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Long-Term Tracking of Physical Activity Behaviors in Women: The WIN Study

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Abstract

Purpose—Interest lies in the prevalence of community-living women meeting 2008 Department of Health and Human Services physical activity guidelines across time. The purpose was to report prevalence and stability of long-term (up to 125 weeks) tracking of physical activity behaviors and compare self-reported physical activity behaviors using different measures.

Methods—The WIN study tracks nearly real-time physical activity behaviors in community-living women. At baseline, 918 women began weekly Internet reporting of physical activity behaviors, accessing a secure Internet site and answering 8 questions about physical activity behaviors for the previous week. Measures included days and minutes of moderate, vigorous, walking, and strengthening activities, and pedometer steps recorded weekly.

Results—Prevalence of meeting physical activity guidelines depended on the criterion used. Weekly averages across the surveillance period indicated 25% reported ≥ 150 mins of moderate physical activity, 47% reported ≥ 75 mins of vigorous physical activity, 57% reported ≥ 150 mins of moderate-to-vigorous physical activity, 63% conducted ≥ 500 MET-mins of physical activity, 15% reported ≥ 2 days of strengthening activities per week, and 39% reported ≥ 7500 steps per week. Alpha coefficients ($\geq .97$) indicated stable physical activity behaviors across all measures.

Conclusion—Across reporting methods, it is estimated that approximately 50% or more of these community-living women engage in sufficient physical activity for health benefits weekly across long-term follow-up. Self-report physical activity behaviors are stable across long periods in these community-living women not participating in a specific physical activity intervention.

Keywords

pedometers; self-report; strength; walking

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The results of the present study do not constitute endorsement by ACSM.

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Introduction

Low levels of physical activity (PA) have increasingly been identified as a risk factor for morbidities and mortality. The U.S. Department of Health and Human Services (DHHS) established national guidelines for physical activity that included both aerobic and strengthening activities (18,27). Current guidelines call for 75 (vigorous [V]) to 150 (moderate [M]) PA minutes per week as sufficient for health benefits. A dose response is suggested with increased benefit from greater PA. *Healthy People 2010* (26) sets a goal of 30% of adults engaging in 30 min of MVPA regularly, preferably daily. Baseline data from 1997 suggest that only 15% of those 18+ years old engaged in moderate physical activity for at least 30 min 5 or more days per week (26). Combinations of VPA and MPA (MVPA) can be accumulated at a 2:1 ratio with 2 min of MPA providing roughly the equivalent benefit of 1 min of VPA. Moderate intensity PA is between 3.0 and 5.99 METs and vigorous intensity PA is ≥ 6.0 METs. As an alternative to minutes of MVPA conducted daily, the DHHS report suggests ≥ 500 MET-mins per week are sufficient for health benefits. The DHHS report (27) also recommends moderate or high intensity muscular strengthening activities involving all major muscle groups on ≥ 2 days per week. *Healthy People 2010* (26) sets a target of 30% of individuals participating in such muscle strengthening activities. The prevalence of muscle strengthening activities conducted ≥ 2 days per week was 18% in 1998 (26).

In addition to self-reported minutes of PA conducted each week, there is increased interest in step counters/pedometers to track PA. An issue with pedometer steps is that they do not reflect intensity of PA (i.e., failure to differentiate between light, M, and V PA). Nevertheless, various guidelines have been suggested for the number of steps per day (SPD) that individuals should accumulate for health benefits. Tudor-Locke et al. (22,24) suggest the following pedometer SPD as indices of public health for adults:

<5,000	Sedentary lifestyle index
5000–7499	Low active
7500–9999	Somewhat active
10,000–12,499	Active
>12,500	Highly active

Reports of the amount of PA conducted by adults vary widely. Results vary due to the questions asked and the reporting window (e.g., days, weeks, months, years). Results from the BRFSS (17) suggest 64.5% of U.S. adults engage in sufficient physical activity for health benefits based on the newly developed DHHS PA guidelines (18,27). It is also reported (17) that 48.8% of American adults reported meeting the *Healthy People 2010* PA objective of 30 min of PA daily. However, Troiano et al. (21), using accelerometers, reported <5% of adults engage in PA for a minimum of 30 min per day involving bouts of ≥ 10 min when more objectively defined amounts of MVPA are utilized.

