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Correlates of 15-Year Maintenance of Physical Activity in Middle-Aged Women

Imke Janssen, Sheila A. Dugan, Kelly Karavolos, Elizabeth B. Lynch, and Lynda H. Powell

Department of Preventive Medicine, Rush University Medical Center, Chicago, IL 60612, Phone: 312-942-8122, FAX: 312 942 8119, Imke_Janssen@rush.edu

Abstract

Purpose—To gain a better understanding of the correlates of sustained physical activity in midlife women, we used longitudinal epidemiologic data to investigate links between sustained physical activity and constructs advocated by three basic behavioral and social science theories: 1) self-determination; 2) social cognitive; and 3) social networks.

Methods—A random sample of 90 mid-life women, stratified by level of physical activity over 15 years, was selected from the Chicago cohort of the longitudinal Study of Women's Health Across the Nation (SWAN). Using data on self-reported physical activity collected over 15 years, women were categorized into consistently active, sporadically active, and sedentary. New data were collected on theory-relevant constructs, i.e. autonomous motivation (assessed by the Treatment Self-Regulation Questionnaire (TSRQ)) and self-efficacy (assessed by the Self-Efficacy and Exercise Habits Survey). Every SWAN woman identified a close female friend who also completed the physical activity questionnaire.

Results—SWAN women with higher autonomous motivation ($p=0.002$) and higher self-efficacy ($p<0.001$) were more likely to be consistently physically active in analyses adjusted for age, race, and socioeconomic status. Sixty one percent of SWAN women with a history of consistent physical activity had a friend who is currently highly active, versus 34% and 23% for sporadically active and sedentary women, respectively (test for trend $p=0.008$).

Conclusions—In midlife women, constructs advocated by basic behavioral and social science theories were consistent with long-term patterns of physical activity behavior. Special focus should be given to these basic theories in the design of interventions to promote sustained physical activity in midlife women.

Keywords

Physical Activity; Sustained Change; Social Determination Theory; Social Cognitive Theory; Social Network Theory

Introduction

Adults participating in sustained physical activity enjoy many health benefits, including increased longevity, decreased risk of cardio-respiratory and metabolic diseases, some cancers (most notably colon and breast), maintenance of energy balance, and improved musculoskeletal, functional and mental health (1). The menopausal transition has been

associated with changes in the cardio-protective hormonal milieu and with adverse health effects, such as weight gain, especially an increase in visceral adipose tissue (2,3), increased cardiovascular risk factors (4-6), reduced bone density (7), and decline in physical functioning (8). Physical activity attenuates these adverse health effects accompanying the menopausal transition. Weight gain in midlife has been partially attributed to a reduction in energy expenditure (9), whereas physical activity is associated with reduced weight gain (10-12), and in particular with lower levels of visceral adipose tissue in menopausal women (13). Regular physical activity is among the primary determinants of bone mineral density and is a key contributor to overall musculoskeletal health (14). Evidence also suggests that physical activity improves physical function, not only in the elderly (15,16), but also in the middle-aged (17). An increase in physical activity has been related to an improvement in CV risk factor profiles over time (18,19) and in inflammatory markers (20). Sustaining high levels of physical activity protects from development of disability (21). Therefore, it is important to understand factors related to sustained engagement in physical activity.

In the current study, insights into how to promote sustained physical activity were derived from three basic behavioral and social science theories. Self-Determination Theory proposes that individuals are more likely to sustain behaviors that are intrinsically motivated than ones that are externally regulated (22). Intrinsically motivated behaviors (23,24) are those that reflect autonomy of choice and are motivated by an internal locus of causality. Intrinsically motivated behavior is performed for the sake of interest, enjoyment or inherent satisfaction. In contrast, externally regulated behaviors are ones which have an external locus of causality and are performed to satisfy external demands. A number of studies have found that sustained physical activity behavior is associated with autonomous, self-determined motivation rather than controlled motivation (25-28). The longest maintenance period investigated in these studies was 22 months (26). In general, these studies explored short-term adherence to a particular organized activity, such as participating in a competitive sports team or free aerobics course (26-28).

