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The Relationship Between Physical Activity and Depressive Symptoms in Healthy Older Women

Virginia Overdorf, EdD[1], Betty Kollia, PhD[1], Katherine Makarec, PhD[1], and Cassandra Alleva Szeles, BS[2]

Abstract

Objective: Depression and inactivity in the elderly are major health problems with significant ramifications for healthy aging. Research shows an inverse relationship between depression and physical activity levels. The purpose of the current investigation is to examine the relationship between physical activity and depressive symptoms in healthy older women, first within the framework of exercise programs, and second via the impact of an intervention. **Method:** Two experiments were conducted. In the first, 65 women, all above the age of 60, participated. Measures of physical activity were gained by self-report using the International Physical Activity Questionnaire while the measure of depressive symptomatology was the Beck Depression Inventory. In the second, 11 women participated in a line dancing intervention, and their self-reported depressive symptomatology was measured prior to and just after the 6-week exercise intervention using the Beck Depression Inventory. In addition, during the second experiment, pedometer data were gathered during the fourth week. **Results and Conclusion:** The data of the first study revealed a relationship between the total amount of physical activity and scores on the Beck Depression Inventory; that is, the more active a person is, the lower her self-reported depressive symptoms. Significant correlations were found between the Beck Depression Inventory and the reports of vigorous and moderate exercise levels, but not with walking. Participants who were part of an organized exercise group exercised significantly more than those who exercised on their own. In the second study, those who participated in a line dancing intervention had significantly lower Beck Depression Inventory scores post intervention. The implications of these findings for public health are discussed.

Keywords

physical activity, depressive symptoms, healthy older women

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Depression is a major health problem in the world today. Although it has been observed that this condition affects both men and women with increasing frequency as they get older, the incidence of depression in women is approximately twice that in men (American Psychiatric Association, 2014; Wolk & Weissman, 1995). This study explored the relationship between depressive symptoms (depressed mood within normal range) and levels of physical activity in generally non-depressed older women. Physical activity patterns indicate that, at all ages in life, men tend to be far more active than women. And although physical activity levels decrease as people age, irrespective of their gender, older women remain less engaged in physical activity than their male counterparts. Reduced physical activity has been shown to increase depressive symptoms (Lampinen, Heikkinen, & Ruoppila, 2000), while an increase in depressive symptoms can lead to diminished amounts of exercise (American Psychiatric Association, 2014). As adults age, these patterns become problematic with respect to older adults, and especially so in the case of women.

Specifically, after the age of 65, about one third of the population leads a less active lifestyle, and sedentariness increases with age. According to the "Healthy People 2010," approximately two thirds of women above the age of 75 years are physically inactive (U.S. Department of Health and Human Services, 2000). In comparison, inactivity for males in the same category is slightly more than 50%. Older African Americans are even less active than their Caucasian counterparts in comparable age groups. "While no one can escape the gradual decline of

[1]William Paterson University, Wayne, NJ, USA
[2]Livingston Public Schools, NJ, USA

Corresponding Author:
Virginia Overdorf, Department of Kinesiology, William Paterson University, 300 Pompton Road, Wayne, NJ 07470, USA.
Emails: overdorfv@wpunj.edu

primary aging . . . we do know that secondary factors such as chronic diseases . . . can accelerate" the process (Overdorf, 2005, p. 250). In addition to the significant role physical inactivity plays in the obesity epidemic, inactivity has been widely identified as one of the critical risk factors in many chronic diseases (e.g., cardiovascular disease, Type II diabetes), as well as in mental health problems, especially depression (Blair & Brodney, 1999). Almost two decades ago, in his book *Beyond Prozac*, Norden (1996) suggested that serotonin levels in the human body may be the possible cause of depression. Because physical activity is known to have a positive impact on mental state through a rise in serotonin levels (Chaouloff, 1989; Meeusen, 2005; Young, 2007), it is reasonable to assume that physical inactivity may be one of the major contributors to the increased frequency of depression in our society. It should be noted that in addition to serotonin, other brain neurotransmitters, such as dopamine and norepinephrine, may well be responsible for the exercise–depression relationship. One also cannot discount the release of endorphins caused by exercise and the consequent elevation of mood (Craft & Perna, 2004). Developments in the future will no doubt enable evaluation of the hypotheses.