Interest lies in how truly physically active individuals are in terms of MVPA and muscle strengthening activities. Long-term tracking of PA behaviors could provide better estimates of PA behaviors. The Women's Exercise Injuries: Incidence and Risk Factors (WIN Study) (1) study tracks self-reported MVPA, muscle strengthening activities, and pedometer steps weekly, and provides the means with which to estimate long-term PA behaviors in community-living adult women. The first purpose of this research is to report prevalence estimates of PA behaviors in the women using multiple criteria. Secondly, using Cronbach's alpha we report the long-term stability (52-week and 4-week periods) of PA behaviors in community-dwelling women. Lastly, the different self-reports of PA were investigated to determine congruence among the self-reporting PA methods.

METHODS

Community-living women were recruited from a listing of >6000 women who have visited, contacted, or completed health and/or fitness assessments at The Cooper Institute. Additional recruitment methods included advertisements, health fairs, and community meetings. Attempts were made to have a sample reflective of the greater Dallas-Fort Worth Metroplex consisting of approximately 6 million people. Participants had to be at least 20 years of age and have access to a computer with Internet capabilities. Women were excluded if they had a disease or condition that limited their mobility, needed an assistive device to ambulate, or if the condition limited or interfered with their usual daily or recreational activities. Recruitment methods resulted in 23% race/ethnic minority at study onset. Prior to study enrollment each participant provided written informed consent that is approved annually by IRBs at The Cooper Institute, University of North Texas, and Texas Woman's University. The WIN study tracks PA behaviors and musculoskeletal injuries in adult women for up to 3.25 years. Details of WIN are presented elsewhere (1). Key to the present work is that BRFSS-related PA behaviors are reported weekly via a secure Internet website. Yore et al. (29) provide evidence of the reliability and validity of the BRFSS physical activity questions. Additionally, women wear an Accusplit 120XL-xBX pedometer and report the number of steps taken and the number of days of pedometer-wearing for the preceding 7- to 8-day period. The Accusplit 120XL-xBX (Livermore, CA) is based on the Digi-Walker internal mechanism and has manufacturer-reported 98% accuracy. Jordan et al. (15) provide documentation of the pedometer's validity. A \$10.00 per month incentive is paid if the participant reports ≥ 3 weeks of PA data during the 4-week reporting period, payable every 6 months. The specific PA questions asked are presented in Table 1.

Women's PA behaviors were determined in five ways:

1. Minutes of self-reported PA averaged across the reporting period:
 - a. MPA minutes,
 - b. VPA minutes, and
 - c. MVPA minutes where V mins are multiplied by 2 and added to M min.
2. Total MET-minutes of MVPA per week were determined and then averaged across total reporting weeks. Moderate minutes were multiplied by 4.5 METs (midway between 3.0 and 6.0 METs) and vigorous minutes were multiplied by 7.5 METs (greater than the minimum VPA METs value with 9 METs viewed as related to all-cause mortality in women) (2).
3. Number of minutes of self-reported walking per week. Walking activity is a subset of both MPA and VPA but includes other reasons for walking (e.g., transportation, employment). Reported walking minutes were averaged across the reporting period for each participant. Walking is one of the most common PA behaviors (12,20).
4. The number of days per week of reported strengthening activities was averaged across the surveillance period.
5. Steps per week were determined by calculating the average steps per day for the reported days that the pedometer was worn that week and then is adjusted to reflect 7 days if the number of days the pedometer was worn less or more than 7 days in the reporting period. The online login window is open 1800 hours Saturday to 2400 Monday so participants can log more or less than 7 days in some weeks.