Social Cognitive Theory proposes that a critical driver of sustained behavior is high perceived self-efficacy, or confidence that one has the ability to successfully carry out an action (29). Social Cognitive Theory suggests that sustainability of any behavior requires the progressive development of a resilient sense of self-efficacy to overcome obstacles to performing the behavior. Self-efficacy has been correlated with physical activity in both cross-sectional (30-32) and prospective studies (33-36). In these studies, self-efficacy was associated with maintenance of physical activity for up to 12 months (35). The current study is the first study to examine the relationship between self-efficacy and very long term maintenance of physical activity spanning a 15 year duration.

Social network research suggests that an individual's social network may be an important determinant of sustained behavior (37,38). Moreover, a number of studies indicate that social support and social norms for physical activity determine individual physical activity (37,39). Obesity spreads through social networks (38). However, to our knowledge, no study has explored the extent to which level of physical activity might be "contagious".

As part of an effort to develop an intervention to promote a sustained increase in physical activity, we studied the association between these three constructs from their respective basic behavioral and social science theories and long-term physical activity patterns in midlife women. We capitalized on accessible data from the longitudinal Study of Women's Health Across the Nation (SWAN). The Chicago cohort of SWAN provided six data points obtained over the course of 15 years, from the baseline SWAN visit in 1996 through 2010. This presented the opportunity to examine the relationship between behavioral theory and real life behavior over fifteen years. It is critical to understand longer-term maintenance of PA behavior because it is sustained PA that has the greatest impact on long-term health (11,12). To our knowledge this is the first study to examine the psychosocial correlates of long-term maintenance of physical activity which was measured by multiple assessments over a 15 year period.

We test the hypotheses that women who have been engaging in sustained physical activity have higher autonomous motivation and higher self-efficacy scores than women who are less active, adjusting for demographic factors. We also hypothesize that participants who have been highly physically active are more likely to have friends who are highly physically active.

Methods

Participants were randomly selected from a cohort of 868 women who have been participating in the SWAN study in Chicago since 1996. The design of SWAN has been reported (40). Briefly, it is an ongoing longitudinal study at seven national sites of women transitioning the menopause. By design, Chicago recruited only African American and Caucasian women, all of whom were pre- or early peri-menopausal at the time of entry in 1996. The Chicago SWAN site is twice the size of other SWAN sites and featured a population-based design, which drew on a complete community census and accomplished a 72% participation rate in those that were randomly selected to participate. Locally, the study is known as the "Women on the South Side Health (WISH) Project". Moreover, communities were racially and socio-economically integrated, thus providing design control for the confound between race and socio-economic status.

To be eligible for the current study, a participant had to have at least 2 physical activity assessments over the past 15 years and a visit within the last 4 years. These criteria resulted in 475 women eligible for our current study. Women were stratified by race and education and classified into physical activity groups based on data collected over 15 years. We used a stratified random sampling scheme to insure a distribution as even as possible across race and education. To assess the association between physical activity in the SWAN women and a close, same-sex friend, each SWAN woman identified a female friend to be included in the study. Between June 2010 and January 2011, both the SWAN woman and her friend were queried on current physical activity level. This study is part of the development work taking place in phase 1 of a 3-phase approach to develop an intervention to reduce menopause-related increase in visceral adiposity in midlife women. The study is called Women in the Southside Health Project Fitness Trial (WISHFIT). WISHFIT is part of the Obesity Related Behavioral Intervention Trials (ORBIT) consortium.

Study Measures

Sociodemographics

Age was calculated as the difference between the WISHFIT interview completion date and self-reported date of birth. Race was self-reported as African-American or Caucasian for the SWAN sample and as African-American, Caucasian, or Other for their friends. Income was self-reported as family income in eight categories, starting with less than \$10,000 through \$150,000 or more. Because of small cell sizes, we categorized income as above and below the median for analysis.