The reasons for studying the relationship between depressive symptoms and physical activity extend beyond the problem of depression. Aside from its inherent interest as a condition with significant health and societal impact, depression has been implicated in the earlier onset of mild cognitive impairment (MCI), dementia, and Alzheimer's disease (AD). Reduction or loss of cognitive functioning in older adults is an increasingly problematic reality, with serious consequences on the person, family, and society. The July 2010 issue of *Neurology* (Vol. 75, Issue 21) was dedicated to this exact topic. In one of the studies published in that issue, Saczynski et al. (2010) followed 949 older adults (mean age of 79 years) over a 17-year period, and found a significantly higher risk of dementia and AD in those men and women who were depressed, compared to those who were not. The authors concluded that depression is associated with a higher risk (more than a 50%) of dementia and AD. A similar study, conducted by Dotson, Beydoun, and Zonderman (2010), followed 1,239 older adults for 24.7 years. Using the same depression index as Saczynski et al., the authors noted an increased risk for dementia and AD in those respondents with elevated depressive symptoms. The authors further found that recurrent depression is especially harmful, as it almost doubles the risk of developing dementia. They recommended that the prevention of depression in older adults may delay, or even avert, the onset of dementia. Wilson et al. (2010) were rather definitive in stating that their comparative study demonstrated clearly that depression is a risk factor for AD.

Later the same year, in the *Annals of Indian Academy of Neurology*, Muliyala and Varghese (2010) cautioned that the relationship between depression and dementia is complex and probably not a straightforward causal one: Several hypotheses are possible, they are not mutually exclusive, and they may interact in multiple ways. To that end, Diniz, Butters, Albert, Dewand, and Reynolds (2013) conducted a review and meta-analysis of 23 cohort studies. The analysis of the studies indicated that depression in older adults was significantly linked with the risk of AD, vascular dementia, and all-cause dementia. Wilson et al. (2014) sought to investigate the possible relationship of depressive symptoms to dementia in older persons, by conducting a pathology analysis of brain tissue from 582 participants. They found that depressive symptoms were associated with faster cognitive decline after the onset of dementia; however, they were not correlated with the histologic indices of dementia (amyloid plaques, Lewy bodies, etc.).

Whatever the complexities of the interactions, depression is probably associated with dementia and, as Muliyala and Varghese (2010) stated, considering our demographics and the longevity of our older adults, the public health implications are momentous. Effecting a reduction in the incidence of depression in older adults may result in a reduction in the incidence of dementia.

Some attention has been paid to exercise as an alternative or additive treatment for major depression. An inverse relationship between depression and those who exercised at least 2 times per week was observed (Hassmen, Koivula, & Uutela, 2000; Krause, Goldenhar, Liang, Jay, & Maeda, 1993). In a systematic review of 46 studies published in the last 12 years on the efficacy of exercise on major clinical depression, Mura, Sancassiani, Machado, and Cartal (2014) concluded that the positive effects seen in some of the studies should be interpreted cautiously, as these effects are small, and methodological flaws exist. Still, the authors do note promising results on physical activity as an additional therapy to pharmacological treatment. Goldberg and Williams (1988) found physical activity to have a protective effect against depression in men if they exercised over 90 min a day; interestingly, no similar protective effect was found for women. Several studies have noted a positive association between depression and exercise as a function of intensity (Brown & Lawton, 1986; Ross & Hayes, 1988; Ruuskanen & Ruoppila, 1985; Stephens & Craig, 1990). Most of the aforementioned studies included a cross section of age groups. However, with the exception of Ruuskanen and Ruoppila (1985), these studies did not specifically target American older adults. It is possible that something as easily instituted as increased physical activity may result in a reduction in depressive symptoms, without the side effects associated with pharmacological treatments.

