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Purposeful exercise and lifestyle physical activity in the lives of young adult women: Findings from a diary study

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Abstract

It is important to know how physical activity is incorporated in women's lives to assess ways they can feasibly attain and maintain lifelong healthy practices. This study aimed to determine whether patterns of activity differed among young women whose physical activity met nationally recommended levels from those who did not. The sample was 42 women (aged 18–30 years) who had completed an exercise intervention (22 from the exercise group, 20 from the control group). Participants recorded pedometer steps and physical activities in diaries including form, duration and perceived exertion during 12 randomly assigned weeks over 26 weeks. We divided the sample into quartiles of moderate to vigorous physical activity [MVPA] to examine the composition of physical activities per quartile. Walking and shopping comprised the majority of physical activity in the lowest quartile of MVPA. In the second and third quartiles, walking and household/ childcare together comprised more than two-thirds of all activities. Only in the highest quartile of MVPA was cardio activity (not including walking, shopping and household/childcare) the largest proportion of activity; this category stood alone as varying significantly across quartiles of MVPA ($p < 0.005$). Among these young adult women, self-reported "lifestyle" physical activity was not sufficient to meet recommended levels of MVPA. The one-quarter who met recommended levels of MVPA did so largely through purposeful physical activities directly associated with exercise. Further research is needed to refine means of more fully measuring physical activities that women frequently perform, with particular attention to household work, childcare and shopping and to differing combinations of activities and levels of exertion by which diverse women can meet the recommended levels. The findings of this small scale study reinforce the ongoing benefit of recommending structured, planned physical activity at moderate and vigorous levels of intensity to young, healthy women to ensure they obtain the health benefits.

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Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

MO'D was the lead investigator of this study. She was involved in the study design, carried out the study, completed data analysis and drafted the manuscript. AA performed some statistical analysis of the data. BK contributed to data analysis. MSK was involved in the interpretation of data. KHS was involved in the study design and in critically revising the manuscript. All authors read and approved the final manuscript.

Background

Regular physical activity at moderate to vigorous levels reduces the risk for cancer and cardiovascular disease. One-quarter of cancers globally may be attributed to overweight and inactivity (McTiernan 2008; Rogers et al. 2008; National Cancer Institute 2006–2007). Benefits of physical activity in preventing chronic disease are thought to accumulate over the life course (Byers et al. 2002). The 2008 U.S. Department of Health & Human Services recommendations for active adults are 150 minutes of moderate intensity activity in bouts that last at least ten minutes each and some additional strength training on a weekly basis (U.S. Department of Health & Human Services 2008). Taking 10,000 steps per day most days of the week is recommended as the amount of energy expenditure effective to maintain cardiovascular health (Montoye et al. 1996).

The majority of adults, however, do not obtain sufficient levels of physical activity to derive the health benefits. From data available on leisure time activity, the proportion of the U.S. adult population reporting insufficient leisure time physical activity increases with age during young adulthood in several U.S. national surveys. For example, 2007 Behavioral Risk Factor Surveillance System data indicate that among adults aged 18–24 years, 39% reported physical activity levels below the recommended guidelines of physical activity, whereas among adults 25–34 years, 46% reported levels below the recommended guidelines (Centers for Disease Control and Prevention (CDC) 2007a). The U.S. National Health and Nutrition Examination Survey [NHANES] Epidemiologic Follow-up Study provides evidence that physical activity declines 30% over a 7-year period in adult male and females between the ages of 18–30 years, yet with notable individual variation (Anderssen et al. 1996). Women engage in lower levels of physical activity than men. Data from the 2007 National Health Interview Survey show that only 33% of women aged 18–24 years reported recommended levels of leisure time physical activity, compared to 41% of men (Centers for Disease Control and Prevention 2007b).

Although biological bases must account for a significant portion of age-related declines in physical activity, changes in physical activity are seen to stem not solely from aging (Sallis 2000). Young adulthood entails major transitions possibly entailing independent housing, college, adult employment, long term relationships, children and all related financial responsibilities. New life conditions of work and family responsibilities create different demands on time (Leslie et al. 2001; Leslie et al. 1999; Speck et al. 2007; Matthews et al. 2008); furthermore, societal expectations relating to roles and financial resources differ for young adults, compared to adolescents (Baranowski et al. 1997). Decreases in leisure time physical activity in young adulthood could therefore relate to increases of physical activity in work and domestic life. The events of going to college, starting work, getting married and having children are gender-inflected (Weiss, Larsen, and Baker 1996): they are associated with decreased physical activity in young women (McIntyre and Rhodes 2009; Horn et al. 2008; Bell and Lee 2005; Ball et al. 2004; Butler 2004; Brown and Trost 2003), but not in men (Dowda et al. 2003a).