Physical Activity

Physical activity (PA) was assessed using an adapted version of the Kaiser Physical Activity Survey (KPAS), a standard questionnaire assessing the frequency of sport/exercise, recreational activities and household/childcare activities (41). It was assessed at the SWAN baseline visit and the third, fifth, sixth, and ninth annual follow-up visits for SWAN women as well as at the WISHFIT baseline visit for SWAN women and their friends. We derived a measure of moderate intensity physical activity using the sports/exercise index of the KPAS in line with recommendations for intensity and duration of physical activity in the 2008 Physical Activity Guidelines for Americans. (<http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html>). At each visit, women were classified into two categories: high PA and low PA using the KPAS sport/exercise index. Women who reported playing sports or exercising more than once a week, for at least 2 hours per week, for more than 9 months per year were classified into the “High PA” group. All other women were classified into the “Low PA” group. We then created a PA Pattern index using the six assessments available since 1996. Women who reported high PA on at least 4 assessments were classified into the “Consistent PA” group. Those who never met the criteria for high PA were classified into the “Sedentary” group. All remaining participants were classified into the “Sporadic PA” group. This group consisted of women who met the criteria for high PA at least once but fewer than 4 times.

Motivation for PA

We assessed motivation for PA using the Treatment Self-Regulation Questionnaire (TSRQ) (24). The TSRQ assesses the degree to which one’s motivation for starting or continuing physical activity is autonomous or controlled. The questionnaire assesses 3 constructs (autonomous regulation, controlled regulation, and amotivation) and consists of 15 questions with possible responses ranging from 1 (not at all true) to 7 (very true). Six out of 15 questions assess autonomous regulation. We chose to refer to this construct as autonomous motivation to emphasize its nature of internal perceived locus of causality and autonomous regulation (22). The Autonomous Motivation variable was formed by averaging responses to these 6 questions, e.g., “Because I have carefully thought about it and I believe it is very important for many aspects of my life” and “Because it is an important choice I really want to make.” The TSRQ has been widely used and is well validated across various settings and for different health behaviors, including PA(27,42-45).

Self-efficacy

Self-efficacy was assessed with the Self-Efficacy and Exercise Habits Survey (46). This scale assesses how confident people are in being able to motivate themselves to consistently engage in physical activity and do so for a period of at least 6 months. The scale consists of 12 items, scored on a 6-point scale and then averaged across items (range=1-6). The scale has excellent internal consistency and test-retest reliability (internal consistency $\alpha = 0.83-0.85$, and test-retest reliability = 0.68) (46), and has been used extensively in numerous research settings (36,47-49).

Statistical Analysis

For SWAN women, we used descriptive statistics to characterize participants on age, race, education, income, current PA, The PA Pattern index, autonomous motivation, and self-efficacy. Age, autonomous motivation, and self-efficacy were continuous variables. Because of the skewness of autonomous motivation and self-efficacy, we report median and quartiles. We assessed the associations of autonomous motivation and self-efficacy with the PA Pattern index adjusting for basic demographic factors, i.e. age, race, and income using cumulative logit models. We chose cumulative logit models due to the nature of the PA Pattern index, which consists of 3 ordered categories. This model uses a generalized logistic regression approach. Parameters quantifying the association may be interpreted as multiplicative increases in the odds of being in each higher class of PA (i.e. exhibiting a more consistent pattern of physical activity). The proportional odds assumption, as tested by the score test, held true. To assess the relative independence of the two predictors, they were standardized and then entered into the same model.

For WISH friends, we used descriptive statistics to characterize participants on age, race, income, and current PA. To evaluate the hypothesis that consistently active women are likely to have highly active friends, we used the Cochran-Armitage test for trend.

All analyses were conducted using PC-SAS (SAS Institute Inc., Cary, North Carolina), version 9.2.

Results

Table 1 shows the characteristics of the cohort separately for SWAN women and their friends. On average, SWAN women were 59 years old (range 54-64), 43% were African American, and 40% had a family income below the median of \$75,000. At the time of the most recent PA assessment (current PA), 43% of the SWAN women were currently highly physically active and 57% were not. The PA Pattern index had a slightly different distribution. Sporadically active women formed the largest group (44%). The other women were equally divided into consistently active and sedentary (28% each). Autonomous motivation was high with a median of 6.5 (observed range: 2-7). The median self-efficacy score was 4.0 (observed range: 2.3-5.0).

On average, SWAN friends were 56 years old (range 26-70 years), 42% were not Caucasian, and 42% had a family income below the median of \$75,000. Of the friends, 40% were

highly physically active, and 60% were not. The friends were about 3 years younger than SWAN women, and the age range was wider. The distribution of race and family income was similar in the two groups.

