

The Effect of Aerobic Indoor Exercise Compared with Green Exercise on Different Symptoms of Depression: An Investigation of Psychological Mediators of Stress and Coping

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Abstract

Objectives: Considering the growing need for using a variety of new non-pharmacological methods in treating depression, this quasi experimental study was conducted to investigate the effect of aerobic indoor exercise in a gym compared with green exercise in an outdoor green environment of an urban park on triple categories of affective, cognitive and somatic symptoms of depression and to examine its psychological mediators of perceived stress and coping strategies. **Methods:** Forty six female outpatients with major depressive disorder were divided into 3 conditions of indoor exercise + routine pharmacotherapy ($n = 15$), green exercise + routine pharmacotherapy ($n = 15$), and a routine pharmacotherapy alone as the control group ($n = 16$). The exercise used for both indoor and green exercise conditions consisted of 36 one hour sessions (three times per week) with an intensity of 50% - 70% of the maximum heart rate. The participants completed the pre- and post-intervention depression, stress and coping questionnaires including Beck Depression Inventory-II, Perceived Stress Scale and Coping Inventory for Stressful Situations. **Results:** The findings indicated a significant decrease in the post-intervention scores of all three categories of affective, cognitive and somatic symptoms of depression and perceived stress in both exercise groups compared with the control group, but there was no significant difference between two exercise groups. With respect to the use of problem-focused, emotion-focused and avoidant-focused coping methods, there was no significant difference between post-intervention scores of all groups. **Conclusion:** In the clinical settings, both of the indoor exercise and green exercise programs can

help to further improvement in all three categories of affective, cognitive and somatic symptoms of depression as an adjunct (or independent) treatment to the same degree, especially mediated by reducing the amount of perceived stress, but not through any significant changes in cognitive-behavioral coping strategies.

Keywords

Exercise and Physical Activity, Major Depressive Disorder, Perceived Stress, Coping Strategies

1. Introduction

Major depressive disorder is considered as one of the most common psychological disorders around the world especially in women [1]. Treatment of depression is typically performed through the use of medicines, psychotherapy or a combination of both [2]. Yet one-third of the patients do not respond favorably to these treatments [3]. Additionally, to avoid side effects many patients are not willing to use medication and on the other hand, since psychotherapy requires considerable cognitive and intellectual capacity, researchers have become increasingly interested in using exercise and physical activity as an adjunct or independent procedure in treating depression [4].

Some studies conducted in this field showed a significant difference in the rate of depression improvement in exercise groups in which aerobic exercise was added to the routine drug and electroshock treatment protocol [4] [5] [6] [7] [8]. An important point here is that the use of high intensity exercise (75% - 85% HR_{max}) is not plausible in patients with depression and does not agree with the public health recommendations [9]. Nevertheless, the present evidence is relatively contradictory still [3] and some experimental studies do not show the effective role of exercise and physical activity in reducing depression [10] [11]. Therefore, some researchers believe that more studies are required to draw an accurate conclusion in this regard [6]. Furthermore, although there is good evidence obtained particularly from cross-sectional studies in the general population, it seems that there is a considerable need for further examination in the clinical settings, especially on depressed outpatients. In this regard, an important subject left unaddressed in other studies is that which affective, cognitive, and somatic categories of depression symptoms are more affected by exercise and physical activity. Accordingly, an aim of this study is to find out if exercises lead to reduced depression, this reduction is achieved mainly from improvement in which groups of depression symptoms.

Moreover, studies have shown that combining exercise and physical activity with green environment (exercising in an outdoor green space) which is known as the green exercise versus indoor exercise entails double beneficial outcomes [12]. Recently some findings suggested that green exercise can have double

beneficial effect on improving the psychological well-being [12] [13] [14] [15]. There are two theories to justify the effect of green nature on mental health. First, the psycho physiological stress recovery theory [16] explains that the pleasant feeling due to exposure to a natural beautiful scene reduces physiological excitation and induces physical and psychological calmness. Second, in the attention restoration theory [17] it is also believed that when we are tired of various problems, looking at natural sceneries without concentrating on any specific problem leads to relaxation and less fatigue. However, given that most research in this field has been done on non-clinical samples and as Mackay and Neill [13] have emphasized, seemingly that to clarify additional effects of green exercise on psychological well-being especially in depressed outpatients, further studies is needed, and this is one of the objectives of the present study.

