Title
Physical activity, weight, and waist circumference in midlife women.

Journal
Health Care for Women International, 33(12)

Authors
Choi, JiWon
Guiterrez, Yolanda
Lee, Kathryn
et al.

Publication Date
2012

DOI
10.1080/07399332.2012.673658

Peer reviewed

Published in final edited form as:
Health Care Women Int. 2012 ; 33(12): 1086–1095. doi:10.1080/07399332.2012.673658.

Physical Activity, Weight, and Waist Circumference in Midlife Women

JiWon Choi,
Department of Social & Behavioral Sciences; and Institute for Health & Aging, University of California, San Francisco, San Francisco, California, USA

Yolanda Guiterrez,
Kaiser Permanente Medical Center, Hayward, California, USA

Catherine Gilliss, and
Duke University School of Nursing, Durham, North Carolina, USA

Kathryn A. Lee
School of Nursing, University of California, San Francisco, San Francisco, California, USA

Abstract

During midlife years, women are at risk of increasing body weight and waist circumference. We evaluated changes in weight and waist circumference from enrollment to 2 years later and examined the influence of physical activity level on those changes among 232 women aged between 40-50. Weight increased significantly for the entire sample. Those who increased their physical activity from enrollment to 2 years later had the smallest increase in weight and had a slight decrease in waist circumference. To maintain ideal weight and waist circumference, midlife women should be encouraged to increase physical activity before and during the menopausal transition.

During midlife, between 40 and 60 years of age, women are at a greater risk for weight gain and increased central adiposity as reflected in waist circumference. Both factors increase their risk of coronary heart disease (Manson et al., 1990; Rexrode et al., 1998; Wing, Matthews, Kuller, Meilahn, & Plantinga, 1991). Regular physical activity is recommended as a lifestyle modification for decreasing the risk of coronary heart disease (Mosca L et al., 2004). Physical activity was associated with less weight gain and less central adiposity in pre-menopausal (Owen et al., 1990) as well as post-menopausal women (Kaye et al., 1990) in cross-sectional studies, but limited longitudinal data exist related to changes in physical activity, weight, and central adiposity, especially before and during the menopausal transition.

The Biobehavioral Health in Diverse Midlife Women Study was a community-based longitudinal observational study describing changes in biological and psychosocial health of women initially recruited while pre-menopausal with regular menstrual cycles and low follicle stimulating hormone values. In this paper, we had a purpose to evaluate the changes in weight and waist circumference from enrollment to 2 years later in the cohort of women and examine the influence of physical activity level on those changes.

Address correspondence to JiWon Choi, Department of Social & Behavioral Sciences/Institute for Health & Aging, University of California, San Francisco, 3333 California Street, Suite 340, Laurel Heights Campus, Box 0646, San Francisco, CA 94118, USA. jiwon.choi@nursing.ucsf.edu.

Methods

Sample Characteristics

In 1996-1997, 346 women were enrolled in the Biobehavioral Health in Diverse Midlife Women Study. Healthy women were recruited through broadcast media (e.g., radio and television public service announcements and special new feature), printed material (e.g., brochures, fliers, or advertisements), face-to-face interaction, and Internet website. Complete details regarding participant characteristics and recruitment are available elsewhere (Gillis et al., 2001). Inclusion criteria were (a) between 40 and 50 years of age, (b) regular menstrual cycles, (c) self-identified as African American, European American, or Mexican/Central American, (d) English- or bilingual Spanish-speakers, and (e) living in the United States for at least 20 years, Women who self-reported any major health problems and those taking hormonal therapy were excluded.

There were 250 participants with complete physical activity data at the initial examination and the 2-year time point. Women who were postmenopausal (n=1), on estrogen or herbs (n = 4), had hysterectomy (n = 3), or had missing data on menopausal status (n = 10) were exclude from this analysis, leaving 232 women for this analysis (175 pre-menopausal women and 57 peri-menopausal women). The study was approved by the Committee on Human Research (CHR) at a major Western university in the United States.

