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Test-Retest Reliability of the WHI Physical Activity Questionnaire

Anne-Marie Meyer¹, Kelly R Evenson¹, Libby Morimoto², David Siscovick³, and Emily White³

¹Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC

²Exponent, Menlo Park, CA

³Department of Epidemiology, University of Washington, Seattle, WA

Abstract

Purpose—Few physical activity (PA) questionnaires were designed to measure the lifestyles and activities of women. We sought to examine the test-retest reliability of a PA questionnaire used in the Women's Health Initiative (WHI) Study. Differences in reliability were also explored by important covariates.

Methods—Participants (n=1092) were post-menopausal women aged 50-79 years, randomly selected from the baseline sample of participants in the WHI Observational Study. The WHI physical activity questionnaire collects usual frequency, duration, and pace of recreational walking, frequency and duration of other recreational activities or exercises (mild, moderate and strenuous), household, and yard activities. Approximately half of the women (n=569) repeated questions on recreational PA, the other half (n=523) repeated questions related to household and yard activities (mean 3 months

Corresponding Author: Anne-Marie Meyer, PhD, NC Center for Public Health Preparedness University of North Carolina at Chapel Hill CB # 8165, 400 Roberson St. Chapel Hill, NC 27599 Phone: 919.843.0837 Fax: 919.843.5563 Email: E-mail: meyera@email.unc.edu.

WHI Program Office: (National Heart, Lung, and Blood Institute, Bethesda, Maryland) Elizabeth Nabel, Jacques Rossouw, Shari Ludlam, Joan McGowan, Leslie Ford, and Nancy Geller.

WHI Clinical Coordinating Center: (Fred Hutchinson Cancer Research Center, Seattle, WA) Ross Prentice, Garnet Anderson, Andrea LaCroix, Charles L. Kooperberg, Ruth E. Patterson, Anne McTiernan; (Medical Research Labs, Highland Heights, KY) Evan Stein; (University of California at San Francisco, San Francisco, CA) Steven Cummings.

WHI Clinical Centers: (Albert Einstein College of Medicine, Bronx, NY) Sylvia Wassertheil-Smoller; (Baylor College of Medicine, Houston, TX) Aleksandar Rajkovic; (Brigham and Women's Hospital, Harvard Medical School, Boston, MA) JoAnn E. Manson; (Brown University, Providence, RI) Charles B. Eaton; (Emory University, Atlanta, GA) Lawrence Phillips; (Fred Hutchinson Cancer Research Center, Seattle, WA) Shirley Beresford; (George Washington University Medical Center, Washington, DC) Lisa Martin; (Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center, Torrance, CA) Rowan Chlebowski; (Kaiser Permanente Center for Health Research, Portland, OR) Yvonne Michael; (Kaiser Permanente Division of Research, Oakland, CA) Bette Caan; (Medical College of Wisconsin, Milwaukee, WI) Jane Morley Kotchen; (MedStar Research Institute/Howard University, Washington, DC) Barbara V. Howard; (Northwestern University, Chicago/Evanston, IL) Linda Van Horn; (Rush Medical Center, Chicago, IL) Henry Black; (Stanford Prevention Research Center, Stanford, CA) Marcia L. Stefanick; (State University of New York at Stony Brook, Stony Brook, NY) Dorothy Lane; (The Ohio State University, Columbus, OH) Rebecca Jackson; (University of Alabama at Birmingham, Birmingham, AL) Cora E. Lewis; (University of Arizona, Tucson/Phoenix, AZ) Cynthia A Thomson; (University at Buffalo, Buffalo, NY) Jean Wactawski-Wende; (University of California at Davis, Sacramento, CA) John Robbins; (University of California at Irvine, CA) F. Allan Hubbell; (University of California at Los Angeles, Los Angeles, CA) Lauren Nathan; (University of California at San Diego, LaJolla/Chula Vista, CA) Robert D. Langer; (University of Cincinnati, Cincinnati, OH) Margery Gass; (University of Florida, Gainesville/Jacksonville, FL) Marian Limacher; (University of Hawaii, Honolulu, HI) J. David Curb; (University of Iowa, Iowa City/Davenport, IA) Robert Wallace; (University of Massachusetts/Fallon Clinic, Worcester, MA) Judith Ockene; (University of Medicine and Dentistry of New Jersey, Newark, NJ) Norman Lasser; (University of Miami, Miami, FL) Mary Jo O'Sullivan; (University of Minnesota, Minneapolis, MN) Karen Margolis; (University of Nevada, Reno, NV) Robert Brunner; (University of North Carolina, Chapel Hill, NC) Gerardo Heiss; (University of Pittsburgh, Pittsburgh, PA) Lewis Kuller; (University of Tennessee Health Science Center, Memphis, TN) Karen C. Johnson; (University of Texas Health Science Center, San Antonio, TX) Robert Brzyski; (University of Wisconsin, Madison, WI) Gloria E. Sarto; (Wake Forest University School of Medicine, Winston-Salem, NC) Mara Vitolins; (Wayne State University School of Medicine/Hutzel Hospital, Detroit, MI) Michael Simon.

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apart). Test-retest reliability was assessed with kappa and intraclass correlation coefficients ($ICC_{1,1}$).

Results—Overall, questions on recreational walking, moderate recreational PA, and strenuous recreational PA had higher test-retest reliability (weighted kappa range 0.50-0.60), than questions on mild recreational PA (weighted kappa range 0.35-0.50). The $ICC_{1,1}$ for moderate to strenuous recreational PA was 0.77 (95% CI 0.73, 0.80) and total recreational PA was 0.76 (95% CI 0.71, 0.79). Substantial reliability was observed for the summary measures of yard activities ($ICC_{1,1}$ 0.71; 95% CI 0.66, 0.75) and household activities ($ICC_{1,1}$ 0.60, 95% CI 0.55, 0.66). No meaningful differences were observed by race/ethnicity, age, time between test and retest, and amount of reported PA.

