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Research article

Low-Intensity Exercise as a Modifier of Depressive Symptoms and Self-Perceived Stress Level in Women with Metabolic Syndrome

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Abstract

The study aims to determine the impact of low-intensity exercise and psychoeducation on depressive symptoms and self-perceived stress in women with metabolic syndrome (MetS). Seventy-four women (mean age 69.35 ± 7.20) were included in the study. Participants were divided into two groups: those with MetS (n = 33) and those without MetS (n = 41). Subjects participated in low-intensity general-fitness exercise sessions combined with psychoeducation distributed regularly over a 12-week period. Participants completed the Geriatric Depression Scale-15 (GDS) and the Stress Level Questionnaire (SLQ) before and after the intervention. All investigated parameters significantly decreased for the participants with metabolic syndrome after the intervention. The level of GDS in this group decreased by approximately 37% ($p < 0.01$), and SLQ by around 23% ($p < 0.01$). Our results suggest, that low-intensity exercise combined with psychoeducation could lower depressive symptoms and stress level in women with MetS. However, the intervention does not lower anthropometric parameter scores.

Key words: Low-intensity exercise, mental health, women, metabolic syndrome, physical activity.

Introduction

Metabolic syndrome (MetS) is currently one of the major threats to health in highly developed societies, mainly due to the increased risk of cardiovascular disease (Tune et al., 2017). The International Diabetes Federation (IDF) advises that three out of five diagnostic criteria must be met in order to classify a person as having MetS. These criteria include first and foremost abdominal obesity, followed by elevated blood pressure, hyperglycaemia, hypertriglyceridemia, and reduced HDL cholesterol (Alberti et al., 2006). In the world's adult population, the proportion of individuals with MetS is now estimated to be at 20-25% (Saklayen, 2018).

However, apart from somatic diseases, there is also a psychological side of the presence of MetS, e.g. elevated symptoms of depression or higher level of perceived stress. Depression refers to a loss of interest and enjoyment in ordinary things and experiences, diminished interest or pleasure in everyday activities, fatigue or loss of energy nearly every day, or fatigue nearly every day (Beck, 1972). A recent study has demonstrated that depression may be significantly associated with MetS in people aged 60 years or over (Repousi et al., 2018). The more components of MetS that are evident in the individual, the more depressive symptoms this individual is likely to exhibit (East et al., 2010). Moreover, people displaying symptoms of low mood, depression and bipolar affective disorders have an increased risk of cardiovascular disease and premature death (Hearing et al., 2016). In turn, stress, defined as a state of disharmony, is a relationship between a person and a source of a stimulus, which may foster the emergence of an unpleasant state of emotional tension that exceeds the ability to cope (Lazarus and Folkman, 1984; Chrousos and Gold, 1992). The reduced coping ability could disrupt central regulatory systems, followed by insulin resistance, visceral obesity, and cardiovascular diseases (Rosmond, 2005).

MetS treatment is essentially founded on implementing lifestyle changes that involve regular physical activity and healthy dietary habits. Systematically undertaking exercise has a beneficial influence on health, particularly on cardiovascular system functions (Melmer et al., 2018) as well as the quality of life and depression status in middle-aged and older women with MetS (Chiang and Chiang et al., 2019). According to Bassi et al. (2014), patient motivation leading to improved lifestyle adherence is a key factor in achieving a reduction in MetS components (Bassi et al., 2014). In the elderly, poor health status appears to lower the motivation for initiating and maintaining physical activity (Stralen et al., 2009). However, a recent study concluded that motivational counseling that incorporates behavioral change principles is effective in reducing sedentary behaviors and depressive symptoms for women with MetS (Chiang et al., 2019).

A systematic review from 2015 concluded that low-intensity exercise might offer both physical and cognitive health benefits to older adults; hence, it may also be appropriate for elderly individuals with MetS (Tse et al., 2015). For mild and moderate depression, the effect of exercise may be comparable with antidepressant medication and psychotherapy (Knapen et al., 2015) and may improve patient's stress management and coping strategies (Knapen et al., 2005). Moreover, Brooks et al. (2018) in a study with rats demonstrated, that due to a reduction in oxidative stress and increased production of nitric oxide in the cerebral vessels, exercise could prevent the negative actions of stress on cerebrovascular function and structure in rats with MetS.

