Depression and Exercise in Elderly Men and Women: Findings From the Swedish National Study on Aging and Care

Magnus Lindwall, Mikael Rennemark, Anders Halling, Johan Berglund, and Peter Hassmén

This study investigated the relationship between light and strenuous exercise and depression, as well as gender differences in this relationship, in a representative sample of 860 elderly Swedish suburb-dwelling men and women in age cohorts from 60 to 96 years, drawn from among participants in the Swedish National Aging and Care study. The relationship between depression and self-reported changes in exercise status over time was also examined. Exercise activities were measured with four survey questions, and depression, with the Montgomery Åsberg Depression Rating Scale. The inactive elderly had higher depression scores than more active individuals, both in terms of light and strenuous exercise. The continuously active group had lower depression scores than both continuously inactive individuals and individuals reporting a shift from activity to inactivity during the preceding year. Light exercise had a somewhat stronger effect on depression for women.

Key Words: gender differences, mental health, physical activity

Prevalence rates of major depression have steadily increased during the past 50 years (Dishman, Washburn, & Heath, 2004), and the World Health Organization has predicted that by the year 2020 depression will be second only to cardiovascular disease as the leading cause of disability and death worldwide (Murray & Lopez, 1996). For older adults, depression might thus be viewed as a severe threat to both “adding years to life” and “adding life to years.” The U.S. Consensus Development Panel of the Depression and Bipolar Support Alliance (2003) recently stated that although safe and efficacious treatments exist, mood disorders—depression, in particular—remain a significant health-care issue for older adults. For example, depressive disorder has been found to be a strong risk factor for suicide in the elderly (Wærn et al., 2002). Moreover, natural occurrences and changes associated with the process of aging, such as bereavement, increased loneliness, increased general and physical disability (Bruce, 2001; Lenze et al., 2001), and declines in cognitive functioning (e.g., Boone et al., 1994) are linked to an increased risk of depression.

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Although there are contradictions in the literature (see Blazer, 2003), recent incidence studies in Sweden support the notion that both the prevalence and the incidence of depression increase with age (Pálsson et al., 2001; Pálsson, 2000).

Regular physical activity has been recognized by researchers, governing bodies, and organizations such as the World Health Organization (e.g., WHO, 1997) as a way to prevent and treat general illnesses and mental disorders among the elderly. In general, physical activity decreases the risk of all-cause mortality among the elderly (Sundquist, Qvist, Sundquist, & Johansson, 2004), is associated with higher levels of physical functioning (Hillsdon, Brunner, Guralnik, & Marmot, 2005), and has consistently been found to be one of the most robust behavioral determinants of healthy aging (Peel, McClure, & Bartlett, 2005).

Exercise also seems to have a mild to moderate anxiety-reducing effect (e.g., Taylor, 2000), a moderate mood-improving effect (Arent, Landers, & Etnier, 2000), and positive effects on self-perception (Taylor & Fox, 2005) and cognitive functioning for older people (Boutcher, 2000; Éttnier et al., 1997). These results were corroborated by a recent meta-analysis showing a small but significant overall effect of exercise on psychological well-being in older adults without clinical disorders (Netz, Wu, Becker, & Tenenbaum, 2005).

When it comes to depression, in particular, epidemiological studies have generally reported that more frequent exercise is linked to lower depression scores for nonclinical samples (Hassmén, Koivula, & Uutela, 2000; Kritz-Silverstein, Barrett-Connor, & Corbeau, 2001). Some large longitudinal prospective studies have found that exercise protects against future depressed mood (e.g., Camacho, Roberts, Lazarus, Kaplan, & Cohen, 1991; Lampinen, Heikkinen, & Ruoppila, 2000; Strawbridge, Deleger, Roberts, & Kaplan, 2002), whereas other studies have not (e.g., Kritz-Silverstein et al.).