Table 2 shows the results of three cumulative logit regression models – model 1 with autonomous motivation as the main predictor, model 2 with self-efficacy, and model 3 with both. Each one point higher autonomous motivation almost doubled the odds ($OR=1.87$) that a woman was in a higher PA Pattern group, and each one point higher self-efficacy almost quadrupled the odds that a woman was in a higher PA Pattern group ($OR=3.80$). Figure 1a illustrates the relationship between autonomous motivation and the PA Pattern index. At the lowest level of autonomous motivation, almost 80% of the women were in the sedentary group, and less than 5% were in the consistently active category. There was a graded relationship between autonomous motivation and level of PA. At the highest level of autonomous motivation, there were 20% sedentary, about 45% sporadically active, and 35% consistently active women. Figure 1b illustrates the relationship between self-efficacy and PA Pattern. At the lowest level of self-efficacy, almost 80% of the women were in the sedentary group, and less than 5% were in the consistently active category. At the median of 4 on the self-efficacy scale, the percentages in the groups were: 20% sedentary, 50% sporadically active, and 30% were consistently active. At the highest level of self-efficacy, almost 60% of the women were consistently active. Model 3 in Table 2 shows that when both predictors were in the same model to assess the relative independence, relationships were attenuated but remained highly significant, indicating that autonomous motivation and self-efficacy were independent predictors of sustained physical activity. Of the demographic covariates, only income was significant with odds ranging from 3.14 to 3.90. Women with income at or above the median were more than 3 times more likely to belong in a higher PA Pattern group.

Table 3 compares the 15-year PA Pattern of SWAN women with current physical activity level of their friends. It shows that 61% of SWAN women with a history of consistent physical activity had a close friend who was currently highly physically active; in contrast, only 34% of sporadically active and 23% of sedentary women had a close friend who was highly physically active (statistical significant trend, $p=0.008$).

Discussion

For the purpose of identifying basic behavioral and social science constructs that could be targets of an intervention that would be successful in bringing about sustained physical activity in midlife women, we sought to explore the relationship between measures of motivation derived from theories that address sustained behavior and 15-year patterns of leisure-time physical activity.

Our findings largely supported our hypotheses. Women with higher autonomous motivation and higher self-efficacy were more likely to be consistently physically active than others. This association was independent of age, race, and income and was stronger for self-efficacy than for autonomous motivation. Both autonomous motivation and self-efficacy contributed

independently to physical activity pattern and were independent of the strong association observed for income.

In light of social network studies that demonstrated that obesity and smoking, among other behaviors, are transmitted via social groups (38,50), we hypothesized that consistently active women would be more likely than less active women to have a friend who is also physically active. Our analyses confirmed this hypothesis, showing that the friends of consistently active women were much more likely to be highly active than friends of women who were not consistently active. This is consistent with findings that obesity, a consequence of a sedentary lifestyle, travels through social networks (38). Perhaps one reason that obesity is “contagious” is because friends tend to motivate each other to be physically active.

To our knowledge, the current study is the first to explore motivational factors that are associated with long-term patterns of physical activity. A limitation is that we cannot draw conclusions about the causal relationship between the motivational factors and physical activity behavior because we were only able to measure the motivational variables at a single time point. Thus, our findings relate current level of motivation to past patterns of physical activity. It may be that higher levels of self-efficacy and autonomous motivation and physically active friends cause some women to sustain high levels of PA over time, or that high levels of PA over time increase self-efficacy and autonomous motivation, and the likelihood of having friends who are also physically active. Although we cannot distinguish the temporal patterns, our purpose was to look for an association as a way to determine whether or not to trust the particular theory. Since we found the hypothesized associations, the theories are likely to be helpful in the design of the intervention.

Other limitations of the study include the reliance upon self-reported physical activity rather than an objective measurement of energy expenditure. We were able to assess the physical activity of only a single friend, rather than sampling a larger portion of the social network. Participants might have selected those friends who matched them on physical activity, thereby creating a biased sample of friends. In an attempt to minimize this bias, participants were recruited for a “study of menopause” rather than a “study of physical activity”.

