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PHYSICAL ACTIVITY PATTERNS IN HEALTHY MIDDLE-AGED WOMEN

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Abstract

Exercise in healthy female adults around the menopausal transition has been routinely examined in leisure activities alone, potentially discounting the physical activity (PA) that is accumulated in household and outdoor domains. The purpose of this study was to quantify PA in healthy middle-aged women and to examine the extent to which the Center for Disease Control (CDC) PA guidelines were met through leisure, household and outdoor activities. Methods: 440 healthy women, 51–64 yrs, BMI 18.5 or < 40 kg/m² participated in the study using the Lifetime Physical Activity Questionnaire (LPAQ) to quantify PA. Results: 25.91% met the CDC PA guidelines if leisure time alone was examined. When multiple domains were included, 73.41% of the women met the PA guidelines. This percentage is much higher than the reported 20.6% of U.S. adults who met the guidelines in 2011. PA in women may be underrepresented in data limited to leisure time PA.

Keywords

Physical activity; middle-aged women; exercise; household; activity; leisure; outdoor; physical activity guidelines

Introduction

Physical activity (PA) levels of women are typically reported to be lower than PA levels of men (US Department of Health and Human Services, 1996). Yet women live longer than men and are more likely than men to experience disabilities that require functional assistance in older age. Age-related changes in women's health are frequently noted around the time of menopause and beyond. There are a host of changes associated with a new hormonal environment around the menopausal transition, such as an increase in bodyweight and waist circumference. PA and exercise have been found to reduce the likelihood of an increase in bodyweight, as well as physical disability that is also associated with aging

(Bruce et al., 2008; Brach et al., 2004) and improve quality of life measures (Martin et al., 2009), regardless of bodyweight.

The Centers for Disease Control and Prevention (CDC) provides age-related PA guidelines that are evidence based for health outcomes. Meeting the 2008 CDC guidelines is associated with decreased risk of morbidity and mortality (Schoenborn & Stommel, 2011). The PA guidelines are separated into three age categories: Children (6–17 years), Adults (18–64 years), and Older Adults (65+ years) with a recently added recommendation of participating in muscle strengthening activities for all ages. The PA guidelines indicate the minimum level of moderate and/or vigorous PA combined with activities that strengthen whole body musculature. The PA guidelines provide adults with three different categories to meet the minimum criteria for adequate PA: (1) 150 min of moderate intensity aerobic activity and muscle strengthening activities on 2 or more days of the week (MPA + MS), (2) 75 min of vigorous intensity aerobic activity and muscle strengthening activities on 2 or more days of the week (VPA + MS), or (3) 150 min of an equivalent mix of moderate and vigorous intensity aerobic activity and muscle strengthening activity on 2 or more days of the week (MVPA + MS).

Previous research suggests that participation in PA that meets the CDC guidelines decreases as people age (CDC: MMWR, 2013; Ruuskanen, 1995). The menopausal transition, and the decade following, could be an opportune time for promoting increased PA among women given that the risk for many chronic diseases increases after menopause. Other life events surrounding the onset of menopause, such as fewer childcare responsibilities, may afford women an increase in discretionary time for greater PA.

Trends in the literature suggest that age, body mass index (BMI), and education are important determinants of PA, yet research has focused more on younger and older individuals (Cotter & Lochman, 2010; Godin, Bélanger-Gravel & Nolin, 2008). Of the limited research examining PA in healthy adult women, much of the research has focused on leisure time; however, women may accrue greater levels of PA through other means, such as through household and outdoor work. This study seeks to add to the current literature by quantifying PA patterns in healthy middle-aged women and to classify patterns of PA according to the PA guidelines. Specifically, in this study, we aim to describe how women healthy middle-aged women accumulate PA and the extent to which they meet the PA guidelines through leisure, household and outdoor activities. Given that traditional analysis of PA in women has focused on leisure activity, we hypothesize that women would be more likely to meet the PA guidelines for PA through a combination of leisure, household and outdoor domains than through leisure time alone.