Another important issue of this study is investigating the underlying psychological mechanisms of the effect of exercise and physical activity on depression. In this regard it seems that the level of perceived stress can be considered as a mediating factor that justifies the relationship between physical activity and depression [18]. Various clinical findings suggest that stress plays an important role in the etiology of depression [19]. On the other hand, it seems that exercise and physical activity can protect the individual against the negative consequences of stress and related disorders such as depression [20]. Although, there are some contest and disagreement on the extent to which exercise can reduce the individual's sensitivity to the psychosocial stress [21]. There is also no clear evidence indicating whether the psychological reactions of stress reduce parallel to the reduction in physiological reactions induced by exercise and physical activity and present empirical evidence in this area is somewhat contradictory [22]. Because of these inconsistencies, many researchers have emphasized the need for more studies [23] and it is another objective of this study.

In addition to the effect of exercise on the level of perceived stress, the cognitive-behavioral responses of patients with depression for coping with stress and the effects of exercise on this variable are very important. However, until now the effect of exercise and physical activity on changes in usage degree of triple methods of problem-focused, emotion-focused, and avoidant-focused coping with stress has not been addressed extensively. According to Folkman and Lazarus [24] stress coping methods can be divided into two categories: Problem-focused coping which includes trying to resolve the stressor and emotion-focused coping which includes trying to relieve the negative emotions induced by stressors. Later, Endler and Parker [25] added a third category called avoidant-focused coping including avoiding the problem or engaging oneself with other activities. Studies conducted in this field show that the individuals with depression use emotion-focused and avoidant-focused coping methods significantly more and problem-focused coping method less frequently than other individuals [26] [27] [28]. Although, based on some researches [29], exercise and physical activity can improve coping with stress, but there is no considerable evidence about the effect of exercise on coping. Therefore, some researchers

emphasize on the need for more comprehensive interventional studies on different clinical and nonclinical populations to determine the exact efficiency of exercise and physical activity on stress coping strategies [29]. Hence, regarding the important role of coping with stress in the prevention, treatment and rehabilitation of depression, investigating the essential role of this factor in the effect of exercise on depression is the final objective of the present study.

In summary, considering the growing need for using a variety of new non-pharmacological methods in treating depression, in the present study as one of the few studies in this area on depressed outpatients, we aimed to answer the following three questions whether adding aerobic indoor or green exercise to routine pharmacotherapy compared to the condition of routine pharmacotherapy alone, and whether adding green exercise to routine pharmacotherapy, compared to the condition of adding indoor exercise to routine pharmacotherapy, can 1) Make a significant decrease in all the three categories of affective, cognitive and somatic symptoms of depression or not? 2) Lead to a significant decrease in the level of perceived stressor not? 3) Cause a significant helpful change in using of cognitive-behavioral methods of problem-focused, emotion-focused and avoidant-focused coping with stress or not?

2. Methods

2.1. Design and Participants

This quasi-experimental study was conducted with two experimental and one control groups. The Participants were selected from the patients presenting to a psychiatric hospital (Bahman hospital in Yazd, Iran) during June-September 2014. This study was approved by the local ethics committee (IR.MUMS.REC.1395.6) and was registered as a clinical trial in Iranian registry of clinical trials (<http://www.irct.ir>) (Register Code: IRCT2016082929598N1).

Research samples were selected from the patients who tended to voluntarily participate in the study using convenience-sampling method. The inclusion criteria were the following: Female patients aged 20 - 50 years who were affected with moderate to severe major depressive disorder diagnosed by a psychiatrist via clinical interview based on the fifth version of the diagnostic and statistical manual of mental disorders (DSM-5) [30] and a minimum score of 20 on the Beck Depression Inventory-II (BDI-II) [31], not being engaged in other mental treatments and physical activity programs during the study period, confirming their willingness to participate in the research and sign the informed consent statement. The exclusion criteria were the following: Patients who were affected with other important mental disorders (e.g., schizophrenia, bipolar disorder, drug and alcohol abuse) and any medical condition that affects their depression (e.g., hypothyroidism and diabetes) or limits their physical activity (e.g., cardiovascular and musculoskeletal problems).

