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When, why and for whom there is a relationship between physical activity and menopause symptoms

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Abstract

Objectives: The relationship between enhanced physical activity and decreased menopause symptoms is equivocal. In this study we sought to better understand this relationship by examining the association of physical activity to different symptom domains and by examining mediating and moderating variables.

Study Design: Women participating in a randomized control trial on physical activity were given a menopause symptom measure (MENQOL) at follow-up. Of the 280 women participating, 113 (mean age=52) reported having symptoms they attributed to menopause. Regression analyses were run to examine if change in physical activity predicted fewer symptoms. Exercise self-efficacy was examined as a mediator and depressive symptoms as a moderator.

Results: An increase in physical activity from baseline was found to be related to reporting fewer total menopause symptoms (β= -0.22, p=.02). When the total menopause symptoms score was examined by domain, increased physical activity was found to be related to reporting fewer general symptoms attributed to menopause (psychosocial (β= -0.18, p=.05) and physical (β= -0.23, p=.01)), but had no effect on specific symptoms of menopause (vasomotor and sexual). Exercise self-efficacy was found to mediate the relationship between increased physical activity and total, physical and psychosocial menopause symptoms. Finally, for individuals with high depressive symptoms, those who increased physical activity the most reported fewer sexual symptoms of menopause.

Conclusion: This study suggests that physical activity participation is associated with lower general symptom reporting as opposed to specifically impacting menopause symptoms. Further exercise self-efficacy mediates the relationship between physical activity and general menopause symptoms, suggesting a psychological pathway.

Despite recent interest in understanding the effect of physical activity on menopause symptoms, the evidence is still equivocal [1]. Physical activity has been found to improve health for menopausal women [2-4] and is linked to improvements in symptom reporting for other health conditions [5, 6]. To date, most of the evidence on the association of physical activity and menopause related symptoms has been correlational, with mixed results. Whereas some studies have found an association between physical activity and reduced symptom reporting [7-10], some have not [11-14], and others have found mixed result depending upon the type of symptoms [2, 15-18]. Three recent randomized control trials have continued to find inconsistent results [19-21]. A systematic review of vasomotor symptoms and exercise concluded that there is currently not enough data to determine if exercise is effective at reducing vasomotor symptoms [22].

The lack of consistent findings of the effects of physical activity on symptom reporting is likely a result of the complexity of menopause symptoms, a lack of research regarding any potential underlying mechanisms or interpersonal factors, and few rigorous studies. Menopause symptoms are varied, and include sexual and vasomotor symptoms, which are “specific” to menopause and are directly linked to the physiological changes of menopause [23]. They also include “general” symptoms, including physical and psychosocial symptoms, that have a less consistent relationship to menopause status and may be influenced by a variety of physical and psychological conditions, like aging [24-26]. Regardless, middle-aged women continue to attribute psychosocial and physical symptoms to menopause [27] and seek treatment for these symptoms [28].

Physical activity may have a greater impact on general symptom reporting as opposed to specific symptoms of menopause. There are preliminary data to support this conclusion [2, 16, 18]. For example, Kemmler et al. [2] found that physical activity was correlated with decreases in insomnia and mood symptoms, but not hot flashes nor migraines. Mirzaiinjmabadi, Anderson and Barnes [16] found that physical activity was related to psychological and somatic symptoms, but not vasomotor nor sexual symptoms.

If physical activity impacts general symptom reporting, one mechanism through which it may work is self-efficacy. Exercise self-efficacy, or the belief in one's ability to participate in physical activity, has consistently been found to be a powerful predictor and mediator of behavioral and psychological outcomes [10, 29]. If exercise self-efficacy mediates this relationship, it would suggest a benefit on menopause symptoms even if women are not willing or able to increase physical activity to recommended levels. To our knowledge, no study has explored self-efficacy as a mechanism for improving menopause symptoms. The impact of physical activity on menopause symptoms may also vary depending upon interpersonal variables, such as mood. Thurston, Joeffe, Soares and Harlow [30], found that physical activity was only related to reporting fewer menopause symptoms for individuals with a history of depression.