Life activities in emerging and young adulthood thus structure daily circumstances in distinct ways, with implications for physical activity. Several researchers have called for further documentation of physical activity in young adulthood (Leslie et al. 2001; Dowda et al. 2003a; Malina 2001; Dollman, Norton, and Norton 2005; Sleap et al. 2007). It is important to know how physical activity is incorporated in young adults' lives, in order to assess how best they can attain and maintain lifelong healthy practices. Relatively little is known about the forms, frequency, intensity or duration of physical activities in young women's lifestyles. Women's physical activities have not traditionally been well documented in survey questionnaires. Ainsworth maintained that women may be more active than surveys have indicated (Ainsworth 2000a). In particular, surveys recording only sports or leisure time

activities fail to capture household physical activity. Women's lack of participation in sports has been associated with home obligations. When domestic activities were recorded, women have shown higher daily expenditures than men (Ainsworth 1993; 2000b).

The aim of this study was to gain a closer, descriptive understanding of the ways young adult women incorporate physical activity into their lives following their participation, as exercisers or controls, in an exercise intervention. We asked two sets of questions. First, what forms of physical activity do young women fit into their daily lives, and what are the frequency, intensity and duration of these activities? Second, we looked specifically at the activities of women at moderate to vigorous levels of intensity to ask: how do patterns of activity, in terms of type, duration and intensity, differ among women whose physical activity levels meet the recommended levels from those who do not? It was hypothesized that these data would help inform future efforts to increase activity levels among young women by describing how women who are active fit this activity into their lives.

Methods

Sample

Young women were recruited from an ongoing clinical trial (the WISER study - "Women in Steady Exercise Research", N=320), which examined the effects of aerobic exercise training on oxidative stress and on metabolic factors, including estrogen metabolism, insulin, glucose and insulin resistance, insulin like growth factor and body composition. The inclusion and exclusion criteria for the trial related to these key aims. The women eligible for this study needed to: be aged 18–30 years; healthy but sedentary (exercised less than three times per week during the prior six months); have a self-reported menstrual cycle of 24–35 days in length; have intact ovaries and uterus and no history of gynecological problems; not be pregnant or breastfeeding within the prior year and have regular menstrual cycles; have no hormonal use in the past three months; have a body mass index (BMI) between 18 and 40; have a stable weight (no more than 10% change in the prior year); have no history of cancer; have no uncontrolled hypertension; be nonsmokers; report consuming no more than seven alcoholic beverages per week; and have no medical conditions or medications prohibiting participation in a vigorous program of weight bearing aerobics exercise. Eligibility criteria to determine whether the woman's health status would allow her to take part in a moderate exercise program were adopted from the Physical Activity Readiness Questionnaire (Chisholm et al. 1975; Thomas et al. 1992). Eligibility criteria regarding menstrual cycle length and pattern were drawn from standardized questions (e.g., Terry et al. 2005). Other hormonal requirements stemmed from the study design to examine endogenous hormones among premenopausal women. Recruitment for the WISER study was conducted from May 2006 to April 2009 and aimed to reach participants living in the ten-county Minneapolis-St. Paul metropolitan area. The main recruitment method was an email sent to female state university students and staff in the age range of 18–30 years. Recruitment expanded from year two forward to include an email sent to county employees from the metropolitan area, fliers posted at area universities, colleges and community colleges, as well as ads in the newspaper and a free weekly variety newspaper. Potential participants were directed to a website for online prescreening. Full screening was completed with 1684 women; 75% (1260) were found eligible, and 31% (390) enrolled in WISER. By far, the most frequently cited reasons for ineligibility stemmed from the study requirements concerning reproductive hormones. Two other main grounds for exclusion were reports of being physically active more than twice weekly and BMI outside the limits of 18–40. The ethnic/racial breakdown of the enrolled participants in WISER was: 5.4% Hispanic/Latina; 0.3% American Indian/Alaskan Native; 14% Asian; 8.7% Black or African American; 71.8% White; and 5.1% more than one race. Participants were randomized into a control group or an exercise intervention for the duration of 4 menstrual cycles. Participants

in the exercise group were asked to complete five 45-minute exercise sessions per week: 30 minutes of weight bearing aerobic exercise at a specified intensity, and five minutes each for the warm-up, cool-down and stretching. Exercise intensity was set at 65–70% of maximum age-predicted heart rate (HR) and increased every four weeks by 5% of maximum HR. Certified fitness professionals supervised the exercisers. The drop out rate was 18.7%.