2.2. Procedures

The sample used in the study included one experimental group of indoor exer-

cise + routine pharmacotherapy, a comparison group of green exercise + routine pharmacotherapy, and a control group of routine pharmacotherapy alone. During the enrollment, the first and second 18 eligible patients allocated to the aerobic indoor and green exercise interventions, respectively. The last third group, containing another 18 eligible patients, underwent only routine pharmacotherapy. To register the participants after referral by psychiatrist, they must have completed demographic data form and the research questionnaires including depression, stress and coping pre-tests at the psychiatric clinic in the form of face to face interview. Resting heart rate was also recorded after a few minutes of resting in sitting position. Enrollment of the patients in each group usually lasted approximately 2 to 4 weeks. Therapeutic intervention was started after finishing all of the enrollments and pre-tests. Post-tests were also conducted at a time within the first day immediately after the finishing of interventions. To enhance the patients' cooperation during the study, researchers paid all costs and expenses incurred (e.g. the costs of transportation, gym and laboratory tests).

2.2.1. Aerobic Indoor and Green Exercise Programs

In the exercise conditions, beside routine medication the participants performed group aerobic exercise for 60 min associated with rhythmic music three sessions per week for three months with a low to medium intensity of 50% - 70% of the maximum heart rate (HR_{max}). According to various ages of the participants ranging from 20 to 50 years, the intensity of physical activity in the indoor exercise group varied from at least 87.20 bpm (50% HR_{max}) in the oldest patient (48 years old) to 135.80 bpm (70% HR_{max}) in the youngest patient (20 years old) and in the green exercise group varied from at least 86.85 bpm (50% HR_{max}) in the oldest patient (49 years old) to 135.80 bpm (70% HR_{max}) in the youngest patient (20 years old). During each session, the total exercise time and intensity of physical activity were controlled by one of the research staff. Indoor exercise was performed in a gym of 90 m² space without the presence of others and under supervision of a coach. Green exercise was performed in a 120 m² open space in a park of approximately 4000 m² space including tree-planted, grass, flowers and waterfront under the supervision of a coach. During green exercise sessions other women were also present at the site. The time of holding the indoor exercise was in the summer of 2014 between 18 - 19 p.m. with an approximate temperature of 20°C and the time of green exercise was during the late summer and early autumn between 16:30 - 17:30 p.m. with an approximate temperature of 25°C - 30°C. Due to the national yearly holidays, two sessions of indoor and three sessions of the green exercise were cancelled.

Aerobic exercise with rhythmic music were performed in this study as follows: 1) About 10 - 15 min of gentle stretching exercise for warming up the body as approved by other studies such as Law and Herbert [32], 2) The main body of exercise included 30 - 40 min of faster exercise including various movements of hands, feet, and trunk in the sitting and standing positions, 3) About 10 - 15 min of gentle stretching exercise for cooling down the body whose benefits have been

confirmed by other researchers such as Mallion, Rokka, Beneka, Mavridis, and Godolias [33]. During the study, the patients in these groups were receiving routine pharmacotherapy in addition to participation in exercise sessions.

2.2.2. Routine Pharmacotherapy

The members of this group just received pharmacotherapy and they were not involved in ECT, psychotherapy or any kind of physical activities. The medications consumed by the participants were included tricyclic antidepressants (clomipramine, imipramine and trimipramine), selective serotonin reuptake inhibitors (SSRIs) (fluoxetine, citalopram and sertraline), norepinephrine-dopamine reuptake inhibitors (NDRIs) (bupropion), benzodiazepines (alprazolam and chlordiazepoxide) and other anti-anxiety drugs and tranquilizers (propranolol, trifluoperazine and perphenazine). The type and dosage of medications for each patient were determined by the psychiatrist.