Methods

Participants

Women aged 39–65 years were recruited for the Physical Activity and Pelvic Floor Disorders Study (PHACTS). The ongoing PHACTS study aims to determine whether a relationship exists between PA and stress urinary incontinence and pelvic organ prolapse, two common pelvic floor disorders. Women were recruited for PHACTS chiefly from

primary care clinics surrounding Salt Lake City, UT, and through announcements and fliers and word of mouth. Women were included if they could read English and if their BMI was 18.5 or $< 40 \text{ kg/m}^2$. Women were excluded if the following conditions were present: disease states affecting mobility (e.g. spinal cord injury, stroke, multiple sclerosis, or current use of a mobility aid such as a walker or wheelchair), conditions that affect the pelvic floor (e.g. current pregnancy, surgery to correct urinary leakage or pelvic organ prolapse, radical hysterectomy for cancer, radiation treatment of the pelvis or abdomen), or conditions affecting overall health (e.g. congestive heart failure, and current treatment of cancer). The present study focuses on women in our database aged 51–64 years. To correspond with the CDC PA recommendations for adults (18–64 years), women 65 years of age were excluded from analysis. All participants provided written and informed consent in accordance with the Institutional Review Board of the University of Utah, which approved all study procedures.

Procedures

All participants completed a medical history form, demographic information, an examination to assess pelvic organ prolapse (POP-Q) (Bump, Mattiasson, Bo, et al., 1996) at a clinic approved for recruitment or at a University of Utah research clinic, and a thorough PA assessment. Height (cm) and weight (kg) were determined by medical scale and stadiometer provided at each clinic to determine BMI (kg/m^2). PA participation was assessed by the Lifetime Physical Activity Questionnaire, which has been shown to be a valid and reliable assessment of PA in the past year (LPAQ, Chasan-Taber et al., 2002a) and a reliable assessment of lifetime PA in women reflecting the age span of our participants (Chasan-Taber et al., 2002b). The LPAQ assesses PA in leisure, household, and outdoor domains and includes age epochs of 12–21, 22–34, 35–50 and 51–65 years.

The LPAQ did not include PA performed for occupational activities; therefore an additional occupational questionnaire was included. We selected the Occupational Questionnaire subscale from the Lifetime Total Physical Activity Questionnaire (LTPAQ) with demonstrated reliability in adults (Friedenreich, Courneya, & Bryant, 1998). For each volunteer or paid occupation, participants recorded years worked, months per year, days per week, hours per day, and assigned an intensity level. We used the occupational PA data in combination with the historical LPAQ data to create a variable that reflects total past PA to include in analyses. Total past PA reflects combined leisure, household, outdoor, and occupational activity in $\text{MET} \cdot \text{hrs/week}$ for all age epochs minus the total combined activity recorded for the past year. Data reported for the past year from the LPAQ were analyzed as the primary dependent variables to determine current compliance with CDC PA recommendations.

Participants had the option of completing the LPAQ on paper or in electronic format using a secure, web-based interface. To determine past year PA, participants indicated which activities they did at least 10 times from lists provided on the LPAQ within each domain area. For each activity indicated, participants recorded the months and the typical hours per week they did the activity over the past year.

To determine whether women met the PA guidelines, the number of hours per week spent in moderate, vigorous and muscle strengthening PA were calculated. Metabolic equivalent

(MET) values from the Compendium of Physical Activities (Ainsworth et al., 2000) were assigned to each of the activities listed on the LPAQ prior to any data collection. Conservative MET values were chosen given the age range of our participants. Activities with MET values of 3–6 were categorized as moderate (MPA) while those >6 were categorized as vigorous (VPA) (Thompson, 2010). The hours per week of moderate and vigorous activity were corrected for the fraction of months, if less than 12, reported by participants over the past year. Moderate and vigorous hours per week were further delineated by leisure, household, and outdoor domains.

Activities on the LPAQ that met the criteria for “muscle strengthening” were chosen by two authors with expertise in resistance exercise training. A conservative approach was used to include activities that involve all major muscle groups (Table 1). Collectively, we decided that one hour per week of muscle strengthening activity was a close approximation of the CDC-recommended “2 days per week”, as participants recorded duration of activity on the LPAQ in hours per week and the frequency in months per year. Muscle strengthening activities were categorized by domain and excluded from the calculation of MPA and VPA.

Women could potentially meet the PA guidelines in many ways; therefore, we made the following decision rules that were implemented in a hierarchical manner. If a woman met the guidelines using the VPA + MS criteria, she was placed in that category, even if she met the guidelines for MPA + MS as well. The only women placed in the MVPA combined intensity group were those who did not individually meet the guidelines for either VPA or MPA. Once the above criteria were determined, then participants were placed categorically into the leisure time only group or the combined leisure plus household plus outdoor activity group. Only those who failed to meet the guidelines by leisure time only were placed into the combined domain group.