Participants in the study reported here ("WISER-Postscript," - WISER-PS) came from the intervention and control groups. Upon completion of WISER, all WISER participants who had completed the WISER trial in 2006–07 (N = 109) were sent one email flier inviting them to participate in a study of their physical activity after the trial, in which they would keep "very simple logs" about their physical activity over 12 weeks, wear a pedometer provided by the study and take part in two interviews regarding social influences on their physical activity. All participants who had completed the WISER study and who were willing to take part in the WISER-PS study were eligible. No further eligibility was used. The clinical trial was timed according to participants' menstrual cycles; therefore WISER participants began and ended the trial on an individual basis. Recruitment for WISER-PS was accordingly staggered. Recruitment for WISER-PS took place over one year, beginning in fall of 2006, and was ongoing through fall 2007. This study was approved by the Institutional Review Board of the University of Minnesota, and all participants provided signed informed consent prior to beginning any study activities.

Physical activity data colleted through diaries and pedometers

Subjective and objective measures were used to document ongoing physical activity over an extended period of time. Participants completed physical activity diaries during 12 randomly assigned weeks over a 26-week period. Because enrollment was staggered over 17 months, WISER-PS participants did not record on the same 12 weeks. The physical activity diary designed for this study differed from physical activity logs recording all activities in the day (Montoye 1996), and it differed from those in which participants select from a list of activity categories (Bouchard et al. 1983; Schmidt at al. 2003). Instead, it was similar to the open, descriptive physical activity record described in Ainsworth (2000). Thus, participants were told that this study entailed no prescribed amount or kind of activity. They were asked to record physical activities in which they engaged soon after completing them, or by the end of the day. Participants were encouraged to define physical activity broadly, and to include physical activities in addition to exercise, while excluding sedentary and very brief, light activities, such as office tasks or washing dishes. The recording sheets asked for the date, type of activity, number of minutes (with a minimum of a 10 minute bout) and rating of perceived exertion, according to the Borg rating of perceived exertion. (Borg 1998; Borg 1982). At baseline and fitness assessments during the clinical trial, participants had previously received instruction on the Borg scale by certified fitness instructors. Written instructions distributed to all participants of the Borg rating of perceived exertion using the scale of 6–20 indicated 6 as "no exertion at all," 7.5 as "extremely light," 9 as "very light," "11" as "light," 13 as "somewhat hard," 15 as "hard," 17 as "very hard," 19 as "extremely hard" and 20 as "maximal exertion." The instruction sheet also included examples of kinds of activities associated with several ratings. Participants were instructed to record only physical activities that were equivalent to an exertion level of a leisurely walk and higher (a rating of ≥9 on the scale of 6–20).

To obtain an objective measure of physical activity, participants received a New Lifestyles Digi-walker ™ SW 200 pedometer to record daily steps during the same 12 weeks. Participants were asked to wear the pedometer for the whole day but were not asked to record the duration of use.

Secondary data from clinical trial

All participants of WISER completed the Modifiable Activity Questionnaire (Kriska 1997) at baseline for the WISER study, in face-to-face interviews with trained staff. The Modifiable Activity Questionnaire, a self-reported physical activity survey, measures physical activity in three domains: leisure-time, occupational and sedentary. All the information collected in this questionnaire is transformed into metabolic equivalents per hour per week (METS-h/week) using accepted MET values for each activity Ainsworth et al. 2000c).

At baseline of the clinical trial (approximately 6 months prior to WISER-PS), body weight and height of WISER participants was assessed at the General Clinical Research Center of the University of Minnesota, using a digital scale and a scale mounted stadiometer (Scale-tronix 5005 stand-on digital scale, Scale-tronix, White Plains, NY), calibrated weekly. All WISER participants also provided demographic information (age, race/ethnicity, education, marital status, caregiving status) at baseline.

Statistical analyses

At baseline of the WISER clinical trial, demographic characteristics across the two groups (exercisers and controls) were calculated as means for continuous variables (age and BMI) and frequencies for categorical variables. For WISER – PS, differences between exercisers and non-exercisers were assessed by Student *t*-test for continuous variables and χ^2 tests for categorical variables.