Taken together, the demonstrated evidence of the effects of exercise on depression seems strong. There is, however, a need for more knowledge about the effects of the different characteristics and facets of physical exercise (such as intensity and dosage) on mental health and depression for older adults, so that cost-effective methods can be implemented into clinical practice (e.g., Fiatarone Singh, 2002).

To understand the reported differences in the affect–depression relationship for various exercise intensities, it is important to view the results within a bigger theoretical framework, something that previous studies on the topic have not done to a satisfactory degree (e.g., Ekkekakis, Hall, & Petruzzello, 2005). The present study was therefore designed according to the principles of a new theoretical framework that has recently gained increased support, namely, dual-mode theory (Ekkekakis, 2003; Ekkekakis et al.). This theory draws heavily from evolutionary theory and stipulates that exercise of moderate intensity (below the lactate threshold) will be associated with homogeneous positive affects of pleasure, whereas exercise of very heavy, or severe, intensity (from the maximal lactate steady state to maximal exercise capacity) will in contrast be perceived with homogeneous negative affects of displeasure. The intensity domain between these two, the heavy domain (from lactate threshold to maximal lactate steady state), is allegedly associated with variable affects of pleasure or displeasure, depending on cognitive factors.

In previous research, gender has been related to both depression and exercise participation (e.g., Blazer, 2003; Pálsson et al., 2001; Taylor et al., 2004), with higher depression scores in women than men (Piccinelli & Wilkinson, 2000), although
Exercise and Depression in the Elderly

this difference appears to be greatest in midlife and decreases with age (e.g., Jorm, 1987, 2000). The exercise patterns of elderly men and women have been found to differ (e.g., Hirvensalo, Lampinen, & Rantanen, 1998; King, 2001), with men generally being more active and engaged in more strenuous exercise than women are; in addition, whereas older women reported decreased physical exercise over time, men’s participation in supervised exercise classes and callisthenic exercises increased over time in an 8-year follow-up study (Hirvensalo et al.). Depression has also been found to differ over time between men and women, with men experiencing increased depressive symptoms over an 8-year follow-up period, while women’s depressive symptoms remained at the same level (Lampinen et al., 2000). Based on these results, Lampinen and colleagues recommended that physical exercise and mental health should be viewed separately for men and women, because physical exercise might have different meanings for the two sexes.

Although meta-analyses have provided little evidence that the effects of exercise on psychological variables differ between men and women (McAuley & Rudolph, 1995; Netz et al., 2005), moderate-intensity exercise has been found to predict subjective health for older men but not women (Loland, 2004). Few previous studies, however, have used gender-specific analyses when investigating the relationship between exercise and depression for the younger and older elderly.

Age, as previously mentioned, is related to elevated depressive symptoms (e.g., Lampinen et al., 2000; Pålsson et al., 2001; Pålsson, 2000) and decreased exercise activity (King, 2001; Taylor et al., 2004). Comorbidity has also been associated with higher depression (Blazer, 2003; Bruce, 2001) and decreased exercise participation (Fiatarone Singh, 2002; Laukkanen, Kauppinen, & Heikkinen, 1998). Given such a link to depression and exercise, these factors might consequently bias any demonstrated relationship between depression and physical activity and were thus controlled for in the present study.

Our primary purpose was to investigate the relationship between exercise of different intensities (light and strenuous exercise) and depression, as well as gender differences in this relationship, controlling for age and comorbidity, in a nonclinical representative sample of Swedish suburb-dwelling older adults. Our secondary purpose was to examine whether self-reported changes in exercise habits over time, using retrospective data, were associated with depression and moderated by gender.