Studies specifically targeting healthy older adults are rare in the literature. Several years ago, Blumenthal et al., (1989) found that yoga and aerobic exercise reduced depressive symptoms but most notably in males. Another study by Emery and Gatz (1990) found

no aerobic benefits on the reduction of depressive symptoms with older adults. Exercise has, however, been shown to reduce depressive symptoms in non-depressed younger adults (Brosse, Sheets, Lett, & Blumenthal, 2002). Currently, there are no definitive findings regarding benefits of exercise on reducing depressive symptoms in healthy older adults, and these results regarding older women are particularly troublesome. Women are more likely to suffer from depression (*Research Agenda for Psychosocial and Behavioral Factors in Women's Health, 1996*), and women, on average, live longer than men (Beltran-Sanchez, Finch, & Crimmings, 2015). Recent research shows that depression costs Americans US$210 billion annually, with 38% of this amount targeting depression, while the remainder is needed for comorbid conditions (Greenberg, Fournier, Sisitsky, Pike, & Kessler, 2015; Unutzer et al., 1997). Thus, there can be a high drain on our health care system by the costs of not understanding and preventing this illness.

The present study sought to shed some light on this problem by addressing three broad questions. The first question was whether the intensity of physical activity relates to the presence of depressive symptoms (i.e., depressed mood within normal range) in healthy older women. Second, the question of whether group exercise is more effective compared with solitary physical activity in reducing depressive symptoms was addressed. The third question was whether a physical activity program would decrease participants' self-reports of their level of depressive symptoms.

Two experiments were conducted to address these questions. The first focused on physical activity intensity levels (low, moderate, vigorous as per the American College of Sports Medicine standards adopted in 1978) and activity patterns (individual or group) as they relate to depressive symptoms (Beck Depression Inventory [BDI] scores) in healthy older women. The second involved an exercise intervention, participation in a line dancing class (LDC), its relationship with increased physical activity (pedometer), and its potential effect on reducing depressive symptoms (BDI scores).

The rationale for this study was that physical activity has been identified as a possible management tool for mild to moderate depression (Blumenthalet al., 1999). Increasing numbers of older adults suffer from depression or depressive symptoms, and while it often goes untreated, the treatments generally recommended and utilized have been medication and psychotherapy. However, drugs, similarly to psychotherapy, are an expensive way of managing the disease (Blumenthal et al., 1999). Furthermore, drugs are often not taken consistently and have many potential side effects. Therefore, it is conceivable that exercise could serve as an effective antidote to and preventive method for depressive symptoms in older adults. Exercise is cheaper, it has basically no side effects, and its efficacy as a mood enhancer is almost instantaneous.

Experiment I

This study was conducted to extend previous findings of an inverse relationship between physical activity levels and depressive symptoms to healthy (non-clinically depressed, as measured by the BDI and self-report) older women. It was hypothesized that higher physical activity levels would be positively related to lower depressive symptoms; that is, there would be an inverse relationship between activity levels and depressive symptoms in healthy older women. Furthermore, it was hypothesized that group exercise (with others, in an exercise class [EC]) would have a greater benefit than independent, solitary exercise.

Method

Participants. Sixty-five healthy older women, above the age of 60 years, from independent-living residential communities in Northern New Jersey volunteered to serve as participants in this study. A poster requesting volunteers was placed in the residences, and one of the researchers was present to accommodate the volunteers. Furthermore, a researcher visited local ECs to observe the content of the classes and recruit volunteers.

The participants selected the age range which pertained to them in 5-year groupings. Two thirds of the participants were between the ages of 70 and 84. Three participants were aged 90 or older. Three of the participants reported that they were on antidepressant medications. Subjects were categorized into two groups for comparison based on self-reports. One group exercised independently, on their own ($N = 26$), and the other group enrolled in ECs ($N = 39$).