To address research question one, on the forms, frequency, intensity and duration of physical activity as recorded in diaries, daily means of pedometer steps and weekly minutes of physical activity were calculated. Categories of physical activity were determined by three members of the research team in a method akin to continuous comparison (Glaser and Strauss 1967). Two team members independently reviewed the same diaries, conferred on categories and continuously revised and adjusted the list of possible categories to account for every log entry. The third team member, a kinesiologist, supervised the procedure and deliberated on any questions or disagreements over categories. Cross-checking of the categories assigned from diary entries was completed to verify correct data entry. Differences between the exercise and control groups with respect to weekly median minutes of the various physical activity categories were assessed through non-parametric one-way ANOVA, using the Kruskal-Wallis test. Associations between total minutes of physical activity within categories of physical activity and pedometer steps were determined using Pearson correlation coefficients. Due to the descriptive and exploratory nature of this study, a significance level of $p < 0.05$ was used without correction for multiple comparisons.

To address research question two, on the patterning of physical activity among women whose physical activity levels met the recommended levels as recorded in diaries, we included as MVPA all minutes of physical activity that participants assigned a rating of exertion of 12 and higher. Vigorous physical activity alone was assigned to ratings of 15 and higher (CDC 2009;Borg 1998;Borg 1982). We then estimated a number of general linear models to examine separately the effects of MVPA on number of minutes engaged in each of the main physical activity categories. MVPA was converted to a four-level variable representing 25% quartiles. In addition, all models included a dichotomous covariate representing the original study conditions (exercise vs control), and, although this variable was not statistically significant (alpha=.05) in any of the models, it was included to adjust for any effects. Furthermore, we reported least square means for each quartile of MVPA, adjusted for the effects of the original study condition. All models were estimated using SAS PROC GLM. We also performed an ordered logistic regression to characterize the association between quartiles of MVPA (dependent variable) and pedometer average (independent variable).

As a check on group differences in the sample, a regression analysis was performed to determine any differences in physical activity levels, as measured at baseline of the WISER trial by the Modifiable Activity Questionnaire, between participants from the exercise and control groups who went on to join WISER-PS. Similarly, a regression analysis was performed to determine any differences in the results in the physical activity levels as recorded in WISER – PS between exercisers and controls. The initial models used to analyze the data included socio-demographic variables as explanatory variables as well as interactions between treatment group and these variables. Covariates and two-way interactions with p-value < 0.05 were eliminated from the model using backward stepwise elimination. Final model fit was assessed by examination of Studentized residual plots for linear regression models and the likelihood ratio test for the logistic regression models. SAS version 9.2 (SAS Institute, Inc. Version 8.2 Cary, NC) was used for this analysis.

Results

Demographics of study sample

Sixty women from the WISER study were recruited into WISER – PS, constituting 55% of all 109 participants who had completed all data collection for the clinical trial between 2006 and 2007. More than half (35, or 58%) were from the exercise group, and 25 were from the control group. Fourteen participants withdrew from WISER - PS. Ten who dropped out were from the exercise group; nine were not Caucasian; six were overweight or obese; and two were parents. The remaining sample included 25 women from the exercise group and 21 from the control group. The following data are from 22 exercisers and 20 controls who provided logs with complete information for all categories: form, frequency, intensity and duration of physical activity as well as pedometer steps for the majority of days.

Participants were well-educated: 88% had a college degree or postgraduate education (Table 1). Twelve of the 42 participants were not Caucasian; of these seven were from the exercise group of the WISER study. Most participants were single and without children. Twelve participants (six from the exercise group and six from the control group) were overweight or obese. No differences were found in baseline physical activity between WISER-PS participants and WISER trial participants (including drop outs). Further, no differences were found in age, race/ethnicity, education, marital status or BMI between the participants who completed WISER-PS and participants who had dropped out of the WISER trial. Exercise group participants tended to have higher educational attainment ($p = 0.078$).

Frequency, intensity and forms of physical activity

In their self-reported diaries, the 42 participants recorded an average of 80 (± 7) days of physical activity data, out of a total possible 84 days. The average number of total minutes of physical activity over the 12 weeks of recording was 3778 minutes (SD = 2014). This translated to about 45 minutes per day of recorded physical activity (at all levels of exertion). The mean daily pedometer steps for all participants were 7873 (SD = 2182) over an average of 77 total days (SD = 9 days) of pedometer usage. Daily pedometer steps were excluded whenever a participant noted having worn the pedometer for anything less than a full day. A trend was suggested for a positive correlation ($r = 0.28$, $p = 0.07$) between mean daily pedometer steps, the objective measure of physical activity used in this study, and MVPA, the self-reported measure of physical activity intensity. Overall, the ranges of recorded physical activity, pedometer steps and MVPA levels were very broad.