Method

Sample

The Swedish National Study on Aging and Care (SNAC) is a national, longitudinal, multidisciplinary study involving four research centers. A more detailed description of the complete design and structure of the SNAC study is outlined by Lagergren et al. (2004). The characteristics of the total SNAC sample closely reflect the general population of the elderly in Sweden, so this total sample might be perceived as representative of older adults in Sweden (Lagergren et al.). The population chosen for the present study was drawn from one of the four main areas of the complete SNAC study, namely, Karlskrona municipality, a suburban region of 61,000 inhabitants located in Blekinge County in the southeast part of Sweden.
This sample closely resembles the other rural and urban subsamples of the total SNAC study in terms of age and gender distribution and functional disability and consists of 465 men and 624 women. For the younger age cohorts, that is, those age 60 ($n = 154$), 66 ($n = 149$), 72 ($n = 147$), and 78 ($n = 142$) years, a random sample stratified for age group was selected from the whole population of those age 60 or over, including those living in institutions. For the older age cohorts, that is, those age 81 ($n = 129$), 84 ($n = 153$), 87 ($n = 105$), 90 ($n = 69$), 93 ($n = 28$), and 96 ($n = 10$) years, all inhabitants of the population were included. Data were collected between 2001 and 2003. Because of missing cases and incomplete answers in the exercise variables, only 860 respondents were included in the final analyses. The mean age in this sample was 75.3 years ($SD = 10.0$).

**Procedure**

The participants were invited by mail to take part in the study, which was carried out by research staff in two sessions of 3 hr each. Individuals who agreed to participate but were not able to come to the research center were visited at their homes. All participants gave informed consent and were asked to sign a release form for their medical records. After the invitations had been sent out, all those who had not responded were invited again. If they then decided not to participate, the reason for this was registered. The participants underwent a medical examination, participated in cognitive tests, and answered survey questions.

**Measures**

Exercise activities were measured by two survey questions: “How often did you exercise with light intensity (e.g., walking on roads, in parks, or in the woods; short bicycle tours; light gymnastics; golf; or similar) in the last 12 months?” and “How often did you exercise more strenuously (e.g., jogging, long and high-intensity walking, heavy garden work, long bicycle tours, intense gymnastics, skating on lakes, skiing, ball sports, or similar activities) in the last 12 months?” The answer alternatives for both questions were (1) never, (2) one to three times per month, (3) several times per week, and (4) every day. The same two questions and answer alternatives were also used to capture previous exercise participation, except that the “last 12 months” statement was changed to “more than 12 months ago.”

To construct a measure of change in exercise status, the variables were dichotomized, with answer alternatives 1 and 2 on the exercise questions being equal to not active and 3 and 4 being equal to active. This was done for both light and strenuous exercise. The coding procedure was based on national recommendations and research recommendations (e.g., WHO, 1997). Hence, the new variables, one for light and one for strenuous exercise, were coded as follows: (1) not previously active (i.e., more than 12 months ago) and not active now, (2) previously active but not active now, (3) not previously active but active now, and (4) previously active and active now.

Depression was measured with the Montgomery Åsberg Depression Rating Scale (MADRS; Montgomery & Åsberg, 1979). The MADRS is an expert rating scale, designed to be administered by a trained interviewer. The scale includes 10 items, producing a total score ranging from 0 to 60. It was specifically constructed to measure depression and to be sensitive to the effects of treatment. In the present
study, one item was not used because of reliability weaknesses (i.e., low interitem correlation for that item and a total alpha value below .70 for the 10-item MADRS). Hence, 9 of the 10 items were used, yielding a score of 0–54. The MADRS has previously (e.g., Montgomery & Åsberg) been demonstrated to be a reliable and valid measure of depression and has been moderately correlated (r = .65) to the Beck Depression Inventory (Tamaklo, Schubert, Mentari, Lee, & Taylor, 1992). In the present study, the reliability of the nine-item MADRS as assessed with Cronbach’s alpha was .77.

Age was dichotomized according to common praxis (e.g., Stuart-Hamilton, 1991) into the younger elderly (60–78 years) and older elderly (≥ 81 years). The theoretical basis for the measurement of comorbidity was the general John Hopkins ACG® case-mix system. The theory stipulates that comorbidity, measured as a sum of diagnoses from a time period using special algorithms for grouping, corresponds to a certain need for health-care resources. In the present study, diagnoses were obtained from the electronic patient records of the primary-care districts in the Karlskrona community for a period of up to 2 years before the baseline study of SNAC. The ACG groups were collapsed into categories of resource-utilization bands. Previous studies (e.g., Carlsson, Strender, Fridh, & Nilsson, 2004) have shown that this measure of comorbidity is reliable and valid.