Conclusions—The WHI PA questionnaire demonstrated moderate to substantial test-retest reliability in a diverse sample of post-menopausal women.

Keywords

Epidemiology; movement; reproducibility; women's health; exercise

Introduction

Paragraph 1 Understanding physical activity and its on impact on health is an important public health challenge (35). Nearly half of the American population does not engage in enough physical activity to prevent disease or benefit health (9). Compared to men, women participate in less vigorous leisure activity (7,8) and may engage in more sedentary behaviors (8,24). Furthermore, previous studies have indicated that minority women report even less leisure time physical activity than white women (7,8,25,35). Additional research on physical activity behaviors in women and minority populations would help guide public health policy and interventions.

Paragraph 2 Previous research demonstrates that women engage in different types and patterns of physical activity than men (2,3,34). Women may have a different interpretation or understanding of what physical activity means to them (2,14,15,21,30,34). Because many physical activity questionnaires used in epidemiologic research were originally designed for white male populations, they may not accurately measure physical activity in women (2,21,33). This makes accurate and reliable measurement of physical activity in women and minority populations especially challenging. Additionally, few physical activity questionnaires have detailed measurement properties reported among minority or other special populations of women. Furthermore, the validity and reliability of physical activity questionnaires may be impacted by other attributes such as age, length of time between test and retest, or level of physical activity. These attributes may affect the ability of individuals to remember, comprehend, and answer questions.

Paragraph 3 One study that has attempted to address issues of physical activity measurement in women is the Women's Health Initiative (WHI) Observational Study. The WHI is a long-term, multi-center, racially and ethnically diverse national cohort study of 161,808 women. The WHI enables scientists to study relationships between lifestyle, health risk factors, and specific disease outcomes. To date, over 230 papers have been published using WHI data. Several of these papers have explored the associations of physical activity with major diseases (10,16,20,22,23). In order to adequately study risk factors, like physical activity, it is important for researchers to understand the questionnaires' measurement properties. The objective of this paper is to examine the test-retest reliability of the WHI physical activity questionnaire in a random sample of the WHI participants overall and by race/ethnicity, age, time between test and retest, and level of physical activity.

Methods

Paragraph 4 Between 1994 and 1998, over 93,676 women between 50 and 79 years of age were enrolled at one of 40 clinic centers across the United States into the WHI Observational Study (19). Eligibility for enrollment included the intention to reside in the area for at least three years, free from any major medical condition which would impact survival within three years of study entry, and no reported mental illness, dementia, alcoholism, or drug dependency. Full details on the study cohort and design are available elsewhere (19).

Paragraph 5 Between October 1996 and June 1997, a sub-sample of the women enrolled in the WHI Observational Study was selected to participate in the Measurement and Precision Study. Participants (n=1,092) were randomly recruited within the 40 clinic centers and stratified by age and race/ethnicity (American Indian/Alaskan Native, Asian or Pacific Islander, Black or African American, Hispanic/Latino, White).

Paragraph 6 The purpose of the Measurement and Precision Study was to assess test-retest reliability of several self-administered questionnaires. Each clinic center was randomly assigned to repeat a set of baseline questionnaires (19). At approximately 12-week intervals (range: 8-15 weeks), half of the women (n=567) repeated questions on exercise/recreational activities (Form 34) and the other half (n=512) repeated questions related to household, yard, and sedentary activities (Form 42). The two questionnaires were distributed between the samples in order to reduce the time burden on the participants. The 12 week time interval (8-15 weeks) was chosen to minimize a “learned” response to the instrument, so participants would not recall their previous answers. Institutional Review Board approval was obtained by each participating WHI center prior to data collection and participants provided their written informed consent.

Physical Activity Questionnaire

Paragraph 7 The physical activity questionnaire was self-administered at enrollment. The questionnaire was intentionally worded without reference to a specific time frame (e.g, last week, last month, last year), in order to collect “usual” activity or patterns of activity. It was designed to collect different types of activities by grouping them together by intensity. This was done to reduce the burden and time needed to complete the questionnaire. The questionnaire was divided into two forms to collect information on usual physical activity. On the first form, participants reported their usual exercise or recreational activity (mild, moderate, strenuous, and walking activities). On the second form, participants were asked about heavy indoor household activities and yard activities. Both forms were completed at the same time, either at the clinics or mailed to the participant, and then returned to the clinic for review.

Paragraph 8 The questionnaire grouped exercise or recreational activities into three separate intensities (mild, moderate, and strenuous) based a range of metabolic equivalent (MET) values associated with the type of activities described. The participants then reported the usual frequency (6 categories, from 0 to 5+ days per week) and duration (4 categories, from < 20 minutes to \geq 60 minutes) of activities performed at each intensity level. Episodes of walking outside of the home (10 minutes or more) were reported separately through frequency (6 levels, 0 to 7 days per week), duration (4 levels, <20 minutes to \geq 60 minutes), and usual speed (4 levels, 2 mph to 5 mph). Questions on household activities were assessed as hours per week (5 categories, from <1 hour to \geq 10 hours). Yard activities included the number of months per year (5 categories, <1 month to \geq 10 months) and hours per week (5 categories, <1 hour to \geq 10 hours) the activities were performed. Participants were also asked to report number of hours spent sitting and lying down, including sleep, each day (8 categories, <4 hours to \geq 16 hours). In addition, the women were also asked to recall whether or not they engaged in strenuous

activity (yes or no) at 18, 35, and 50 years of age. The questionnaire and scoring protocol can be found in Appendix 1.