Walking, as reported in diaries, was not significantly correlated with pedometer steps, nor were pedometer steps correlated with total physical activity. In further analysis, we found that a subset of 13 participants with the lowest recordings of walking did, however, record their

pedometer steps regularly. The diaries of eight of these 13 participants showed they initially wrote in some walking activities but discontinued doing so in the majority of weeks, writing instead "normal day" or leaving the description blank but for the pedometer steps. The diaries of three participants indicated that they mainly recorded very active recreational physical activities (e.g., spin class, canoeing); the two others commuted to work daily via bicycle including during the winter months. Among this group, the daily pedometer steps were between 5006 and 12108 steps, thus included from low to high ranges.

All of the women's physical activities outside of work occurred in seven categories, which we report as group percentages of median minutes per week of total physical activity (Table 2). Taking the sample as a whole, all forms of walking (for transportation and for recreation) together constituted 43% of recorded activity. Walking constituted 50% of all recorded activity among control participants, compared to 33% among exercisers. After walking for transportation, the second highest median minutes of physical activity recorded in the whole sample were for "all other cardio" activities. "All other cardio" encompassed indoor and outdoor aerobic activities other than walking for transportation or recreation; moreover, shopping and household/childcare were also set apart as distinct categories. Shopping ranked third, followed by walking for recreation and household chores/childcare. Strength training and bicycling (for transportation and recreationally) constituted 4% or less of the total. There were no statistically significant differences between the controls and exercisers with respect to the different physical activity categories. There was a trend towards a significant difference in median minutes of bicycling between exercisers and controls, with more control participants bicycling ($p = 0.05$). Of the nine participants in the sample who recorded any bicycling, one control participant used it as her means of transportation to work throughout the year. The mean number of recorded weeks during cold and winter months (from November through March) was 7.5 (SD = 2.5).

Quartiles of MVPA and associations with category of physical activity

Given the wide range within the sample of frequency of activities and levels of exertion, we divided the sample into quartiles of MVPA, as assessed from diary data, to examine related patterning of total physical activity. The mean MVPA per week was 119 minutes (SD = 99). We examined each quartile of MVPA in relation to the categories of walking, household/childcare, shopping, strength training and "all other cardio" (Table 3). Walking (for transportation and recreation) was distributed across all quartiles of MVPA. Walking and shopping comprised the vast majority of physical activity in the first (lowest) quartile of MVPA. The category "all other cardio" ranked low among women in the lowest quartile of MVPA. Household/childcare and shopping were distributed similarly across three of the four quartiles. In the second and third quartiles of MVPA, walking and household/childcare together comprised more than two-thirds of all activities. No significant differences or trends of activity were observed by quartile of MVPA for the activities of walking, shopping or household/childcare. Strength training constituted a minor part of women's physical activity.

The category "all other cardio" stood alone as varying significantly across quartiles of MVPA ($p < 0.005$). In the fourth (highest) quartile of MVPA "all other cardio" was the largest portion of activity, followed by walking and household/childcare. Within the highest quartile, the mean minutes of "all other cardio" were more than twice that of the middle quartiles and seven times that of the lowest quartile. No differences were found between the participants from the exercise group and from the control group. A closer look at the forms of activity among women whose physical activity levels met the recommended levels of 150 minutes per week of moderate physical activity showed that 12 participants, including nine participants in the highest quartile, and three in the higher end of the third quartile, obtained a high portion of the recommended levels of MVPA through bouts of aerobic exercise, in the category "all other cardio." Three

participants in the highest quartile met or exceeded the recommended levels of MVPA from "all other cardio" activity alone. Other participants who met the recommended levels did so largely through walking or household chores. Two women (including one obese participant) obtained more than 150 minutes per week from walking. One participant in the highest quartile obtained most of her physical activity, including MVPA, from household chores. (This participant was involved in doing finish work, such as painting walls in her new home during study participation). Finally, three participants in the highest quartile met the recommended levels with a combination of three or more of the main activities ("all other cardio," walking, household/childcare, strength training).

