It is unclear to what extent the known psychosomatic benefits of exercise hold true for the obese. In the present study, we investigated the hypothesis that the psychosomatic health and components of general intelligence, such as the capacity for logical-deductive tasks, would be better in regularly exercising than non-exercising obese women. We addressed the issue in a self-reported survey study, comprising two groups of middle-aged obese women (age 30-50 years, BMI >30 kg/m\(^2\)) of 25 persons each. The criterion for the group division was regular exercise, minimum twice a week, for at least 2 months. The following psychometric tools were used: Physical Fitness and Exercise Scale, Patient Health Questionnaire-9 for depression, Life Satisfaction Scale, General Health Inventory-28, Raven's Matrices Test for intelligence, and a test for self-contentment with one's body figure shape. The exercising obese women scored significantly better in Life Satisfaction Scale (17.1 ± 1.2 vs. 12.0 ± 0.9), had a lower level of depression (8.1 ± 0.6 vs. 13.4 ± 0.7), and a better assessment of the health status (24.6 ± 1.6 vs. 36.4 ± 2.2) (reversed score) compared with non-exercising ones (P<0.05). The exercising obese women also appreciably better assessed their bodily looks. Interestingly, if depression was present in exercising women, it had more detrimental health effects than in physically inactive ones. The study failed to substantiate appreciable changes in general intelligence between active and non-active obese women. In conclusion, physical activity is of benefit for the psychosomatic health in obese women, which should be considered in behavioral counseling.

**Key words:** exercise, depression, obesity, psychosomatic health, woman

**INTRODUCTION**

The problem of obesity seems perennial in the history of humankind. The prevalence of obesity is sharply on the rise worldwide in recent years (1, 2).
Studies point to a multifactor background of obesity. Acquired habits, stress of everyday life, lack of physical activity, improper diet are just a few commonly recognized factors fostering body weight gain. Obesity is known to have a negative influence on the general health status and may underlie the development of a number of pathologies such as the metabolic syndrome, diabetes, or different types of cancer to name just a few (3-6). Moreover, there are psychological and social repercussions of being overweight or obese, all of which may lead to a worse quality of life, or even enhanced morbidity, of individuals (7-9).

Women in the mid-life period, who fecklessly try to lose weight, are quite often socially discriminated against or stigmatized due to their looks and thus are particularly prone to psychological sequelae of obesity (10). On the other side, studies indicate a wide positive influence of regular physical activity on the general health status, which includes not only the proper body weight and proportion, but also the psychological well-being. Exercise allows to decrease emotional tension, and thus to better cope with stress, to increase self-esteem, and to counteract depression (11, 25).

Experimental studies suggest that a surplus of fat tissue and dyslipidemia worsen cognitive functions through inhibition of N-methyl-d-aspartate-related component of the synaptic long-term potentiation in the hippocampus (12). Disturbance in the metabolism of glucose may lead to memory and intellectual deficits in obesity (13). Obesity also may disturb the hypothalamus-pituitary-adrenal axis, which results in enhanced secretion of corticosterone; the effect also linked to lower intellectual activity (14). Results of human studies corroborate the possibility of an untoward effect of obesity on the mental state (5, 7).

It is unclear to what extent physical activity could counteract the negative influence of obesity in the psychosomatic realm. In the present study, we addressed this issue by comparing the psychological and general health conditions in the physically active, exercising regularly for at least two months, and inactive obese women. We hypothesized that physically active obese women would be in a better general shape.

**MATERIAL AND METHODS**

**Subjects**

The study was approved by the Review Board of the Institute of Psychology of Opole University in Poland. Informed consent as obtained from all study participants.

All women enrolled into the study were obese, as assessed from the body mass index (BMI 31-39 kg/m²), and all were aged 30-50 years. The women were divided into two groups, consisting of 25 persons each, and the criterion of division was the level of physical activity. One group consisted of physically active women, mean age 40.2±1.2(SE) years, mean BMI 32.4 ±0.4 kg/m², exercising and involved in sports activities at the minimum of two times a week for at least two months preceding the time of survey. A second group consisted of women, mean age 41.7±1.2 years, mean BMI 33.4 ±0.4 kg/m², who did not fulfill the above-set criterion of physical activity.
The women of both groups were recruited from fitness and dietary clubs in the Opole and Wroclaw voivoidships in Poland.