The LPAQ requires participants to recall a great deal of information. We employed a member of the study staff to review individual LPAQ forms for potential mistakes (e.g. nonsensical responses, hours per week recorded as a range or written text provided instead of numerical data). This staff member would then contact the participant to clarify the recorded information. In extreme cases of error, such as recording more than 168 hours per week of activity or exceptionally high or low volume of activity, for which a participant could not be contacted for clarification, the LPAQ was considered un-analyzable and not included in the current analyses. Complete PHACTS procedures are detailed elsewhere (Nygaard et al., 2012).

Statistical Analysis

All statistics were completed using SAS (version 9.3) with significance level set at $\alpha = 0.05$. The study population was characterized using means and standard deviations. Data that resulted in a positive skew were expressed as medians with a 25th and 75th quartile range for demographic and PA variables. To address our first hypothesis, we calculated the proportion of women aged 51 to 64 years who met the CDC guidelines for PA when leisure, household and outdoor categories are combined, compared to using the leisure time category alone.

Results

In the population from the PHACTS study, 1,333 women were enrolled at the time of analysis. Of these, 840 did not meet entry criteria into this ancillary study because of 1 or more of the following exclusions (not mutually exclusive): age <51 or >64 (n=732), BMI < 18.5 or ≥ 40 (n=23), medical conditions (n=2), recruited from tertiary care, rather than primary care, source (n=30), incomplete or not returned LPAQ (n=119). Of the remaining 493 women, we judged the LPAQ insufficient for analysis in 53 (10.8%). Thus, the analytic sample for this analysis was comprised of 440 women. The sample characteristics are provided in Table 2. The sample included women with a relatively high education level. Women were generally healthy; 77.7% of the population reported 0–1 current medical conditions. These results coincided with the personal perception of overall health. Women were asked to report their current health status, 79.05% reported “Very good” to “Excellent” health categories. Parity results indicated that 78.4% of women had 1 or more vaginal or cesarean deliveries. The majority (77.6%) of the sample had experienced menopause.

The results for the hours per week of PA accumulated in the three domains (i.e. leisure, household, and outdoor) are displayed in Table 3. Accumulated hours per week of moderate and vigorous activity was highest in the leisure category. Only a small percentage of vigorous PA was performed in the household category. No vigorous PA was performed in the outdoor category. Muscle strengthening activities were largely accumulated in the household and outdoor domains.

Table 4 displays the percentage of women who met the CDC guidelines. According to our hierarchical approach that prioritized meeting the guidelines through the vigorous PA category first, and secondly the moderate PA category, only 25.91% of the sample met the guidelines if leisure time alone was examined. A majority (76.92%) of the women who met the guidelines through the vigorous PA category also met the guidelines through the moderate PA category for leisure time alone. When household and outdoor activities were included, an additional 47.5% of the sample met the guidelines. As with leisure time alone, a majority (90.28%) of the women who met the guidelines through the vigorous PA category also met the guidelines through the moderate PA category when combining leisure, household, and outdoor time. Combining moderate, vigorous, and muscle strengthening for all PA domains resulted in 73.41% of the sample meeting the CDC PA guidelines. Only 26.59% of the women did not meet the PA guidelines.

Discussion

Healthy women at and around the menopausal transition perform a broad spectrum of PA. To our knowledge, this is the first study quantifying PA in this population that has identified a discrepancy between the percentage of women who meet the CDC PA guidelines using a domain-inclusive approach to PA data compared to leisure PA alone. If the PA in this population of women was described strictly using the leisure time activity, the total PA performed would be misrepresented. The majority of the muscle-strengthening activities was accumulated in the household and outdoor domains and would thus not be reflected if only the leisure domain was examined. If our population was described using the leisure time

category alone, 47.5% of the women would have been misclassified as failing to meet the PA guidelines. This finding is important for classifying PA patterns in healthy middle-aged women, which has largely relied on the leisure domain alone (Cotter & Lachman, 2010; Bélanger-Gravel & Nolin, 2008; Lee, et al., 2011).

Using all three domains of PA for VPA + MS, MPA + MS, and MVPA + MS, we found that 73.41% of our population met the CDC guidelines. This percentage is much higher than the 2009 prevalence of 51.0% of U.S. adults meeting the PA guidelines (National Center for Chronic Disease Prevention and Health Promotion website, 2012). In 2011, according to the Behavioral Risk Factor Surveillance System (BRFSS), using the new 2008 PA guidelines (that includes the muscle strengthening component), the prevalence of US adults meeting the guidelines was 20.6%. The proportion of US adults in a similar age range as our population (55–64 yrs) met the PA guidelines at a drastically lower rate (17.1%) than in our study (CDC: MMWR, 2013). Relevant to our geographic location, 22.5% of US adults residing in Utah met the PA guidelines (CDC: MMWR, 2013), but this number includes men and women 18–64 years.