Paragraph 9 The WHI physical activity measures were designed to be summarized into continuous variables estimating weekly energy expenditure (MET-hours per week) from each type of activity (mild, moderate, strenuous, walking, household, and yard). An estimated MET level for each type of activity was assigned from a compendium of activities (1) (Appendix 2), where the MET level is kilocalories per kilogram of body weight expended each hour during a specific activity. Summary variables were created by combining frequency, duration and MET-estimated intensity in the following equation: $[(\text{Frequency of activity per week} \times \text{Minutes per session} \times \text{MET for that activity}) / (60 \text{ min/hour})]$. These summary variables in “MET-hours” quantify the total kilocalories expended per kilogram per week. MET units are independent of body weight.

Socio-demographic Measures

Paragraph 10 Participants answered questions on a number of important health behaviors and demographic attributes. Race/ethnicity (American Indian/Alaskan Native, Asian or Pacific Islander, Black or African American, Hispanic/Latino, White), education (10 levels), main occupation (professional/managerial, technical/sales/administrative, service/labor, homemaker), retirement status, marital status, smoking status, and general health were all self-reported at the first clinic visit. Additionally height and weight for each individual were measured at this visit and used to calculate body mass index (BMI) (weight in kilograms divided by height in meters squared), and categorized as underweight ($<18.5 \text{ kg/m}^2$), normal weight ($18.5\text{-}<25 \text{ kg/m}^2$), overweight ($25\text{-}<30 \text{ kg/m}^2$), and obese ($\geq 30 \text{ kg/m}^2$) (37).

Statistical Analysis

Paragraph 11 Two-level kappa and weighted kappa (3-8 levels) statistics were used to assess the test-retest reliability of each individual question or corresponding component (e.g., frequency, duration). Weighting for the kappa statistics was applied using the default in SAS, the Cicchetti-Allison form, taking into account the degree of non-agreement between the test and retest. Agreement between the test and retest were categorized into five categories: poor (0 to <0.2), fair (0.2 to <0.4), moderate (0.4 to <0.6), substantial (0.6 to <0.8), and almost perfect (0.8 to 1.0) (18). Test-retest reliability of the continuous variables was assessed with the Shrout and Fleiss intraclass correlations coefficient (ICC_{1,1}) (29). This ICC_{1,1} uses test and retest measures to estimate single trial reliability, instead of the average of repeated measures. More specifically the ICC_{1,1} and 95% confidence intervals were calculated using a one-way analysis of variance model (ANOVA) (29,31,32) and assessed the proportion of the total variance (true variability and measurement error) that was attributable to participant variability.

Paragraph 12 Stratified analyses were performed by race/ethnicity, time between test and retest (≤ 3 months vs. >3 months), age ($50\text{-}\leq 65$ years, $>65\text{-}79$ years), and by level of recreational activity (one or more episodes vs. none). Lastly, because the participants were not randomized to the type of activity form (exercise/recreation form vs. household/yard form), differences between the two samples were also examined.

Results

Study Sample

Paragraph 13 The majority of the sample ($n=1092$) reported good, very good, or excellent health (90%) and the average age was 64 years old (Table 1). The population was predominantly White (66%) followed by Hispanic (14%), African American (13%), and Asian/

Pacific Islander (7%). Only 1% of the women identified themselves as American Indian/Alaskan Natives. These women were excluded from the racially stratified analysis only because of inadequate sample size. Most women had completed high school (93%) and reported an occupation (current or former) other than being a homemaker (90%). More than half of them (55%) were retired. Approximately half of the sample (51%) reported never smoking and more than half (57%) were overweight or obese. The majority of the women were married, while one-third were either widowed, separated, or divorced.

Paragraph 14 Although participants were randomly chosen from within each center, each center was assigned to only one of the two physical activity forms (exercise/recreational activity vs. yard/household). Several differences in the populations were found between the two forms. Differences of 5% or more were observed between the two samples for the following variables: race/ethnicity, education, and BMI. A greater proportion of the participants who answered the questionnaire on exercise/recreation activities were normal weight (43% vs. 36%), White (69% vs. 63%), and college graduates (40% vs. 34%), compared to the sample that answered the questions on household/yard activities. Differences were not observed between general health, occupational status, marital status, and smoking.

Paragraph 15 At baseline, 73% of the women were not strenuously active, and more than half had not participated in regular strenuous activity in their earlier adulthood (ages 18, 35, 50 years) (data not shown). At least 80% of the women reported some walking. However, when all exercise was combined, fewer than half of the women reported fewer than 10 MET-hours per week (median 9.0 MET-hours/week, S.D. 14.3). Whites and Asian/Pacific Islanders had higher median levels of total recreational activity than Hispanic and African Americans (9.8, 8.7, 7.5, 7.5 MET-hours/week, respectively). A similar pattern was observed for strenuous recreational activity and moderate to strenuous recreational activity by race/ethnicity (data not shown). More women reported at least one episode of moderate recreational activity (e.g., easy swimming, biking, or dancing) than mild recreational activity (e.g., bowling or golf) (Table 2).

Test-retest Reliability

Paragraph 16 Within the entire sample, substantial test-retest reliability was demonstrated in most summary measures, with the exception of mild recreational activity, which had lower reliability (Table 3). The continuous estimate of total physical activity ($ICC_{1,1}$) was 0.76 (95% CI 0.71, 0.79) and the categorical estimate of total physical activity (weighted kappa) was 0.61 (95% CI 0.56, 0.66) (Tables 3 and 4).

Paragraph 17 Reliability was similar when the sample was reduced to only those women who reported at least one episode of exercise or recreational activity (Table 3). Stratifying by race/ethnicity resulted in a loss of precision, but the associations were similar (Table 5). The exception was mild recreational activity which consistently demonstrated the lowest reliability, especially in non-white participants. When stratified by age, women who were ≤ 65 years of age demonstrated higher reliability than women > 65 years (Table 6). However the magnitude of these differences was small, as the measures in both strata remained similar to the reliability of the entire sample. Additionally, the population of women who repeated the tests within three months also tended to have slightly higher reliability compared to women for whom more than three months had passed at retest (Table 6).