The strength of this study is that it was able to identify long-term patterns of physical activity and link them to theory-derived psychological and social constructs believed to be associated with sustained behavior. Although a number of studies suggest that interventions which increase autonomous motivation and self-efficacy result in increased physical activity initiation, there have been no investigations of the relation between these factors and patterns of physical activity over longer periods of time (51-57). In this study, autonomous motivation and self efficacy were independent predictors of sustained physical activity. They were independent of each other and independent of the strong contribution of socio-economic status (SES). This means that we need to promote both self-efficacy and autonomous motivation. Together, they might override the powerful effect of lower SES.

Since the factors important for initiation are likely to differ from the factors influencing maintenance of behaviors (58), the analyses presented in this report advance our understanding only of how these constructs correlate with sustained physical activity.

However, since the challenge is less with the initiation of physical activity than it is with sustaining this behavior, these findings deserve attention.

The implications for the development of a physical activity intervention that can promote sustained change are linked to the recommended approaches to promoting sustained change advocated by the respective theories. Social Cognitive Theory suggests that promotion of self-efficacy within a domain of behavior is enhanced by exposure to modeling from coping peers, repetition, and the provision of repeated, objective feedback (29). Self-Determination Theory adds to this by underscoring the value of autonomy of choice among alternatives (22). Social Network Theory suggests that interventions would have a greater likelihood of being sustained if they focused not just on the individual but also on their social network (38). Given the support for the three theories provided by this study, we will, and others might, consider featuring these approaches in the design of interventions aimed at producing sustained change.

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Abbreviations

KPAS	Kaiser Physical Activity Survey
METs	metabolic equivalents
ORBIT	Obesity Related Behavioral Intervention Trials
PA	Physical activity

SWAN	Study of Women Across the Nation
TSRQ	Treatment Self-Regulation Questionnaire
WISH	Women in the Southside Health Project
WISHFIT	Women in the Southside Health Project Fitness Trial

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Figure 1.
Autonomous Motivation (a) and Self-Efficacy (b) as Predictors of Sustained Physical Activity

Table 1

Participant characteristics

	SWAN Women	Friends
N	89	81
Age, years (mean±SD)	59±3	56±9
Minority [†] , n (%)	38 (43)	34 (42)
Income < \$ 75,000, n (%)	36 (40)	30 (42)
Current Physical Activity, n (%)		
Low physical activity	51 (57)	49 (60)
High physical activity	38 (43)	32 (40)
Physical Activity Pattern, n (%)		
Sedentary	25 (28)	-
Sporadic Physical Activity	39 (44)	-
Consistent Physical Activity	25 (28)	-
Autonomous Motivation, median (25 th –75 th percentile)	6.5 (5.5–7.0)	
Self-efficacy, median (25 th –75 th percentile)	4.0 (3.3–4.4)	

[†] All SWAN women were either African American and Caucasian; friends included 4 “other” (1 American Indian, 3 mixed race).

Table 2

Autonomous Motivation and Self-Efficacy in SWAN Women as Predictors of Physical Activity Levels, with Adjustment for Demographic Factors

		Odd Ratio (95% CI)
Model 1	Age	1.00 (0.87,1.16)
	Race (African–American)	0.89 (0.39,2.06)
	Income > Median	3.28 (1.35,7.96)
	Autonomous Motivation	1.87 (1.25,2.82)
Model 2	Age	1.01 (0.87,1.17)
	Race (African–American)	0.92 (0.39,2.15)
	Income > Median	3.14 (1.29,7.63)
	Self-Efficacy	3.80 (2.02,7.12)
Model 3	Age	1.02 (0.88,1.18)
	Race (African–American)	0.90 (0.38,2.14)
	Income > Median	3.90 (1.54,9.84)
	Autonomous Motivation ^a	1.79 (1.13,2.82)
	Self-Efficacy ^a	2.49 (1.55,4.01)

^a standardized predictor

Table 3

15-Year Pattern of Physical Activity of SWAN Women and Current Physical Activity of Their Friends

SWAN women, n (%)	SWAN friends, n (%)	
	Low Physical Activity	High Physical Activity
Sedentary	17 (77)	5 (23)
Sporadic Physical Activity	23 (66)	12 (34)
Consistent Physical Activity	9 (39)	14 (61)