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Previous work has shown moderate or high intensity exercise to be optimal for the treatment of MetS (Lin et al., 2015; Loprinzi and Cardinal, 2012). Nevertheless, many patients with MetS have hypertension and obesity. Therefore, for safety reasons, the patient's condition during intensive group exercises should be constantly monitored by a physician or specialized equipment, which generates costs and may limit the availability of this type of intervention (Pedersen and Saltin, 2015). Hence, the authors aimed to determine the impact of 12 weeks of low-intensity exercise, combined with psychoeducation, on the severity of depressive symptoms and self-perceived stress in women with MetS. We hypothesized that individuals with MetS would achieve improvement in examined psychological parameters after the intervention and that their depressive symptoms and stress level would become similar to that of the non-MetS group.

Methods

Participants

The study was conducted in the Foundation for Senior Citizen Activation '*SIWY DYM*' (Wroclaw, Poland). Eighty-eight females who volunteered to participate in general-fitness exercise sessions distributed regularly over a period of 12 weeks were included. The average age of the subjects was 69.35 ± 7.20 years. All the subjects gave their written consent to take part in the project. The study was granted ethical approval by the Scientific Research Ethics Committee at the University School of Physical Education in Wroclaw, Poland, and was retrospectively registered in the ClinicalTrials.gov (NCT04346836). Outcome measures were assessed at the baseline and after the intervention (pre-post design).

The research participants were divided into two groups: group with metabolic syndrome (MetS, n = 44), with average age was 71.54 ±7.66 years; and group without MetS (non-MetS, n = 44), aged 67.58 ± 6.35 years on average. The presence of MetS was diagnosed using the IDF-recommended criteria (Alberti et al., 2006): "mandatory" central obesity (defined as waist circumference ≥ 80 cm in females) and any two of the following: raised triglycerides (>150 mg/dL), reduced HDL cholesterol (50 mg/dL in females), elevated blood pressure (BP; systolic BP > 130 or diastolic BP > 85 mm Hg) and increased fasting plasma glucose (>100 mg/dL). The exclusion criteria included disturbed cognitive functions (Mini-Mental State Examination > 23), the inability to move independently or a motor disability precluding exercise, serious neurological or orthopaedic conditions (e.g., advanced Parkinson's disease, severe stroke consequences), and attending fewer than 13 intervention sessions. Table 1 presents the baseline characteristics of the research sample. Table 2 shows the prevalence of metabolic syndrome risk factors.

Table 1. Participants' baseline characteristic (mean ±SD).

		Total (n=74)	MetS (n=33)	non-MetS (n=41)	*p*-Value
Age (years)		69.35 ±7.20	71.54 ±7.66	67.58 ±6.35	0.02
Mass (kg)		75.23 ±16.65	79.61 ±17.56	71.70 ±15.18	0.04
Height (m)		1.59 ±0.06	1.59 ±0.06	1.59 ±0.05	NS
BMI (kg/cm^2)		29.37 ±5.70	31.08 ±5.50	28.00 ±5.54	0.02
Waist circumference (cm)		96.73 ±13.97	100.36 ±10.80	93.80 ±15.60	0.04
Hip circumference (cm)		111.32 ±13.69	115.30 ±15.14	108.13 ±11.63	0.02
WHR		0.86 ±0.07	0.87 ±0.06	0.86 ±0.08	NS
Total cholesterol (mg/dL)		203.10 ±38.99	188.45 ±35.16	214.90 ±38.29	0.003
HDL-C (mg/dL)		65.96 ±12.74	61.07 ±13.16	69.90 ±11.04	0.002
LDL-C (mg/dL)		118.28 ±33.14	109.33 ±31.86	125.48 ±32.75	0.04
Triglycerides (mg/dL)		117.02 ±42.05	133.60 ±50.70	103.68 ±27.58	0.001
Fasting glucose (mg/dL)		102.74 ±18.93	112.14 ±23.62	95.17 ±8.72	0.001
Resting SBP (mm Hg)		134.24 ±20.64	146.96 ±18.11	124.00 ±16.56	0.001
Resting DBP (mm Hg)		74.62 ±9.68	78.39 ±10.77	71.58 ±7.55	0.002
Hypertension (%)		64.86	90.90	43.90	0.000
Physically active (%)		25.67	24.24	26.82	NS
Current smoking (%)		9.45	12.12	7.31	NS
Education (%)	**Basic/vocational**	17.57	18.18	17.07	NS
	Secondary	47.30	51.51	43.91	NS
	Higher education	35.13	30.31	39.02	NS