Paragraph 18 In general, the reliability of the individual questions on the components of frequency and duration of exercise (strenuous, moderate, mild, and walking) was between 0.36 and 0.62 for the entire sample (Table 4). Better reliability was observed for the strenuous and walking components than moderate or mild components. The reliability estimates of hours

spent sitting and lying down, as well as yard and indoor household activities ranged from 0.60 to 0.71 for the entire sample (Table 3).

Paragraph 19 History of strenuous activity at the ages of 18, 35, and 50 years, measured by kappa statistics, ranged between 0.53 to 0.55 overall (Table 4). Similar to the summary measures, reliability was not meaningfully influenced by restricting the analysis to only women who reported at least one episode of exercise or recreational activity. When stratified by the other relevant covariates (age, race/ethnicity, time between tests) the reliability of moderate, strenuous, and walking physical activity were all fair to moderate.

Discussion

Paragraph 20 The WHI Physical Activity Questionnaire demonstrated moderate to substantial test-retest reliability in a racially diverse sample of post-menopausal women. The reliability estimates observed in this sample are similar to reliability measures from other self-reported questionnaires designed for women (6) and for older adults (36). Additionally, the physical activity in this population generally paralleled activity patterns observed in the US population of adults (7,8,35).

Paragraph 21 The most consistent difference in the test-retest reliability estimates appeared to be lower reliability in the mild exercise or activity measures. Although it is possible that the lower reliability observed in the mild intensity questions may be an artifact of reduced precision, it is consistent with other research (27,36). Activities of mild intensity are less memorable and less likely to be recalled, and are consequently less well captured by self-report questionnaires. Another potential explanation for the weaker performance of the mild activity measures may be a result of the questionnaire design. Mild walking, a popular recreational activity in this population, was assessed separately from other mild-intensity activities, and showed higher reliability than mild activity. Therefore, if walking had been included in the mild activity measure, instead of assessed separately, mild activity might have shown higher reliability.

Paragraph 22 Differences in test-retest reliability were not observed when reducing the sample to only women who reported at least one episode of any exercise or recreational activity. Interestingly, there were also no meaningful differences in reliability observed across race/ethnic groups. Previous studies have been mixed in their reporting of differences in reliability by race/ethnicity (5,12,28). However, it is also important to consider the wide confidence intervals in the race/ethnicity estimates, as stratifying the data resulted in a loss of precision.

Paragraph 23 Although we did not observe differences in reliability between the different race/ethnic groups, or by level of activity, some patterns were observed by age and length of time between test and retest. Women who were 65 years or younger demonstrated better test-retest reliability than women who were older. Variability of physical activity in older women may be influenced by a number of factors, such as changing health status, (e.g., fatigue, injury, disease progression), retirement, or loss of a spouse (4,11,13). Any of these changes within the study period could impact questionnaire reliability as women's activity patterns are affected. Additionally, aging is associated with cognitive decline that can impact memory and could in turn affect reliability (26).

Paragraph 24 Not surprisingly, a slightly higher pattern was observed in some measures among the sample of women who repeated tests within a three-month time period compared to women who experienced more than three months between the tests. One explanation could be because tests repeated within a shorter time frame are more likely to be given in the same season or comparable time of year with regards to weather. Furthermore, a change in activity (either

increase or decrease) could have occurred after the administration of the first questionnaire, such that the reliability estimates would be lower.

Paragraph 25 While reliability could be explored with this data, validation of the WHI physical activity questionnaire could not be assessed. However, the questionnaire's validity was recently explored among 74 women enrolled in the Women's Healthy Eating and Living Study (17). In this convenience sample of women, the WHI physical activity questionnaire was correlated with both the accelerometer (Actigraph 7164) and 7-day physical activity recall ($r=0.73, 0.88$, respectively). Although the WHI questionnaire had 100% sensitivity for identifying women who met the physical activity guidelines, the specificity was only 60%. The questionnaire tended to underestimate moderate activities and overestimate vigorous activities.

Study Limitations

Paragraph 26 Despite the diverse and large sample, this study had several limitations. The WHI sample was not population-based and may not be representative of a specific source population. White women comprised a larger sample than other racial/ethnic groups. Because of the small sample sizes representing Hispanic, African American, and Asian/Pacific Islander women, the bounds of the lower confidence interval were estimated below zero in several of the stratified analyses. Additionally the level of education in our sample was very high and we were unable to examine variation in test-retest reliability by education. Another limitation to this study was that participants were not randomized to the two forms and some differences were observed between the two groups.

Paragraph 27 Several other considerations should be made when using the questionnaire. While the WHI physical activity assessment included a measure of yard and household activity, it was not a comprehensive measure of women's potential activities. Several domains of activity such as non-motorized transportation (active travel), child or elder care activity, and work or occupational physical activity were not included in the WHI physical activity questionnaire.

Conclusions

Paragraph 28 Reliable and valid questionnaires are a cost-effective and useful method for collecting physical activity information in large cohort studies, such as in the WHI Observational Study. However, measurement of physical activity is challenging as many questionnaires do not collect detailed information on types of activities and use terminology many women do not identify with (2,21,33,34). The WHI Physical Activity Questionnaire is one of the first questionnaires to examine different types of physical activity in a large, multiethnic sample of women. This analysis shows that the different domains of physical activity behavior, such as recreational, yard, and household activity, can be reliably estimated in an ethnically diverse sample of post-menopausal women.

