CHAMPS Physical Activity Questionnaire for Older Adults: outcomes for interventions

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ABSTRACT

STEWART, A. L., K. M. MILLS, A. C. KING, W. L. HASKELL, D. GILLIS, and P. L. RITTER. CHAMPS Physical Activity Questionnaire for Older Adults: outcomes for interventions. *Med. Sci. Sports Exerc.*, Vol. 33, No. 7, 2001, pp. 1126–1141. **Purpose:** To evaluate effectively interventions to increase physical activity among older persons, reliable and valid measures of physical activity are required that can also detect the expected types of physical activity changes in this population. This paper describes a self-report physical activity questionnaire for older men and women, developed to evaluate the outcomes of the Community Healthy Activities Model Program for Seniors (CHAMPS), an intervention to increase physical activity. **Methods:** The questionnaire assesses weekly frequency and duration of various physical activities typically undertaken by older adults. We estimated caloric expenditure/wk expended in physical activity and created a summary frequency/wk measure. We calculated measures of each of these for: 1) activities of at least moderate intensity (MET value ≥ 3.0); and 2) all specified physical activities, including those of light intensity. Six-month stability was estimated on participants not likely to change (assessment-only control group, physically active cohort). Several tests of construct validity were conducted, and sensitivity to change was analyzed based on response to the CHAMPS intervention. **Results:** The sample ($N = 249$) comprised underactive persons ($N = 173$ from the CHAMPS trial) and active persons ($N = 76$). The sample was aged 65–90 yr (mean = 74, SD = 6); 64% were women, and 9% were minorities. Six-month stability ranged from 0.58 to 0.67, using intraclass correlation coefficients. Nearly all construct validity hypotheses were confirmed, though correlations were modest. All measures were sensitive to change ($P \leq 0.01$), with small to moderate effect sizes (0.38–0.64). **Conclusions:** The CHAMPS measure may be useful for evaluating the effectiveness of programs aimed at increasing levels of physical activity in older adults. **Key Words:** EXERCISE, AGED, ASSESSMENT, DATA COLLECTION, MEASURE

Over the past several decades, physical activity levels in older adults have been assessed using numerous approaches depending on the study purpose. Epidemiological studies that examine natural levels of physical activity in relation to cardiovascular risk factors, functioning, or mortality (25,26) often estimate energy expenditure in exercise or daily physical activities. Intervention studies to determine the extent to which various types of structured physical activity interventions in older adults improve physical fitness (e.g., balance, endurance, strength, cardiorespiratory fitness) and physical function typically estimate physical activity in terms of adherence to prescribed regimens (e.g., number of sessions completed) (6,17,21).

Some studies have examined the extent to which changes in physical activity (or fitness) (i.e., dose-response associations) are associated with changes in health-related quality of life in older adults (e.g., psychological well-being, sleep, energy) (5,17,22,37). When considering how physical activity affects various aspects of health-related quality of life, characteristics of physical activity other than energy expenditure may be relevant such as the frequency, type, or intensity of physical activity (33).

Recent interventions have been designed primarily to increase the level of physical activity in older adults, based on the acknowledged role of physical activity behavior as an important contributor to health (3,36). Evaluating the efficacy and effectiveness of these types of interventions requires a measure of physical activity that is not only reliable and valid in older adults but can be used as a primary outcome, i.e., is able to detect the kinds of physical activity changes that are likely to occur in such interventions. For example, for inactive older adults, increased light walking or general conditioning can represent a meaningful change in activity that might not be detected by a measure that focuses on more vigorous activities.

Because we needed a questionnaire for evaluating an intervention to increase physical activity in older adults, we reviewed measures that were published at the time of the initial development of the questionnaire (1989). These included the Harvard Alumni Activity Questionnaire (28),

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Minnesota Leisure Time Physical Activity Questionnaire (39), Stanford 7-Day Physical Activity Recall (PAR) (30), and the National Health Interview Survey (41). Although the questionnaires available in 1989 had been used in many studies, they did not meet our needs for an outcome measure. None were designed to be sensitive to changes in physical activity levels for primarily underactive older men and women, and many did not use assessment methods that were appropriate for older populations. Many could only be administered through a face-to-face interview, which was impractical for our purposes. Since the time that our questionnaire was originally developed, four new instruments developed for older adults have been published (7,9,42,44). The two developed for U.S. populations, the Physical Activity Scale for the Elderly (PASE) (44) and the Yale Physical Activity Survey (YPAS) (9) are described in a companion article (14).

This paper describes a self-report questionnaire developed to provide several physical activity outcome measures for the Community Healthy Activities Model Program for Seniors (CHAMPS), an intervention aimed at increasing levels of physical activity in older adults. The CHAMPS questionnaire was used in the first CHAMPS intervention study (36) and revised slightly for administration in the second study, CHAMPS II. We review the methods for developing the CHAMPS questionnaire and present data on the variability, reliability/stability, construct validity, and sensitivity to change of the measures scored from the questionnaire.

METHODS

Development of CHAMPS Questionnaire to Address Conceptual and Methodological Issues in Older Adults

Several conceptual and methodological issues must be considered when attempting to measure levels of physical activities in older adults as outcomes of interventions. These pertain to: 1) assessing appropriate types and amounts of the activities assessed, 2) designing questions and methods to facilitate accurate reporting, 3) minimizing socially desirable responding, and 4) enhancing sensitivity to change. Below, we discuss each issue and indicate how we addressed it in the development of the CHAMPS questionnaire (see Appendix). Based on our experience, it is important to use the 14-point font version of this questionnaire, including the original spacing, to meet the needs of most older adults. (For copies of the questionnaire in a 14-point font WORD file, please contact Dr. Stewart at anitast@itsa.ucsf.edu, and include "CHAMPS Questionnaire" in the subject line.)

Assessing appropriate types and amounts of physical activities. The questionnaire needs to assess the types and intensity levels of physical activity that are meaningful and appropriate for older adults, including lighter (e.g., leisurely walking, water exercises, stretching) as well as more vigorous activities. Most adults, especially older adults, prefer moderate intensity exercise rather than vigorous exercise (24). Our focus was thus on activities typically undertaken by older adults for exercise (e.g., walking, bicycle or stationary cycle, swimming, general conditioning, stretching), activities done in the course of their day that were physical in nature (e.g., gardening), and recreational activities that provided exercise (tennis, golf). A comprehensive list was drawn from available questionnaires as well as our own preliminary work with older adults and an assessment of available community-based physical activities.