The current study examined the relationship between change in physical activity and symptoms attributed to menopause among women participating in a physical activity intervention. A better understanding of how, for whom and which menopause symptoms physical activity may improve will elucidate inconsistencies in the literature and improve clinical care. Recent estimates have reported that as many as 76% of women use alternative and complimentary treatments for menopause symptoms [31]. Without complete information as to what to expect, women may become disillusioned with using physical activity to improve their menopause symptoms, and drop out of this time intensive treatment.

Method

1.1 Participants

Participants were sedentary women recruited from the community through signs at grocery stores, print media, and radio advertisements (see Napolitano et al. [32]). Women who participated in less than 90 minutes of intentional moderate-intensity physical activity per week or less than 60 minutes of vigorous intensity physical activity per week were eligible. Women with medical problems that could be exacerbated by physical activity were excluded from the study (e.g. asthma, cardiovascular

disease). The goal of the parent study was to compare two print based physical activity interventions against a contact control treatment. Of the 660 women initially screened, 369 met eligibility and 280 were randomized, 113 of these reported having menopause symptoms at the month 12 timepoint.

1.2 Procedure

Participants were randomized to one of three groups. The Jumpstart group (n=95) was designed to address participants' stage and processes of change, self-efficacy and decisional balance through a tailored intervention [32-34]. Participants completed a written questionnaire which was processed through a computer expert system [33, 34]. Participants then received a tailored feedback report and educational brochure matched to their stage of change at 1, 3, and 6 months. The Choose to Move group (n=93) received a booklet, designed by the American Heart Association, which is a 12 week self-managed program designed to increase physical activity using strategies based on Social Cognitive Theory and the Transtheoretical Model [32]. Participants received one mailing which detailed the program. The contact control group (n=92) was a Wellness group that received one mailing of health related print materials including information on sleep and nutrition. Individuals in all groups were assessed at baseline, month 3 and month 12. This study was conducted in accordance to ethical guidelines, and Institutional Review Board approval was received prior to the start of the study.

The primary study outcome data have been previously described and will be briefly reviewed here [32]. There were no significant differences in the baseline characteristics between the 3 arms of the trial. At month 3, individuals in the Jumpstart arm increased physical activity significantly more than individuals in either the Choose to Move or Wellness arm. At month 12, all groups had significantly increased their physical activity and there were no significant differences between the groups.

1.3 Measures

Menopause Specific Quality of Life Questionnaire (MENQOL) [35, 36]. The primary outcome measure, MENQOL, has been used in both cross-sectional and intervention research and been found to be a reliable and valid measure of menopause quality of life [35, 36]. The MENQOL asks participants "For each of the following items, indicate whether you have experienced the problem in the past month.

If you have, rate how much you have been bothered by the problem." For the purposes of this study, we operationalized these problems to be equivalent to symptoms related to menopause. To achieve this, participants were told the goal of the measure was to assess the impact of the physical activity on menopause symptoms and asked if they had menopause symptoms. The questions of the MENQOL are very similar to other measures used to assess menopause symptoms [19, 37].

The MENQOL was given at month 12, and provides an overall "total" measure and 4 domains: vasomotor, physical, sexual, and psychological (see Table 1). The original reliability and validity study found adequate reliability and construct validity for 3 of the 4 domains. More recent examinations of the scale found adequate test-retest reliability (.69-.81) and internal consistency (.82-.89) for all domains. The domain scores are calculated by taking the mean of the symptoms within the domain, after converting the scores according to an algorithm. The converted scores are on a scale from 1-8, where 1 is no symptoms, 2 is having the symptom but not bothered by it, to 8 which is having the symptom and extremely bothered by it. The total measure is the mean of the four domain scores. Psychosocial and physical symptom domains were considered "general" symptoms; while sexual and vasomotor were considered menopause specific.

7-Day Physical Activity Recall (PAR) [38, 39]. The primary independent variable was the PAR. The PAR has been found to have adequate reliability and validity [38, 39]. It was administered by an interviewer who was blind to the participant's group assignment. The PAR was used to collect data on minutes of physical activity that was at least moderate intensity in a 7 day period. For this analysis, minutes at month 12 was subtracted from minutes at baseline to obtain change in physical activity.

Center for Epidemiological Study Depression Scale (CESD) [40]. The CESD is an often used measure of depressive symptoms with established reliability, validity and internal consistency. The cut off score of 16 is generally used to delineate individuals with significant depressive symptoms. For the purposes of this study, the measure was dichotomized at the established cut-off of 16, in order to compare individuals with significant depression from individuals without. Baseline depressive symptoms were examined as a moderator of the relationship of physical activity and menopause symptoms.