Cronbach's coefficient alpha was used to estimate three different intraclass reliabilities for each PA measure. Initially, alpha was calculated across the first 52-week period for all

participants who had at least 52 reported PA weeks. This provides a consistency estimate of self-reported PA measures across the year. Secondly, a randomly chosen 4-week consecutive period was identified for each participant who had at least 52 weeks and the alpha coefficient reliability calculated for this random 4-week period. Lastly, a random 4 weeks of self-reports across the entire weeks of reporting were analyzed. The random 4 weeks varied across each participant. The last two analyses provide estimates of the reliability of 4-weeks of data collection.

Sufficient MVPA was categorized in seven ways, with those not meeting the criterion identified as not sufficiently active for health benefits. All values were averaged across the total number of reporting weeks for each participant.

1. ≥ 150 min of MPA,
2. ≥ 75 min of VPA,
3. ≥ 150 min of MVPA with each minute of VPA counted twice as much as MPA,
4. ≥ 500 MET-min per week based on the calculation above,
5. ≥ 150 min of walking per week,
6. ≥ 2 days of muscle strengthening activities, and
7. ≥ 7500 SPD.

Weekly data were excluded if the participant reported an injury ($n = 1749$ weeks) during the reporting period that interrupted their work or physical activity behaviors for ≥ 2 days or saw a health care provider for an injury. Additionally, step data were excluded from the analyses if the participant reported < 3500 ($n = 1411$ weeks) or $> 150,000$ ($n = 316$ weeks) steps in a week. These lower and upper bound values were deemed outliers. 3500 steps per week is 500 steps a day for a 7-day period and indicate very limited activity during the reporting period, failure to wear the pedometer most waking hours, and/or pedometer malfunction. During the early phase of the WIN study, there was no self-verification on step counts $> 150,000$. The WIN Internet site now asks participants to confirm steps in excess of 150,000 steps per week. Early verification of step reports in excess of 150,000 indicated $> 99\%$ were reporting errors.

RESULTS

Mean $\pm$ standard deviation PA results are presented for 917 women (77% White, 23% Non-White) across an average of 68.15 (± 29.07) and median of 71.0 follow-up weeks (range = 1 to 125) for all 917 participants. One participant was excluded due to insufficient data. Baseline descriptive statistics are presented in Table 2. 763 (83%) of the women remained active in the WIN study at reporting of the current data. Comparisons between those who remain involved and those withdrawing indicate those withdrawing are significantly younger ($p < .001$). Other descriptive characteristics were not meaningfully different for continuing participants and those withdrawing. Withdrawing participants reported more PA minutes and MET-minutes than those continuing to participate, but reported less days of strengthening activities and weekly pedometer steps. Education level, employment status, and household income are also presented in Table 2.

Whether a woman reported meeting PA guidelines across long-term follow-up depended on the criterion used (see Table 3). Approximately a quarter of women reported ≥ 150 min of MPA per week and nearly half reported ≥ 75 min of VPA per week. More than half (55.7%) of participants report on average weekly MVPA minutes sufficient for health benefits. When transformed to MET-minutes per week, this percentage increases to 63%. Considering solely

walking minutes, approximately one-quarter (23%) of participants meet the ≥ 150 mins per week of MVPA guideline. Only 15% of WIN participants self-report conducting strengthening activities ≥ 2 days per week. Nearly 2 in 5 (39%) of women reported step counts in excess of 7500 SPD. Another commonly (7,13) used guideline/criterion is 10,000 SPD. Only 12.9% of WIN participants averaged 10,000 SPD across the reporting period. Approximately 9 of 10 (88.9%) WIN participants wore their pedometer 6 or 7 days per week (see Table 4). We tested the associations between meeting goals and age decades (20–29; 30–39; 40–49; 50–59; 60+) and BMI categories (<25; 25–29.9; 30+) to determine if meeting PA goals is a function of age and BMI. Increasing age was related ($p < .05$) to meeting PA goals with MPA. Older individuals were less likely ($p < .001$) to meet PA goals with VPA. Younger women were more likely ($p < .05$) to meet the strengthening activities goal. Older individuals were less likely to meet the 7500 and 10,000 SPD goal ($p < .01$). BMI was related to meeting the various PA goals (all $ps < .001$) except walking mins with prevalence of meeting PA goals decreasing as BMI increased. These results are consistent with previous national research, where PA was related to age (6) and BMI (16).