To assess amount of activity, the questionnaire was designed to estimate weekly frequency of participation and energy expenditure in physical activities that could lead to health benefits. It was based primarily on the approach used by the National Health Interview Survey (41) as well as on unpublished surveys developed for use with older adults by Dr. David Buchner and Dr. Donald Patrick (personal communication).

Obtaining information on amount of activity needs to account for the fact that older adults may not always participate in physical activities on a fixed or regular schedule. Often, available questionnaires assume regularity in the way in which people participate in exercise, i.e., asking about the frequency per week and duration per session, which assumes that duration is consistent each time. Our preliminary work suggested that older adults participate in at least some of their activities on an irregular basis and for different amounts of time per session. To account for this, we asked respondents to report the total time spent per week rather than the average time per session. The YPAS adopted this strategy as well (9).

Designing questions and methods to facilitate accurate reporting of activities. Memory difficulties and cognitive problems are more prevalent in older persons; thus, an issue is their ability to recall activities over a particular time period. Questions that require respondents to remember and report all physical activities over a specified time period (i.e., use recall memory) are challenging for anyone, but especially for older adults. Many available questionnaires require recall of all physical activities over various time periods or recall of all activities within various categories, such as light, moderate, or hard, with examples given. Use of recognition memory is preferred, e.g., by providing lists of specified activities that are easily recognized (31).

The CHAMPS questionnaire is formatted so that specific activities are listed along the left side of the page (see Appendix), which stimulates recognition. If they engaged in an activity, respondents report the number of times per week they did so in a typical week in the past 4 wk. Once they indicate the frequency, they then report the approximate duration (in hours) of participation over the entire week. Again, to enable use of recognition memory, we provided a set of preformatted categories for the duration of time spent. This enables respondents to recognize the approximate amount of time they spent, a considerably easier task than calculating the exact amount of time.

Memory for high-intensity activities is clearly better than that for lower-intensity activities (4,9,10). Because older adults are more likely to take part in less vigorous activities, efforts must be made to make the reporting task as easy and accurate as possible for lower-intensity activities. To avoid

having respondents rate the intensity level of each activity, which is a common method but a difficult task, activities that could vary in intensity were stated to reflect the level of intensity using familiar descriptors (e.g., leisurely walking, brisk walking) to enable assignment of appropriate energy expenditure weights to the activities.

Because of increasing sensory problems with age, a questionnaire needs to be able to be self- as well as interviewer-administered (by telephone or face-to-face). For example, visually impaired individuals may prefer a personal or telephone interview, whereas those with hearing impairments might do better with self-administration. For self-administration, it is easier for older adults to read font sizes of at least 14, with high contrast (e.g., black on white) and with considerable blank space (i.e., not crowding questions together) (16). Having bars or lines across the page helps them track response choices. The CHAMPS questionnaire follows these principles and is appropriate for either self- or telephone administration.

Existing questionnaires varied considerably in the time frame used, ranging from the past 7 d (30) to the past year (39). Accurate recall also diminishes with the length of time being assessed (4); thus, for older adults, a shorter time frame is optimal. We used a 4-wk time frame.

Minimizing socially desirable responding. Our collective experience in working with older adults in many studies suggests that they value being active and tend to want to present themselves as active people, potentially leading to overreporting of physical activities (socially desirable responding). Because underactive individuals (those likely to be in a physical activity intervention) are thus likely to have to report "no" to the majority of typical questions about moderate and vigorous physical activities, we attempted to develop the questionnaire to minimize this likelihood. We included activities other than physical activities (e.g., social activities, volunteering, hobbies) in the list to enable those who are less physically active to report participation in other types of valued activities. Although this approach is slightly more burdensome to respondents, we hoped that the burden would be minimal and worth the potential improvement in validity. We were not, however, able to test whether this approach indeed reduced socially desirable responding. The nonphysical activities are not included in deriving the measures of estimated energy expenditure or frequency of physical activity.

Enhancing sensitivity to change. To serve as an outcome measure of an intervention to increase physical activity, the questionnaire must assess lower intensity physical activities in order to detect potentially small but meaningful changes. For example, a change from very little walking to walking a few times a week (a meaningful change for a sedentary person) would require a questionnaire that included leisurely walking. Ideally, the outcome measures would focus primarily on the types of physical activities that are being targeted for change in the intervention, to improve sensitivity. We thought that it would be difficult to detect change through use of a total caloric expenditure measure that included all everyday activities, many of which were not the target of the program (e.g., cooking, standing).

Derivation of Measures from Questionnaire

From the questionnaire, we derived measures of frequency per week and estimated caloric expenditure per week in physical activity. Although not independent, these were derived to provide alternative outcomes depending on the purpose and goal of a particular study or analysis. For both frequency and caloric expenditure, two measures were derived based on: 1) physical activities of moderate or greater intensity (MET value $\geq$ 3.0), and 2) all specified physical activities that included activities of light intensity in addition to moderate and greater. Thus, four total scores can be derived from the questionnaire. Briefly, the estimated caloric expenditure measures were calculated by multiplying the estimated duration of each activity by the MET value (i.e., weighting the time spent by the intensity) and summing these across all relevant activities. The frequency measures were calculated by summing the frequency per week across all relevant activities. Detailed formulas for developing these scores are presented in the Appendix.

Assigning MET values. Each specified activity was assigned a MET value based on values reported by Ainsworth and colleagues (1). Table A2 in the Appendix lists each activity from the questionnaire along with the values published in the Ainsworth et al. paper that are comparable or identical to the activity. The basis for our estimates is also shown. For activities not specifically listed in Ainsworth et al. (e.g., water exercises, Tai chi), we assigned a weight by interpolating a value based on other similar activities (e.g., water exercises' MET value was drawn from water aerobics and water calisthenics).