**Analyses**

Chi-square tests were used to investigate gender differences in exercise frequency and the distribution of missing cases in exercise variables between men and women. ANCOVA was used to analyze gender differences in depression scores. Two ANCOVAs were used to examine the effects of light and intensive exercise on depression, and another two to examine the effects of self-reported changes in light and strenuous exercise status. All ANCOVAs controlled for comorbidity and age and were conducted first for the whole group and then separately for men and women.

**Results**

Based on the cut-off criteria for MADRS (0–6, absence of depression; 7–19, mild depression; 20–34, moderate depression; and 35 and above, severe depression) suggested by Snaith, Harrop, Newby, and Teale (1986), 79 men (17%) and 124 women (20%) were classified as having mild depression, and 4 men (0.8%) and 10 women (1.8%), as having moderate depression. Hence, the majority of both men (82%) and women (78%) were classified as not clinically depressed.¹

¹Because the present study used a nine-item version of the MADRS, not the 10-item version for which the cut-off criteria were suggested, the numbers concerning prevalence of depression in the present study most probably represent slight underestimations. That is, more people would have been classified as having mild depression, in particular, if the 10-item MADRS had been used. Nonetheless, because a relatively small proportion of the sample scored very close to the next depression-criterion group (for example, 33 women and 10 men, representing 5% of the sample, scored 6 and thus were close to being classified as being mildly depressed), the data for the different depression classifications would probably not have been very different if the 10-item MADRS had been used.
Initial analyses showed that missing cases in the exercise variables were more frequent among women and the older elderly \( (p < .05) \). The depression scores of the missing-cases group did not differ from those of the other participants.

Chi-square tests revealed that men were more active than women in regard to both light and strenuous intensity (see Table 1). More women than men reported never having exercised either with light or strenuous intensity in the preceding 12 months \( (p < .01) \). Moreover, the younger elderly (i.e., those age 60–78 years) were more active than the older elderly (i.e., those >81 years old) in terms of both light and strenuous exercise \( (p < .001) \). Women had higher depression scores than men, \( F(1, 845) = 4.08, p < .05 \), controlling for age and comorbidity. In addition, age was significantly but weakly correlated with depression scores for men, \( r(381) = .24, p < .05 \), but not for women.

**Light Exercise Versus Depression**

An ANCOVA controlling for comorbidity and age demonstrated a significant main effect of light exercise, \( F(3, 849) = 6.35, p < .001, \eta^2 = .02 \). The subgroup that reported no exercise in the preceding 12 months reported the highest depression scores. Post hoc (Scheffé) analyses revealed, however, that this inactive group did not differ significantly from the group exercising one to three times a month but showed significantly greater depression than the groups who exercised several times a week or every day \( (p < .05) \). The group that reported exercising several times a week demonstrated the lowest depression scores (Table 2), but the differences

<table>
<thead>
<tr>
<th>Exercise Status by Gender and Age (Young Elderly vs. Old Elderly), ( n (%) )</th>
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<tbody>
<tr>
<td><strong>Exercise group</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Light exercise&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>never</td>
</tr>
<tr>
<td>1–3 times a month</td>
</tr>
<tr>
<td>several times a week</td>
</tr>
<tr>
<td>every day</td>
</tr>
<tr>
<td>total</td>
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<tr>
<td>Strenuous exercise&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>never</td>
</tr>
<tr>
<td>1–3 times a month</td>
</tr>
<tr>
<td>several times a week</td>
</tr>
<tr>
<td>every day</td>
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<tr>
<td>total</td>
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<sup>a</sup>For example, walking on roads, in parks, or in the woods; shorter bicycle tours; light gymnastics; golf; or other similar activities; <sup>b</sup>For example, jogging, quick long walks, heavier garden work, long bicycle tours, intensive gymnastics, skating on lakes, skiing, swimming, playing ball sports, or other similar activities.
between this group and the groups who exercised one to three times a month or every day were not significant. Gender-specific analyses revealed that the effect of light exercise on depression was significant for women, \( F(3, 472) = 2.80, p < .05, \eta^2 = .01 \), and there was a nonsignificant trend for men, \( F(3, 377) = 2.33, p = .07 \). For both men and women, the group exercising every day had higher depression scores than the group exercising several times a week.