BMI-body mass index; WHR-waist-hip ratio; HDL-C-high-density lipoprotein cholesterol; LDL-C-low-density lipoprotein cholesterol; SBP-systolic blood pressure; DBP- diastolic blood pressure; NS-non significant

Table 2. Prevalence of metabolic syndrome risk factors, % (n)

Risk Factor	Total (n=74)	MetS (n=33)	non-MetS (n=41)
Waist circumference (≥80cm)	90.54% (67)	100% (33)	82.92% (34)
Impaired fasting glucose (≥100 mg/dL)	50.00% (37)	75.75% (25)	29.26% (12)
Hypertension (≥130 SBP or 85 DBP mm Hg)	64.86% (48)	90.90% (30)	43.90% (18)
HDL-C (<50 mg/dL)	9.45% (7)	21.21% (7)	0.00% (0)
Triglycerides (≥150 mg/dL)	16.21% (12)	33.33% (11)	2.43% (1)

HDL-C- high-density lipoprotein cholesterol

Intervention

Over the course of 12 weeks, both groups took part in regular sessions of general-fitness group exercise and psychoeducation that were conducted by a trained physiotherapist and a psychotherapist twice a week in a small, fixed group of 10-12 women. A single session of exercise lasted 40 minutes and consisted of 42 low-intensity, general-fitness exercises. Perception of effort was monitored using the Borg 6-20 rating the perceived exertion (RPE). Participants were familiarized with the RPE scale before the start of the intervention and instructed to maintain their effort on the level of the intensity score at 10-11. After each set of exercises, the participants were asked to rate their -perception of effort by answering the question 'How hard are you working at this moment?' If they rated their RPE below 10 or above 11, the feedback was given to make an adjustment. Thirty-three exercises were done sitting down, seven standing, and two in the hand-and-knees position. The exercises were classified as either aerobic, musculo-articular, or stabilising. The aerobic portion served as a general warm-up for the subsequent exercises, and the musculo-articular section focused on strengthening muscles and enhancing the mobility of joints in the upper limbs, the lower limbs, and the torso. Stabilising exercises were designed to improve the stability of the body and to augment spatio-visual coordination. After the exercises, a psychotherapist provided 20 minutes of psychoeducation, which contained mini-lectures about mental well-being, psychohygiene, and healthy dietary habits. The assumptions of the described model are in accordance with the newest recommendations (Cabanel et al., 2017; Eschweiler, 2017; Hölzel et al., 2017), and its effectiveness has been empirically supported (Muszyńska et al., 2017; Zając et al., 2017).

Psychological assessment

The intensity of depressive symptoms was assessed using the Geriatric Depression Scale-15 (GDS), which consists of 15 yes-or-no questions (Greenberg, 2007). A score greater than 5 points is suggestive of depression, and 10 points or more is almost always indicative of depression. With the sensitivity standing at 92% and reliability at 76%, the GDS is useful in the diagnosis of late-life depression in primary care (Mitchell et al., 2010).

The level of self-reported stress was measured using the Stress Level Questionnaire (Plopa and Makarowski, 2010). The measure is designed to gauge the level of stress through the dimensions of emotional tension, external stress (resulting from the individual's confrontation with the burdens in their surroundings), and intrapsychic stress (resulting from the individual's confrontation with themselves). Collating partial scores in these dimensions yields a total score that represents the general stress level. The SLQ consists of 27 statements to which the subject responds using a five-point Likert scale ranging from *true* to *untrue*. The designers of the measure report that Cronbach's α for the individual scales ranges between 0.69 and 0.80 (Plopa and Makarowski, 2010).