Instrumentation. Two questionnaires frequently used for observing the relationship between physical activity and depressive symptoms were utilized for data collection.

First, an overall rating of depressive symptoms was obtained using the commonly used BDI (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). The BDI is easily obtained and well researched and its use herein will facilitate comparisons between studies. This instrument is a 21-item self-report inventory measuring manifestations of depression, and takes about 10 min to complete. It has a mean internal consistency rating (reliability, alpha coefficients) of .81 for non-psychiatric populations and .86 for psychiatric populations (Beck, Steer, & Garbin, 1988). It also has good content and concurrent validity with internal consistency ranging from .73 to .92 (mean of .86; Beck et al., 1988). Although the BDI is not a diagnostic tool, it can be used reliably as an index of depressive symptoms.

Second, the participants' levels of habitual physical activity were assessed via the International Physical Activity Questionnaire (IPAQ; www.ipaq.ki.se; long form). The participants reported the number of minutes per week during which they engaged in physical activity

Table 1. Descriptive Statistics of Participants (Excludes Those on Antidepressant Medication) and With Complete Exercise Information.

Participant group	All (n = 55)		Exercising independently (n = 22)		Exercising in a class (n = 33)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Minutes per week of vigorous exercise	38.02	53.10	10.50	23.10	56.36	64.23
Minutes per week of moderate exercise	38.25	59.02	14.50	31.74	54.9	67.62
Minutes per week of low-intensity exercise (walking)	35.36	62.51	36.33	57.84	34.73	66.14
BDI score	5.87	3.67	5.92	3.84	5.84	3.60

Note. BDI = Beck Depression Inventory.

of defined low, moderate, and vigorous intensity. Exercise intensity was defined for participants within the IPAQ. In addition, the IPAQ records distinct sociological factors related to differences between cultures. It further enables insight into exercise patterns related to exercise compliance, adherence, fitness guidelines, transportation, job-related physical activity, recreation, and sport and leisure-time physical activity. The IPAQ has well established reliability and validity (Welk, 2002). Our rationale for administering the IPAQ was that knowledge of the mitigating factors associated with habitual physical activity can be helpful in planning intervention programs so as to improve participatory behaviors.

Procedures. Institutional Review Board approval was obtained prior to data collection. Both questionnaires, the BDI and the IPAQ, were administered by the researchers to those who indicated their willingness to participate in the study by signing a consent form.

Data analysis. Demographic information, scores from the BDI, and scores from the IPAQ were analyzed utilizing correlational analysis, *t* tests, and regression analysis.

Results

The hypothesis called for an analysis of the association between the degree to which participants exercise and their score on the BDI. Sixty-five healthy older women, living independently, who self-reported their exercise patterns, were divided into two groups for the analysis. One group was those who exercised independently and those who were enrolled in ECs. Descriptive statistics for the BDI scores and measures of exercise levels can be found in Table 1.

The number of minutes per week of physical activity combined (for vigorous, moderate, and low-intensity physical activity) and the BDI scores for all participants underwent a simple regression analysis (via SPSS). There were seven participants with missing data who were excluded from this analysis resulting in a total sample of 58. This analysis yielded a non-significant result. BDI scores and the computed exercise variables were assessed for assumptions of normality using the Kolmogorov–Smirnov test for goodness of fit; for both variables, the assumption of normalcy was met.

The regression was repeated without the three participants who reported being on antidepressant medication (N = 55). This time, the regression trended in the direction expected: the higher the exercise level the lower the BDI score (R = .261, R^2 = 0.68), F = (1, 54) 3.882, p = .055.

Next, a series of non-parametric correlations were computed between the BDI scores and the amount of time spent exercising for each of the three dose measures of physical activity: low-intensity (leisurely walking), moderate exercise, and vigorous exercise. When all participants were analyzed together, the correlations were not significant. However, they were in the expected direction, so that higher levels of activity correlated with lower scores on the BDI. When the three participants who were taking antidepressant medications were removed from the analysis, two of the three exercise doses (moderate and vigorous intensity) yielded significant negative correlations with the BDI, but not the low intensity represented by walking. These results can be found in Table 2.