Measures

Physical activity was assessed using the Paffenbarger Physical Activity Questionnaire every six month including the initial examination and the 2-year examination. Participants were asked to report on the number of blocks they walked in the past week, the number of stairs they climbed daily, and all sports or exercise in which they had participated during the past year as well as their frequency and duration (Lee, Paffenbarger, & Hsieh, 1992). According to established standards, each sport or exercise were assigned a multiple of resting metabolic rate (MET score) and physical activity level (MET-hour/wk) was estimated from the three domains of walking, climbing stairs, and sports/exercise (Ainsworth et al., 2000; Lee et al., 1992). Although a self-report measure of physical activity might not estimate accurate energy expenditure, the Paffenbarger Physical Activity Questionnaire has been shown to detect changes in exercise produced by intervention (Simkin-Silverman, Wing, Boraz, & Kuller, 2003) as well as changes in biological risk factor levels (Owens, Matthews, Wing, & Kuller, 1992) and has satisfactory validity and reliability (Ainsworth, Leon, Richardson, Jacobs, & Paffenbarger, 1993). In this study, the participants' physical activity levels were significantly correlated (intraclass correlation – ICC) across the 2-year interval (r = 0.39, p < 0.001) in this study, indicating acceptable internal consistency.

Weight and waist circumference were assessed by an ethnically-matched research assistant every six month including the initial examination and the 2-year examination at essentially the same time of day at each visit. Participants wore light clothing and removed their shoes. Weight was measured using an electronic scale (Precision Health Scale®, UC-300). Waist circumference was measured to the nearest 0.1 cm using a specialized tape (Gullick II, Model 67020, Country Technology, Inc.). If the first two waist measures differed by more than 1 cm, a third measure was obtained and up to three measures were averaged and used for the final measure at each time point. Menopausal status was determined with urinary levels of follicle stimulating hormone (FSH) and menstrual cycle regularity every 6 months. Women with urinary FSH levels ≤ 2.5 IU/DL and regular menstrual cycles were categorized as late pre-menopausal while women with FSH levels > 2.5 IU/DL and irregular menstrual cycles were categorized as early peri-menopausal.

Data Analysis

Distributions of physical activity levels were skewed and log transformed to meet the assumptions for statistical analyses. Change scores were created for physical activity level, weight, and waist circumference by subtracting the value at their initial evaluation from their value 2 years later.

Paired *t*-tests were conducted on the levels of weight and waist circumference at each evaluation. Analysis of Covariance (ANCOVA) tests were conducted to assess the effect of change in physical activity in weight at the 2-year examination after controlling for age, log-transformed physical activity level, and weight at the initial examination. Analysis of Covariance (ANCOVA) tests were conducted to assess the effect of change in physical activity in waist circumference at the 2-year examination after controlling for age, log-transformed physical activity level, and waist circumference at the initial examination. Women were categorized into three physical activity groups: a) increased physical activity at least 300 MET-hour/wk over time, b) decreased physical activity at least 300 MET-hour/wk over time, and c) a change in either direction of less than 300 MET-hour/wk. Energy expenditure of 300 MET-hour/wk is approximately equivalent to walking three times per week for 20 minutes.