Recent trends from 1965–2010 show that women have decreased the time spent in household activity as societal roles of women have evolved (Archer, et al., 2013). These authors observed that this decrease in weekly time spent doing household tasks was associated with lower energy expenditure and an increase in body mass compared to earlier decades. We found that a significant portion of muscle strengthening and moderate activities were performed in the household and outdoor categories, indicating that these domains were significant contributors to healthful activity for the women in our study.

Recently, the CDC changed its approach to the assessment of PA through the BRFSS (CDC: MMWR, 2013). Previous BRFSS methods randomly assessed participants in the United States 18 years, through random digit-dialing, to report the days per week that moderate and vigorous activities were performed, and then to estimate the average number of minutes by intensity category performed. The previous methods employed by the BRFSS could be compared to the current MPA and VPA aspects of the guidelines, but would not assess the muscle-strengthening component. As of 2011, the CDC changed its procedures by asking individuals to report specific activities across all domains, which are all assigned MET values, much in the same manner we have done in our present study. The change in CDC procedures supports the notion that some individuals may be doing adequate PA in domains other than in the leisure domain as traditionally assessed in the past.

The muscle-strengthening component included in the 2008 CDC PA guidelines should not be discounted due to the potential impact that muscle strength has on health outcomes, especially in the age group we studied. Analysis of women aged 20–83 years in the Women's Injury Study found that those who did not meet the CDC muscle strengthening guidelines, after controlling for potential confounders, were 2.28 (CI: 1.61, 3.23) more likely to be obese (BMI ≥ 30 kg/m²) than those who did meet the muscle strengthening guidelines (Trudelle-Jackson, Jackson & Morrow, 2011). Further, those who did not meet either the moderate or vigorous and muscle strengthening guidelines were 3.45 times (2.23, 5.35) more likely to be obese than those who met the moderate or vigorous and muscle

strengthening guidelines. The association between muscle strength, measured directly, and bone health has been established in the literature and has been demonstrated among postmenopausal women with bone mineral density values that place them into normal, osteopenic and osteoporotic categories (Rikkinen, Sirola, Salovaara, et al., 2012). It is widely accepted that physical activity accrued through the occupational domain is associated with lower rates of chronic disease. Physical activity that includes heavy carrying and lifting in the occupational domain was examined in farmers (n=21,296) and spouses (n=30,591) in the Agricultural Health Study, the authors determined that over half of farmers (58%) and 26% of spouses performed >1hour of heavy carrying and lifting each day (Racine, et al., 2012), which would easily meet the requirements for muscle strengthening-activities in the CDC 2008 PA guidelines. While the benefits of muscle strengthening activities and presumably higher levels of muscular strength are specifically tied to health outcomes, it is unknown how lifting and carrying activities performed in or outside of the home compare to traditional muscular strengthening activities on health outcomes. Additional research would be helpful in quantifying the stimulus of lifting episodes in and outside of the home to determine whether it is sufficient for improvements in muscle strength.

Strengths and Limitations

The strengths of our study include a relatively large sample size and use of a reproducible and valid instrument for assessing PA. All PA data, once collected, underwent rigorous quality control. This study is one of the first to examine the new CDC guidelines, with the specific addition of muscle strengthening activities, new to the 2008 guidelines. A DAG was used to guide our logistic regression, which provided insight into the variables that needed to be statistically adjusted in the analysis.

Our study has limitations. The women in our sample were well educated and most had access to health care; less educated women without health care are not represented in our sample. The rigorous screening procedures potentially limit our findings generalizability to the general population. Our study utilized self-reported PA data, which likely contained error associated with recall that we were not able to correct. CDC guidelines dictate that moderate and vigorous PA be completed in bouts of at least 10 minutes, and that muscle-strengthening activities be done twice weekly, with no specific time component. Our data collection methods did not allow for the assessment of PA in bouts of time and muscle strengthening was collected as number of minutes per week, rather than days per week as in the CDC guidelines. Our DAG included multiple variables including personal, social, and environmental aspects, which relate to motivation for being physically active. Yet, our study was not designed to determine why women were active, so we are unable to comment on some of the psychosocial antecedents to physical activity behavior.