Six of the 11 participants in the highest quartile of (MVPA) averaged 10,000 ± 500 steps or more over the 12 weeks. However, according to the ordered logistic regression analysis used to characterize the association between quartiles of MVPA (dependent variable) and pedometer average (independent variable), women with higher pedometer averages were less likely to be in a higher quartile of MVPA. One likely reason for this lack of association is that pedometers tend to underestimate vigorous activity (Bassett 2000), and diaries tend to overestimate it (Durante and Ainsworth 1996). Eight of the 11 participants in the highest quartile and one in the third quartile registered ≥ 75 minutes per week of vigorous physical activity. By comparison, two participants in the third quartile and three in the second quartile registered from 50 to 71 minutes per week of vigorous physical activity. In the lowest quartile all participants except one registered from 0–5 minutes per week of vigorous physical activity.

Discussion

This study obtained physical activity diary and pedometer data from young women to address first, what forms of physical activity they incorporated into their lives, and second, how patterns of activity, in terms of form, duration and intensity, differed among women whose physical activity levels met the recommended levels from those who did not. Regarding our first research aim, the results of this study indicate a similar array of non-occupational activities. The main categories of activity reported by the 42 young women who participated in this study were walking for transportation and for recreation, household/childcare, other indoor and outdoor aerobic cardio activities and shopping. These findings are somewhat similar to those of Dowda et al (2003a), who reported that young adult women aged 18–30 years in the NHANES III cohort were mainly active in these five areas: walking, gardening/yard work, calisthenics, cycling and dancing (aerobics or other). Walking for transportation and the category "all other cardio," designated in this study to include indoor and outdoor aerobic activities other than walking for transportation or recreation, shopping and household/childcare, were the most frequently recorded activities.

Walking for transportation, recreation and shopping was about 34 minutes per day or about four hours per week, according to the median values reported by women in the WISER – PS study, among whom 41% were students. This amount is higher than that reported in the 2000 Behavioral Risk Factor Surveillance Systems data on leisure time activities, where walking among adult men and women has remained fairly consistent at 2.9 times per week in 30 minute sessions, or about 1.6 hours per week (Simpson et al. 2003). It is also higher than a 2002–03 phone survey in which 49% of US adults reported walking 30 and more minutes per day for "all purpose" walking, that is, walking for transportation, recreation and shopping (Reis et al. 2008). The question arises as to whether other forms of physical activity will replace walking for transportation once the participants complete their education. Nearly all the women in the present study dedicated sizable and comparable portions of their weekly activities to shopping. Caspersen et al. have suggested that shopping be encouraged as a form of physical activity with health benefits (Caspersen, Pereira, and Curran 2000). This group of women, however, rarely rated their exertion as more than light during shopping.

Another study finding was that for many of the women, domestic activities were important in their weekly physical activity. National time-use studies continue to indicate considerable care-giving and household activities among women: 1.8 hours per day among women aged 15–24 years and 3 hours per day among women aged 25–34 years (Bureau of Labor Statistics 2005). According to a survey of over 2,600 ethnically diverse women aged 20–65 years, the highest quartile of household/caregiving was positively associated with age, Hispanic ethnicity, being married, having children at home and lack of employment (Sternfeld et al. 1999). Other survey data suggest that declines in leisure time activity occurring in young adults aged 18–30 years may relate to household activities taking their place (Dowda et al. 2003b). In the present study women spent about 28 minutes per week on household/childcare. More than half (23 participants) rated their exertion at moderate levels for these activities. Given the low number of women with children in this study, it appears that these young, mostly single women dedicated a significant portion of their time and energies to household chores.

Our second research aim was to address how the physical activity patterns of participants who met the recommended levels of about 150 minutes per week of MVPA differed from those who did not. While variability was limited in categories of activity, the range in frequency and intensity was very broad. When we considered intensity of physical activities according to a ranking of quartiles of MVPA, we found that "all other cardio" was positively associated with quartile of activity: low averages were associated with the lowest quartile, higher averages with the mid quartiles and much higher averages with the highest quartile. Those in the highest quartile of the highest mean minutes of MVPA maintained levels meeting and exceeding the recommended guidelines for moderate to vigorous physical activity. By contrast, no significant associations were observed between quartiles of MVPA and walking, shopping and household/childcare categories.

It appears from self-reported diary data that among the young women in this study, non-occupational "lifestyle" physical activity alone (including walking or bicycling for transport, household activities and shopping) was not sufficient to meet the recommended levels of moderate to vigorous activity. Those participants attaining the highest levels of MVPA obtained a larger portion of their physical activity through activities directly associated with structured and/or planned exercise: they were going to the gym to work out on exercise machines, taking aerobics classes, running/jogging; and some engaged in outdoor activities such as hiking, snowshoeing, etc. They met the recommended levels through purposeful exercise activities in addition to lifestyle activities. This amount of purposeful exercise activity distinguished one quarter of the sample (11 of the 42) from all others in the study.