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Appendix 1

Description and scoring of the WHI Physical Activity Questionnaire

Questions	Response Options	Scoring
<p>The following questions are about your usual physical activity and exercise. This includes walking and sports.</p>		
1. Think about the walking you do outside the home. How often do you walk outside the home <u>for more than 10 minutes without stopping?</u> (Mark only one.)	Rarely or never	0 - skip to #2
	1-3 times each month	0.5 times
	1 time each week	1.0 times
	2-3 times each week	2.5 times
	4-6 times each week	5.0 times
1.1 When you walk outside the home for more than 10 minutes without stopping, for how many minutes do you usually walk?	7 or more times each week	7.0 times
	Less than 20 minutes	15 minutes
	20-39 minutes	30 minutes
	40-59 minutes	50 minutes
	1 hour or more	70 minutes
1.2 What is your usual speed?	Casual strolling or walking (less than 2 miles an hour)	2.0 METs
	Average or normal (2-3 miles an hour)	3.0 METs
	Fairly fast (3-4 miles an hour)	4.0 METs
	Very fast (more than 4 miles an hour)	5.0 METs
	Don't know	2.0 (set to lowest MET intensity)
<p>Not including walking outside the home, <u>how often each week</u> (7 days) do you usually do the exercises below?</p>		
2. STRENUOUS OR VERY HARD EXERCISE (You work up a sweat and your heart beats fast.) For example, aerobic dancing, jogging, tennis, wimming laps.	None	0 - skip to #3
	1 day per week	1 times
	2 days per week	2 times
	3 days per week	3 times
	4 days per week	4 times
2.1 How long do you usually exercise like this at one time?	5 or more days per week	6 times
	Less than 20 minutes	10 minutes
	20-39 minutes	30 minutes
	40-59 minutes	50 minutes
	1 hour or more	70 minutes
3. MODERATE EXERCISE (Not exhausting). For example, biking outdoors, using an exercise machine (like a stationary bike or treadmill), calisthenics, easy swimming, popular or folk dancing.	None	0 - skip to 4
	1 day per week	1 times

Questions	Response Options	Scoring
	2 days per week	2 times
	3 days per week	3 times
	4 days per week	4 times
	5 or more days per week	6 times
3.1 How long do you usually exercise like this at one time?	Less than 20 minutes	10 minutes
	20-39 minutes	30 minutes
	40-59 minutes	50 minutes
	1 hour or more	70 minutes
4. MILD EXERCISE. For example, slow dancing, bowling, golf.	None	0--skip to 5.1
	1 day per week	1 times
	2 days per week	2 times
	3 days per week	3 times
	4 days per week	4 times
	5 or more days per week	6 times
4.1 How long do you usually exercise like this at one time?	Less than 20 minutes	10 minutes
	20-39 minutes	30 minutes
	40-59 minutes	50 minutes
	1 hour or more	70 minutes
For each of the ages below, did you usually do strenuous or very hard exercises <u>at least 3 times a week</u> ? This would include exercise that was long enough to work up a sweat and make your heart beat fast. (Be sure to mark "No" if you did not do very hard exercises at the ages listed below.)		
5.1 18 years old	No	0
	Yes	1
5.2 35 years old	No	0
	Yes	1
5.3 50 years old	No	0
	Yes	1
The next set of questions ask about some of your usual activities.		
6. About how many hours each week do you usually spend doing heavy (strenuous) indoor household chores such as scrubbing floors, sweeping, or vacuuming?	Less than 1 hour	0
	1-3 hours	2.0 hours
	4-6 hours	5.0 hours
	7-9 hours	8.0 hours
	10 or more hours	12.0 hours

Questions	Response Options	Scoring
7. About how many months during the year do you usually do things in the yard, such as mowing, raking, gardening, or shoveling snow?	Less than 1 month	0
	1-3 months	3.0 months
	4-6 months	5.0 months
	7-9 months	8.0 months
	10 or more months	11.0 months
7.1 When you do these things in the yard, how many hours each week do you do them?	Less than 1 hour	0
	1-3 hours	2.0 hours
	4-6 hours	5.0 hours
	7-9 hours	8.0 hours
	10 or more hours	12.0 hours
8. During a usual <u>day and night</u> about how many hours do you spend sitting? Be sure to include the time you spend sitting at work, sitting at the table eating, driving or riding in a car or bus, and sitting up watching TV or talking.	Less than 4 hours	2.0 hours
	4-5 hours	4.5 hours
	6-7 hours	6.5 hours
	8-9 hours	8.5 hours
	10-11 hours	10.5 hours
	12-13 hours	12.5 hours
	14-15 hours	14.5 hours
9. During a usual <u>day and night</u> about how many hours do you spend sleeping or lying down with your feet up? Be sure to include the time you spend sleeping or trying to sleep at night, resting or napping, and lying down watching TV.	Less than 4 hours	2.0 hours
	4-5 hours	4.5 hours
	6-7 hours	6.5 hours
	8-9 hours	8.5 hours
	10-11 hours	10.5 hours
	12-13 hours	12.5 hours
	14-15 hours	14.5 hours
16 or more hours	16.5 hours	

Appendix 2

Metabolic equivalent (MET) estimates* for intensity for each activity

Activity	MET used in algorithm
Walking	
Casual	2.0
Average	3.0
Fast	4.0
Very Fast	4.5
Strenuous Exercise	7.0

Activity	MET used in algorithm
Moderate Exercise	4.5
Light Exercise	3.0
Yard work	4.0
Housework	3.5

*based on Ainsworth, et al. (1)