Exercise Self-Efficacy. Exercise self-efficacy, or belief that one can participate in physical activity program, was assessed with 5 questions [41]. This measure has demonstrated adequate test-retest reliability and internal consistency. Participants are asked to rate their confidence in their ability to exercise in 5 situations including when they are (1) tired, (2) in a bad mood, (3) don't have time, (4) on vacation, (5) in the rain or snow. For these analyses exercise self-efficacy assessed at month 12 was used.

Stress. Stress was assessed at baseline with the Perceived Stress Scale (PSS) [42]. This scale is 14 questions and has been found to have adequate reliability and validity [43]. Baseline stress was included as a control variable as stress has been shown to cause increases in symptom reporting.

Menopause. Women were asked if they were taking any measures to help relieve their symptoms, and if yes to describe.

1.5 Statistical Analyses

Data were analyzed with SPSS 12.0.1 for Windows. Missing values were implemented with the last-value-carried-forward. The MENQOL was given at Month 12 and was missing in some of the questionnaire packets. As a result 31 individuals did not fill out the MENQOL and their data are not included in these analyses. Independent sample T-tests and Chi-square tests were computed to compare baseline variables for individuals who reported menopause symptoms as compared to those who did not.

The primary analyses were separate regression analyses conducted for the total MENQOL and each of the four domains to determine the effect of physical activity change on MENQOL. Age, baseline stress and BMI at month 12 were entered as controls in all regression analyses. The latter 2 variables were included because BMI has been found to be related to menopause symptoms, and stress has been shown to cause increases in symptom reporting [44].

Next exercise self-efficacy was tested as a mediator of the relationship between physical activity and MENQOL. Based on Baron and Kenny [45] we conducted a four step test of mediation. In the first step, the independent variable was regressed on the dependent variable. In the second step, the

independent variable was regressed on the mediator variable. In the third step, the mediator was regressed on the dependent variable controlling for the independent variable. In the fourth, the relationship of the dependent variable to the independent variable controlling for the mediator is examined. If the relationship of the dependent variable to the independent variable is no longer significant there was complete mediation. The Sobel test [46] was used to examine the indirect effects to determine significance. The indirect effect is a test of the reduction in the effect of the independent variable on the dependent variable after including the mediator [47].

Finally, hierarchical regression analyses were conducted to determine the interaction of depressive symptoms at baseline on the total menopause symptoms and each of the 4 domains. Follow up analyses of significant interactions were run following procedures by Aiken & West [48] and Dawson & Richter [49], control variables were standardized for the post-hoc analyses.

To ensure the stability of our findings, we ran additional analyses. Our original hypotheses were that change in physical activity from baseline to month 12 would predict general menopause symptoms. We also ran the primary regression analyses with physical activity at month 12 as an independent variable, controlling for physical activity at month 1. This analysis is essentially a mediation analysis. Since the pattern of results was the same we reported the analyses consistent with our original hypotheses. The variables were also examined for normality. Change in physical activity and sexual symptoms were skewed. Using the total data set, change in physical activity was transformed with a square root transformation and sexual symptoms with a log10 transformation. The primary regression analyses were run again using the transformed data and the pattern of results was the same. In order to conserve interpretability of the scores, we reported the non-transformed data.

Results

2.1 Participant Characteristics

When comparing the women in terms of symptoms reported, those who reported experiencing symptoms were significantly older. No other group differences were found (see Table 2). We examined

additional potential confounds of our analyses including smoking, marital status and hormone replacement therapy use. Of the women experiencing menopause symptoms, 4 reported currently smoking, and 42 women reported smoking ever. Sixty-one women reported using some measure to relieve their symptoms, with 11 of these women reported using hormone replacement therapy and/or a medication that is used for hormone replacement therapy. Finally, 8 women reported being married, with the remaining reporting being divorced (n=74), single (n=10), widowed (n=12) or separated (n=8). When examined with independent T tests, women using hormone replacement therapy, women who smoked or women who ever smoked did not report significantly more total menopause symptoms or significant differences in their change of physical activity. Women who were married did not report significant differences in sexual symptoms, total symptoms or change in physical activity. As a result, none of these variables were included in the remaining models.