Data analysis

Descriptive statistics, i.e., means ± standard deviations (SD), quantities, and percentages were calculated for the continuous variables. Given that the data variables follow a normal distribution, parametric statistical tests were used in statistical analyses. The groups were compared by using the independent *t*-test, while the effect of the intervention on psychological parameters was established by using the paired *t*-test. Dichotomous variables were compared using the chi-square test. Statistical significance was set at the level of $\alpha < 0.05$. Due to data sensitiveness, the datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Results

After the 12 weeks of the intervention, the final evaluation encompassed 74 women (84.1%), 33 in MetS group and 41 in non-MetS group without MetS. Due to attendance of less than 51%, fourteen participants were excluded from the data analysis. Examination of the prevalence of metabolic syndrome risk factors shows that after "mandatory" central obesity, the most frequent risk factors in the MetS group were raised blood pressure (90%) and raised fasting plasma glucose (75%). In the non-MetS group, hypertension was found in 43% of the subjects and impaired fasting glucose in 29% (Table 2). The attendance rate was 72%, and it did not differ significantly between the groups (74% in MetS vs 71% in non-MetS, $p > 0.05$).

Participants in the MetS group reported significantly higher depression level (5.39 vs. 4.26, $p = 0.04$) and stress level (5.03 vs. 4.36, $p = 0.02$) than the non-MetS group. Differences in two components of stress level were also noted, specifically Emotional Tension ($p = 0.03$) and External Stress ($p = 0.03$). The studied groups did not differ significantly in their post-intervention psychological parameter scores. Table 3 illustrates the differences between the groups in the results of psychological parameters before and after the intervention.

The scores for psychological parameters after the 12-week-long intervention show a significant decrease in all the investigated parameters for the participants with MetS. The level of GDS in this group decreased by approximately 37% ($p < 0.01$), and the stress level decreased by about 23% ($p < 0.01$). The scores for the components of stress level also decreased by over 20% ($p < 0.01$). However, the implemented intervention did not affect the psychological parameter scores of the non-MetS group (Table 3). In both groups, the intervention did not have a significant effect on the anthropometric parameters in the two studied groups.

Discussion

The aim of this study was to determine the effectiveness of low-intensity exercise combined with psychoeducation on decreasing the depression and stress level in elderly people with MetS. This current study found that the investigated groups significantly differed in psychological parameters before the intervention. The MetS group achieved a GDS score of 5.39, which is a threshold value for the presence of depression (Table 3). The level of self-perceived stress was also significantly higher in this group than in the non-

MetS participants. These differences may be associated with raised oxidative stress (OS) in people with MetS. People with MetS have been found to characteristically display higher levels of OS than people without MetS, and the level of OS is directly connected with the incidence of depressive symptoms (Grandl and Wolfrum, 2018; Liu et al., 2015; Lindqvist et al., 2017).

Table 3. The effect of the twelve-week intervention on psychological parameters Outcome

	MetS (n=33)	non-MetS (n=41)	*p*-Value*
GDS			
Before	5.39 ±1.78	4.26 ±2.08	0.04
After	3.38 ±1.30	3.40 ±1.12	NS
Change	2.01	0.86	
Cohen's *d*	1.31	0.54	
***p*-Value**	0.008	NS	
Stress level			
Before	5.03 ±2.21	4.36 ±1.82	0.02
After	3.84 ±1.60	4.07 ±1.69	NS
Change	1.19	0.29	
Cohen's *d*	0.62	0.17	
***p*-Value**	< 0.001	NS	
Emotional Tension			
Before	4.90 ±1.92	4.34 ±1.79	0.03
After	3.84 ±1.58	4.12 ±1.36	NS
Change	1.06	0.22	
Cohen's *d*	0.61	0.14	
***p*-Value**	0.002	NS	
External Stress			
Before	4.33 ±2.02	3.63 ±1.68	0.03
After	3.27 ±1.71	3.52 ±1.52	NS
Change	1.06	0.11	
Cohen's *d*	0.57	0.07	
***p*-Value**	0.002	NS	
Intrapsychic stress			
Before	5.06 ±2.17	4.34 ±1.87	NS
After	3.78 ±1.57	4.04 ±1.78	NS
Change	1.28	0.30	
Cohen's *d*	0.68	0.16	
***p*-Value**	< 0.001	NS	