Adjusting MET values. Adjustments were then made by the authors to some of the activities, to convert the METs to those more likely to be correct for older adults, because many of the MET values reported by Ainsworth and colleagues are based on assessments of younger persons. The basic premise for adjusting endurance-type activities down is that the published values exceed the aerobic capacity of older adults. Adjustments for activities involving strength are based on the premise that older persons will be working at a lower intensity due to their lower levels of muscle strength.

Other reasons for specific adjustment decisions had to do with the way the activity was likely to be performed by older adults, how individuals tend to report the amount of time spent in the activity, and the extent to which the activity consisted of constant effort or included a range of effort. For example, previously underactive older persons may be likely to use an exercise machine in a different way than a younger or more active person, e.g., are more likely to exercise at a moderate to light pace. These adjustments were determined primarily by one of the authors (W.L.H.), an expert in MET values and a coauthor on the original publication on energy expenditure of activities (1). These adjusted values (for those activities that were adjusted) are shown in Table A2 in the Appendix.

Methods for Testing Variability, Reliability/Stability, Validity, and Sensitivity to Change

To test the variability, reliability/stability, and validity, we used baseline data from the CHAMPS intervention trial ($N = 173$) (86 in intervention and 87 in control group) and a parallel study of an active cohort of older adults ($N = 76$) recruited from those who were ineligible for CHAMPS because of being too active. To examine sensitivity to change, we used data from those who were randomized into the CHAMPS trial and completed the 1-yr study ($N = 164$, 95% of those randomized) (81 in intervention, 83 in control group). The trial results are presented elsewhere (38).

Reliability/stability. We examined the 6-month stability between the physical activity measures administered at baseline and 6 months for two subgroups not expected to change (i.e., received no intervention): the randomized trial control group and the active cohort. We used intraclass correlation coefficients (ICC). Such estimates of stability can provide a lower-bound estimate of reliability, as using a shorter time span would very likely produce a higher correlation. The ICC reflects the percent of variance explained in each measure and also takes into account the mean differences over time; thus, the coefficients reflect true variation in the measures as well as measurement variance. For this reason, the ICC coefficients tend to be lower than Pearson product-moment correlations (27). The 2-wk test-retest reliability of these measures was tested in Harada and colleagues' article (14) and will be presented here as well.

Construct validity. Several construct validation strategies were designed in which we hypothesized various associations and evaluated the extent to which our data corresponded to our hypotheses. Known-groups validity was examined by defining three groups known to be more or less active based on self-reported data collected during screening for the randomized trial and the cohort. At screening, a different more detailed approach was used to assess physical activity levels based on Computer Assisted Telephone Interviewing (CATI) methods. The CATI method allowed us to ask questions regarding what exercise and recreational sports they did; when an activity was reported, a series of questions queried about the frequency, duration, and intensity of each activity, as well as the length of time the person had been doing this activity. After allowing each respondent to report up to four activities, the information was aggregated to classify the person into one of three groups: 1) not participating in any exercise or recreational sports (least active); 2) participating in some exercise or recreational sports but not meeting American College of Sports Medicine (ACSM) guidelines of 20 min per session, 3 or more times per week, at an intensity that increases heart rate or breathing (2) and not doing it regularly (for at least 3 months) (underactive); and 3) participating at levels that met the ACSM guidelines (active). The validity test determined whether the CHAMPS physical activity measures discriminated between persons in these three groups. Analysis of variance was used to determine whether physical activity scores were significantly different across the three defined groups. We hypothesized that the levels of physical activity on the CHAMPS measures would be lowest for the least active, and increase to be highest in those who were active.

Because of evidence that physical activity levels at a given point in time are often associated with physical functioning, overweight, and other aspects of health-related quality of life (9,29,33), we also examined correlation coefficients between the physical activity measures and several health measures. These included body mass index (based on self-reported weight and height); two physical performance measures, one of lower body functioning, the Short Physical Performance Battery developed for the EPESE studies (11) and the other a 6-min walk (12); and four self-reported measures: physical functioning (32,43), energy/fatigue (43), pain (43), and psychological well-being (43). These measures were obtained through a baseline self-administered questionnaire and a series of physical performance tests administered by our staff. Based on prior literature, we hypothesized that more physically active people would have lower body mass index (9). We also hypothesized that correlations of physical activity would be higher with lower body functioning (25), distances walked in 6 min (15), physical functioning, and energy/fatigue levels than they would with measures of pain and psychological well-being (34,35). Further, we hypothesized that all of the latter correlations would be positive.

Testing independence of measures. We created four alternative physical activity measures to provide choices depending on study goals. Because investigators may wish to examine frequency in addition to caloric expenditure in a particular study, we examined the Pearson correlations between the frequency and caloric expenditure measures for the moderate and greater intensity and for the all activities measures.

Sensitivity to change. We assessed the sensitivity to change of the four physical activity measures to the 1-yr CHAMPS intervention program, which was a randomized controlled design (38). Using ANCOVA, we examined the extent to which 1-yr changes in physical activity differed between the intervention and the control group, controlling for age and gender (the primary between-groups test). We also calculated the effect size as the difference in physical activity change scores between the intervention and control groups, divided by the standard deviation of the pooled baseline scores (18). The effect size is a method for reporting the magnitude of the change that is expressed in units of variability and therefore free of the unit of measurement (8).

Subjects

The sample consisted of all persons who completed the baseline questionnaire, which includes those randomized to the intervention ($N = 87$) or control group ($N = 86$) and those enrolled in the active cohort group ($N = 76$), for a total sample size of 249. Sample characteristics are presented in Table 1 for the total sample ($N = 249$) as well as separately for the (underactive) sample enrolled in the randomized trial ($N =$

TABLE 1. Sample characteristics at baseline.

Variable	Total Sample (N = 249)	Randomized Trial Subjects (N = 173)	Active Cohort (N = 76)
Age			
Mean (SD)	74.1 (5.6)	74.6 (5.9)	72.9 (4.8)
Range	65–90	65–90	65–85
Education (%)			
High school or less	15.2	19.1	6.6
Some college	21.7	24.9	14.5
College degree	30.5	26.6	39.5
Some graduate school	8.0	6.9	10.5
Graduate degree	24.5	22.5	29.0
Female (%)	63.9	66.5	57.9
Minority (%)	9.2	9.2	9.2
Married (%)	59.0	55.5	67.1
Employed full or part time (%)	17.3	15.0	22.4
Self-rated health fair or poor (%)	8.0	11.6	0
Hypertension (%)	36.5	39.3	30.3
Arthritis or joint problems (%)	59.4	65.3	46.1
Cardiovascular problems (%)	18.1	16.8	21.0
Asthma, chronic bronchitis, or emphysema (%)	10.5	11.0	9.3
Diabetes (%)	6.8	7.5	5.3
Does not set aside time for exercise (%)	30.9	43.9	1.3[a]

[a] One person was inadvertently included in this cohort.