The data on group versus solitary exercise were then explored. The participants' exercise regime was affected by whether they exercised in groups or on their own. Specifically, *t* tests on the amount of time weekly that the participants spent exercising indicated that in both moderate and vigorous intensity levels, those who exercised independently spent significantly less time exercising than those who participated in EC. For Vigorous Intensity Exercise, t(60.67) was −3.03, p = .004, and for Moderate Intensity Exercise, t(57.47) was −2.59, p = .012. These results are displayed in Table 3.

Summary

In summary, our analyses indicated first, the expected relationship between intensity of activity and BDI scores. Low-intensity physical activity (i.e., walking) did not correlate significantly with BDI scores. Although some studies have shown walking to have a mediating effect, this has been only with clinically depressed participants, and the women in this study were not clinically depressed.

Table 2. Spearman Rho (One-Tailed) Between Weekly Physical Activity and the BDI.

	Vigorous exercise			Moderate exercise			Low intensity (walking)		
	rs	*df*	*p*	*rs*	*df*	*p*	*rs*	*df*	*p*
All	−.244	58	.030	−.211	53	.061	−.031	59	*.501*
Exercising independently	−.025	22	*.454*	−.071	22	*.376*	.028	22	*.448*
Exercising in a class	−.433	34	.004	−.359	31	0.02	−.144	35	*.197*

Note. Does not include those taking antidepressant medications. The varying sample size in the groups is determined by missing data; the moderate exercise variable had the most incomplete responses. BDI = Beck Depression Inventory.

Table 3. *t*-Test Results of the Differences in the Amount of Time (Minutes Per Week) Spent Exercising for Participants in EC Versus Participants Exercising Independently (EI).

	M	*SD*	*t*(*df*) for unequal variances	*p*	95% CI	Effect Size (*d*)
Vigorous EC	49.3	62.7	−3.03 (60.67)	.004	[−58.1, −11.9]	.74
Vigorous EI	14.3	30.9				
Moderate EC	54.7	68.3	−2.59 (57.47)	.012	[−63.1, −8.1]	.67
Moderate EI	19.1	38.0				

Note. EC = exercise class; EI = exercising independently; CI = confidence interval.

Thus, if searching for a protective effect in non-clinically depressed older adults, these data suggest that exercise has to be at least of moderate intensity. Second, we found the expected significant negative correlation between scores on the BDI and the amount of exercise people do. The more the participants exercised, the lower their BDI score was. Interestingly, this was the case only for those participants who were not taking antidepressant medication but not so for the three participants who were on antidepressants. Third, those participants engaging in ECs spent significantly more time being active than those who exercised alone or exercised independently.

Experiment II

Experiment I indicated that increased physical activity correlated with a reduced score in depressive symptoms. We then questioned whether an intervention would have similar effects. We hypothesized first that healthy older women's depressive symptoms, as indexed by the BDI score, would decrease after participating in an exercise program for 6 weeks.

Second, we hypothesized that the overall activity level of the participants during the days when they had the EC would increase as a result of participating in the program. As an index of physical activity, we used the total number of steps taken per day by each of the participants on days with and without EC.

Method

Participants. Healthy older women living in a senior independent residential community, who had not participated in Experiment I, consented to participate in a 6-week line dancing program. Eleven healthy women above the age of 70 (mean age = 81 years, *SD* = 2.73 years) volunteered and all completed the program. One of the researchers observed several of the classes.

Instrumentation. The BDI was used to obtain baseline and post-intervention scores. The exercise program consisted of line dancing instruction and practice of various line dances. Finally, a pedometer was provided to the participants to use mid-way through the exercise program along with forms on which to keep track of their steps.

Procedure. Prior to beginning the program, each participant completed the 21-item BDI. Participants completed the BDI again after completion of the 6-week line dancing program.