Alpha reliabilities (α) for PA measures are presented in Table 4. The first 52 weeks of reporting was used for all participants ($\alpha \geq .97$). When a random 4-week reporting period was used, the α was reduced but still remained very high ($\alpha \geq .88$ in all but one case). Reliabilities for 4 non-consecutive, random weeks, while also lower, remain very high ($\alpha \geq .84$ in all variables except VPA min per week). We calculated alpha reliabilities for 52-week and for randomly chosen consecutive 4-week periods for each of the physical activity measures by the age decades and BMI categories provided above. Reliabilities remained high ($\geq .96$ for 52-weeks and 52 of 56 α are $\geq .80$ for the consecutive 4-week period and 34 of 56 are $\geq .90$). In all variables, PA behaviors are quite stable across the reporting periods and subgroups.

Comparisons of PA criteria sufficient for health benefits are presented in Table 5. Table 5 illustrates significant congruency between measures of PA. There is 93% agreement between meeting guidelines for minutes per week and MET-minutes per week. This is a result of MET-minutes per week being a function of reported MVPA minutes per week. When considering SPD, congruency reduces to 63% for MVPA minutes per week and 61% for MVPA MET-minutes per week. The largest incongruencies (27% and 32%) occur with SPD where participants report meeting MVPA minutes or MET-minutes per week guidelines but the reported step counts are <7500.

DISCUSSION

The results for MVPA minutes per week suggest approximately half (55.7%) of women engage in sufficient minutes of physical activity for health benefits. However, when converted to MET-minutes per week, nearly two-thirds (63%) of women reported engaging in sufficient PA for health benefits. The 63% compares to the 64.5% reported from BRFSS data (17). Walking minutes may be an important means of PA for women given that 23% of women report engaging in walking behaviors ≥ 150 min per week. Concern is often raised about the validity of self-reported PA behaviors. In an attempt to validate the WIN self-reports, we conducted a WIN substudy and found the correlation between self-reported MVPA and MVPA estimated with the Walk4Life MVP® pedometer to be $r = .41$, indicating convergent validity of the self-report PA behaviors is about mid-range for those reported by Yore et al. (29). The correlation between WIN reported steps and MVPA minutes was .27 ($p < .0001$). Collectively these coefficients provide evidence of the validity of WIN-reported PA behaviors.

The amount of self-reported strengthening activity compares with that reported for females (14%) as baseline in *Healthy People 2010* (26). Only 15% of WIN participants meet DHHS guidelines for strengthening activities. This is particularly significant given the accumulating evidence of the importance of strengthening activities on health (10,19) and calls for increasing strengthening activities (27,28). The resistance training question (see Table 1) is generic in nature and does not specifically identify moderate and/or vigorous intensity, nor does it specifically query about all major muscle groups. Thus, one might expect that a liberal interpretation of the resistance training question would increase the reported prevalence of resistance training activities. No attempt is made in the WIN study to encourage PA behaviors different from those typically conducted when they enrolled in the study. The WIN procedures are solely surveillance and there is no intent of intervention or encouragement to initiate, continue, increase, or change PA behaviors.

The WIN participants averaged 6476 SPD across a week of reporting. This is similar to the SPD reported for women in a meta analysis (3). The prevalence of women taking >7500 SPD is slightly less and those >10,000 is slightly more than the “censored” SPD reported by Tudor-Locke et al. (25). In sum, the SPD and week counts in long-term tracking are similar to those reported elsewhere.