**Psychometric tools**

Women in both groups studied were surveyed with the use of the following self-reported questionnaires. Complacency with one's body looks was assessed with a five-stage scale created by the authors for the purpose of this study. The scale assessed the following body parts: face, shoulders, breasts, waist, hips, thighs, legs, height, and weight. Complacency with each body part was scored separately and a higher score was indicative of greater complacency.

The presence and intensity of depression were assessed with the Patient Health Questionnaire (PHQ-9) by Kroenke, Spitzer, and Williams (15), which is a widely recognized diagnostic tool for mental health disorders used by health care professionals. The nine items of this test are based on the diagnostic criteria of depressive disorders as per the Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV. The score above four indicates the presence of depression. The results may achieve up to 27 points, the higher the score the greater the intensity of depression.

Satisfaction with life was assessed with the Life Satisfaction Scale by Diener, Emmons, Larson, and Griffin (16) in a Polish adaptation by Juczynski (17). The scale assesses the satisfaction from life and the presence of positive feelings. The score ranges from 5 to 35 points and the higher the score the better the satisfaction level. The results also may be expressed in stens; 1-4 stens indicate low, 5-6 stens medium, and 7-10 stens a high level of satisfaction with life.

Health status was assessed with the General Health Questionnaire (GHQ-28) according to Goldberg (18). The questionnaire is a tool that allows singling out persons whose suffer from a temporary or long-term breakdown due to experienced difficulties and problems. The GHQ-28 is structured into 4 subscales that evaluate different symptoms: somatic ailments, anxiety, insomnia, and impaired functions. The subscales are interdependent; therefore, their results are related to the general score. The higher overall score indicates a greater probability of psychosomatic ailments.

The main components of general intelligence, such as cognitive capacity to encode and analyze information and to think clearly and make sense of complexity were evaluated with Raven's Standard Progressive Matrices (19) in a Polish adaptation (TMS-K standard version) (20). The test consists of 5 sets; each containing 12 items. The items are in the form of incomplete matrices and the respondent is asked to identify the missing segment required to complete a larger pattern. Consecutive items in a set become increasingly difficult, requiring ever-greater cognitive and abstract reasoning capacity. The maximum possible score is 60 points which are recalculated into the centile and sten scales. The results encompass 5 categories:

- Category I (>95) - very high intelligence
- Category II (75-95) - over average intelligence
- Category III (25-75) - average intelligence
- Category IV (5-25) - below average intelligence
- Category V (<5) - very low intelligence

Physical activity, the criterion of study group attachment, was evaluated with the Physical Fitness and Exercise Questionnaire (21) in the authors' own adaptation. The test consists of 41 items for self-assessment of physical activity, divided into the following categories: fitness, psychological barriers, motivation for exercise, and the frequency of exercise. Points achieved in each category are summed up. There are no cut-off limits, but the following rules apply. For the fitness and motivation for exercise subscales, the lower the result the greater the fitness and the stronger the motivation. For the psychological barriers and exercise frequency subscales the higher the result the lower the barriers and the greater the exercise frequency.
Data elaboration

Data were expressed as means ±SE or in stens when indicated. Differences between the mean values for physically active and inactive obese women were evaluated with a two-tailed unpaired t-test. The influence of the intensity of depressive symptoms on the general health condition was evaluated with a linear regression analysis according to the equation y = ax + b, where 'a' is the slope describing a change in health on a unit increase in depression scale. P<0.05 was taken as indicative of significant differences.

RESULTS

Comparison of the mean group results for the physically active and inactive obese women is demonstrated in Table 1. There were significant differences concerning the level of self-contentment with one's body, the intensity of depression, the general health condition, and in the components of physical activity between the two groups. The physically active obese women had a significantly better judgment concerning the looks of their faces, breasts, legs, and height compared with the physically inactive ones. The active women also scored better on the Life Satisfaction Scale, had a lower level of depression, and a better self-assessment of health status (Table 1).