A skilled line dancing instructor trained the group for 1 hr, 3 times per week (LDC). Each session consisted of a warm-up period at the beginning, the line dancing practice, and a cool-down period at the end. During the fourth of the 6 weeks, participants were asked to wear a provided pedometer all day for the entire week; that is, both for days with LDC and for days with No Line Dance Class (NLDC). They were also given prepared forms and were asked to record their total daily steps for each of the 7 days. Seven of the 11 subjects completed this requirement by the end of the week. For the comfort of the participants and not to detract from with the line dances, the use of the pedometers was delayed until the fourth week of the study.

Data analysis. The BDI scores, pre and post exercise program, were analyzed via a *t* test for significant differences related to the intervention. The total number of steps that each participant took for each day of the week was compared via a *t* test to discern differences due to participation in the LDC (3 days LDC and 4 days NLDC).

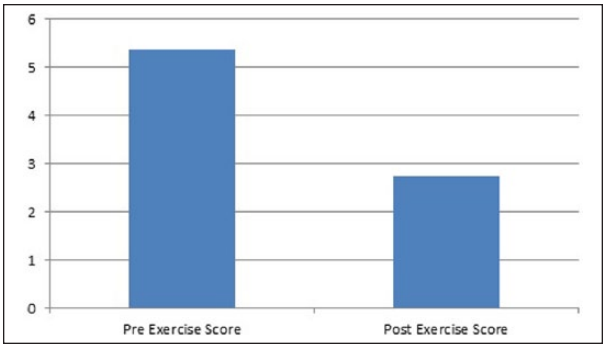

Figure 1. Mean BDI scores for the 11 participants pre and post the LD exercise program.
Note. BDI = Beck Depression Inventory; LD = line dancing.

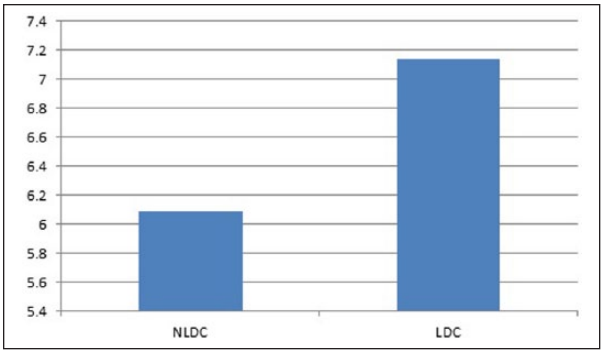

Figure 2. Mean total number of steps taken (in thousands, *y* axis) on days of NLDC and LDC by the seven participants.
Note. NLDC = Noline dancing class; LDC = line dancing class.

Results

It was hypothesized that the 6-week line dancing program would result in a decrease in the depressive symptoms as measured by the BDI score. A lower BDI score after the exercise program would indicate an improvement in overall mood.

A paired samples *t* test comparing scores on the BDI pre and post the line dancing program indicated a significant difference between the mean BDI scores pre (5.73) and post (2.73) exercise program ($t = 4.45$, $df = 10$, $p = .001$). The BDI scores were on average 3 points lower after participation in the exercise program. These results can be seen in Figure 1.

In addition, we compared the number of steps that the participants took each day of their fourth week in the program. For each of the seven participants who completed this part, we compared the average number of daily steps for NLDC with the average number of daily steps for the LDC. Given that our sample size was small ($N = 7$), we performed a One-Sample Kolmogorov–Smirnov Test, which indicated that our data were normally distributed for the steps taken on both types of days—days with exercise (=.977) and days without exercise (=.996)—and, therefore, a *t* test would be appropriate for our data.

The second paired samples *t* test compared the averaged total number of steps per day in the two conditions listed above (NLDC vs. LDC). The paired samples *t* test indicated a significant difference ($t = 2.59$, $df = 6$, $p = .041$) with participants taking more than a thousand more steps during the LDC days compared to the NLDC days. These results can be found in Figure 2.