2.3. Measures

2.3.1. Intensity of Physical Activity and Resting Heart Rate

HR_{max} measured by the digital heart rate monitor Beurer model PM110 made in Germany was used to determine the intensity of physical activity. HR_{max} is commonly used as an index for prescribing exercise intensity in rehabilitation programs [34]. The formula: “ $208 - 0.7 \times \text{age}$ ” [35] was also used here in identifying HR_{max} . HR_{max} divides intensity of physical activities to the low (50% - 65% HR_{max}), medium (65% - 75% HR_{max}), and high (75% - 85% HR_{max}) levels [36]. Resting heart rate was also measured by the monitor.

2.3.2. Depression

The Persian version of the Beck Depression Inventory-II (BDI-II) [31] was applied to measure the before and after intervention depression in the experimental and control groups. BDI-II has 21 sections and each section scored on a Likert scale of 0 - 3 points yielding a total score of 0 - 63. The scores 0 - 13 are classified as minimal depression, 14 - 19 as mild to moderate depression, 20 - 28 as moderate to severe depression and above 29 as severe depression [31]. The BDI-II is one of the most powerful used instruments for measuring the severity of depression and has a high reliability and acceptable concurrent, content, and structural validity [37]. In a study [38] the reliability and validity of the Persian version of this inventory was estimated to be very satisfactory.

2.3.3. Stress

The Persian version of the 10-item Perceived Stress Scale (PSS-10) [39] was used to assess perceived stress. This test is scored on a 5-point Likert scale scored from 0 (never) to 4 (most of the time). Items 4, 5, 7 and 8 are scored in reverse. Accordingly, the total score will range from 0 - 40. The scores 0 - 7 indicate very low stress, 8 - 11 low, 12 - 15 average, 16 - 20 high, and above 21 very high stress [39]. The reliability and validity of the original version of this scale [40] and those of the Persian version [41] are optimal and acceptable.

2.3.4. Coping

The Persian version of Coping Inventory for Stressful Situations (CISS) developed by Endler and Parker [42] was used to assess the methods of stress coping. This inventory consists of 48 items measuring the three methods of coping including problem-focused (16 items), emotion-focused (16 items), and avoidant-focused (16 items) methods. The answer to each question is based on a five-point Likert scale including 1 (never) to 5 (very high) and so the total score of each section varies between 16 to 80. The reliability and validity of the original version [43] and those of the Persian version [44] has been approved.

2.4. Sample Size

Based on a two sided confidence interval of 95%, test power of 80%, standard deviation of 11 with regard to BDI-II scores from some former studies, and in order to attain a significant difference based on a minimum difference of 12 between group mean scores, sample size was chosen to be three groups of 15. A total of 3 individuals (20%) were then added to each group in order to compensate for subject loss. As such, the final number of individuals in each group was 18.

2.5. Statistical Analysis

Data were analyzed using the SPSS-20 software. Regarding the normal distribution of the data based on Kolmogorov-Smirnov test ($p > 0.05$), the parametric statistics of one-way ANOVA, ANCOVA, MANCOVA, Bonferroni post hoc test and partial eta squared were used as appropriated. One-way ANOVA was used to compare the pre-test scores of demographic characteristics, clinical symptoms (depression, perceived stress, and coping strategies), and the doses of consumed medications of the three study groups. ANCOVA, MANCOVA, and Bonferroni test in addition to partial eta squared were also used to check the observed differences between the pre- and post-test scores of clinical variables, and calculate effect size, respectively.

3. Results

A total of 105 patients were referred to participate in the study. Of these patients, 51 (48.5%) excluded from the study and 54 were non-randomly allocated to the indoor exercise ($n = 18$), green exercise ($n = 18$) and control ($n = 18$) groups. Among the 54 patients that met the criteria and were invited to participate in the study, 8 (14.8%) dropped out in the early stages of the study (three in each of the exercise groups and two in the control group). The dropouts were because of lack of motivation to exercise and lack of required physical preparation in the two exercise groups, and discontinuing the use of drugs because of their side effects in the control group. Therefore, the research data were analyzed using 15, 15 and 16 patients in the indoor exercise, green exercise and control groups, respectively.

3.1. Baseline Findings

Table 1 shows the baseline demographic characteristics and pre-intervention

Table 1. Baseline demographic characteristics and pre-intervention scores of the major study variables.