*between group; GDS-Geriatric Depression Scale; NS-non significant

These findings imply that regular exercise combined with psychoeducation may beneficially contribute to reducing the intensity of depressive symptoms and to lower the level of stress in women with MetS. After the intervention, the levels of the assessed parameters became equal between the two groups. In other words, the intervention reduced the intensity of the symptoms of depression and the level of stress in women with MetS down to the level exhibited by people without MetS. This effect may be linked to a reduction in OS. Regular exercise reduces OS markers (Korsager Larsen and Matchkov, 2016). However, when exercise is too intense, the physical effort by itself enhances the production of free radicals (Boccatonda et al., 2016). The study also shows that low-intensity exercise did not influence the anthropometric parameters in the entire sample. Research has found that high-intensity exercise is necessary to significantly reduce MetS risk factors (Xu et al., 2019). Nevertheless, the existing findings show that in the case of MetS, any amount of exercise may positively influence MetS risk factors, but this impact will be weaker with lower-intensity exercises (Zhang et al., 2017). Another possible explanation for these results is that the intervention was implemented in a group. Besides stimulating physical activity, group exercise also serves an important social function. In 2011, the study demonstrated that people who exercised in a group reported lower stress levels than people in the control sample who did not undertake such exercise (Hsieh, 2011). Combined with the existing literature, these results reveal a positive influence of low-intensity exercise, because it slightly reduces MetS risk factors while simultaneously and advantageously decreasing psychological parameters. The findings of the current study seem highly relevant in that, for example, overly intense exercise may discourage elderly people from taking up regular exercise, because in this group, the biggest barriers to engaging in the exercise include the fear of pain, the fear of falling, and/or the fear of overdoing activity post-illness, while low-intensity exercise minimises such fears (Baert et al., 2011).

Regular exercise offers several mental and physical benefits. Research has shown that regularly practised exercise beneficially contributes to reversing the symptoms of depression and anxiety, enhancing resistance to stress and fatigue, and improving mood, wellbeing, and cognitive outcomes. As a rule, these changes occur before the physiological parameters improve, and they can be identical to or bigger than those brought about by other methods, including pharmacotherapy. Even slight physical effort reduces stress and anxiety, with these advantages increasing as the frequency of exercise increases (Manferdelli et al., 2019; Pareja-Galeano et al., 2016; Kelley et al., 2015; Archer et al., 2014; Penedo and Dahn, 2005).

The research project described here was observational in nature, as the health prevention and health promotion programme implemented at the Foundation for Senior Citizen Activation *'SIWY DYM'* assumed that all the people willing to take pro-health activities would receive the necessary specialist help. For this reason, no control group was created (a group without the therapeutic intervention). Thus, the analysis of our results focused on assessing the impact of the programme on the participants assigned to two groups, with and without MetS. Generalizability of our findings is also limited due to (1) the research sample in this study being composed solely of females, (2) the relatively small sample size, (3) the sample having moderate GDS scores, at the threshold of depression, and (4) the use of self-reported RPE as the measure of intensity. Therefore, the conclusions should be formulated carefully, considering all the above restrictions.

Conclusion

At the time of joining our health prevention and health promotion project, women with MetS were more depressed and had a higher level of self-perceived stress compared to women without MetS. The low-intensity physical exercises used in group conditions combined with psychoeducation contributed to a significant improvement in both depression and stress level in women with MetS. After three months of participation in the project, there were no significant differences between the group with MetS and without MetS in terms of the presence of mood disorders and the level of self-perceived stress. However, it does not lower anthropometric parameter scores. Nevertheless, improving mental condition is a good starting point for further health-related activities that can also contribute to weight reduction in the long run. The obtained results seem to be particularly important for the elderly, who due to their health should not undertake high-intensity physical activities, and for organizations that due to their profile of activity are not able to provide safe conditions for conducting high-intensity physical activities (lack of cardiac monitoring, lack of a cardiologist participating in all classes, no cardiopulmonary resuscitation devices).

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References

Alberti, K. G. M. M., Zimmet, P. and Shaw, J. (2006) Metabolic syndrome a new world-wide definition. A Consensus Statement from the International Diabetes Federation. *Diabetic Medicine: A Journal of the British Diabetic Association* **23**(5), 469-480. https://doi.org/10.1111/j.1464-5491.2006.01858.x

Archer, T., Josefsson, T. and Lindwall, M. (2014) Effects of physical exercise on depressive symptoms and biomarkers in depression, *CNS & neurological disorders drug targets* **13(10)**, 1640-1653. https://doi.org/10.2174/1871527313666141130203245

Baert, V., Gorus, E., Mets, T., Geerts, C. and Bautmans, I. (2011) Motivators and barriers for physical activity in the oldest old: A systematic review. *Ageing Research Reviews* **10(4)**, 464-474. https://doi.org/10.1016/j.arr.2011.04.001

Bassi, N., Karagodin, I., Wang, S., Vassallo, P., Priyanath, A., Massaro, E. and Stone, N. J. (2014) Lifestyle modification for metabolic syndrome: a systematic review. *The American Journal of Medicine* **127(12)**, 1242.e1-10. https://doi.org/10.1016/j.amjmed.2014.06.035

Beck, A. T. (1972) *Depression: Causes and Treatment*, University of Pennsylvania Press.