Table 1. Comparison of psychometric results between physically active and inactive obese women.

<table>
<thead>
<tr>
<th>Scale for complacency with:</th>
<th>Physically inactive</th>
<th>Physically active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face</td>
<td>2.1 ±0.2</td>
<td>2.9 ±0.2*</td>
</tr>
<tr>
<td>Breasts</td>
<td>2.1 ±0.2</td>
<td>2.8 ±0.2*</td>
</tr>
<tr>
<td>Shoulders</td>
<td>2.4 ±0.1</td>
<td>2.5 ±0.2</td>
</tr>
<tr>
<td>Waist</td>
<td>1.3 ±0.1</td>
<td>1.4 ±0.1</td>
</tr>
<tr>
<td>Hips</td>
<td>1.4 ±0.1</td>
<td>1.5 ±0.1</td>
</tr>
<tr>
<td>Thighs</td>
<td>1.3 ±0.1</td>
<td>1.4 ±0.1</td>
</tr>
<tr>
<td>Legs</td>
<td>1.7 ±0.1</td>
<td>2.2 ±0.2*</td>
</tr>
<tr>
<td>Height</td>
<td>1.4 ±0.2</td>
<td>3.6 ±0.2*</td>
</tr>
<tr>
<td>Weight</td>
<td>1.2 ±0.1</td>
<td>1.3 ±0.1</td>
</tr>
<tr>
<td>Fitness</td>
<td>26.2 ±0.8</td>
<td>20.8 ±0.6*</td>
</tr>
<tr>
<td>Motivation for exercise</td>
<td>28.1 ±0.8</td>
<td>23.4 ±1.2*</td>
</tr>
<tr>
<td>Psychic barriers</td>
<td>24.5 ±1.2</td>
<td>35.2 ±1.1*</td>
</tr>
<tr>
<td>Frequency of exercise</td>
<td>10.5 ±0.4</td>
<td>15.6 ±0.5*</td>
</tr>
<tr>
<td>Satisfaction with life</td>
<td>12.0 ±0.9</td>
<td>17.1 ±1.2*</td>
</tr>
<tr>
<td>Level of depression</td>
<td>13.4 ±0.7</td>
<td>8.1 ±0.6*</td>
</tr>
<tr>
<td>Health status</td>
<td>36.4 ±2.2</td>
<td>24.6 ±1.6*</td>
</tr>
<tr>
<td>Cognitive functions</td>
<td>75.4 ±3.2</td>
<td>75.9 ±3.0</td>
</tr>
</tbody>
</table>

Values are means ±SE of raw score. *P< 0.05 for the differences between physically active and inactive obese women.
However, there were no differences in the perception of other bodily parts, such as the shoulders, waist, hips, and thighs, or in body weight.

The above-mentioned differences between the physically active and inactive obese women were confirmed in the qualitative analysis. The level of satisfaction with life in the physically active obese women averaged 4.4 sten, which, albeit below the lower cut-off for the medium sten level of 5, was higher than that for the inactive women (3.0 sten).

The level of depressive symptoms was rather modest in both groups of the obese women studied. However, the group of physically active women had a smaller intensity of depression than that in the inactive ones, 8.1 ±0.6 vs. 13.4 ±0.7 points, respectively, P<0.05. The physically active women also scored significantly better on the general health status: 24.6 ±1.6 vs. 36.4 ±2.2 points in the inactive ones (reversed score) and had a significantly fewer psychological barriers and a higher motivation for regular exercise (Table 1; P<0.05). It is worthwhile to note that the results did not confirm the impact of obesity on the level of general intelligence, as women of both groups had similar capacity for cognitive and logical-deductive tasks (Table 1).

Since the physically inactive obese women scored worse regarding general health and depression, we examined the possible influence of physical activity on the interaction between these two factors in obesity. We found that in both groups the increasing level of depression was associated with worsening of the general health status (P<0.01 for both). Interestingly, however, as judged from the slope of the linear regression line describing this relationship, depression had a two-fold greater negative effect on psychosomatic health in the physically active than inactive obese women (Fig. 1).