2.2 Regression Analyses

Separate regression analyses were conducted for total symptoms and each of the symptom domains, age, stress and BMI were entered as control variables (see Table 3). The first model tested the relationship between total menopause symptoms and change in physical activity $F(4,105) = 3.6$, $p<.01$. Change in physical activity was found to predict total symptoms $\beta= -0.22$, ($p=.02$). Next, the relationship between change in physical activity and psychosocial symptoms was examined $F(4, 105)= 6.74$, $p<.01$. Change in physical activity was found to predict psychosocial symptoms $\beta= -0.18$, ($p=.05$). The third model predicted physical symptoms attributed to menopause $F(4, 105)= 4.42$, $p<.01$. Change in physical activity was found to predict the physical symptoms $\beta= -0.23$, ($p=.01$). Change in physical activity was not related to sexual nor vasomotor symptoms.

2.3 Mediation Analyses

In order to examine mediation, we completed four steps following Baron and Kenny [45]. The first, we examined the relationship between change in physical activity and symptoms. The first set of regression analyses provided evidence of a relationship for total symptoms, psychosocial and physical symptoms (see above).

In the second step, the independent variable (change in physical activity) was regressed on the mediator variable (exercise self-efficacy), controlling for age, BMI and stress $F(4, 104) = 5.4$, $p<.01$. Change in physical activity was significantly related to exercise self-efficacy $\beta= 0.30$, ($p<.01$).

In the third and fourth step, we examined the relationship between exercise self-efficacy and symptoms controlling for change in physical activity (see Table 4). If the relationship between change in physical activity and symptoms is no longer significant, it is considered complete mediation. Exercise self-efficacy completely mediated the relationship between change in physical activity and total symptoms $\beta= -0.13$, ($p=.16$.), psychosocial symptoms $\beta= -0.12$, ($p=.19$) and physical symptoms $\beta= -0.16$, ($p=.09$). Finally, Sobel Tests [46] were conducted to determine if there was a significant indirect effect. We found a significant indirect effect for total symptoms ($z=-2.6$, $p=.01$), physical symptoms ($z=-2.5$, $p=0.1$) and psychosocial symptoms ($z=-2.3$, $p=.02$).

2.4 Moderation Analyses

Moderation was examined through hierarchical regression analyses. In the first step age, BMI, stress, change in physical activity and baseline depressive symptoms were entered. In the second step, the interaction of change in physical activity and baseline depressive symptoms were entered. The interaction was not significant for total symptoms, physical symptoms, psychosocial symptoms or vasomotor symptoms. The interaction was significant for sexual symptoms ($F(6,103)=2.55$, $p=.02$ and $\Delta R^2=.05$, $\beta= -0.28$, ($p=.02$)). Following Aiken & West [48] and Dawson & Richter [49] recommendations follow up analyses were conducted to determine the direction of the relationship (see Figure 1). As the graph indicates, individuals who had high increases in physical activity and had high depressive symptoms at baseline were less likely to report sexual symptoms as compared to individuals with high depressive symptoms at baseline who reported low or no increases in physical activity.

3.1 Discussion

This study examined the relationship between physical activity and symptoms attributed to menopause in a randomized controlled physical activity trial. Change in physical activity was found to predict total menopause symptoms. We hypothesized that change in physical activity would be more highly related to general or non-specific symptoms attributed to menopause as opposed to specific menopause symptoms. Regression analyses confirmed these hypotheses. Increase in physical activity was related to fewer physical and psychosocial symptoms attributed to menopause but there was not a main effect of increased physical activity on vasomotor or sexual symptoms.

These results are consistent with Slaven and Lee's [18] cross-sectional study which found that physical activity was correlated with psychological and physical menopause symptoms, but not with hot flashes. The results of our study provide some explanation for the inconsistencies in the literature, and suggest that increasing physical activity helps to reduce general symptom reporting, as opposed to having a specialized impact on menopause specific symptoms.