Boccatonda, A., Tripaldi, R., Davì, G. and Santilli, F. (2016) Oxidative Stress Modulation Through Habitual Physical Activity. *Current Pharmaceutical Design* **22(24)**, 3648-3680. https://doi.org/10.2174/1381612822666160413123806

Brooks, S., Branyan, K. W., DeVallance, E., Skinner, R., Lemaster, K., Sheets, J. W., Pitzer, C. R., Asano, S., Bryner, R.W., Olfert, I. M., Frisbee, J. C. and Chantler, P. D. (2018) Psychological stress-induced cerebrovascular dysfunction: the role of metabolic syndrome and exercise. *Experimental Physiology* **103(5)**, 761-776. https://doi.org/10.1113/EP086892

Cabanel, N., Kundermann, B., Franz, M. and Müller, M. J. (2017) Multiprofessional inpatient psychotherapy of depression in old age. *Der Nervenarzt* **88(11)**, 1221-1226. https://doi.org/10.1007/s00115-017-0406-z

Chiang, L.-C., Chiang, S.-L., Tzeng, W.-C., Lee, M.-S., Hung, Y.-J. and Lin, C.-H. (2019) Active Physical Activity Patterns Are Associated With Improved Quality of Life and Depression Status in Taiwanese Women With Metabolic Syndrome. *The Journal of Cardiovascular Nursing* **34(6)**, 491-502. https://doi.org/10.1097/JCN.0000000000000602

Chiang, L.-C., Heitkemper, M. M., Chiang, S.-L., Tzeng, W.-C., Lee, M.-S., Hung, Y.-J. and Lin, C.-H. (2019) Motivational Counseling to Reduce Sedentary Behaviors and Depressive Symptoms and Improve Health-Related Quality of Life Among Women With Metabolic Syndrome. *Journal of Cardiovascular Nursing* **34(4)**, 327-335. https://doi.org/10.1097/JCN.0000000000000573

Chrousos, G. P. and Gold, P. W. (1992) The concepts of stress and stress system disorders. Overview of physical and behavioral homeostasis. *Journals of the American Medical Association* **267(9)**, 1244-1252. https://doi.org/10.1001/jama.1992.03480090092034

East, C., Willis, B. L., Barlow, C. E., Grannemann, B. D., FitzGerald, S. J., DeFina, L. F. and Trivedi, M. H. (2010) Depressive symptoms and metabolic syndrome in preventive healthcare: the Cooper Center longitudinal study. *Metabolic Syndrome and Related Disorders* **8(5)**, 451-457. https://doi.org/10.1089/met.2010.0017

Eschweiler, G. W. (2017) Diagnostics and multimodal treatment of depression in old age : New developments. *Zeitschrift Fur Gerontologie Und Geriatrie* **50(2)**, 99-105. https://doi.org/10.1007/s00391-016-1174-2

Grandl, G. and Wolfrum, C. (2018) Hemostasis, endothelial stress, inflammation, and the metabolic syndrome. *Seminars in Immunopathology* **40(2)**, 215-224. https://doi.org/10.1007/s00281-017-0666-5

Greenberg, S. A. (2007) How to try this: the Geriatric Depression Scale: Short Form. *The American Journal of Nursing* **107(10)**, 60-69. https://doi.org/10.1097/01.NAJ.0000292204.52313.f3

Hearing, C. M., Chang, W. C., Szuhany, K. L., Deckersbach, T., Nierenberg, A. A. and Sylvia, L. G. (2016) Physical Exercise for Treatment of Mood Disorders: A Critical Review. *Current Behavioral Neuroscience Reports* **3(4)**, 350-359. https://doi.org/10.1007/s40473-016-0089-y