REFERENCES

1. Ainsworth B, Haskell W, Whitt M, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sport Exer* 2000;32:S498–S516.
2. Ainsworth BE. Issues in the assessment of physical activity in women. *Res Q Exerc Sport* 2000;71:S37–42. [PubMed: 10925823]
3. Ainsworth BE, Irwin ML, Addy CL, Whitt MC, Stolarczyk LM. Moderate physical activity patterns of minority women: the Cross-Cultural Activity Participation Study. *J Womens Health Gend Based Med* 1999;8:805–13. [PubMed: 10495261]
4. Brown WJ, Trost SG. Life transitions and changing physical activity patterns in young women. *Am J Prev Med* 2003;25:140–3. [PubMed: 12880882]
5. Brownson RC, Eyster AA, King AC, Shyu YL, Brown DR, Homan SM. Reliability of information on physical activity and other chronic disease risk factors among US women aged 40 years or older. *Am J Epidemiol* 1999;149:379–91. [PubMed: 10025482]
6. Cauley JA, LaPorte RE, Sandler RB, Schramm MM, Kriska AM. Comparison of methods to measure physical activity in postmenopausal women. *Am J Clin Nutr* 1987;45:14–22. [PubMed: 3799499]
7. CDC. Physical activity trends--United States, 1990-1998. *MMWR Morb Mortal Wkly Rep* 2001;50:166–9. [PubMed: 11393487]
8. CDC. Prevalence of no leisure-time physical activity--35 States and the District of Columbia, 1988-2002. *MMWR Morb Mortal Wkly Rep* 2004;53:82–6. [PubMed: 14762333]
9. CDC. Prevalence of regular physical activity among adults--United States, 2001 and 2005. *MMWR Morb Mortal Wkly Rep* 2007;56:1209–12. [PubMed: 18030281]
10. Chlebowski RT, Pettinger M, Stefanick ML, Howard BV, Mossavar-Rahmani Y, McTiernan A. Insulin, physical activity, and caloric intake in postmenopausal women: breast cancer implications. *J Clin Oncol* 2004;22:4507–13. [PubMed: 15542801]
11. Evenson K, Rosamond W, Cai J, Diez-Rioux A, Brancati F. The influence of retirement on leisure-time physical activity: The Atherosclerosis Risk in Communities Study. *Am J Epidemiol* 2002;15:692–9. [PubMed: 11943686]
12. Evenson KR, McGinn AP. Test-retest reliability of adult surveillance measures for physical activity and inactivity. *Am J Prev Med* 2005;28:470–8. [PubMed: 15894151]
13. Eyster AA. Correlates of physical activity: who's active and who's not? *Arthritis Rheum* 2003;49:136–40. [PubMed: 12579605]
14. Henderson K, Ainsworth B. Researching leisure and physical activity with women of color: Issues and emerging questions. *Leisure Sciences* 2001;23:21–34.
15. Henderson KA, Ainsworth BE. A synthesis of perceptions about physical activity among older african american and american Indian women. *Am J Public Health* 2003;93:313–7. [PubMed: 12554592]
16. Hsia J, Wu L, Allen C, et al. Physical activity and diabetes risk in postmenopausal women. *Am J Prev Med* 2005;28:19–25. [PubMed: 15626551]
17. Johnson-Kozlow M, Rock CL, Gilpin EA, Hollenbach KA, Pierce JP. Validation of the WHI brief physical activity questionnaire among women diagnosed with breast cancer. *Am J Health Behav* 2007;31:193–202. [PubMed: 17269909]

18. Landis JR, Koch GG. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics* 1977;33:363–74. [PubMed: 884196]
19. Langer RD, White E, Lewis CE, Kotchen JM, Hendrix SL, Trevisan M. The Women's Health Initiative Observational Study: baseline characteristics of participants and reliability of baseline measures. *Annals of Epidemiology* 2003;13:S107–S21. [PubMed: 14575943]
20. Manson JE, Greenland P, LaCroix AZ, et al. Walking compared with vigorous exercise for the prevention of cardiovascular events in women. *N Engl J Med* 2002;347:716–25. [PubMed: 12213942]
21. Masse L, Ainsworth B, Tortolero S, et al. Measuring physical activity in midlife, older, and minority women: Issues from an expert panel. *J Women's Health* 1998;7:57–67. [PubMed: 9511133]
22. McTiernan A, Kooperberg C, White E, et al. Recreational physical activity and the risk of breast cancer in postmenopausal women: the Women's Health Initiative Cohort Study. *Jama* 2003;290:1331–6. [PubMed: 12966124]
23. McTiernan A, Wu L, Chen C, et al. Relation of BMI and physical activity to sex hormones in postmenopausal women. *Obesity (Silver Spring)* 2006;14:1662–77. [PubMed: 17030978]
24. Nielsen Media Research. Nielsen Media Research Reports Television's Popularity is Still Growing. Nielsen Media Research; New York, NY: Sep 21. 2006 [press release]
25. Ransdell L, Wells C. Physical activity in urban white, African-American, and Mexican-American women. *Med Sci Sports Exercise* 1998;30:1608–15.
26. Rikli RE. Reliability, validity, and methodological issues in assessing physical activity in older adults. *Res Q Exerc Sport* 2000;71:S89–96. [PubMed: 10925830]
27. Sallis JF, Haskell WL, Wood PD, et al. Physical activity assessment methodology in the Five-City Project. *Am J Epidemiol* 1985;121:91–106. [PubMed: 3964995]
28. Shea S, Stein AD, Lantigua R, Basch CE. Reliability of the behavioral risk factor survey in a triethnic population. *Am J Epidemiol* 1991;133:489–500. [PubMed: 2000859]
29. Shrout PE, Fleiss JL. Intraclass Correlations - Uses In Assessing Rater Reliability. *Psychological Bulletin* 1979;86:420–8. [PubMed: 18839484]
30. Sternfeld B, Ainsworth B, Quesenberry C Jr. Physical activity patterns in a diverse population of women. *Prev Med* 1999;28:313–23. [PubMed: 10072751]
31. Streiner, D.; Norman, G. Health measurement scales: a practical guide to their development and use. Oxford Medical Publications; Oxford: 1995. p. 111-112.
32. Streiner DL. Learning how to differ: agreement and reliability statistics in psychiatry. *Can J Psychiatry* 1995;40:60–6. [PubMed: 7788619]
33. Tudor-Locke C, Henderson KA, Wilcox S, Cooper RS, Durstine JL, Ainsworth BE. In their own voices: definitions and interpretations of physical activity. *Womens Health Issues* 2003;13:194–9. [PubMed: 14583168]
34. Tudor-Locke CE, Myers AM. Challenges and opportunities for measuring physical activity in sedentary adults. *Sports Med* 2001;31:91–100. [PubMed: 11227981]
35. U.S. Surgeon General's report on physical activity and health. From the Centers for Disease Control and Prevention. *Jama* 1996;276:522. [PubMed: 8709391]
36. Washburn RA. Assessment of physical activity in older adults. *Res Q Exerc Sport* 2000;71:S79–88. [PubMed: 10925829]
37. World. Physical status: The use and interpretation of anthropometry. In: W. H. Organization. , editor. Report of a WHO Expert Committee. Geneva, Switzerland: 1995. p. 854WHO Technical Report Series