The uniqueness of this study is that >900 women were initially tracked for PA behaviors weekly for an extended period of time (up to 125 weeks), providing long-term estimates of PA behaviors in a community-living cohort. Alpha reliabilities across the first 52 weeks and for randomly selected 4-week periods (Table 4) indicate very stable PA behaviors across long reporting periods. The current PA measures are the largest long-term, nearly real-time surveillance of PA behaviors in women. Bowles et al. (4) report the validity of historical recall of physical activity over a 10-year period. Others (23) have used more objective measures, but for smaller sample sizes and/or shorter reporting periods. The current results suggest PA behaviors in a large sample of community-living women are quite stable across long time periods.

Overall the current results suggest stable estimates of PA behaviors can be obtained in as little as 4 weeks of self-reporting. Interestingly, VPA has the lowest estimated reliability across periods. Previous shorter-term reports of PA behaviors have lower reliability for PA measures (9) and others report very high reliabilities (11). It is suggested as a result of the long-term tracking conducted in WIN that PA behavior appears to be quite stable across long periods. Certainly, individuals adopt, increase, or decrease PA behaviors as a result of injury, health, motivation, and lifestyle behaviors; however, changes appear to have little influence on total PA behavior patterns.

Depending on the criterion used, it is estimated that many of the WIN women do engage in sufficient PA for health benefits. The estimates are between 25% (MPA only) and 63% (MET-min per week). Minutes per week indicate more than half the women engage in ≥ 150 min of MVPA per week. Agreement among the minutes, MET-minutes, and SPD measures suggest that at least 29% (other estimates are 32% and 56% - see Table 5) of WIN participants have two indicants that they are meeting PA guidelines for health benefits over long periods of time. These dissimilarities in reported values are further indication of the difficulty in determining true PA behaviors. Nevertheless, >60% of self-report PA measures agree with regard to meeting PA guidelines. The results suggest that large portions of the WIN Study population women engage in PA behaviors that meet national guidelines and are sufficiently active for health benefits. Importantly, based on three different PA criteria, *Healthy People 2010* (26) objectives for PA are met in this cohort. While the WIN purposes did not include increases in PA, it is possible that since participants report their weekly PA behaviors, they may have become more aware of their PA levels and this alone could have

served as motivation to increase PA. Clemes and Parker (8) have reported reactivity in pedometer wearing. Bravata et al. (5) reported increased daily steps when using pedometers, a daily step goal, and logging procedures during short-term tracking.

While the WIN study is long-term and the sample size substantial, a limitation to the work is that participants are incentivized, albeit only a maximum of \$10.00 per 4-week period, to participate. Thus, some may report values that are estimates or that do not accurately reflect behaviors simply to comply with the study protocol and receive study incentives. We have no evidence that such occurs. To the contrary, the WIN team meets weekly to track adherence, contact participants, encourage participation, and disenroll those not interested in continuing. A second limitation is that levels of education and income may limit generalizability.

Compliance to the WIN self-report protocol has been excellent. Greater than 90% of active WIN participants self-report their PA behaviors ≥ 3 times in a 4-week reporting period. Continued tracking of PA behaviors in large-scale cohorts can be conducted if sufficient time, effort, incentives, and resources are provided to encourage continued participation. Longitudinal tracking such as that demonstrated in WIN can provide insight into long-term PA behaviors in other cohorts (e.g., men, elderly, patients, and youth). Importantly, high alpha reliabilities (generally $\geq .88$) are obtained across long periods (52 weeks, 4 randomly selected weeks, and 4 randomly selected consecutive weeks). The high alphas suggest stable estimates of PA behaviors can be obtained in as little as a single month. These high alpha reliabilities are obtained across age and BMI subgroups.

CONCLUSION

PA behaviors are stable across long time periods and may be an indication of the difficulty associated with behavior change and adoption of PA behaviors sufficient for health benefits. Based on long-term PA surveillance, it is suggested approximately 50% or more of these community-living women engage in sufficient physical activity for health benefits. Far fewer (15%) engage in strengthening activities for ≥ 2 days per week. As expected, the prevalence of specific PA behaviors varies as a function of the types of items asked. Nevertheless, depending on the criterion used, roughly half of this community-living adult women population self-report sufficient physical activity for health benefits, a value exceeding the *Healthy People 2010* physical activity goal.