Summary

In summary, it was seen that a 6-week exercise program caused a significant reduction in depressive symptoms in healthy older women. It was further observed that these women were more physically active on days when LDCs were held.

Discussion

This study addressed the relationship between physical activity and depressive symptoms in healthy older women. We focused on depressive symptoms because they are readily measurable and have been shown to have robust correlations with other indicators of physical, mental, and cognitive well-being. It was predicted that a significant inverse relationship between the two would emerge, and it was indeed found for moderate and vigorous exercise levels. Although several studies over the years (e.g., Beck et al., 1961; Ku, Fox, Chen, & Chou, 2012; Salguero, Martínez-García, Molinero, & Márquez, 2011) have noted an inverse relationship between reported depressive symptoms and participation in physical activity at least twice per week, our study found that this inverse relationship was significant only for moderate and vigorous physical activity levels, which is contrary to Jetsir's and others' finding that low level of physical activity as represented by walking helps to maintain strength, aerobic capacity, and functional capacities. Perhaps walking affects physical factors more so than mental ones. The finding that low-intensity physical activity (i.e., walking) had no impact on the BDI score suggested a dose requirement of at least moderate intensity physical activity for antidepressant benefits to manifest as a lower BDI score. This finding is in general agreement with the finding of Lindwall, Rennemark, and Berggren (2008). They studied 813 older adults (aged 60+ years) and noted that moderate and vigorous exercise had optimal benefits. Furthermore, in their study, moderate, rather than vigorous, exercise showed a greater correlation with both depression and better cognition.

All participants in our study were women. Thus, contrary to the cross-sectional epidemiologic study of Goldberg and Williams (1988), physical activity was found to have a protective mental health benefit for women as well. This benefit was indicated by a lower score on the BDI for those who exercised at a self-reported moderate or high-intensity exercise level compared with those who did not exercise or exercised at a

low-intensity level. These findings must be interpreted with caution, as somatic symptoms were also included in the BDI. An interesting future study could compare these findings with a group in which BDI somatic factors are eliminated.

The finding that group exercise programs led to greater physical activity and lower BDI scores than exercising alone highlights a potential public health issue. Communities may benefit from providing organized group exercise opportunities for their older adults, rather than leaving their patterns of physical activity to chance. This suggestion is further supported by the finding within Experiment II of significantly higher number of steps taken on days when there was a LDC. Promoting a more active lifestyle as we age, aside from positive effects on health and wellness, may ameliorate some of the symptoms of depression and potentially reduce the need for more expensive medical interventions.

The relatively short intervention included in this study further confirms the need for organized exercise programs for older adults. Similar to a 6-month moderate intensity walking program for women that found a decrease in depression in post-menopausal women (Bernard et al., 2014), this study indicated a reduction in depressive symptoms in a 6-week line dancing program for healthy older women. Clearly, exercise interventions can be helpful and must be further explored for intensity, frequency, delivery, and duration. It should be noted that further research is needed to determine whether our findings regarding depressive symptoms indicate possible protective effects from physical activity against the development of depression disorders or whether they are only creating a better mood state in healthy older adults. It is highly recommended that future research explore the duration of these positive protective effects of physical activity on depressive symptomatology by following up with one or more additional qualitative interviews. In addition, another question that naturally follows is whether organized intervention programs can decrease depressive symptom scores on other populations as well. The selected intervention used within the second experiment, line dancing, includes elements of social interaction as well as exposure to music, each of which may have contributed to the lower BDI scores at the second testing. For example, Chan, Chan, Mok, and Tse (2009) found lower depression scores in those exposed to music than those not. Although a recent review of risk factors for depression in elderly people concluded that lower levels of social interaction and social support were contributing factors in the development of depression in the elderly (Cole & Dendukuri, 2014), more intervention studies are needed to tease out the differential effects of social interaction, music, and physical activity. In addition, replication of this study with follow-up data collected periodically in subsequent years might provide information as to the relationship between depressive symptoms and physical activity in preventing depressive disorders.

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