To summarize, the effect of light exercise on depression was significant for women and close to significant for men. The lowest depression scores were associated with exercising several times a week.

### Strenuous Exercise Versus Depression

Another ANCOVA controlling for age and comorbidity showed a significant effect for strenuous exercise, \( F(3, 783) = 5.64, p < .01, \eta^2 = .02 \). The inactive group reported the highest depression scores (see Table 2). Post hoc analyses revealed that this group reported significantly higher depression than both the group exercising one to three times a month (who showed the lowest depression scores) and the group exercising several times a week. The difference, however, between the inactive group and the group who exercised strenuously every day was not significant. Gender-specific analyses revealed different patterns in the effects of strenuous exercise on depression for men and women. For men, the effect was significant, \( F(3, 341) = 4.12, p < .01, \eta^2 = .04 \), with the inactive group showing the highest depression scores and the group that exercised strenuously every day demonstrating the lowest scores. For women, however, the effect of strenuous exercise on depression was not significant.

To summarize, the effect of strenuous exercise on depression was significant for men but not for women. Men who exercised every day had the lowest depression scores.
Exercise-Status Change Versus Depression

For both light- and strenuous-exercise status change, there were too few cases in the group that was previously not regularly active but had been active in the preceding 12 months. Hence, only three groups were used in the analyses. Overall, a relatively large proportion of the sample reported a change from a previously regularly active life to a currently inactive life, both in terms of light (26% of men and 24% of women) and strenuous (36% of men and 38% of women) exercise during the preceding 12 months.

An ANCOVA controlling for age and comorbidity demonstrated a significant effect of change in light-exercise status on depression among the whole group, $F(2, 825) = 5.07, p < .01, \eta^2 = .01$ (see Table 3). Follow-up analyses showed that the continuously regularly active group (i.e., those who regularly engaged in light exercise over the preceding 12 months, as well as previously) reported significantly lower depression scores than both the continuously inactive group (i.e., those who did not exercise regularly either currently or previously) and the group that had moved from being previously regularly active to not being active during the preceding 12 months. The effect was significant both for men and women, although it was more pronounced for women. Among men, however, the previously active but currently inactive group demonstrated the highest depression scores, whereas among women the continuously inactive group had the highest depression scores. In both groups the continuously active groups reported the lowest depression scores.

For strenuous-exercise change, there was a nonsignificant trend toward a relationship between exercise-status change and depression for the whole group, $F(2, 796) = 2.81, p = .06$. The consistently active group showed the lowest depression scores, whereas the previously but not currently active group reported the highest depression scores. This effect was significant for men, $F(2, 361) = 4.17, p < .05, \eta^2 = .02$, but not for women. In addition, among men, the previously and currently active groups reported the lowest depression scores.

### Table 3 Depression Scores ($M$ and $SD$) and Effects of Self-Reported Change in Light and Strenuous Exercise by Gender