173) and the active cohort (N = 76). All subjects completed written informed consent forms in compliance with Institutional Review Board requirements. The total sample included persons aged 65–90 yr, represented both men and women, and included persons with a variety of health problems. The group was fairly well educated and included a relatively small proportion of minority seniors, consistent with the geographic area in which the study was conducted.

RESULTS

Time to Complete

In our study, the questionnaire was embedded in a larger survey battery that included a variety of other questions pertaining to the study (e.g., health, health behaviors, experiences of exercise). The physical activity questionnaire completed by itself takes about 10–15 min on average, although this can vary from 5 to 20 min with some individuals taking longer.

Variability and Reliability/Stability

Descriptive statistics of the CHAMPS measures at baseline are presented in Table 2 for the total sample and by gender. A large range of levels of physical activity is apparent; the range includes zero (the minimum value) on all measures. The range of skewness statistics was 0.01 to 1.56, where being closer to zero indicates less skewness. All but one skewness coefficient were positive, indicating that all of the measures were skewed somewhat in the direction of more people having lower levels of activity, with a tail of higher levels of activity. Skewness was greater in women than in men for all measures. None of the skewness statistics were greater than 2.0, which would be cause for concern.

In the total sample, the 6-month ICC for the moderate and greater caloric expenditure measures was 0.67 and 0.66 for the all activities measure. For the moderate and greater frequency measures, the ICCs were 0.58 and 0.62 (moderate and all, respectively). Pearson's coefficients were nearly identical. Coefficients were about the same for men and women and paralleled the total sample findings. The coefficients for the caloric expenditure measures thus indicate moderate reliability. The lower coefficients for the frequency measures suggest that frequency may be more difficult to recall. In the Harada et al. study (14), the 2-wk test-retest reliability of the caloric expenditure measures for both the ICC and Pearson's were 0.76 for the moderate activities measure and 0.62 for all activities.

Validity and Sensitivity to Change

Known-groups validity. As seen in Table 3, all four baseline measures discriminated across the three groups known to vary in their physical activity levels based on prior, more detailed assessment of their activity levels. The group that did not set aside time for exercise exhibited the lowest levels of activity and the active cohort the highest, as hypothesized. The F-statistic ranged from 17.80 to 38.93 for the four measures (df 2,246 for all tests) and all were significant ($P < 0.001$). Although we did not hypothesize that the differences between the lowest and middle level would be similar to the differences between the middle and high level, it is interesting that the mean values of the physical activity measures were more similar for the initially sedentary and the somewhat active; the difference between the somewhat active and the already active was much larger.

Correlations with health measures. Pearson correlations are shown in Table 4 between the baseline physical activity and construct validity measures. Hypotheses were generally supported. Correlations between the caloric expenditure measures and lower body functioning, 6-min walk, self-reported physical functioning, and self-reported energy/fatigue were higher ($r = 0.17–0.30$) than correlations with pain and psychological well-being ($r = 0.05–0.11$), although the magnitude of all correlations was small. Similarly, correlations between the frequency measures and the same four validity measures were generally higher ($r = 0.10–0.30$) than with pain and psychological well-being ($r = 0.02–0.17$), although the magnitude was small. The correlation of frequency per week of all activities and the 6-min walk was very low (0.10), which was unexpected. The pattern of correlations of frequency per week varied slightly from the pattern of caloric expenditure, suggesting that these are somewhat distinct. The hypothesis regarding body mass index was not supported for the caloric expenditure measures (0.04, −0.06), although the frequency measures had low associations in the hypothesized direction ($r = -.17$ to -0.21).

Correlations among physical activity measures. The correlation between the frequency and caloric expenditure measure was 0.73 for moderate intensity activities and 0.55 for all specified activities.

Sensitivity to change. All four physical activity measures were sensitive to change (Table 5). Those in the intervention group increased their estimated caloric

TABLE 2. Physical activity measures derived from the baseline CHAMPS questionnaire: descriptive statistics (N = 249) and 6-month stability (N = 147).

		Total Sample			Men			Women		
Measure/Definition[a]	Range	Mean (SD) (N = 249)	Skewness (N = 249)	6-Month Stability[b]—ICC[c] (Pearson) (N = 147)	Mean (SD) (N = 159)	Skewness (N = 159)	6-Month Stability—ICC (Pearson) (N = 91)	Mean (SD) (N = 90)	Skewness (N = 90)	6-Month Stability—ICC (Pearson) (N = 57)
Moderate and greater intensity measures										
Caloric expenditure per week in at least moderate intensity physical activities (MET ≥ 3.0)	0–7443	1486 (1472)	1.56	0.67 (0.67)	1870 (1564)	1.12	0.66 (0.68)	1270 (1376)	1.94	0.65 (0.66)
Frequency per week in at least moderate intensity physical activities (MET ≥ 3.0)	0–28	5.7 (4.5)	1.12	0.58 (0.60)	5.9 (4.2)	0.90	0.51 (0.65)	5.6 (4.7)	1.22	0.63 (0.63)
All activities measures										
Caloric expenditure per week in all listed physical activities	0–9345	2420 (1831)	1.32	0.66 (0.66)	2851 (1896)	1.03	0.67 (0.68)	2176 (1753)	1.58	0.62 (0.62)
Frequency per week in all listed physical activities	0–51	13.1 (8.0)	1.08	0.62 (0.62)	12.9 (7.0)	0.88	0.60 (0.62)	13.3 (8.5)	1.12	0.63 (0.63)

[a] Higher score indicates higher activity level.
[b] Lower bound estimate of test-retest reliability; correlations between baseline and 6 months for the control group and active cohort group only.
[c] Intraclass correlation coefficient.

expenditure by 487 calories·wk^{-1} in moderate intensity activities (MET ≥ 3.0) (P < 0.001) and by 687 calories·wk^{-1} in physical activities of any intensity (P < 0.001) (38). Control group changes were negligible. Between-group analyses confirmed that the changes were significantly different in both measures (P < 0.05). The effect sizes for the caloric expenditure measures were 0.38 and 0.42 (small to moderate); the effect sizes for the frequency measures were 0.54 and 0.64 (moderate) (8,18). In the context of our sample size (about 80 per group), we were thus able to detect an effect size as small as 0.38 (for the caloric expenditure measure).