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Reference List

1. Bain T, Morrow JR Jr, Frierson GM, et al. Internet Reporting of Weekly Physical Activity Behaviors: The WIN Study. *J Phys Act Health*. 2010 in press.
2. Blair SN, Kohl HW III, Paffenbarger RS Jr, et al. Physical fitness and all-cause mortality. A prospective study of healthy men and women. *JAMA*. 1989; 262:2395–2401. [PubMed: 2795824]
3. Bohannon RW. Number of pedometer-assessed steps taken per day by adults: A descriptive meta-analysis. *Phys Ther*. 2007; 87:1642–1650. [PubMed: 17911274]
4. Bowles HR, FitzGerald SJ, Morrow JR Jr, et al. Construct Validity of Self-reported Historical Physical Activity. *Am J Epi*. 2004; 160:279–286.

5. Bravata DM, Smith-Spangler C, Sundaram V, et al. Using pedometers to increase physical activity and improve health: a systematic review. *JAMA*. 2007; 298:2296–2304. [PubMed: 18029834]
6. Carlson SA, Densmore D, Fulton JE, et al. Differences in physical activity prevalence and trends from 3 U.S. surveillance systems: NHIS, NHANES, and BRFSS. *J Phys Act Health*. 2009; 6 (Suppl 1):S18–S27. [PubMed: 19998846]
7. Choi BC, Pak AW, Choi JC, et al. Daily step goal of 10,000 steps: a literature review. *Clin Invest Med*. 2007; 30:E146–E151. [PubMed: 17716553]
8. Clemes SA, Parker RA. Increasing our understanding of reactivity to pedometers in adults. *Med Sci Sports Exerc*. 2009; 41:674–680. [PubMed: 19204581]
9. Dubbert PM, Vander Weg MW, Kirchner KA, et al. Evaluation of the 7-day physical activity recall in urban and rural men. *Med Sci Sports Exerc*. 2004; 36:1646–1654. [PubMed: 15354050]
10. FitzGerald SJ, Barlow CE, Kampert J, et al. Muscular fitness and all-cause mortality: prospective observations. *J Phys Act Health*. 2004; 1:7–18.
11. Gross LD, Sallis JF, Buono MJ, et al. Reliability of interviewers using the Seven-Day Physical Activity Recall. *Res Q Exerc Sport*. 1990; 61:321–325. [PubMed: 2132889]
12. Ham SA, Kruger J, Tudor-Locke C. Participation by US adults in sports, exercise, and recreational physical activities. *J Phys Act Health*. 2009; 6:6–14. [PubMed: 19211953]
13. Iwane M, Arita M, Tomimoto S, et al. Walking 10,000 steps/day or more reduces blood pressure and sympathetic nerve activity in mild essential hypertension. *Hypertens Res*. 2000; 23:573–580. [PubMed: 11131268]
14. Jackson AS, Pollock ML, Ward A. Generalized equations for predicting body density of women. *Med Sci Sports Exerc*. 1980; 12:175–181. [PubMed: 7402053]
15. Jordan AN, Jurca GM, Locke CT, et al. Pedometer indices for weekly physical activity recommendations in postmenopausal women. *Med Sci Sports Exerc*. 2005; 37:1627–1632. [PubMed: 16177618]
16. Kruger J, Ham SA, Prohaska TR. Behavioral risk factors associated with overweight and obesity among older adults: the 2005 National Health Interview Survey. *Prev Chronic Dis*. 2009; 6:A14. [PubMed: 19080020]
17. MMWR. Prevalence of self-reported physically active adults--United States, 2007. *MMWR Morb Mortal Wkly Rep*. 2008; 57:1297–1300. [PubMed: 19052527]
18. Physical Activity Guidelines Advisory Committee. Physical activity guidelines advisory committee report, 2008. Washington, DC: U.S. Department of Health and Human Services; 2008. p. A-5-A-6.
19. Ruiz JR, Sui X, Lobelo F, et al. Association between muscular strength and mortality in men: Prospective cohort study. *BMJ*. 2008; 337:a439. [PubMed: 18595904]
20. Simpson ME, Serdula M, Galuska DA, et al. Walking trends among U.S. adults: the Behavioral Risk Factor Surveillance System, 1987–2000. *Am J Prev Med*. 2003; 25:95–100. [PubMed: 12880875]
21. Troiano RP, Berrigan D, Dodd KW, et al. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008; 40:181–188. [PubMed: 18091006]
22. Tudor-Locke C, Bassett DR Jr. How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Med*. 2004; 34:1–8. [PubMed: 14715035]
23. Tudor-Locke C, Bassett DR, Swartz AM, et al. A preliminary study of one year of pedometer self-monitoring. *Ann Behav Med*. 2004; 28:158–162. [PubMed: 15576253]
24. Tudor-Locke C, Burkett L, Reis JP, et al. How many days of pedometer monitoring predict weekly physical activity in adults? *Prev Med*. 2005; 40:293–298. [PubMed: 15533542]
25. Tudor-Locke C, Johnson WD, Katzmarzyk PT. Accelerometer-determined steps per day in US adults. *Med Sci Sports Exerc*. 2009; 41:1384–1391. [PubMed: 19516163]
26. U.S. Department of Health and Human Services. Healthy People 2010: Understanding and improving health. 2. Washington, DC: U.S. Government Printing Office; 2000. p. 22-9-22-10.
27. U.S. Department of Health and Human Services. 2008 Physical activity guidelines for Americans. Washington DC: U.S. Department of Health and Human Services; 2008. p. 31
28. Williams MA, Haskell WL, Ades PA, et al. Resistance exercise in individuals with and without cardiovascular disease: 2007 update: a scientific statement from the American Heart Association

- Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. *Circulation*. 2007; 116:572–584. [PubMed: 17638929]
29. Yore MM, Ham SA, Ainsworth BE, et al. Reliability and validity of the instrument used in BRFSS to assess physical activity. *Med Sci Sports Exerc*. 2007; 39:1267–1274. [PubMed: 17762359]

TABLE 1

Weekly physical activity reporting questions in the WIN study.

2) ^{a,b} During the past 7 days, when you are at work, which of the following best describes what you do?
Mostly sitting or standing
Mostly walking
Mostly heavy labor or physically demanding work
I do not work for pay outside the house
3) ^b During the past 7 days, did you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes small increases in breathing or heart rate and would not make you strain?
Yes – If answer is yes, branches to a query for days per week and minutes per day
No
4) ^b During the past 7 days, did you do vigorous activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate and would eventually make you strain?
Yes – If answer is yes, branches to a query for days per week and minutes per day
No
5) ^c During the past 7 days, did you walk for at least 10 minutes at a time, while at work, for recreation, to get to and from places, or for any other reason?
Yes – If answer is yes, branches to a query for days per week and minutes per day
No
6) ^c During the past 7 days, did you do activities to increase muscle strength or tone, such as lifting weights, using weight machines, using exercise bands, or doing pull-ups, or sit- ups?
Yes – If answer is yes, branches to a query for days per week and minutes per day
No
7) Please record your weekly (Sunday through Saturday) pedometer steps:
Steps per week
8) How many days did you wear the pedometer?
Days (After entering the number, please reset your pedometer to “0”.)

^aQuestion number 1 asks about injury occurrence.^bExisting BRFSS question (www.cdc.gov/brfss/questionnaires/english.htm)^cBased on BRFSS questions

TABLE 2

Descriptive statistics (N = 918).