<table>
<thead>
<tr>
<th>Exercise Type</th>
<th>Gender</th>
<th>Not active now, not previously active</th>
<th>Not active now, previously active</th>
<th>Active now, previously active</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light exercise</td>
<td>men, $n = 377$</td>
<td>3.3 $^{a,b}$ (3.8)</td>
<td>4.1 $^{b}$ (4.3)</td>
<td>2.9 $^{a}$ (4.1)</td>
<td>3.13</td>
<td>&lt;.05</td>
</tr>
<tr>
<td></td>
<td>women, $n = 472$</td>
<td>5.7 $^{a}$ (5.2)</td>
<td>4.4 $^{a,b}$ (4.8)</td>
<td>3.5 $^{a}$ (4.6)</td>
<td>5.06</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>4.8 $^{b}$ (4.8)</td>
<td>4.3 $^{b}$ (4.6)</td>
<td>3.2 $^{a}$ (4.3)</td>
<td>5.07</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Strenuous exercise</td>
<td>men, $n = 341$</td>
<td>3.3 $^{a,b}$ (3.8)</td>
<td>4.1 $^{b}$ (4.8)</td>
<td>2.5 $^{a}$ (3.4)</td>
<td>4.17</td>
<td>&lt;.05</td>
</tr>
<tr>
<td></td>
<td>women, $n = 442$</td>
<td>4.3 $^{a}$ (4.7)</td>
<td>3.9 $^{a}$ (4.8)</td>
<td>3.6 $^{a}$ (4.5)</td>
<td>0.88</td>
<td>.42</td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>3.8 $^{a}$ (4.3)</td>
<td>4.0 $^{a}$ (4.8)</td>
<td>3.1 $^{a}$ (4.0)</td>
<td>2.81</td>
<td>.06</td>
</tr>
</tbody>
</table>

*Note.* Scores on the Montgomery Åsberg Depression Rating Scale ranging from 0 to 54. Cut-off scores (Snaith et al., 1986): 0–6, absence of depression; 7–19, mild depression; 20–34, moderate depression; and 35 and above, severe depression. Values in the same row that do not share a common subscript are significantly different at the $p < .05$ level.
active group showed significantly lower depression scores than the previously but not currently active group; the latter group also had the highest depression scores among the men. For women, however, the continuously inactive group demonstrated the highest depression scores, but these were not significantly higher than in the other groups.

To summarize, there was a clear beneficial effect of a change from being inactive to being lightly active. A similar trend, although not a significant one, was found for becoming regularly strenuously active. In addition, gender-separate analyses showed differences between men and women in the strength and direction of the effects of exercise-status change on depression. For men, an active past in conjunction with an inactive present seemed to be most detrimental to depression state, whereas for women, those who had been continuously inactive were worst off in terms of depression scores.

**Discussion**

The purpose of the present study was to examine the relationship between light and strenuous exercise and depression in a representative sample of older Swedish adults. The results showed that both light and strenuous exercise were related to depression, with the currently inactive group demonstrating the highest depression scores. These effects remained after controlling for age and comorbidity (with the help of data obtained from the medical services). Hence, the results of the present study are generally in line with both previous meta-analyses on exercise and psychological health (Arent et al., 2000; Netz et al., 2005) and cross-sectional and large epidemiological studies on exercise and depression (e.g., Hassmén et al., 2000; Kritz-Silverstein et al., 2001; Strawbridge et al., 2002) and support the previously documented relationship between regular exercise and lower depression.

The present study has several similarities, in terms of sample characteristics, with the cited previous studies on exercise and depression (e.g., the majority of the samples being active, not depressed, and not institutionalized) that could account for this consensus in results. On the other hand, this study used different measures of exercise and depression (e.g., MADRS vs. Beck Depression Inventory) than the previous studies, yet the conclusions drawn from the results are the same. The fact that the studies have drawn similar conclusions despite differences in the measures used further corroborates the beneficial effects of exercise on depression.

Looking at the nature of the relationship between exercise and depression, the data in this study do not in general support a linear relationship. For example, the group reporting daily light exercise had somewhat higher depression scores than the group exercising with light intensity several times a week, in both men and women. Similarly, among women, the group reporting daily strenuous exercise had higher depression scores than both the group who exercised strenuously one to three times a month and those who exercised strenuously several times a week. Although not significant, these results demonstrate a clear trend. Hence, instead of a straight linear relationship between exercise status and depression scores, there seems to be a J-curve effect, wherein depression scores are increased to some degree at the most active exercise level. This trend has also been observed in previous studies (e.g., Hassmén et al., 2000). A possible reason for this effect might be that thought-distracting activities such as exercise and physical activity
are well-known strategies for handling problems such as loneliness, as well as
depressed thoughts and mood.