Table 1

Socio-demographic description of participants in the WHI Measurement and Precision Study at the first clinic visit (n=1092)

	N	%
Education		
Less than high school	75	6.9
High school	197	18.2
Some college or vocational/associates	406	37.6
College degree	402	37.2
Race/Ethnicity		
American Indian or Alaskan Native	13	1.2
Asian or Pacific Islander	74	6.8
Black or African-American	138	12.6
Hispanic/Latino	148	13.6
White	719	65.8
General Health		
Excellent	178	16.4
Very good	421	38.8
Good	382	35.2
Fair	91	8.4
Poor	14	1.3
Occupation		
Managerial / Professional	415	39.3
Technical / Sales / Administrative	340	32.2
Service/Labor	190	18.0
Homemaker	110	10.4
Retired		
No	487	45.0
Yes	596	55.0
Marital status		
Never married	52	4.8
Divorced, separated or widowed	345	31.7
Presently married or marriage-like relationship	680	63.5
Body mass index		
Underweight	31	2.8
Normal	433	39.7
Overweight	360	32.0
Obese	268	24.5
Smoking		
Never	553	51.3
Former	458	42.5
Current	67	6.2
Total exercise and recreational activity		
No exercise or recreational activity	50	8.9

	N	%
Some activity of limited duration or frequency	254	45.4
2 to <4 episodes per week	108	19.3
4 or more episodes per week	148	26.4

Table 2
Description of physical activity at the first clinic visit, among participants of the WHI Measurement and Precision Study

Variable	N	Mean	Median	SD	Missing
<i>Form 34: Exercise or recreational physical activity (n=569)</i>					
Mild recreational physical activity (MET-hours/week)	551	1.2	0	2.6	18
Moderate recreational physical activity (MET-hours/week)	553	3.2	0	5.1	16
Vigorous recreational physical activity (MET-hours/week)	562	4.0	0	9.0	7
Walking recreational physical activity (MET-hours/week)	563	4.9	2.5	6.2	6
Moderate to strenuous recreational physical activity (MET-hours/week)	544	9.8	4.5	13.2	25
Total recreational physical activity (MET-hours/week)	526	13.3	9.0	14.3	43
<i>Form 42: Household and yard physical activity (n=523)</i>					
Household physical activity (MET-hours/week)	518	7.7	7.0	9.1	5
Yard physical activity (MET-hours/week)	515	3.8	0	6.8	8
Sitting and lying down (hours per week)	519	14.5	15.0	4.3	4

Table 3

Intraclass correlation coefficients ($ICC_{1,1}$) and 95% confidence intervals (CI) of physical activity measures overall and among women who reported recreational activity in the WHI Measurement and Precision Study

	Entire sample		Women with ≥ 1 episode of recreational physical activity [#]	
	$ICC_{1,1}$	95% CI	$ICC_{1,1}$	95% CI
<i>Form 34: Exercise or recreational physical activity</i>		n=569		n=310
Mild recreational physical activity (MET-hours/week)	0.51	0.45, 0.57	0.55	0.47, 0.62
Moderate recreational physical activity (MET-hours/week)	0.57	0.52, 0.63	0.60	0.53, 0.67
Strenuous recreational physical activity (MET-hours/week)	0.76	0.73, 0.80	0.76	0.71, 0.80
Walking recreational physical activity (MET-hours/week)	0.75	0.72, 0.79	0.71	0.65, 0.76
Moderate to strenuous recreational physical activity (MET-hours/week)	0.77	0.73, 0.80	0.74	0.68, 0.78
Total recreational physical activity (MET-hours/week)	0.76	0.71, 0.79	0.73	0.67, 0.77
<i>Form 42: Household and yard physical activity</i>		n=523		
Household physical activity (MET-hours/week)	0.60	0.55, 0.66	N/A *	
Yard physical activity (MET-hours/week)	0.71	0.66, 0.75		
Sitting and lying down (hours per week)	0.60	0.54, 0.65		

* Only applicable for women who completed the recreational physical activity form

[#] One episode of any recreational physical activity, regardless of intensity or duration

Table 4
Kappa statistics and 95% confidence intervals (CI) of the physical activity components measures overall and among women who reported recreational activity in the WHI Measurement and Precision Study