Results

Mean weight significantly increased over 2-year period by 3 pound (standard deviation (SD), 11), but there was no significant change in mean waist circumference (Table 1). The same trend was found regardless of menopausal status at 2-year examination. In 175 women who remained as being premenopausal as well as 57 women who had transitioned from their menopausal status at the initial examination (premenopausal) to peri-menopausal by year 2, there was a significant increase in weight ($p < .05$), but not in waist circumference (Table 1). The proportions of women for three physical activity groups did not significantly differ by ethnicity ($\chi^2(4) = 7.54$, $p = 0.11$). Figure 1 and 2 illustrate the mean within-subject change in weight and waist circumference by different categories of change in physical activity level, adjusted for covariates. None of the covariates (weight, physical activity level, and age at the initial examination) were significantly related to the participants' weight change, but there were differences in weight change by categories of change in physical activity level after controlling for the covariates ($F(2, 218) = 2.93$, $p = .055$). For change in waist circumference between the initial and 2-year examinations, only the covariate of waist circumference at the initial examination was significantly related to change in waist circumference at the 2-year examination ($F(1, 220) = 5.55$, $p < .05$). There was also a significant effect of change in physical activity level on change in waist circumference after controlling for the effect of waist circumference at the initial examination ($F(2, 220) = 3.75$, $p < .05$). Women who decreased their physical activity ≥ 300 MET-hour/wk between the initial and 2-year examinations gained the most weight over time (5.3 ± 8.9 pounds) whereas those who reported increased physical activity ≥ 300 MET-hour/wk between the initial and 2-year examinations gained the least weight (0.8 ± 12.2 pounds) (Figure 2). Women who maintained their physical activity between the initial and 2-year examinations had a moderate weight gain of 3.3 ± 12.2 pounds. Similar group differences in mean waist circumference gain were also observed. Women who decreased their physical activity increased their waist circumference the most between the initial and 2-year examinations (1.7 ± 4.1 cm) whereas those who reported increasing their physical activity lost an average of 0.8 + 5.9 cm. Those who maintained their physical activity had a moderate increase in waist circumference (0.5 + 5.6 cm). The group of women who increased their physical activity by ≥ 300 MET-hour/wk compared to the group who decreased their physical activity ≥ 300 MET-hour/wk from enrollment to 2 years later, had significantly less weight gain ($p < .05$) and less waist circumference increase ($p < .01$).

Discussion

The finding that weight increased over time, even in this brief two-year span of time is consistent with other observations that weight tends to increase with age in midlife women. Midlife women gained an average of 4.9 pounds over a 3-year period in one study (Owens et al., 1992) and 4.5 pounds over a similar period of time in the Study of Women Across the Nation (SWAN) cohort of midlife women (Sternfeld et al., 2004).

In the SWAN, mean waist circumference increased by 2.2 cm over the 3-year period (Sternfeld et al., 2004) while there was no significant increase in waist circumference over the 2-year period in the present study. In a few cross-sectional studies, post-menopausal women showed greater central adiposity compared to pre-menopausal women (Ley, Lees, & Stevenson, 1992; Toth et al., 2000). Menopausal status was not significantly related to waist circumference, but women who became postmenopausal showed higher waist circumference in SWAN (Sternfeld et al., 2004). Midlife women gain weight with age, but significant increases in waist circumference may be more associated with ovarian aging (e.g., decreases in estrogen and increases in FSH associated with menopause) (Sowers et al., 2007). The relatively few who transitioned to peri-menopausal status and the absence of post-menopausal women in our cohort may account for this minimal change in waist circumference.

In a prospective cohort of 11,974 (7089 women) university graduate in Spain, Basterra-Gortari et al. (2008) reported that women who decreased physical activity after 2 years showed a significant increase in weight. In another prospective cohort of 233 middle-aged women, Davidson, Tucker, and Peterson (2010) reported that women who increased physical activity had a lower risk of gaining abdominal fat compared with those who maintained or decreased physical activity across 20 months. In keeping with these prospective studies, any increase in physical activity (in this case ≥ 300 MET-hour/wk) in midlife women was associated with the least amount of gain in weight and change in waist circumference over time, while decrease in physical activity was associated with the highest weight gain and waist circumference gain over time regardless of the starting level of activity. The fact that women who increased their physical activity level gained the least amount of weight and waist circumference underscores the role of regular physical activity in maintenance of weight and waist circumference.

This study focused on physical activity, but similar research addressing dietary intake as well as physical activity is needed to better determine how weight or waist circumference are influenced. However, dietary intake and physical activity had shown significant independent effects on weight or waist circumference in other studies (Koh-Banerjee, et al., 2003; Macdonald et al, 2003) and, in at least one study, the variance of weight change explained by change in physical activity was more than seven times that accounted for by dietary change (Macdonald et al., 2003). Thus, it is unlikely that the strong relations between physical activity and weight and between physical activity and waist circumference shown in the current study were confounded by diet.