DISCUSSION

We have presented one of the first physical activity questionnaires for older adults designed specifically for use in evaluating interventions that primarily aim to increase levels of physical activity in older adults. The development of the questionnaire addressed several conceptual and methodological assessment issues. Our results provide evidence of the reliability, validity, and sensitivity to change of the measures derived from this questionnaire, which is consistent with the evidence of reliability and validity from our prior study (36) and from a companion study (in this issue) evaluating the CHAMPS and other physical activity questionnaires in older adults (14).

Our reliability/stability coefficients were reasonably good and were better for the caloric expenditure measures than for the frequency measures. These coefficients represent a lower bound estimate of reliability, as a 6-month period is long and incorporates seasonal effects. Thus, we would expect the true reliability to be somewhat greater. In Harada and colleagues' (14) study of seniors recruited from residential facilities and community centers, the 2-wk test-retest reliability (ICC and Pearson's) for the CHAMPS caloric expenditure measure for moderate and greater intensity activities was higher than ours (0.76 compared with our 0.67), and for all listed physical activities it was lower than ours (0.62 compared with 0.66). Coefficients were roughly similar in women and men in both their study and ours. The reliabilities of the CHAMPS measures in both studies fall somewhere between those of other physical activity measures for older adults. DiPietro and colleagues (9) found 2-wk test-retest reliabilities (Pearson's) of 0.42–0.65 for the YPAS and Washburn and colleagues (44) found a 3- to 7-wk test-retest coefficient of 0.75 for the PASE.

It is clear that the reliability of the CHAMPS measures could be improved. We suspect that our findings may partially be due to the fact that light and moderate activities are harder to recall than vigorous ones (4,9,10). Although we designed the questionnaire to enhance recognition, methods for helping respondents to be more accurate may be needed. In the version of the questionnaire attached in the Appendix, we have attempted to minimize random error through several revisions: 1) added instructions that were not in the version administered for this study; 2) revised slightly some of the items to be clearer to respondents (e.g., specified what

TABLE 3. Known-groups validity of measures at baseline: comparison of those initially inactive,[a] somewhat active,[b] and active[c] ($N = 249$).

Measure	Initially Sedentary ($N = 76$) Mean (SE)	Somewhat Active ($N = 97$) Mean (SE)	Already Active ($N = 76$) Mean (SE)	*F*-Test
Moderate and greater intensity measures				
Caloric expenditure per week in at least moderate intensity physical activities (MET $\geq$ 3.0)	1057 (149)	1163 (125)	2328 (181)	$F_{2,246} = 20.85$***
Frequency per week in at least moderate intensity physical activities (MET $\geq$ 3.0)	3.19 (0.4)	5.27 (0.42)	8.81 (0.5)	$F_{2,246} = 38.93$***
All activities measures				
Caloric expenditure per week in all listed physical activities	1843 (198)	2116 (157)	3386 (219)	$F_{2,246} = 17.80$***
Frequency per week in all listed physical activities	8.45 (0.7)	13.52 (0.8)	17.33 (0.9)	$F_{2,246} = 29.26$***

*** $P < 0.001$.
[a] Does not set aside time for exercise or recreational sports.
[b] Does set aside time for exercise but does not meet ACSM's guidelines of exercising 3 times per week in a moderate-intensity exercise for at least 20 minutes per time, and has been doing so for at least 3 months (*ACSM's Guidelines for Exercise Testing and Prescription*, 5th Ed. Baltimore: Williams & Wilkins, 1995).
[c] Meets CDC-ACSM 1995 guidelines.

not to include in some items); and 3) changed the format of the questions on the page to simplify the task of responding (based on subsequent pretests of this reformatted questionnaire in groups with lower socioeconomic status).

Our findings provide preliminary evidence of construct validity. All but one of our hypotheses were confirmed, although correlations with functioning and health-related quality of life measures were small in magnitude. These correlations differed from those of Harada and colleagues (14): correlations of the caloric expenditure measures with four functioning measures (self-reported physical functioning and energy/fatigue, 6-min walk, lower body functioning) were considerably higher in their study (ranging from 0.39 to 0.54) compared with ours (0.22–0.30). These differences may be due to sample differences or to statistical anomalies in the bivariate distributions that we have not detected. Clearly, more studies will be needed to continue to acquire evidence of the construct validity of these measures across different samples.

The finding of no association with BMI was similar across the two studies on the caloric expenditure measures (which were the only ones tested in Harada and colleagues' study), and are consistent with findings of Washburn et al. (44), who also found no association.

Additional studies of the construct validity of the CHAMPS questionnaire (e.g., associations with activity monitor data and two other recent physical activity measures for older adults) are described by Harada et al. (14). Future studies should continue to examine construct validity and compare more than one physical activity measure in the same study. By summarizing findings across studies and populations, the evidence base for the validity of these measures will grow.

Perhaps the most important finding of this study is that the measures derived from the CHAMPS questionnaire were sensitive to expected changes, detecting increased levels of physical activity associated with the intervention. The CHAMPS measures have also been shown to be sensitive to change in physical activity associated with several other physical activity intervention studies targeting older adults (19,20,23,36). These findings may reflect the fact that, by asking about duration per week instead of duration per session, we allowed for considerable variation in exercise routines, which may have helped detect activities that may have been missed using more traditional approaches. Another explanation is that we focused on specific physical activities appropriate for older adults, including those likely to be recommended in interventions, rather than on an exhaustive assessment of all activities in which energy is expended. The sensitivity findings confirm the appropriateness of this questionnaire for use in evaluating outcomes of physical activity interventions for older adults. The information on effect sizes can be useful to others in planning sample sizes for similar intervention studies. A larger sample size would be needed to detect differences in caloric expenditure than in frequency at the same level of power.