Measures	1—indoor	2—green	3—control	<i>F</i> (2, 43)	<i>p</i>
	exercise (<i>n</i> = 15) M (SD)	exercise (<i>n</i> = 15) M (SD)	(<i>n</i> = 16) M (SD)		
Age (years)	34.40 (8.33)	32.46 (8.52)	33.31 (6.95)	0.22	0.801
Education (years)	10 (4)	10.26 (2.98)	11.12 (3.48)	0.43	0.649
Height (cm)	163.06 (7.37)	164.93 (6.64)	166.31 (3.71)	1.11	0.339
Weight (kg)	76.33 (8.48)	75.46 (8.39)	73.31 (7.31)	0.58	0.564
Rest heart rate (bpm)	84.60 (5.06)	83.86 (8.57)	84.43 (6.99)	0.04	0.956
BDI-II (Total score)	36.33 (9.67)	35.93 (11.60)	40.87 (10.62)	1.03	0.363
BDI-II (Affective symptoms)	12.73 (3.75)	12.93 (4.26)	14.31 (4.31)	0.68	0.512
BDI-II (Cognitive symptoms)	14.33 (5.36)	13.40 (4.80)	16.50 (4.97)	1.54	0.225
BDI-II (Somatic symptoms)	9.33 (2.12)	9.60 (4.03)	10.06 (2.81)	0.22	0.802
PSS-10	27.93 (7.04)	25.93 (7.71)	30.62 (7.22)	1.60	0.213
CISS (P-FC)	39.26 (14.55)	36.93 (14.37)	37.18 (15.98)	0.11	0.896
CISS (E-FC)	59.93 (10.11)	56.86 (8.87)	57 (14.61)	0.34	0.713
CISS (A-FC)	29.66 (8.99)	35.40 (13.45)	29.12 (9.63)	1.56	0.221

Note. bpm = beats per minute; BDI-II = Beck Depression Inventory-II; PSS = Perceived Stress Scale; CISS = Coping Inventory for Stressful Situations; P-FC = Problem-Focused Coping; E-FC = Emotion-Focused Coping; A-FC = Avoidant-Focused Coping.

scores of the major study variables. The total means (standard deviations) of age, education, height, weight and resting heart rates of all groups were 33.39 (7.81) years, 10.47 (3.46) years, 164.80 (6.09) cm, 75 (7.98) kg, and 84.30 (6.87) bpm, respectively. The total means (standard deviations) of pre-intervention scores obtained on the major study variables in the three groups were as follows: BDI-II: total score: 37.78 (10.67), affective symptoms: 13.34 (4.09), cognitive symptoms: 14.78 (5.11), and somatic symptoms: 9.67 (3.03); PSS-10: 28.21 (7.42); CISS: problem-focused coping: 37.78 (14.71), emotion-focused coping: 57.91 (11.38), and avoidant-focused coping: 31.34 (10.98). Based on a one-way between groups ANOVA, there was no statistically significant difference among the three groups regarding all baseline demographic characteristics and major study variables (see **Table 1**). According to baseline findings, the participants were affected with moderate to severe depression, very high degrees of stress, and greater use of emotion-focused coping compared to problem-focused and avoidant-focused coping methods. There was also no significant difference between the average doses of medications taken by the groups of indoor exercise ($M = 149.53$, $SD = 85.83$), green exercise ($M = 136.53$, $SD = 94.99$), and control group ($M = 154.56$, $SD = 84.38$) mg, $F(2, 43) = 0.17$, $p = 0.844$). In addition, the average length of affliction with depression for all of the three groups was 16.22 (11.37) months.

3.2. Exercise Effects on Depression

Post-tests comparison of the total depression scores using an ANCOVA demon-

strated a significant difference in the three groups ($F(2, 43) = 9.98, p = 0.001, \eta_p^2 = 0.32$) (see **Table 2**). Post-hoc comparisons using the Bonferroni test indicated that the post-test mean scores for indoor exercise ($M = 18.46, SD = 11.64$) and green exercise ($M = 18.27, SD = 8.44$) conditions were significantly different from control condition ($M = 32.93, SD = 10.50$). Based on a MANCOVA this difference was also observed in all the triple affective ($F(2, 43) = 9.82, p = 0.001, \eta_p^2 = 0.33$), cognitive ($F(2, 43) = 5.72, p = 0.007, \eta_p^2 = 0.22$), and somatic ($F(2, 43) = 9.99, p = 0.001, \eta_p^2 = 0.33$) subscales at BDI-II. These results suggest that participating in an exercise program truly has a positive effect on further improvement of all triple categories of depression symptoms. But importantly, there was no significant difference between the two indoor and green exercise conditions regarding the post-intervention decrease in the amount of depression scores.