Interestingly, when asked, women appeared to intuitively understand that physical activity may have a greater relationship with general symptoms and well-being. At the end of the MENQOL questionnaire, participants were asked if they thought physical activity helps relieve symptoms of menopause, and if yes to describe. In order to keep the results concise, we did not include the qualitative description within the results, but briefly included them here to provide context. These qualitative results were coded by two authors (NF and LM). Most participants (74%) reported that "Yes", they felt physical activity improved menopause symptoms. Of the 73 participants who provided a qualitative response, physical activity was believed to positively impact physical (n=31), and psychosocial (n=26) symptoms of menopause. Only 3 women reported that physical activity would improve hot flashes and none described it impacting sexual symptoms. Women also reported physical activity increasing general well-being (n=18) and helping them to better deal with their menopause symptoms (n=10). As one women described "It [physical activity] definitely promotes a feeling of wellness and decreases anxiety - it elevates the mood!"

The second set of analyses examined exercise self-efficacy as a mediator of the relationship between change in physical activity and menopause symptoms. We anticipated that the relationship between increased physical activity and menopause symptoms would be primarily through a psychological pathway as opposed to predominately physiological pathway. As was expected, exercise self-efficacy mediated the relationship between change in physical activity and menopause symptoms. That is, the women's belief in their ability to participate in physical activity accounted for the relationship between change in physical activity and total, psychosocial and physical symptoms attributed to menopause. Previous research has shown that self-efficacy mediates the relationship between physical activity and quality of life in a sample of elderly men and women. Elavsky et al., propose that quality of life is improved when physical activity impacts the individuals "cognitive appraisal of their abilities [10]." Our findings suggest that exercise self-efficacy may also improve quality of life through a reduction in physical and psychological symptoms.

The finding that exercise self-efficacy mediates the relationship between physical activity and menopause symptoms is important for two reasons. While other studies have shown that exercise self-efficacy leads to improvements in general well-being, this is the first to explore this effect for symptoms attributed to menopause. Second, this finding has implications for the dose and type of exercise necessary to improve symptoms attributed to menopause. It suggests that for women unable to increase their physical activity to a recommended level, activities that improve their exercise self-efficacy may still lead to significant improvements in psychological and physical symptoms attributed to menopause.

The final analyses explored baseline depressive symptoms as a moderator of the relationship between change in physical activity and menopause symptoms. Baseline depressive symptoms were found to moderate the relationship of physical activity and sexual menopause symptoms such that women who had significant depressive symptoms at baseline and increased their physical activity reported fewer sexual symptoms. This is consistent with Thurston, Joffe, Soares, and Harlow [30], who found that a prior history of depression moderated the relationship between physical activity and

vasomotor menopause symptoms. It is unclear why baseline depressive symptoms only moderated sexual symptoms in this study. It may because only 15% of the women with menopause symptoms had significant baseline depressive symptoms.

Although this study provides evidence of one possible psychological pathway in the relationship between physical activity and menopause symptom reporting, this study was not designed to eliminate the possibility of a physiological component. Future studies should directly examine the impact of physical activity on hormonal changes and examine both self-report and objective measures of hot flashes. In addition to limitations inherent in homogeneous populations (see Napolitano [32]), this study was limited by only measuring menopause symptoms at month 12 and lack of data on menopause status. Because of these limitations, the results must be interpreted with caution. It is possible that if the women were not menopausal, or experiencing symptoms at baseline this could lead to false negative findings. We are encouraged by the fact that symptoms which were statistically significant in analyses (physical and psychosocial), were reported at similar rates as symptoms which were not statistically significant in analyses (sexual and vasomotor). While this doesn't guarantee similar rates at baseline, it is suggestive that these results are not simply an artifact of frequency of symptom reporting. In addition, previous studies have not found differences in the effect of physical activity on menopause symptoms across the menopause transition [16, 18]. Future studies should explore the effect of menopause status on the relationship of physical activity and symptoms attributed to menopause.

Strengths of this study include examining the effects of change in physical activity on menopause symptoms within a physical activity intervention. The current investigation set out to test hypotheses regarding when and for whom increasing physical activity may be effective in reducing menopause symptoms. Without a careful examination of these factors, findings in the literature may seem inconsistent and confusing. Clinically, practitioners and patients may become discouraged when the physical activity has an effect different than what might be expected. It is important to note that our finding that physical activity primarily impacts general symptoms should not lessen its importance. General symptoms are often the cause of prescribing pharmaceutical treatments for menopause, one

study found that 39% of women reported depression or irritability as a reason for starting hormone replacement therapy [28].