	Entire sample			Women with ≥ 1 episode of recreational activity [#]		
	N	Weighted Kappa	95% CI	N	Weighted Kappa	95% CI
<i>Form 34: Exercise or recreational physical activity</i>						
Mild physical activity, days per week	548	0.36	0.27, 0.45	303	0.40	0.28, 0.51
Mild physical activity, minutes per session	528	0.52	0.43, 0.61	295	0.51	0.40, 0.62
Moderate physical activity, days per week	563	0.53	0.47, 0.59	314	0.54	0.47, 0.47
Moderate physical activity, minutes per session	544	0.48	0.41, 0.54	297	0.44	0.36, 0.53
Strenuous physical activity, days per week	555	0.62	0.55, 0.68	314	0.62	0.55, 0.69
Strenuous physical activity, minutes per session	546	0.61	0.54, 0.68	306	0.60	0.52, 0.68
Number of walks per week ≥ 10 minutes	567	0.60	0.55, 0.65	314	0.55	0.48, 0.61
Minutes per walk	555	0.59	0.54, 0.65	307	0.59	0.52, 0.66
Usual speed of walk	556	0.60	0.54, 0.65	306	0.58	0.50, 0.66
Total exercise and recreational activity exposure	569	0.61	0.56, 0.66	314	0.51	0.42, 0.59
<i>Form 42: Household and yard physical activity</i>						
Heavy indoor chores hours per week	517	0.52	0.45, 0.58	N/A*		
Yard work, months per year	511	0.67	0.62, 0.71			
Yard work, hours per week	509	0.64	0.59, 0.70			
Historical strenuous physical activity						
Strenuous physical activity at age 18 years	527	0.55**	0.48, 0.63	288	0.57**	0.47, 0.66
Strenuous physical activity at age 35 years	526	0.55**	0.48, 0.63	294	0.55**	0.45, 0.65
Strenuous physical activity at age 50 years	535	0.53**	0.46, 0.60	301	0.53**	0.44, 0.63

* Only applicable for women who completed the recreational physical activity form

One episode of any recreational physical activity, regardless of intensity or duration

** Simple kappa statistic

Table 5
 Intraclass correlation coefficients (ICC_{1,1}) and 95% confidence interval's (CI) of physical activity measures by race/ethnicity in the WHI Measurement and Precision Study

	White		African American		Hispanic		Asian/Pacific Islander	
	ICC _{1,1}	95% CI	ICC _{1,1}	95% CI	ICC _{1,1}	95% CI	ICC _{1,1}	95% CI
<i>Form 34: Exercise or recreational physical activity</i>								
Mild recreational physical activity (MET-hours/week)	0.53	0.46, 0.60	0.07	-0.19, 0.31	0.44	0.24, 0.59	0.66	0.60, 0.72
Moderate recreational physical activity (MET-hours/week)	0.77	0.72, 0.81	0.68	0.52, 0.79	0.82	0.74, 0.88	0.73	0.54, 0.86
Strenuous recreational physical activity (MET-hours/week)	0.74	0.69, 0.78	0.64	0.46, 0.77	0.92	0.88, 0.95	0.80	0.76, 0.84
Walking recreational physical activity (MET-hours/week)	0.75	0.70, 0.79	0.87	0.79, 0.92	0.69	0.56, 0.79	0.75	0.70, 0.79
Moderate to strenuous recreational physical activity (MET-hours/week)	0.77	0.72, 0.81	0.68	0.52, 0.79	0.82	0.74, 0.88	0.73	0.54, 0.86
Total recreational physical activity (MET-hours/week)	0.73	0.68, 0.77	0.72	0.58, 0.83	0.85	0.78, 0.90	0.78	0.74, 0.82
<i>Form 42: Household and yard physical activity</i>								
Household physical activity (MET-hours/week)	0.62	0.55, 0.68	0.65	0.50, 0.76	0.52	0.31, 0.67	0.77	0.60, 0.87
Yard physical activity (MET-hours/week)	0.78	0.73, 0.82	0.70	0.56, 0.80	0.31	0.07, 0.51	0.59	0.34, 0.76
Sitting and lying down (hours per week)	0.56	0.48, 0.63	0.66	0.52, 0.77	0.67	0.51, 0.78	0.54	0.28, 0.73

Table 6
 Intraclass correlation coefficients (ICC_{1,1}) and 95% confidence intervals (CI) of physical activity measures by age and time between tests in the WHI Measurement and Precision Study

	<=65 years		>65 years		<= 3 months		>3 months	
	ICC _{1,1}	95% CI	ICC _{1,1}	95% CI	ICC _{1,1}	95% CI	ICC _{1,1}	95% CI
<i>Form 34: Exercise or recreational physical activity</i>								
Mild physical activity MET-hours per week	0.66	0.59, 0.72	0.40	0.29, 0.50	0.60	0.51, 0.67	0.44	0.34, 0.52
Moderate physical activity MET-hours per week	0.59	0.51, 0.66	0.56	0.47, 0.64	0.57	0.48, 0.64	0.58	0.50, 0.65
Strenuous physical activity MET-hours per week	0.80	0.76, 0.84	0.71	0.64, 0.76	0.71	0.65, 0.77	0.80	0.76, 0.84
Walking MET-hours per week	0.75	0.70, 0.79	0.76	0.70, 0.80	0.84	0.81, 0.87	0.62	0.54, 0.68
Moderate to strenuous recreational physical activity (MET-hours/week)	0.79	0.75, 0.83	0.73	0.67, 0.78	0.75	0.70, 0.80	0.78	0.74, 0.82
Total recreational physical activity MET- hours per week	0.78	0.74, 0.82	0.72	0.65, 0.77	0.76	0.70, 0.80	0.75	0.69, 0.79
<i>Form 42: Household and yard physical activity</i>								
Household physical activity (MET-hours/week)	0.65	0.58, 0.71	0.52	0.42, 0.61	0.60	0.55, 0.66	0.54	0.45, 0.62
Yard physical activity (MET-hours/week)	0.67	0.60, 0.73	0.77	0.72, 0.82	0.71	0.66, 0.75	0.66	0.58, 0.72
Sitting and lying down (hours per week)	0.68	0.62, 0.74	0.48	0.37, 0.57	0.60	0.54, 0.65	0.59	0.51, 0.67