Education (highest year completed)			
Years	N (%)		
≤12	76 (8)		
13–15	250 (27)		
16	296 (32)		
>16	303 (33)		
Employment Status			
	N (%)		
Full-time	624 (68)		
Part-time	115 (13)		
Retired/Not employed	179 (19)		
Household Income			
Total	N (%)		
<\$40,000	183 (20)		
≥\$40,000 and <\$80,000	226 (25)		
≥\$80,000	464 (51)		
Refused	45 (5)		
	Active (n=763)	Withdrew (n=155)	p<
Baseline Characteristics			
Age (yr)	53.9 (12.0)*	46.4 (13.2)	0.001
Weight (kg) [†]	73.4 (16.8)	75.8 (19.0)	0.113
Height (cm)	163.6 (6.3)	163.6 (6.1)	0.974
BMI [†]	27.4 (6.1)	28.3 (6.7)	0.109
Percent fat [‡]	32.1 (7.7)	31.3 (7.7)	0.210
Physical Activity			
Average weekly MVPA (min)	252.5 (453.0)	285.6 (437.3)	0.001
Average weekly MET-min PA	1041.6 (1853.0)	1173.0 (1801.4)	0.001
Average weekly walking minutes	133.7 (325.9)	157.4 (360.2)	0.001
Average weekly days of strengthening activities	0.9 (1.5)	0.8 (1.3)	0.005
Average weekly steps	45,334 (23,048)	43,427 (23,056)	0.001
Weeks measured	59,377	3,187	

* Mean (sd)

[†] n=917 due to refusal of weight measurement[‡] 3-site skinfold method (14)

TABLE 3Prevalence (%) of women meeting physical activity guidelines (N = 917)^a

<u>Physical Activity Measures</u>		
MPA minutes per week (≥ 150)		24.9%
VPA minutes per week (≥ 75)		46.6%
MVPA minutes per week (≥ 150) ^b		55.7%
MET-mins of MVPA per week (≥ 500)		63%
Walking minutes (≥ 150)		23%
Strengthening days (≥ 2)		15%
Pedometer steps per day (≥ 7500)		39%
Pedometer steps per day ($\geq 10,000$)		12.9%
<u>Pedometer wearing (days per week)^c</u>		
Days worn	N	(%)
0	19	.0
1	258	.4
2	422	.7
3	761	1.2
4	1438	2.3
5	3633	5.8
6	8188	13.1
7	47,417	75.8
8	419	.7

^aOne individual was eliminated due to insufficient data^bMVPA min = Vigorous min * 2 + Moderate min^cacross all participants and all weeks (N = 62,564). The reporting period is from 1800 hours Saturday until 2400 Monday so it is possible to record 8 days of pedometer wearing

TABLE 4Alpha reliabilities for physical activity measures (N = 725)^a

	First 52-week period	Random 4 weeks consecutive	Random 4 weeks non-consecutive
MPA minutes per week	.98	.88	.86
VPA minutes per week	.97	.82	.76
MVPA minutes per week	.98	.90	.86
MET-mins of MVPA per week	.98	.90	.86
Walking minutes per week	.99	.91	.89
Strengthening days per week	.98	.91	.84
Steps per week	.99	.93	.88

^aOnly participants with ≥52 reported weeks were included.

TABLE 5

Comparison of criteria for physical activity sufficient for health benefits

	DID meet guidelines for MVPA MET-min per week (≥ 500)	DID NOT meet guidelines for MVPA MET-min per week (< 500)
DID meet guidelines for MVPA min per week (≥ 150)	511 56%	0 0%
DID NOT meet guidelines for MVPA min per week (< 150)	68 7%	338 37%
$\chi^2 = 673.76, p < .0001$		

	DID meet guidelines for steps per day (≥ 7500)	DID NOT meet guidelines for steps per day (< 7500)
DID meet guidelines for MVPA min per week (≥ 150)	267 29%	244 27%
DID NOT meet guidelines for MVPA min per week (< 150)	90 10%	316 34%
$\chi^2 = 86.1, p < .0001$		

	DID meet guidelines for steps per day (≥ 7500)	DID NOT meet guidelines for steps per day (< 7500)
DID meet guidelines for MVPA MET-min per week (≥ 500)	289 32%	290 32%
DID NOT meet guidelines for MVPA MET-min per week (< 500)	68 7%	270 29%
$\chi^2 = 79.7, p < .0001$		