There remain some limitations of the CHAMPS instrument. Because there are a few respondents needing assistance in completing the questionnaire, we recommend that the first time it is administered, someone should be available to provide assistance if needed, or to review the returned questionnaire to ensure completeness. Because of the

TABLE 4. Correlations between CHAMPS baseline physical activity measures and physical functioning/health-related quality of life ($N = 249$).[a]

Measure	Body Mass Index	Lower Body Functioning	6-Min Walk	Self-Reported Physical Functioning	Self-Reported Energy/Fatigue	Self-Reported Pain	Self-Reported Psychological Well-Being
Moderate and greater intensity measures							
Caloric expenditure per week in at least moderate intensity physical activities (MET $\geq$ 3.0)	−0.06	0.28***	0.27***	0.30***	0.20**	0.11	0.09
Frequency per week in at least moderate intensity physical activities (MET $\geq$ 3.0)	−0.17**	0.20**	0.21***	0.30***	0.23***	0.17**	0.14*
All activities measures							
Caloric expenditure per week in all listed physical activities	0.04	0.27**	0.22***	0.27***	0.17**	0.07	0.05
Frequency per week in all listed physical activities	−0.21*	0.15*	0.10	0.23***	0.14*	0.08	0.02

* $P < .05$; ** $P < .01$; *** $P < .001$.
[a] All measures are scored so that a high score indicates better health or functioning (e.g., less pain, more energy).

TABLE 5. Sensitivity to change of CHAMPS measures of physical activity to a physical activity promotion intervention ($N = 164$).

Measure	Within Group Change	Unadjusted Effect Size[a]	*F*-Test for Adjusted[b] Difference in Change between Groups
Moderate and greater intensity measures			
Caloric expenditure per week in at least moderate intensity physical activities (MET ≥ 3.0)	Intervention 487 (t=3.65, $P < 0.001$) Control 5 (NS)	0.38	$F_{1,159} = 8.84$, $P = 0.003$
Frequency per week in at least moderate intensity physical activities (MET ≥ 3.0)	Intervention 3.1 (t=5.55, $P < 0.001$) Control 0.99 (NS)	0.54	$F_{1,159} = 6.55$, $P = 0.01$
All activities measures			
Caloric expenditure per week in all listed physical activities	Intervention 687 (t=3.67, $P < 0.001$) Control −10 (NS)	0.42	$F_{1,159} = 9.06$, $P = 0.003$
Frequency per week in all listed physical activities	Intervention 5.18 (t=6.80, $P < 0.001$) Control 0.58 (NS)	0.64	$F_{1,159} = 16.39$, $P = 0.0001$

[a] Mean difference in change between groups/SD of the pooled baseline scores.
[b] Adjusted for age and gender.

complexity of obtaining this type of detailed information, and the need for relatively short questionnaires, the ability to format the questions in a way that can be easily completed using self-administration continues to be a challenge.

Another limitation of any measure that provides a summary estimate of energy expenditure is the difficulty determining whether an individual is meeting the current national guidelines of 5 or more days per week, 30 min per day, of moderate intensity activity (40). For researchers needing to know this, we suggest that additional questions be included in a survey or that the approach taken by us in our screening process be used. An estimate of the duration of moderate intensity or greater activities per week can be easily calculated from our questionnaire by simply summing the moderate-intensity duration variables across all activities without weighting them by the MET values, although this will provide the weekly rather than the daily duration.

Another limitation of all measures of caloric expenditure is that they are based on crude estimates of energy expenditure, using MET values based on average expenditures of young and middle-aged adults, which are then used to weight self-reported estimates of time spent by respondents. Although this approach is fraught with errors, it has been used for many years and appears to be the current state of the art. For example, both new measures for older adults for use in the United States (PASE, YPAS) use summary indexes of energy expenditure. We hope that as more validity studies of these methods are conducted, we will find ways of improving the accuracy of assessment of physical activity through self-report. Further, normative MET values are needed that are based on older adults to improve our ability to report caloric expenditure more accurately.

Another debate regarding the scoring of these measures is whether or not to incorporate the individual's weight into the caloric expenditure measure, as opposed to using a measure of expenditure per kilogram of body weight. By individualizing the expenditure to the weight of the person, heavier persons will achieve a greater expenditure for a particular activity than lighter persons. However, this does in fact reflect the reality of energy expenditure for the person with higher body weight. Given that most applications of measures like ours are to evaluate interventions, the randomization process should equalize the effects of weight across the groups. For analyses in which one does not want the individual's body weight to affect the results, one approach is to create another measure that does not adjust the estimated energy expenditure for body weight. We used this approach when analyzing whether overweight people responded differently to the CHAMPS intervention than nonoverweight people (38). In comparison with the original measures of caloric expenditure, we found the same pattern of results; a significant interaction of group by overweight status. However, the significance levels of the interaction were reduced for both measures: for the "all activities" caloric expenditure measure, the level changed from $P < 0.01$ to $P < 0.05$), and for the "moderate activities" caloric expenditure measure, the significance level changed from $P < 0.05$ to $P = 0.07$.

The questionnaire has been adapted for Latino elders and translated into Spanish, developed with input from Latino community members. However, no psychometric testing has yet been done on the Spanish language version. Some minor revisions were made to the version published here (from the one administered in the CHAMPS study), including adding and revising some activity questions based on our experience in coding the questionnaire in CHAMPS, and on our experience in pretesting the questionnaire in Spanish and English in a broad range of community settings. A few questions were added or adapted to be comparable to the Spanish language version, which required some cultural adaptation to include additional household and daily activities.

Older adults are becoming an increasing focus of health promotion programs to provide exercise and physical activity interventions (37). The CHAMPS questionnaire should be useful in evaluating the effectiveness of these programs, given the evidence presented here of the appropriateness, reliability, validity, and sensitivity to change of the measures. It would be useful for future studies to continue to explore in depth the issues that face older adults in reporting their physical activity levels. Such studies could include, for example, studies of the cognitive processes involved in

constructing answers to questions about physical activity. Because of the importance of physical activity to subsequent health, functioning, and quality of life, efforts to improve its measurement will contribute greatly to research attempting to improve the health of our older populations through increased physical activity.