Particularly for the women in the present study who reported both daily strenuous
exercise and relatively high depression scores, exercise might function as a
coping strategy for handling negative affect and thoughts. Although this hypothesis
might intuitively seem to suggest that exercise is not a beneficial coping strategy
(contradicting the main results of this study and the majority of previous studies), it
is also possible that those reporting daily exercise used to be even more depressed
before beginning regular exercise. The results might also suggest, however, that
exercise does not have a universally positive effect on mental health or that the
group reporting regular daily exercise represents a special subgroup in terms of
characteristics linked to personality and mental health, indirectly affecting the rela-
tionship between exercise and depression. Moreover, an alternative explanation is
that the observed depression scores are a result of too much exercise in combination
with insufficient recovery. Even though negative overtraining is rarely associated
with older adults, depression is frequently described as an early warning sign in an
unbalanced training process (cf. Kenttä & Hassmén, 1998). Unfortunately, none of
the possible explanations can be verified by the available data.

Finally, in discussing the relationship between exercise and depression in the
present study, it is important to highlight the fact that, in general, the group that
exercised every day still had lower depression scores than the inactive group. In
addition, the sample in the present study represented a relatively healthy group of
elderly people, most of whom were not clinically depressed. The fact that a posi-
tive relationship between exercise and depression was still apparent, despite there
being less room for variation in terms of depression scores than there would be in
a clinical group, seems to offer even stronger support for the positive link between
regular exercise and mental health for the elderly.

This study demonstrated gender differences in both the strength and the nature
of the effects of strenuous exercise on depression. Similar results have previously
been reported, with moderate-intensity exercise predicting subjective health for older
men but not for women (Loland, 2004). The dual-mode model (Ekkekakis, 2003;
Ekkekakis et al., 2005) might afford some explanation. This model proposes that
heavy-intensity exercise could result in positive or negative affect, depending on
cognitive factors such as physical self-efficacy and tolerance for pain and fatigue.
Although we did not directly measure exercise intensity in the present study, the
activities described under strenuous exercise intensity probably fall within the domain
of heavy exercise for many older adults, with workload above the lactate threshold.
Hence, in accordance with the framework, general differences between men and
women in terms of cognitive factors such as physical self-perceptions (e.g., Fox,
1997; Lindwall, 2004; Lindwall & Hassmén, 2004) and attitudes and preferences
for exercise of different intensities might, to some extent, underlie the demonstrated
differences in the effects of strenuous exercise on depression scores.

The effects of light exercise on depression were, in contrast, similar among men
and women, again as would be expected from the dual-mode model. Our category
of “light exercise activities” might be exercise that is of moderate intensity for
older adults. If this is the case, the likely result would be a more homogeneously
experienced positive affect. The results of the present study and previous research,
however, show that men and women seem to differ in activity patterns (e.g., Hirven-
salo et al., 1998; King, 2001) and might also differ in the way they interpret and are motivated by different exercise activities. Future studies should therefore continue to separate men and women when investigating the effects of exercise and physical activity on mental health and well-being.