The finding that those obtaining recommended levels of physical activity did so via conventional exercise forms would appear to be unsurprising when one recalls half of the participants were drawn from a gym based exercise intervention. One might anticipate carry over, with the exercise participants continuing aerobic exercise soon after the intervention. We must emphasize, however, that no differences were observed in levels of exertion between exercisers and controls. The commonality among several participants in incorporating structured physical activity may in part be attributable to their educational status: higher levels of educational attainment are associated with greater gym use (Dunton et al. 2008; Kruger et al. 2008). It is important to note, however, that vigorous activities tend to be more often registered in diaries and surveys (Durante and Ainsworth 1996). Lifestyle activities appear to be more difficult to recall, more cumbersome to record and/or may occur in bouts of less than ten minutes. While recall was less a factor in this diary study, participants in this study may have considered some lifestyle activities not only too short in duration but also too light to document, given the instructions to record activities at levels associated with a leisurely walk and higher.

This study also entailed collection of objective physical activity data, through pedometers worn on 77 days across six months. Pedometer data showed a trend for a positive correlation ($r = 0.28$, $p = 0.07$) with perceived MVPA, but that correlation was weak. Furthermore, pedometer data were not correlated with total physical activity or walking, as reported in diaries. One possible reason for the low correlations in this study may be due to the diary's capture of infrequent activities. Ainsworth (1993) found higher correlations with daily or regular activities, such as housework and caregiving, than with intermittent ones, such as major cleaning, grocery shopping and yardwork. Other studies have also found modest correlations between physical activity logs and objective measures (Chasan-Taber et al. 2002; Schmidt et al 2003; Carter-Nolan 2006; Macfarlane et al. 2006, Ferrari et al. 2007). Pedometers underestimate low and high levels of intensity and appear to be best at capturing walking speeds at 3–4 miles per hour (Bassett 2000). It has been suggested that the lack of wide variability in the intensity of physical activity combined with a constant rate of within-woman variability (as well as measurement error) would result in reduced correlations of objective and self-report measures (Perisic and Rosner 1999; Schmidt et al. 2003). Studies have found highest correlations with vigorous activity. This higher correlation may in part be due to their planned nature and more salient quality than intermittent, routine activites (Durante and Ainsworth 1996).

This study, while offering useful descriptive data with implications, had limitations. This was a small sample of largely white, single college students and graduates conducted in a climate with several cold and wintery months. In 2008, half of women high school graduates (50.5%) in the U.S. aged 15–24 years attended college (U.S. Census Bureau), so that our findings may not be generalizable to half of the women in this age group, i.e., those who do not attend college, as well as non-white women and women with children. The data in this study were largely based on physical activity diaries. As such, they were subject to some degree of bias in recording based on social desirability and to self-reporting errors (Montoye 1996), such as over- and under-reporting of activities. To avoid some of these biases, this study assigned weeks of recording randomly and used an open-ended method in which women described activities on their own, rather than from a set, required list. Questions arose over the comparability across the sample, as discussed above regarding the modest correlation between the pedometer and physical activity data. The drop out rate of WISER was nearly 19%. Fourteen of the 60 WISER – PS participants (23%) dropped out. The low participation rates in WISER and in WISER – PS indicate the possibility of participation bias. The reasons for the drop out rate in the WISER trial are the subject of a future study. Participants who dropped out of WISER-PS stated that they became busy or forgot to complete the diaries. It is possible that the large number of weeks assigned for recording activity and the random assignment of recording in weeks spread across several months made dropping out more likely. Furthermore, study staff did not initiate contact or send reminders to participants during the 26 weeks. The study may have seemed additionally burdensome following completion of a complicated clinical trial. Despite these limitations, common to other physical activity diary studies, a study strength was in collecting physical activity data over a substantial time frame.

This work contributes to efforts to examine how the recommended levels of physical activity can be met in different subgroups of the population on a regular basis. The findings can help us develop more targeted research and recommendations. The examination of physical activity categories by quartile of MVPA allowed us to discern which domains and types of activities were significantly associated with greater weekly minutes of moderate to vigorous physical activity. Given the well-known positive association of education with physical activity, it is of concern that not more than 26% of this sample met recommended levels of physical activity as measured by reported time and perceived exertion.