This sample was not recruited from health-care clinic setting, however, one limitation of this study was the nonrandom nature of participant recruitment and enrollment. Our sample closely resembles the published demographic profile of California's population by ethnic groups of women except Asian Americans (California Department of Health Services, 1997). This study purposely excluded Asian American women because another large-scale population-based study was recruiting Asian American women in the same geographic area where the current study was conducted during the same time period. Another limitation of this study was the use of a self-report questionnaire to assess physical activity, which is

prone to errors with regard to memory recall and responder bias. However, the Paffenbarger Physical Activity Questionnaire has been widely used to assess midlife women's physical activity level and has shown satisfactory reliability and validity.

In this present study, midlife women showed their strong tendency of weight increase even over the 2-years period and the significant health promoting effects of physical activity on the control of weight and waist circumference. Midlife women should be informed with these findings and be advised to increase their current physical activity level enough to maintain their current weight and waist circumference. In addition, the professional endeavor to develop more effective strategies to promote adoption and maintenance of regular physical activity in midlife women is needed the most.

Acknowledgments

The study received financial support from The National Institutes of Health, National Institute of Nursing Research (R01NR0459, Kathryn A. Lee, RN, PhD, Principal Investigator). Manuscript preparation was supported by the National Institutes of Health, National Institute of Nursing Research (T32 NR07088).

References

Ainsworth BE, Leon AS, Richardson MT, Jacobs DR, Paffenbarger RS. Accuracy of the College Alumnus Physical Activity Questionnaire. Journal of clinical epidemiology. 1993; 46(12):1403–1411. [PubMed: 8263567]

Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, et al. Compendium of physical activities: an update of activity codes and MET intensities. Medicine & Science in Sports & Exercise. 2000; 32(9 Suppl):S498–S516. [PubMed: 10993420]

Basterra-Gortari FJ, Bes-Rastrollo M, Pardo-Fernandez M, Forga L, Martinez JA, Martinez-Gonzalez MA. Changes in weight and physical activity over two years in Spanish Alumni. Medicine & Science in Sports & Exercise. 2008; 41(3):516–522. [PubMed: 19204600]

California Department of Health Services. Profile of women's health status in California, 1984–1994. Office of Women's Health. Sacramento, CA: California Department of Health Services; 1997.

Davidson LE, Tucker L, Peterson T. Physical activity changes predict abdominal fat change in midlife women. Journal of physical activity & health. 2010; 7(3):316–22. [PubMed: 20551487]

Gilliss CL, Lee KA, Gutierrez Y, Taylor D, Beyene Y, Neuhaus J, et al. Recruitment and retention of healthy minority women into community-based longitudinal research. Journal of Women's Health & Gender-Based Medicine. 2001; 10(1):77–85.

Lee IM, Paffenbarger RS, Hsieh CC. Time trends in physical activity among college alumni, 1962-1988. American Journal of Epidemiology. 1992; 135(8):915–925. [PubMed: 1585904]

Ley CJ, Lees B, Stevenson JC. Sex- and menopause-associated changes in body-fat distribution. American Journal of Clinical Nutrition. 1992; 55(5):950–954. [PubMed: 1570802]

Kaye SA, Folsom AR, Prineas RJ, Potter JD, Gapstur SM. The association of body fat distribution with lifestyle and reproductive factors in a population study of postmenopausal women. International Journal of Obesity. 1990; 14(7):583–91. [PubMed: 2228393]

Koh-Banerjee P, Chu NF, Spiegelman D, Rosner B, Colditz G, Willett W, Rimm E. Prospective study of the association of changes in dietary intake, physical activity, alcohol consumption, and smoking with 9-y gain in waist circumference among 16,587 US men. American Journal of Clinical Nutrition. 2003; 78(4):719–727. [PubMed: 14522729]

Macdonald HM, New SA, Campbell MK, Reid DM. Longitudinal changes in weight in perimenopausal and early postmenopausal women: effects of dietary energy intake, energy expenditure, dietary calcium intake and hormone replacement therapy. International Journal of Obesity and Related Metabolic Disorders. 2003; 27(6):669–676. [PubMed: 12833110]

Manson JE, Colditz GA, Stampfer MJ, Willett WC, Rosner B, Monson RR, Speizer FE, Hennekens CH. A prospective study of obesity and risk of coronary heart disease in women. New England Journal of Medicine. 1990; 322(13):882–889. [PubMed: 2314422]