3.3. Exercise Effects on Stress and Coping

Post-tests comparison of the three groups using an ANCOVA and post hoc Bonferroni test indicated a significantly reduced perceived stress ($F(2, 43) = 8.46, p = 0.006, \eta_p^2 = 0.16$) in both indoor and green exercise conditions compared with the control condition (see **Table 2**). These results suggest that participating in the two exercise programs can lead to a significant reduction in the amount of perceived stress. More importantly, similar to the depression variable, there was no significant difference between the two exercise conditions regarding the post-intervention decrease in the amount of perceived stress.

In addition, in the post intervention scores for stress coping strategies including problem-focused ($F(2, 43) = 1.84, p = 0.172, \eta_p^2 = 0.08$), emotion-focused

Table 2. Post-intervention comparison of the major study variables in the three groups.

Measures	1—indoor exercise (<i>n</i> = 15) M (SD)	2—green exercise (<i>n</i> = 15) M (SD)	3—control (<i>n</i> = 16) M (SD)	<i>F</i> (2, 43)	<i>p</i>	η_p^2	Bonfereni
BDI-II (Total score)	18.46 (11.64)	18.27 (8.44)	32.93 (10.50)	9.98	0.001	0.32	1, 2 < 3
BDI-II (Affective symptoms)	6.33 (3.77)	6.60 (3.81)	11.68 (4.34)	9.82	0.001	0.33	1, 2 < 3
BDI-II (Cognitive symptoms)	7.73 (6.09)	7.20 (3.61)	13.31 (4.52)	5.72	0.007	0.22	1, 2 < 3
BDI-II (Somatic symptoms)	4.40 (2.55)	4.47 (2.20)	7.93 (2.51)	9.99	0.001	0.33	1, 2 < 3
PSS-10	16.60 (6.68)	15.53 (6.26)	27.06 (6.27)	8.46	0.006	0.16	1, 2 < 3
CISS (P-FC)	47.26 (15.34)	45.60 (9.37)	40.87 (13)	1.84	0.172	0.08	---
CISS (E-FC)	47.53 (8.22)	49.26 (9.90)	54.37 (13.64)	1.79	0.179	0.08	---
CISS (A-FC)	31.46 (8.72)	35.80 (12.04)	30.50 (10.26)	0.52	0.598	0.02	---

Note. BDI-II = Beck Depression Inventory-II; PSS = Perceived Stress Scale; CISS = Coping Inventory for Stressful Situations; P-FC = Problem-Focused Coping; E-FC = Emotion-Focused Coping; A-FC = Avoidant-Focused Coping.

($F(2, 43) = 1.79, p = 0.179, \eta_p^2 = 0.08$) and avoidant-focused coping methods ($F(2, 43) = 0.52, p = 0.598, \eta_p^2 = 0.02$), there was no significant difference among the three groups (see **Table 2**). This part of the results indicated that participating in the two exercise programs fail to have a significant effect on changing various cognitive-behavioral strategies of coping methods.

4. Discussion

The aim of this study was to examine the effect of aerobic indoor exercise compared to green exercise on triple categories of affective, cognitive and somatic symptoms of depression and to investigate the role of psychological mediators of perceived stress and coping strategies. Comparison of post-tests of the indoor and green exercise conditions to those of the control condition indicated that adding exercise to pharmacotherapy significantly improved all three categories of affective, cognitive and somatic symptoms of depression in these two groups compared with the control group. This finding is consistent with the results obtained by other studies [4] [5] [7] [8] [45] [46]. The results of some other studies also indicated that exercise can improve the affective, cognitive and somatic symptoms of depression through, for example, increasing the level of serotonin secretion [47], increasing self-esteem [48] and optimizing sleep quality [49], respectively.