Hölzel, L. P., Härter, M. and Hüll, M. (2017) Multiprofessional outpatient psychosocial treatment for elderly patients with mental disorders. *Der Nervenarzt* **88(11)**, 1227-1233. https://doi.org/10.1007/s00115-017-0407-y

Hsieh, P.-L. (2011) A school-based health promotion program for stressed nursing students in Taiwan. *The journal of nursing research* **19(3)**, 230-237. https://doi.org/10.1097/JNR.0b013e318228d010

Kelley, G. A., Kelley, K. S. and Hootman, J. M. (2015) Effects of exercise on depression in adults with arthritis: a systematic review with meta-analysis of randomized controlled trials. *Arthritis Research & Therapy* **17**, 21-43. https://doi.org/10.1186/s13075-015-0533-5

Knapen, J., Van de Vliet, P., Van Coppenolle, H., David, A., Peuskens, J., Pieters, G. and Knapen, K. (2005) Comparison of changes in physical self-concept, global self-esteem, depression and anxiety following two different psychomotor therapy programs in nonpsychotic psychiatric inpatients. *Psychotherapy and Psychosomatics* **74(6)**, 353-361. https://doi.org/10.1159/000087782

Knapen, J., Vancampfort, D., Moriën, Y. and Marchal, Y. (2015) Exercise therapy improves both mental and physical health in patients with major depression. *Disability and Rehabilitation* **37(16)**, 1490-1495. https://doi.org/10.3109/09638288.2014.972579

Korsager Larsen, M. and Matchkov, V. V. (2016) Hypertension and physical exercise: The role of oxidative stress. *Medicina (Kaunas, Lithuania)* **52(1)**, 19-27. https://doi.org/10.1016/j.medici.2016.01.005

Lazarus, R. S. and Folkman, S. (1984) *Stress, Appraisal, and Coping*, Springer Publishing Company.

Lin, C.-H., Chiang, S.-L., Yates, P., Lee, M.-S., Hung, Y.-J., Tzeng, W.-C. and Chiang, L.-C. (2015) Moderate physical activity level as a protective factor against metabolic syndrome in middle-aged and older women. *Journal of Clinical Nursing* **24(9-10)**, 1234-1245. https://doi.org/10.1111/jocn.12683

Lindqvist, D., Dhabhar, F. S., James, S. J., Hough, C. M., Jain, F. A., Bersani, F. S., Reus, V. I., Verhoeven, J. E., Epel, E. S., Mahan, L., Rosser, R., Wolkowitz, O. M. and Mellon, S. H. (2017) Oxidative stress, inflammation and treatment response in major depression *Psychoneuroendocrinology* **76**, 197-205. https://doi.org/10.1016/j.psyneuen.2016.11.031

Liu, T., Zhong, S., Liao, X., Chen, J., He, T., Lai, S. and Jia, Y. (2015) A Meta-Analysis of Oxidative Stress Markers in Depression, *Plos One*, **10(10)**, e0138904. https://doi.org/10.1371/journal.pone.0138904

Loprinzi, P. D. and Cardinal, B. J. (2012) Interrelationships among physical activity, depression, homocysteine, and metabolic syndrome with special considerations by sex. *Preventive Medicine* **54(6)**, 388-392. https://doi.org/10.1016/j.ypmed.2012.03.016

Manferdelli, G., La Torre, A. and Codella, R. (2019) Outdoor physical activity bears multiple benefits to health and society. *The Journal of Sports Medicine and Physical Fitness* **59(5)**, 868-879. https://doi.org/10.23736/S0022-4707.18.08771-6

Melmer, A., Kempf, P. and Laimer, M. (2018) The Role of Physical Exercise in Obesity and Diabetes. *Praxis* **107(17-18)**, 971-976. https://doi.org/10.1024/1661-8157/a003065

Mitchell, A. J., Bird, V., Rizzo, M. and Meader, N. (2010) Diagnostic validity and added value of the Geriatric Depression Scale for depression in primary care: a meta-analysis of GDS30 and GDS15. *Journal of Affective Disorders* **125(1-3)**, 10-17. https://doi.org/10.1016/j.jad.2009.08.019

Muszyńska, M., Jaworska-Burzyńska, L. and Szczepańska-Gieracha, J. (2017) Severity of depressive symptoms in women over 60 who undertake regular physical exercise and health-seeking activities. *Gerentologia Współczesna* **5(3)**, 113-119.