Mosca L, Appel LJ, Benjamin EJ, Berra K, Chandra-Strobos N, Fabunmi RP, et al. Evidence-based guidelines for cardiovascular disease prevention in women. Circulation. 2004; 109(5):672–693. [PubMed: 14761900]

Owens JF, Matthews KA, Wing RR, Kuller LH. Physical activity and cardiovascular risk: A cross-sectional study of middle-aged premenopausal women. Preventive Medicine. 1990; 19:147–157. [PubMed: 2359739]

Owens JF, Matthews KA, Wing RR, Kuller LH. Can physical activity mitigate the effects of aging in middle-aged women? Circulation. 1992; 85:1265–1270. [PubMed: 1555270]

Rexrode KM, Carey VJ, Hennekens CH, Walters EE, Colditz GA, Stampfer MJ, Willett WC, Manson JE. Abdominal adiposity and coronary heart disease in women. Journal of American Medical Association. 1998; 280(21):1843–1848.

Simkin-Silverman LR, Wing RR, Boraz MA, Kuller LH. Lifestyle intervention can prevent weight gain during menopause: Results fro a 5-year randomized clinical trial. Annals of Behavioral Medicine. 2003; 26(3):212–220. [PubMed: 14644697]

Sternfeld B, Wang H, Quesenberry CP, Abrams B, Everson-Rose SA, Greendale GA, et al. Physical activity and changes in weight and waist circumference in midlife women: Findings from the Study of Women's Health Across the Nation. American Journal of Epidemiology. 2004; 160(9): 912–922. [PubMed: 15496544]

Toth MJ, Tchernor A, Sites CK, Poehlman ET. Effect of menopausal status on body composition and abdominal fat distribution. International Journal of Obesity and Related Metabolic Disorders. 2000; 24(2):226–231. [PubMed: 10702775]

Wing RR, Matthews KA, Kuller LH, Meilahn EN, Plantinga PL. Weight gain at the time of menopause. Archives of internal medicine. 1991; 151(1):97–102. [PubMed: 1985614]

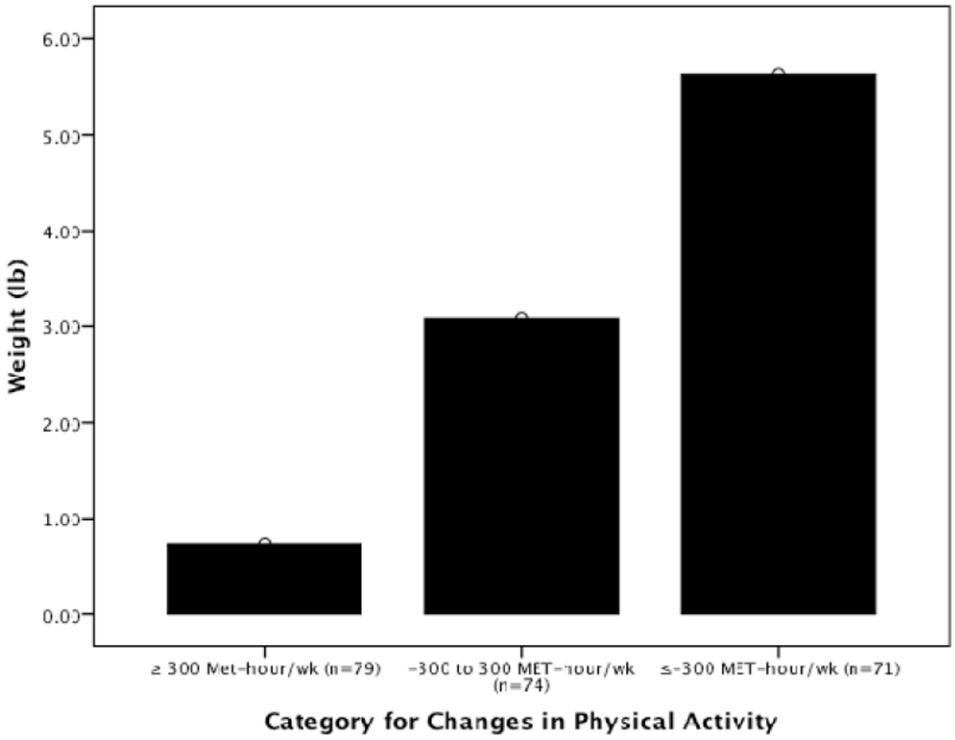

Figure 1.
Mean weight change between initial and 2-year examination according to category of change in physical activity