Fig. 1. Relationship between the level of depression, assessed with PHQ-9, and general health status, assessed with GHQ-28, in physically active and inactive obese women. In physically active women, depression had about 2-fold greater impact on the health status than in inactive ones. On the Y-axis, a higher score denotes worse health status. Lines are linear regression lines, r - correlation coefficient.
DISCUSSION

The goal of the present study was to evaluate the influence of regular physical activity on the psychosomatic condition of obese women. The major finding of this study was that physical exercise had a positive effect on the majority of psychosomatic indices measured. Exercise fostered the self-esteem and complacency with one's looks, enhanced satisfaction with life, improved general health indicators, and, importantly, decreased the level of depression. Thus, it seems a reasonable assumption that physical activity also could counteract any social stigma stemming from sometimes disfigured body shapes in obese women and could improve their feeling of well being. To this end, the results of this study corroborate the findings of other authors, indicating beneficial effects of exercise on mood and anxiety (11).

By far, however, little is known about the influence of exercise on psychological health in the obese. The present study was spurred by the literature data pointing to the lack of physical exercise as a determinant of obesity and its health-related consequences (1, 4). On the other hand, there are plentiful data indicating the possible beneficial influence on health-related quality of life of regular exercise in the general population (22). We now extended those findings to the population of obese middle-aged women.

Obesity is a global problem (1). The underlying causes of it are multifaceted. Obesity comes from genes and life style habits; one of the latter being physical inactivity. One other cause, which should not be underestimated, is inaptitude in coping with anxiety or negative emotions which are supposed to be eased up by excessive eating; a substitutive effect from the psychological standpoint (9, 10). Secondary reasons for obesity are sedentary life, hormonal disorders, drugs, and past diseases (1-5). Middle-aged women are often prone to develop obesity, which becomes uncontrollable, decreases health-related quality of life, and becomes the source of social discrimination against, all of which leads to psychosomatic consequences (10, 23, 24).

The present study demonstrates no influence of regular exercise on cognitive and mental capacities, such as performing logical and deductive tasks, in obese women. Our results are discordant with those previous findings that suggest a negative influence of obesity on cognitive functioning in women (7). The reasons for the discordance are not readily apparent. In general, we noted an above-average level of intelligence in both study groups of obese women. All women were professionally active, which may help maintain intellectual functioning in both study groups of obese women. All women were professionally active, which may help maintain intellectual functioning, and which, therefore, might skew the results of intelligence testing. It is plausible that the impact of obesity on the level of cognitive and intellectual capacity would have come to sight had the women been older or the population sample larger. The level of education also may be influential in shaping intellectual activity; the factor not considered in the present study.
The present findings indicate that increasing intensity of depression worsened psychosomatic health in both physically active and inactive obese women, as reflected by a positive correlation between the PHQ-9 and GHQ-28 scores (the higher the GHQ-28 score the worse the health status; Fig. 1). Interestingly, this relationship was about two-fold stronger in physically active than in inactive women. The cause of more intense health impairment in the physically active obese in case of the appearance of depression is difficult to explain. A lower incidence of depression in physically active persons is known (25), and that was confirmed in the obese women of the present study as well. It is unclear, however, whether physical exercise, of what type and frequency, may constitute an adjunct treatment of depressive disorders. Some studies do seem to point to beneficial effects of exercise in depression and its prevention (11). On the other hand, intensification of depression, which usually involves a neglecting attitude toward regular physical exercising, may have a dedicatedly more negative effect on psychosomatic health in persons adapted than non-adapted to exercise training. The results of the present study suggest that a break in regular exercising hastens worsening of psychosomatic health in the physically active obese. Therefore, the appearance of symptoms of depression in this group of persons should prompt an active therapeutic approach to prevent detrimental health effects.

In conclusion, the present study gives a consistent impression that physical activity bears positive effects on general health and psychological quality of life in obese women; the effects otherwise hardly attainable. Therefore, regular physical exercise should become part of behavioral counseling in obesity, as it would facilitate more effective interventions to health-related issues of obesity and, considering the widespread prevalence of obesity, may favorably influence public health.

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