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TABLE A1. Codebook for CHAMPS physical activity measures.

Variable Label	Item Nos.	Coding Algorithms
Caloric expenditure/week in all exercise-related activities[a]	7, 9, 10, 14–16, 19–35, 37–40	For each activity 1. Create new duration variables for each activity recoded as follows: 1=0.5, 2=1.75, 3=3.75, 4=5.75, 5=7.75, 6=9.75; if duration variable is not answered, score = 0. Duration is hours/week. 2. For each recoded duration variable, create new weighted duration variable for each activity by multiplying duration variable (no. 1) by corresponding MET value (see Table 2). 3. For each weighted duration variable, create caloric expenditure per week variable for each activity by multiplying weighted duration variable (no. 2) by 3.5 and by 60 (to convert METs/minute to METs/hour) and by (weight in kg/200). 4. Sum caloric expenditure per week variables across activities to create caloric expenditure/week.
Caloric expenditure/week in moderate-intensity exercise-related activities	7, 9, 14–16, 19, 21, 23–26, 29–33, 37, 38, 40	Same as above, subset of activities with MET values ≥3.0.
Frequency/week of all exercise-related activities	7, 9, 10, 14–16, 19–35, 37–40	SUM frequency scores/week for each of the activities (allow those with missing data on frequency to be included in the sum).
Frequency/week of moderate-intensity exercise-related activities	7, 9, 14–16, 19, 21, 23–26, 29–33, 37, 38, 40	SUM frequency scores/week for each of the activities (allow those with missing data on frequency to be included in the sum).

[a] Based on American College of Sports Medicine formula: kcal/min = METs *3.5* (body weight in kg/200). Our formula converts this into kcal/week. *ACSM's Guidelines for Exercise Testing and Prescription*, 5th Ed. Baltimore: Williams & Wilkins, 1995.

TABLE A2. Summary of original metabolic weights and revised weights for selected items to adjust for older adults: CHAMPS physical activity questionnaire.

Item No.	Questionnaire Item	Comparable MET Values From Ainsworth and Colleagues[a] and Rationale for Adjustment	Original Metabolic Weight	CHAMPS Metabolic Weight
7	Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)	Average of (emphasis on general dancing) General dancing = 4.5 Square = 5.5 Folk = 5.5 Ballroom slow = 3.0 Line = 5.5	4.5	4.5
9	Play golf, carrying or pulling your equipment (count walking time only)	Golf pulling clubs 5.0 Adjusted down to accommodate older adults' expenditure and to accommodate nature of golf (walking 3 mph)	5.0	3.0
10	Play golf, riding a cart (count walking time only)	Golf using power cart 3.5 Adjusted down to accommodate older adults' expenditure and to accommodate nature of golf	3.5	2.0
14	Play singles tennis (do not count doubles)	Singles tennis 8.0 Adjusted down for reduced exertion of older adults	8.0	6.0
15	Play doubles tennis (do not count singles)	Doubles tennis 6.0 Adjusted down for reduced exertion of older adults	6.0	4.0
16	Skate (ice, roller, in-line)	Roller skating 7.0 Adjusted down to be similar to very very brisk walk	7.0	4.5
19	Do heavy work around the house (such as washing windows, cleaning gutters)	Washing windows 4.5 Adjusted down to account for lack of specificity of task	4.5	3.0
20	Do light work around the house (such as sweeping or vacuuming)	Light cleaning, moderate effort = 2.5	2.5	2.5
21	Do heavy gardening (such as spading, raking)	Average of Spading 5.0 Mowing power 4.5 Weeding 4.5 Planting bushes and seedlings 4.0 Raking 4.0 Trimming 4.5 Sacking leaves 4.0 Adjusted to reflect intermittent nature of heavy gardening, and because it uses small muscle groups	4.4	4.0
22	Do light gardening (such as watering plants)	Average of Watering lawn or garden, standing or walking, 1.5 Walking/standing, picking up yard, light 3.0	2.25	2.25
23	Work on your car, truck, lawn mower, or other machinery	Machine tooling, welding = 3.0 Auto repair = 3.0	3.0	3.0
24	Jog or run	Jogging general = 7.0 (5 mph) Jog/walk = 6.0	7.0	7.0
25	Walk uphill or hike uphill (count only the uphill part)	Walking uphill 6.0	6.0	6.0
26	Walk fast or briskly for exercise (do not count walking leisurely or uphill)	Walking 3 mph = 3.5 Brisk walking 3.5 mph = 4.0 Selected lower value	3.5	3.5
27	Walk to do errands (such as to/from a store or to take children to school (count walk time only))	Walking 2 mph = 2.5 Probably average speed for older adults.	2.5	2.5
28	Walk leisurely for exercise or pleasure	Walking 2 mph = 2.5 Probably average speed for older adults.	2.5	2.5
29	Ride a bicycle or stationary cycle	Average of Bicycling 10 mph = 4.0, 10–12 mph = 6.0 Stationary cycling general = 5.0 Adjusted down for likely lower resistance for older adults	5.0	4.0
30	Do other aerobic machines such as rowing or step machines (do not count treadmill or stationary cycle)	Comparable values Rowing ergometer, general = 9.5 Rowing erg. light effort, 50 W = 3.5 Rowing erg. moderate effort, 100 W = 7.0 Rowing erg. very vigorous effort 200 W = 12 Stair-treadmill ergometer, general = 6.0 Ski machine, general = 9.5 Cross-country skiing light = 7.0 Cross-country skiing moderate speed and effort = 8.0 Cross-country skiing vigorous effort = 9.0 MET of 7.0 reflects moderate effort rowing and light cross-country skiing Adjusted down to account for the way in which older adults use aerobic machines on average	7.0	5.0
31	Do water exercises (do not count other swimming)	Swimming, treading water, moderate effort, general = 5.0 Adjusted as the estimated effort doing exercises in a swimming pool	4.0	3.0
32	Swim moderately or fast	Swim crawl, slow, moderate or light effort = 8.0 Adjusted down to account for way in which older adults swim on average	8.0	5.0
33	Swim gently	Swim leisurely = 6.0 Adjusted down to account for way in which older adults swim on average	6.0	3.0
34	Do stretching or flexibility exercises (do not count yoga or Tai Chi)	Stretching and hatha yoga = 4.0 Adjusted down for reduced exertion by older adults	4.0	2.0
35	Do yoga or Tai Chi	Stretching and hatha yoga = 4.0 Adjusted down for reduced exertion by older adults	4.0	2.0
36	Do aerobics or aerobic dancing	Aerobic dance—low impact = 5.0 Adjusted to low-intensity aerobics at 3.5	5.0	3.5