Our results demonstrate heterogeneous patterns of PA in healthy middle-aged women that indicate many meet the recommended levels according to the CDC. Future research should examine similar populations of women with objective measures of PA that incorporate many avenues for accruing PA and muscle strengthening activities. It is crucial that future studies determine whether women who meet the CDC PA guidelines primarily through household and outdoor activities experience the same health benefits as those who meet the guidelines

through leisure time activity, since doing activities in and outside of the home may be more practical for most women. Prospective study of PA done in multiple domains of should be compared to determine whether the manner of meeting the guidelines (e.g. weightlifting vs. household and outdoor muscle strengthening) influences the magnitude of health benefits experienced.

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Table 1

Muscle-Strengthening Activities as Determined from the Lifetime Physical Activity Questionnaire

Name of Activity	Type of Activity
Baling hay	Outdoor Work
Carrying large pails of hay or feed	Outdoor Work
Heavy garden work (shoveling, turning over soil)	Outdoor Work
Heavy manual work (handling materials >50 lb)	Outdoor Work
Snow shoveling by hand	Outdoor Work
Chopping wood	Outdoor Work
Heavy carpentry	Outdoor Work
Calisthenics/toning exercises	Leisure Time
Lifting weights (heavy)	Leisure Time
Lifting and/or carrying children or dependent elder at home	Household Activity
Carrying loads over 30 lb (bags of salt, dog food)	Household Activity
Lifting >30 lb from counter height	Household Activity
Lifting >30 lb from floor	Household Activity
Moving furniture without assistance	Household Activity

Table 2

Sample Characteristics

Variable	Mean $\pm$ SD or # (%)
Age, years	56 $\pm$ 3.8
BMI, kg/m ²	26.3 $\pm$ 4.7
Post-menopausal (n=438)	
Yes	340 (77.6%)
No	79 (18.0%)
Don't know	19 (4.4%)
Education	
<High School	2 (0.46%)
High School	62 (14.1%)
Some College / AS	122 (27.7%)
BS/BA	131 (29.8%)
Advanced degree	123 (28.0%)
Self reported Health	
Excellent	130 (29.55%)
Very good	218 (49.5%)
Good	84 (19.1%)
Fair	8 (1.8%)
Poor	0 (0.00%)

Table 3
Physical Activity by Moderate, Vigorous, and Muscle Strengthening MET hrs/week in the Past Year

	Leisure			Household			Outdoor		
	Median	Q1-Q3	Median	Q1-Q3	Median	Q1-Q3	Median	Q1-Q3	Median
Total MPA hrs/week	3.146	1.5 – 6.0	2.0	1.0-4.0	1.0	0.25-1.667			
Total VPA hrs/week	0.25	0-2.0	0	0-0.25	0	0-0			
Total MS hrs/week	0	0-1.0	0.833	0.083-2.5	0.333	0.021-0.833			

MPA: Moderate physical activity

MVPA: Moderate and vigorous physical activity

VPA: Vigorous physical activity

MS: Muscle strengthening activity

Table 4

Percentage of Women Meeting the CDC Guidelines by Group and Physical Activity Domain

Groups	% who met guidelines through the Leisure domain only	% who met guidelines through the Leisure + HH +OD domains
MPA + MS	8.18%, n=36	29.77%, n=131
VPA + MS	17.73%, n=78 *	16.37%, n=72 **
MVPA + MS	0%, n=0	1.36%, n=6
Did Not Meet Guidelines	26.59%, n=117	

Groups	MPA + MS n=167	VPA + MS n=150	MVPA + MS n=6	Did not Meet Guidelines n=117
% who met guidelines through the Leisure domain only	8.18%, n=36	17.73%, n=78 *	0%, n=0	0%
% who met guidelines through the Leisure + HH +OD domains	29.77%, n=131	16.37%, n=72 **	1.36%, n=6	0%

* 60 women in this group also met the MPA + MS criteria for leisure only

** 65 women in this group also met the MPA + MS criteria for combined group

MPA: Moderate physical activity

MVPA: Moderate and vigorous physical activity

VPA: Vigorous physical activity

MS: Muscle strengthening activity

HH: Household domain

OD: Outdoor domain

* 60 women in this group also met the MPA + MS criteria for leisure only

** 65 women in this group also met the MPA + MS criteria for combined group

MPA: Moderate physical activity

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HH: Household domain

OD: Outdoor domain