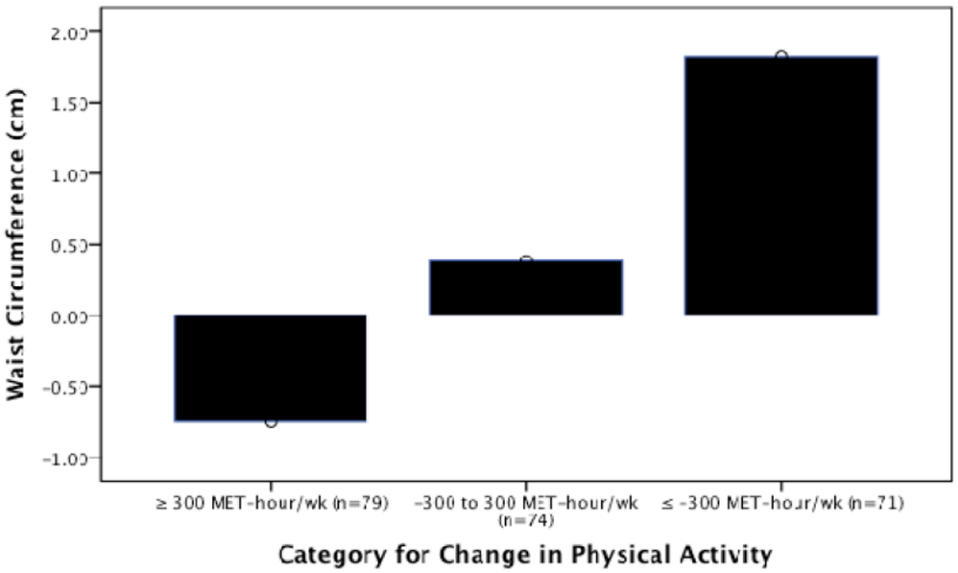

Figure 2.
Mean waist circumference change between initial and 2-year examination according to category of change in physical activity

Table 1

Initial characteristics and changes in body composition and physical activity over a 2-year period (n=232)[†]

Variables	Mean ± S.D. or Frequency (%)			p[‡]
	Initial	2-year	2-year change	
Age (years)	43.42 ± 2.25			
Ethnicity				
African American	57 (24.6%)			
European American	122 (52.6%)			
Mexican/Central American	53 (22.8%)			
Education				
High school or less	20 (8.7%)			
Partial college	68 (29.4%)			
College graduate	67 (29%)			
Graduate degree	76 (32.9%)			
Annual household income				
≤ $30,999	45 (19.7%)			
$31,000 - $60,999	83 (36.2%)			
≥ $61,000	101 (44.1%)			
Marital status				
Married or partnered	136 (58.6%)			
Others	96 (41.4%)			
Physical activity (MET-hour/wk)	1599±1828	1544±1533	-55±1960	0.67
Increased			35% (n=79)	
Between -300 and 300			33% (n=74)	
Decreased ≥ 300			32% (n=71)	
Weight (lb)	160.8±35.9	163.9±37	3±11	<.001
Premenopausal after 2 years	158.86±36.76	161.65±37.74	2.79±10.98	.001
Perimenopausal after 2 years	166.89±32.56	170. 81±34.00	3.92±12.57	<.05
Waist circumference (cm)	82.7±13.9	83.2±14.0	.45±5.38	.21
Premenopausal after 2 years	82.05±14.09	82.51±14.03	.46±5.38	.26
Perimenopausal after 2 years	84.73±13.21	85.14±14.01	.41±5.42	.57

[†]Sample sizes differ for specific variables because of missing values and nonparticipation in the 2-year follow-up.

[‡]*p* value from paired *t* test.