TABLE A2. *Continued.*

Item No.	Questionnaire Item	Comparable MET Values From Ainsworth and Colleagues[a] and Rationale for Adjustment	Original Metabolic Weight	CHAMPS Metabolic Weight
37	Do moderate to heavy strength training (such as hand-held weights of more than 5 lbs., weight machines, or push-ups)	Push-ups, heavy, vigorous effort 8.0 Weight lifting using free weights, nautilus, or universal type vigorous effort 6.0 Adjusted because caloric expenditure low compared to walking	7.0	4.5
38	Do light strength training (such as hand held weights of 5 lbs. or less or elastic bands)	Weight lifting (free, nautilus or universal type) light or moderate effort 3.0	3.0	3.0
39	Do general conditioning exercises, such as light calisthenics or chair exercises (do not count strength training)	Calisthenics, home exercise, light or moderate, up and down from floor = 4.5 Adjusted for reduced effort of older adults	4.5	2.5
40	Play basketball, soccer, or racquetball (do not count time on sidelines)	Average of Basketball: game = 8.0 Nongame, general = 6.0 Shooting baskets = 4.5 Soccer and racketball, competitive = 10.0 Soccer and racketball, casual, general 7.0 Adjusted for lower expenditure in this sport	7.1	5.0
41	Other	Not scored		

[a] Ainsworth BE, Haskell WL, Leon AS, Jacobs DR, Montoye HJ, Sallis JF, and Paffenbarger RS. Compendium of physical activities: classification of energy costs of human physical activities. *Med. Sci. Sports Exerc.* 25:71–80, 1993.

APPENDIX: CHAMPS Activities Questionnaire for Older Adults

CHAMPS: Community Healthy Activities Model Program for Seniors
Institute for Health & Aging, Center for Healthy and Active Aging
University of California San Francisco
Stanford Center for Research in Disease Prevention, Stanford University

Date:_____

Name or ID:_____

Appendix. *Continued.*

This questionnaire is about activities that you may have done in the past 4 weeks. The questions on the following pages are similar to the example shown below.

INSTRUCTIONS

If you DID the activity in the past 4 weeks:

Step #1 **Check the YES box.**

Step #2 **Think about how many TIMES a week you usually did it, and write your response in the space provided.**

Step #3 **Circle how many TOTAL HOURS in a typical week you did the activity.**

Here is an example of how Mrs. Jones would answer question #1: Mrs. Jones usually visits her friends Maria and Olga twice a week. She usually spends one hour on Monday with Maria and two hours on Wednesday with Olga. Therefore, the total hours a week that she visits with friends is 3 hours a week.

In a typical week during the past 4 weeks, did you…							
1. Visit with friends or family (other than those you live with)? ☒ **YES** How many TIMES a week? 2 ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	(3-4½ hours)	5-6½ hours	7-8½ hours	9 or more hours

If you DID NOT do the activity:

- **Check the NO box and move to the next question**

In a typical week during the past 4 weeks, did you …							
1. Visit with friends or family (other than those you live with)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
2. Go to the senior center? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
3. Do volunteer work? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
4. Attend church or take part in church activities? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
5. Attend other club or group meetings? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
6. Use a computer? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
7. Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

Appendix. *Continued.*

In a typical week during the past 4 weeks, did you …							
8. Do woodworking, needlework, drawing, or other arts or crafts? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
9. Play golf, carrying or pulling your equipment (count walking time only)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
10. Play golf, riding a cart (count walking time only)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
11. Attend a concert, movie, lecture, or sport event? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
12. Play cards, bingo, or board games with other people? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
13. Shoot pool or billiards? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

In a typical week during the past 4 weeks, did you …							
14. Play singles tennis (do not count doubles)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
15. Play doubles tennis (do not count singles)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
16. Skate (ice, roller, in-line)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
17. Play a musical instrument? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
18. Read? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
19. Do heavy work around the house (such as washing windows, cleaning gutters)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
20. Do light work around the house (such as sweeping or vacuuming)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

Appendix. *Continued.*

In a typical week during the past 4 weeks, did you …							
21. Do heavy gardening (such as spading, raking)? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
22. Do light gardening (such as watering plants)? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
23. Work on your car, truck, lawn mower, or other machinery? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
****Please note: For the following questions about running and walking, include use of a treadmill.**							
24. Jog or run? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
25. Walk uphill or hike uphill (count only uphill part)? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
26. Walk fast or briskly for exercise (do not count walking leisurely or uphill)? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
In a typical week during the past 4 weeks, did you …							
27. Walk to do errands (such as to/from a store or to take children to school (count walk time only)? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
28. Walk leisurely for exercise or pleasure? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
29. Ride a bicycle or stationary cycle? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
30. Do other aerobic machines such as rowing, or step machines (do not count treadmill or stationary cycle)? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
31. Do water exercises (do not count other swimming)? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
32. Swim moderately or fast? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
33. Swim gently? ☐ **YES** How many TIMES a week?____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

Appendix. *Continued.*

In a typical week during the past 4 weeks, did you …							
34. Do stretching or flexibility exercises (do not count yoga or Tai-chi)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
35. Do yoga or Tai-chi? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
36. Do aerobics or aerobic dancing? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
37. Do moderate to heavy strength training (such as hand-held weights of more than 5 lbs., weight machines, or push-ups)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
38. Do light strength training (such as hand-held weights of 5 lbs. or less or elastic bands)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
39. Do general conditioning exercises, such as light calisthenics or chair exercises (do not count strength training)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

In a typical week during the past 4 weeks, did you …							
40. Play basketball, soccer, or racquetball (do not count time on sidelines)? ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
41. Do other types of physical activity not previously mentioned (please specify)? _____ ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

Thank You