3.2 Conclusion

In conclusion, physical activity was found to be related to fewer physical symptoms, and fewer psychosocial symptoms. Also, of interest, exercise self-efficacy mediated the relationship between physical activity and reporting of menopause symptoms. Finally, there was an interaction between mood and physical activity. For individuals with high baseline depressive symptoms, increasing physical activity the most is associated with reporting fewer sexual symptoms. These results together point towards the importance of further understanding the relationship between mood, psychosocial attributions, physical activity and the experience of menopause symptoms. By better understanding these relationships, interventions can be designed to help women with their quality of life during the menopausal period.

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Table 1: Symptoms Assessed for each of the 4 MENQOL Domains.

Sexual	Change in your sexual desire; Vaginal dryness during intercourse; Avoiding intimacy
Physical	Flatulence (wind) or gas pain; Aching in muscles and joints; Feeling tired or worn out; Difficulty sleeping; Aches in back of neck or head; Decrease in physical strength; Decrease in stamina; Feeling a lack of energy; Drying skin; Weight gain; Increased facial hair; Changes in the appearance, texture, or tone of your skin; Feeling bloated; Low backache; Frequent urination; Involuntary urination when laughing or coughing.
Psychosocial	Feeling anxious or nervous; Experiencing poor memory; Accomplishing less than I used to; Being dissatisfied with my personal life; Feeling depressed, down or blue; Being impatient with other people; Feelings of wanting to be alone.
Vasomotor	Hot Flushes or Flashes; Night Sweats; Sweating.

Table 2: Participant Characteristics.

Variable	No Menopause Sx (n=136) Mean or Percent (SD)	Reported Menopause Sx. (n=113) Mean or Percent (SD)	P-value
Age	44.2 (12.1)	52.1 (6.2)	<.01
Race and Ethnicity			
Caucasian	95.6 %	96.5 %	NS
Hispanic or Portuguese	31.6 %	21.4 %	NS
Education			
High School or less	14.0 %	15.2 %	NS
Trade/Some College	28.7 %	31.3 %	NS
College	37.5 %	27.7 %	NS
Post-graduate	19.9 %	25.9 %	NS
BMI Month 12	28.1 (5.5)	28.7 (4.9)	NS
Significant Depressive Symptoms at Baseline (>16)	16.2 %	15.2 %	NS
Change in PA	77.5 (168.8)*	80 (182.5)*	NS
MENQOL domains			
Psychosocial	NA	3.4 (1.6)	NA
Physical	NA	3.8 (1.5)	NA
Vasomotor	NA	3.4 (2.0)	NA
Sexual	NA	3.2 (2.1)	NA
Total	NA	3.4 (1.2)	NA

NS=Not Significant, NA=Not Applicable, Sx=Symptoms, BMI=Body Mass Index, PA= Physical Activity, *=Reported as median with (interquartile range).

Table 3: Increased Physical Activity Is Related To Lower Reporting Of Physical and Psychosocial Symptoms Attributed to Menopause.

	Total Sx			*Psychosocial*			*Physical*		
	β	t	p	β	t	p	β	t	p
Age	.06	.64	.53	-.07	-.73	.47	.06	.60	.55
BMI	.10	1.1	.29	.07	.75	.46	.16	1.8	.08
Stress	.24	2.6	.01	.39	4.4	<.01	.23	2.5	.01
Δ PA	-.22	-2.4	.02	-.18	-2.0	.05	-.23	-2.6	.01

BMI=Body Mass Index, Δ PA=Change in Physical Activity

Table 4: Physical Activity Self-Efficacy Mediates the Relationship between PA and Symptoms Attributed to Menopause.

		Total Sx				*Psychosocial*				*Physcial*			
Step 2		β	t	p	ΔR^2	β	t	p	ΔR^2	β	t	p	ΔR^2
	Δ PA	-.13	-1.4	.16	.07	-.12	-1.3	.19	.03	-.16	-1.74	.09	.06
	ESE	-.28	-2.9	<.01		-.19	-2.0	.05		-.27	-2.85	<.01	

Δ PA=Change in Physical Activity, ESE=Exercise Self-Efficacy

Figure 1: Graph of the Interaction of Physical Activity and Depression Predicting Sexual Symptoms.