## RESULTS

### *Reliability of NCHRBS Physical Activity Items*

The ICCs for physical activity items ranged from .94–.99. The ICCs and 95% confidence intervals are presented in Table 1.

### *Validity of NCHRBS Physical Activity Items*

Several of the correlation coefficients between NCHRBS physical activity items and the direct measures of physical activity were significant. The correlations are presented in Table 2.

## DISCUSSION

This is the first study to examine the psychometric properties of the NCHRBS VPA, MPA, FLEX, and MSE items. The results of this study indicate that the items have excellent test-retest reliability and validity indices similar to other physical activity questions.

This study examined the reliability of the NCHRBS physical activity items using the design recommended by Patterson (2000). Because participation in physical activity fluctuates from week to week, subjects

**Table 1. Intraclass Correlation Coefficients**

| NCHRBS Item | *R* | 95% Confidence Interval |
|---|---|---|
| Vigorous | .98 | .95–.99 |
| Flexibility | .99 | .97–.99 |
| Muscular strength/endurance | .99 | .98–.99 |
| Moderate (2000) | .94 | .86–.98 |
| Moderate (1995) | .96 | .89–.98 |

**Table 2. Pearson Correlation Coefficients**

| | NCHRBS Physical Activity Item | | | | |
|---|---|---|---|---|---|
| Measure | Vigorous | Flexibility | Muscular Strength/ Endurance | Moderate (2000) | Moderate (1995) |
| Actigraph vigorous[A] | .60** | .22 | .29 | .42 | .58** |
| Actigraph moderate[B] | .32 | .11 | -.11 | .61** | .60** |
| Steps[C] | .03 | -.11 | -.28 | .49* | .45* |
| Activity log vigorous[D] | .82** | .36 | .57** | .23 | .30 |
| Activity log flexibility[D] | .36 | .57** | .28 | .24 | .18 |
| Activity log muscular strength/endurance[D] | .46 | .42 | .89** | .14 | .12 |
| Activity log moderate[D] | -.25 | -.18 | -.09 | .66** | .49* |

[A]Actigraph mean number of days vigorous activity ≥20 minutes per day
[B]Actigraph mean number of days moderate activity ≥30 minutes per day
[C]Digiwalker mean number of steps per day
[D]Activity Log mean number of days for each activity

Note: *p< .05; **p< .01

recalled their activity for the same reference week. This design controls for the weekly variability in physical activity and allows for a more accurate assessment of instrument reliability. ICCs in this study were very high, ranging from .94–.99. This indicates that the physical activity items are reliable.

Although the validity of the NCHRBS physical activity items has not been previously assessed, there are other physical activity questionnaires in the literature that require subjects to recall their participation in physical activity during the previous 7 days. Several researchers have explored the validity of the 7-day physical activity recall (PAR) using activity logs as the physical activity criterion measure. Reported correlation coefficients between PAR physical activity and activity recorded in logs range from .39–.82 (Dishman & Steinhardt, 1988; Taylor et al., 1984). The correlations between the NCHRBS physical activity items and log activity found in this study are slightly higher (.49–.89).

Researchers have also examined the validity of physical activity questionnaires using a Caltrac accelerometer as the criterion measure (Miller, Freedson, & Kline, 1994). The correlations between the Actigraph accelerometer and the VPA item ($r$=.60) or MPA item ($r$=.61) in this study are higher than those reported between the Caltrac and Godin Leisure-Time Exercise Questionnaire ($r$=.45) and lower than those reported between the Caltrac and PAR ($r$=.79).

The current moderate physical activity recommendation states that all adults should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week (Pate et al., 1995). The revised MPA item (2000) reflects this recommendation by including a variety of activities and distinguishes MPA from VPA better than the original MPA item (1995). In addition, the revised MPA item had slightly higher correlations with the Actigraph, DW, and log than the original MPA item (Figure 1 and Table 2).

The low correlation coefficients for the MSE and FLEX items with Actigraph and DW are not surprising. Both the Actigraph and DW are waist-worn devices that measure ambulatory physical activity only; therefore, we did not expect them to capture participation in MSE and FLEX activities. MSE and FLEX activities often require that an individual's trunk remain stationary throughout the activity, while the arms and legs move. The correlations for these two items and their respective log activity indicate that the items accurately assess students' participation in these activities.

Physical inactivity is a major health issue among college students. The results of this study indicate that the NCHRBS VPA, MPA, FLEX, and MSE items have excellent test-retest reliability and validity indices similar to other self-report physical activity questions. Therefore, health promotion professionals can confidently use these items to assess college students' participation in physical activity.

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