Moreover, the results demonstrated that self-reported changes in exercise status affected depression scores. It is interesting that the group that had moved from regular activity to inactivity in the preceding 12 months showed levels of depression similar to those of the constantly inactive group and significantly higher depression scores than the constantly active group. Similar results have been reported previously (e.g., Lampinen et al., 2000). It thus seems that the effects of exercise might only persist while exercise is maintained; that is, giving up a previously active life might produce negative health effects. Although in the present study, change in exercise status was measured through retrospective self-report data, an obvious limitation when drawing conclusions from the results, the results are nevertheless in line with those of previous studies demonstrating that exercise might protect against depressive symptoms over time (e.g., Camacho et al., 1991; Strawbridge et al., 2002) and that changes in exercise intensity over time predict depression symptoms for older adults (Lampinen et al.). Given the demonstrated relationship between change in exercise status and depression, the relatively large proportion of the sample reporting a “negative” change from regular activity to inactivity during the preceding 12 months is particularly relevant, from both a research and a practitioner perspective. For example, two highly relevant questions linked to the results are, first, which elderly people might be willing to become more active and, second, why are they willing to do so—what motivation do they have for exercising?

Because we cannot draw any conclusions from the present study about the direction of causality of the exercise–depression relationship, another valid interpretation could be that increased depressive symptoms in the elderly might contribute to a change from regular activity to inactivity. Hence, from an exercise-adherence point of view, the mental-health status of an individual probably not only is affected by regular exercise but also influences the motivation to exercise and the capacity to maintain a regularly active life in old age. In addition, because we found a generally stronger relationship between light exercise and depression than between strenuous exercise and depression, and because the dual-mode theory (Ekkekakis, 2003; Ekkekakis et al., 2005) assumes moderate-intensity exercise to be a more robust predictor of a positive emotional state, health professionals working with the elderly should be encouraged to prescribe primarily activities of light or moderate intensity to previously inactive elderly individuals who are starting an exercise program.

The population in the present study could be perceived as relatively active (with at least 60% of even the oldest group reporting light exercise several times a week and 20–30% engaging in strenuous exercise several times a week) and clinically healthy in terms of depression (with about 80% not being clinically depressed). Because previous research has shown that the effects of exercise seem to be most significant in previously inactive populations with moderate or major depression (see Fiatarone Singh, 2002), the relatively small effect sizes in the present study were expected.

In terms of generalizability of the results, the present study comprised a representative sample of a suburban population that, in turn, reflects the general
population of older adults in Sweden in terms of, for example, age and gender distribution. Hence, the results in the present study can be generalized at least to Swedish suburb-dwelling older adults.

Limitations of the study include, in particular, the use of self-report and the cross-sectional design. Collectively, these limitations restrict our ability to infer cause-and-effect relationships. For example, our data might support an alternative interpretation of the relationship between exercise and depression in that changes in depressive symptoms predict changes in physical activity; that is, having an emergent depression is linked to moving from an active life into a sedentary lifestyle (Van Gool et al., 2003). Moreover, exercise intensity was measured through single survey questions with uncertain reliability and validity properties. Another factor is that the exercise measure in the present study included only light and strenuous exercise, not exercise with moderate intensity. Because previous recommendations and meta-analyses (e.g., Netz et al., 2005; Pate et al., 1995) support the notion that moderate intensity, rather than light or strenuous intensity, has the strongest effect on psychological health, the absence of a measure of moderate intensity should be highlighted as a limitation of the study. On the other hand, the strengths of this study include the use of a representative sample of older adults, the inclusion of older adults, the use of gender-specific analyses, and the use of a large-scale research design with rigorous data collection and valid outcome measurements, controlling for important confounding biases (age and comorbidity).

To summarize, the present study demonstrated that regular exercise, at either light or strenuous intensity, is related to lower depression scores in a representative sample of older adults, beyond the confounding effects of age and comorbidity. Moreover, older women seem to benefit primarily from exercising at light intensity several times a week, whereas strenuous exercise had more noticeable effects on depression for older men. The study further suggests that self-reported change in exercise status over time might influence depression differently for men and women.

Future studies should further investigate the relationship between mental health and exercise in the elderly from a gender-specific perspective by conducting the analyses separately for men and women, instead of merely controlling for gender. More specifically, well-controlled experimental studies, based on solid theoretical frameworks such as the dual-mode model, on differences in dose response for psychological concepts such as physical self-perceptions, self-efficacy, cognitive function, depression, and anxiety will contribute important new knowledge, both theoretical and applied.

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