Further research is needed on lifestyle physical activities. It is important to learn the frequency, duration and intensity at which they occur in a given population to then develop interventions and recommendations for combinations of activities and intensities by which diverse populations can meet the recommended levels (Troiano et al. 2001; Ball et al. 2004). This study, like previous research on women's physical activity, indicates ongoing need to refine means of more fully measuring physical activities common to the gender. Household chores, childcare and shopping activities could be specifically examined to discern whether they meet the threshold of moderate level activity. Research is needed to measure the impact of low intensity physical activity, as it is potentially the most important area of energy expenditure and the most variable among people (Levine 2004). It would be important to identify how much prolonged, light activity would afford the same health benefits as the current recommendations for moderate activity. Research should be conducted on demographically diverse women, especially women with lower educational attainment, who are married, have children and are non-wage earning in order to better assess their usual physical activities and tailor interventions and recommendations. Research protocols should, however, give due attention to the problem of participant burden. While much research remains to be done to assess the full range of women's physical activities, the findings of this small scale study reinforce the ongoing benefit of recommending structured, planned physical activity at moderate and vigorous levels of intensity to young, healthy women in order to ensure they obtain the health benefits.

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Table 1

Selected characteristics of WISER – PS participants

	Control Group N = 20	Exercise Group N = 22	p-value[b]
Age (years)[a]	25.1 ± 0.7	26.0 ± 0.7	0.38
BMI (kg/m^2)[a]	24.1 ± 1.06	24.6 ± 1.15	0.76
Education [N]			
High School	0	2	
Some College	2	1	0.078
College degree	12	6	
Grad. or prof. degree	6	13	
Race [N]			
Asian	1	1	
Black	1	2	
Latina	0	4	0.12
White	15	15	
Multirace	3	0	
Marital Status [N]			
Single	15	16	
Married/Domestic partnered	5	4	0.56
Divorced	0	2	
Number of Children [N]			
None	20	19	
1	0	1	0.23
2	0	2	

[a] Mean ± SE.

[b] Based on two-sample t-test for age and BMI, and χ^2 test for education, race, marital status and number of children.

Table 2

Median minutes per week WISER – PS participants engaged in various physical activities during 80 days of recording.

Activity[a] Minutes (range)	Control N = 20	Exercise N = 22	p-value[b]
Walking –Transportation	94 (0.8 – 296.8)	17.1 (0 – 186)	0.13
Walking - Recreation	22.4 (0 – 211.7)	38.1 (0 – 242.5)	0.82
Bicycling[c]	0 (0 – 169.6)	0 (0 – 37)	0.05
"All other cardio"[d]	46.5 (0 – 178.9)	50.5 (0 – 300)	0.53
Strength training	4.2 (0 – 35.2)	0 (0 – 62.5)	0.40
Household chores/childcare	26.9 (0 – 320.8)	28.5 (0 – 597.5)	0.91
Shopping[e]	37.7 (0 – 155)	31.5 (0 – 155)	0.38

[a] The percent of participants recording each activity was: walking – transportation (90%); walking – recreation (90%), bicycling (21%), "all other cardio" (98%), strength training (55%), household chores/childcare (83%), shopping (93%).

[b] Based on Kruskal-Wallis test.

[c] Biking for transportation constituted 90% of all biking.

[d] Aerobic exercise sessions completed indoors constituted 80% of "all other cardio."

[e] Grocery shopping constituted 21% of all shopping.

Table 3

Mean weekly minutes and percent of activity by quartile of moderate to vigorous physical activity (MVPA).[a]

Activity[b]	Quartiles of MVPA[c]			
Minutes (%)	**1st**	**2nd**	**3rd**	**4th**
Walking	113 (58%)	129 (41%)	158 (43%)	108 (29%)
Household/ Childcare	20 (10%)	83 (26%)	76 (21%)	78 (21%)
Shopping	37 (19%)	39 (12%)	65 (18%)	36 (10%)
Strength	4 (2%)	5 (2%)	7 (2%)	16 (4%)
"All other cardio"	20 (10%)	61 (19%)	58 (16%)	141 (37%)

[a] Least square means for each quartile of MVPA, adjusted for the study condition effect (exercise vs. control group).

[b] Walking for transportation and recreation are combined.

[c] 1st quartile: 0–58 min/12 weeks or 26 min/wk (N = 10).
2nd quartile: 55–91 min/12 weeks or 69 min/wk (N = 11).
3rd quartile: 82–141 min/12 weeks or 102 min/wk (N = 10).
4th quartile: 151–444 min/12 weeks or 257 min/wk (N = 11).