Regarding the mediating role of perceived stress level, our findings demonstrated that the rate of stress reduction after interventions was significantly greater in the indoor and green exercise conditions compared with the control condition. This finding suggests that adding exercise to routine pharmacotherapy can significantly improve all the affective, cognitive and somatic symptoms of depression particularly via decreasing the stress rate. According to the kindling-sensitization hypothesis, it is believed that repeated stressful events gradually lead to sensitivity and vulnerability of the brain to stress and subsequent depression attacks [50]. Moreover, some researchers believe that physically more active individuals are not only more resistant and adaptable to the adverse consequences of physical stress, but also to psychosocial stresses of daily living due to reduced physiological reactions [51]. In this regard the findings of a study [52] indicated the positive effect of a 20-week aerobic exercise program in significantly improving the students' emotional reactions to final exam stress.

Based on our findings, in post-intervention measures the rate of reduction in all three categories of affective, cognitive and somatic symptoms of depression and perceived stress was not greater in the green exercise condition compared with the indoor exercise one. This finding is different from the results obtained by other researchers in the field of mental health such as Pretty, Peacock, Sellens, and Griffen [12], Mackay and Neill [13], Mitchel [14] and Ward Thompson *et al.* [15]. This inconsistency could be attributed to several reasons. First, as Pretty *et al.* [53] have reported, other studies mostly used more pleasurable green exercise such as cycling, horse riding, fishing, kayaking and mountain running. However, it seems that performing aerobic exercise in a green space compared

with indoor situation may not produce a double effect on decreasing depression such as the above mentioned activities. Second, in other studies about the effect of exercise on mental health like Mackay and Neill [13] green exercise was usually conducted in a bracing natural environment such as roads, forests and mountains while the exercise used in this study was conducted in an artificial green environment of an urban park. It is possible that performing exercise in an artificial green environment like a park cannot double the rate of improvement of clinical depression as well as performing exercise in a natural green environment such as the above mentioned bracing situations. It is also possible that patients do not perceive the greenness of artificial green environments as much as natural ones and this consequently reduces the potential effect of green exercise in an artificial green environment on depression. Some researchers also pointed out that the amount of health benefits of physical activity is a result of various factors including exercise variables (such as type, duration and intensity), individual differences (such as personality), environmental variables (such as perceived greenness) and socio-cultural variables [13]. Accordingly, as Thompson Coon *et al.* [54] have noted, it should be emphasized that to determine the advantages of the green exercise compared with indoor exercise, there is a need for further experimental studies on clinical populations of both sexes especially depressed patients using a variety of physical activities in various green spaces.

Finally, regarding the use of various stress coping strategies, the results of baseline measurements indicated that the participants of the study mostly used emotion-focused coping methods compared with the other two methods. This is consistent with the findings of other studies including Hori *et al.* [26], Horwitz *et al.* [27] and Sugawara *et al.* [28]. More importantly, based on post intervention scores regarding the use of stress coping strategies we found that performing one program of aerobic indoor or green exercise did not lead to any significant difference in these two groups compared with the control group. This is not consistent with the findings of some studies such as Wijndaele *et al.* [29]. One possible justification for this finding is that for exercise and physical activity to exert its positive effect on the cognitive and behavioral characteristics especially stress coping methods, there is a need for a longer time, perhaps some years, a situation that can be confirmed by cross-sectional or cohort studies such as Wijndaele *et al.* [29]. Some researchers [55] [56] also state that encouraging and training patients to use more effective stress coping strategies is an indispensable component of cognitive-behavioral interventions. Thome and Espelage [57] in a different point of view believe that exercise and physical activity should be considered as a stress coping method independent of other methods. They also believe that some items should be added to the stress coping questionnaires measuring problem-focused, emotion-focused and avoidant-focused methods to assess stress coping via exercise as an independent method.

5. Conclusion

In conclusion, our findings demonstrated that in the clinical settings, both of the

indoor exercise program in a gym and green exercise program in an outdoor green environment of an urban park can help to further improvement of all three categories of affective, cognitive and somatic symptoms of depression as an adjunct (or independent) treatment to the same degree, especially mediated by reducing the amount of perceived stress, but not through any changes in cognitive-behavioral coping strategies.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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