Pareja-Galeano, H., Mayero, S., Perales, M., Garatachea, N., Santos-Lozano, A., Fiuza-Luces, C., Emanuele, E., Gálvez, B. G., Sanchis-Gomar, F. and Lucia, A. (2016) Biological Rationale for Regular Physical Exercise as an Effective Intervention for the Prevention and Treatment of Depressive Disorders. *Current Pharmaceutical Design* **22(24)**, 3764-3775. https://doi.org/10.2174/1381612822666160322144537

Pedersen, B. K. and Saltin, B. (2015) Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian Journal of Medicine & Science in Sports* **25(S3)**, 1-72. https://doi.org/10.1111/sms.12581

Penedo, F. J. and Dahn, J. R. (2005) Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry* **18(2)**, 189-193. https://doi.org/10.1097/00001504-200503000-00013

Plopa, M. and Makarowski, R. (2010) *Kwestionariusz poczucia stersu The Perception of Stress Questionnaire.* Warsaw, VIZJA Press & IT. Available from URL: https://www.researchgate.net/publication/326317660. The_Perception_of_Stress_Questionnaire_Plopa_Makarowski_2010.

Repousi, N., Masana, M. F., Sanchez-Niubo, A., Haro, J. M. and Tyrovolas, S. (2018) Depression and metabolic syndrome in the older population: A review of evidence. *Journal of Affective Disorders* **237**, 56-64. https://doi.org/10.1016/j.jad.2018.04.102

Rosmond, R. (2005) Role of stress in the pathogenesis of the metabolic syndrome. *Psychoneuroendocrinology* **30(1)**, 1-10. https://doi.org/10.1016/j.psyneuen.2004.05.007

Saklayen, M. G. (2018) The Global Epidemic of the Metabolic Syndrome. *Current Hypertension Reports* **20(2)**, 12-20. https://doi.org/10.1007/s11906-018-0812-z

Stralen, M. M. van, Vries, H. D., Mudde, A. N., Bolman, C. and Lechner, L. (2009) Determinants of initiation and maintenance of physical activity among older adults: a literature review. *Health Psychology Review* **3(2)**, 147-207. https://doi.org/10.1080/17437190903229462

Tse, A. C. Y., Wong, T. W. L. and Lee, P. H. (2015) Effect of Low-intensity Exercise on Physical and Cognitive Health in Older Adults: a Systematic Review. *Sports Medicine Open* **1**, 37-50. https://doi.org/10.1186/s40798-015-0034-8

Tune, J. D., Goodwill, A. G., Sassoon, D. J. and Mather, K. J. (2017) Cardiovascular consequences of metabolic syndrome. *The Journal of Laboratory and Clinical Medicine* **183**, 57-70. https://doi.org/10.1016/j.trsl.2017.01.001

Xu, F., Cohen, S. A., Lofgren, I. E., Greene, G. W., Delmonico, M. J. and Greaney, M. L. (2019) The Association between Physical Activity and Metabolic Syndrome in Older Adults with Obesity. *The Journal of Frailty & Aging* **8(1)**, 27-32. https://doi.org/10.14283/jfa.2018.34

Zając, K., Serweta, A., Salomon-Krakowska, K. and Szczepańska-Gieracha, J. (2017) The level of stress experienced in women over the age of 60 who take regular physical activity and pro-health activities. *Gerentologia Współczesna* **5(3)**, 120-124.

Zhang, D., Liu, X., Liu, Y., Sun, X., Wang, B., Ren, Y., Zhao, Y., Zhou, J., Han, C., Yin, L., Zhao, J., Shi, Y., Zhang, M. and Hu, D. (2017) Leisure-time physical activity and incident metabolic syndrome: a systematic review and dose-response meta-analysis of cohort studies. *Metabolism: Clinical and Experimental* **75**, 36-44. https://doi.org/10.1016/j.metabol.2017.08.001

Key points

- The low-intensity physical exercises combined with psychoeducation can significantly lower depression and stress levels in women with metabolic syndrome.
- The intervention does not lower anthropometric parameter scores.
- Improving mental condition is a good starting point for further health-related activities that can also contribute to weight reduction in the long run.

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