

MOOD CHANGES IN WOMEN PARTICIPATING IN THE AEROBIC EXERCISE PROGRAMME

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Abstract

Objective: The purpose of the study was to determine the impact on mood of participation in a six-month aerobic exercise programme.

Methods: The study was conducted using a natural experiment. The experiment included 60 women aged 24-45 years who were randomly assigned to the experimental group (group E), and the control group (group C). The participants of group E took part in the six-month programme of aerobic exercise known as low-impact aerobics. The classes were 60-minutes long and took place twice a week. Mood was measured using the UWIST Mood Adjective Checklist. Measurements were performed at four different points in time: in the first week of the programme (pre-test), after three months of exercising (halfway test), in the last week of the programme (post-test after six months of regular exercise), and six months after the programme's completion (follow-up).

Results: Lower levels of tense arousal (TA), as well as higher levels of both energetic arousal (EA) and hedonic tone (HT), were reported in group E only in the post-test. There was a significant decrease in TA in group E in the halfway test (after three months of exercise) and in the post-test, while EA and HT significantly increased in group E in the post-test. Such changes did not occur in group C.

Conclusions: The study has confirmed that regular physical exercise brings time-limited affective benefits, and the dynamics of changes varies depending on the dimension of mood.

Key words: mood, exercise, aerobic, women

Introduction

The impact of physical exercise on the affective sphere is well documented in literature on the subject. Researchers have mostly been interested in so-called acute effects, i.e., the impact of one-time physical exercise on the current emotional state of an individual [1-3]. The chronic effects of regular physical exercise, manifesting themselves mainly in mood changes, have been less examined. The results of studies, research reviews, and meta-analyses have indicated that regular physical exercise leads to improved mood [4-6]. The observed effects have ranged from minor to moderate, depending on the studied affective state, the type of exercise, as well as the intensity and duration of the programme. Most of the data have confirmed the beneficial effects of aerobic exercise of moderate intensity [6,7]. The affective states have mostly been studied using the Profile of Mood States [8]. Changes have been monitored throughout exercise programmes lasting from a few weeks to about a dozen weeks [9,10]. Rarely has it been checked whether the effects remained after the programme's completion [11]. In our opinion, this is the greatest limitation of previous studies.

The Profile of Mood States, developed by McNair, Lorr, and Droppleman [8] to track the effects of psy-

chotherapy, allows for the effective tracking of changes in the emotional sphere due to physical exercise. However, the scale was not based on any particular concept of mood, and the authors did not even provide definitions of measured states. This hinders the interpretation of the measurements.

The scale assesses five negative states and only one positive state (vigour). This proportion corresponds to greater interest in changes in negative emotional states, which is typical of the studies in the second half of the 20th century. The perspective of positive psychology, increasingly supported by sports psychologists, emphasises research on affective phenomena of positive valence [12]. More recent studies using other tools have gradually eliminated the disproportion between data on positive and negative affective states. The most recent meta-analysis [10] has confirmed a moderate increase in positive affect under the influence of regular aerobic exercise.

The impact of regular physical exercise on mood has mostly been examined only in a pre-test before a programme and in a post-test in a few weeks to about a dozen weeks after the completion of a programme. This makes it impossible to determine the dynamics of changes in mood. The small number of follow-up studies after a programme's completion results in in-

sufficient knowledge about the duration of emotional benefits [11,13].

The purpose of the present study was to determine the impact of participation in a six-month aerobic exercise programme on mood states of adult women and to determine the dynamics and duration of these changes. The study assumed that mood is an affective phenomenon not connected directly with an object. Further, that mood lasts longer than an emotion, for days or weeks and usually without any clear reasons, and that mood is either positive or negative and of low intensity [14]. A three-dimensional model of mood that takes into account three correlated factors – hedonistic tone, tense arousal, and energetic arousal – was a theoretical basis for the study. Schimmack and Grob [15] conducted an analysis of three models of affect: a) the pleasure-arousal model [16]; b) the energetic arousal-tense arousal model [17]; and c) the three-dimensional model [18]. The researchers found that the three-dimensional model best fits the empirical data.

Materials and Methods

The study was conducted using a natural experiment in compliance with the experimental study design for two groups adhering to the principle of randomisation. Volunteers willing to participate in the experiment were randomly assigned to the experimental group (group E) and the awaiting control group (group C).

Participants

The study included women who had previously led sedentary lifestyles (had not undertaken regular physical activity in leisure time over the previous year) and declared their willingness to take part in the exercise programme. Since affective well-being is dependent on, among other things, demographic and situational factors, additional inclusion criteria were used in order to unify the studied group in terms of socio-demographic characteristics: a) age (early-middle adulthood); b) place of residence (village in Masovian Voivodeship, Poland); c) having at least one school-age child attending primary or middle school. An additional criterion was the lack of medical contraindications to participation in sports classes.

Eventually, the study comprised 60 women aged 24-45 years ($M_{\text{age}} = 34.53$). The groups did not differ significantly with respect to age (group E: $M = 34.90$; $SD = 5.47$; group C: $M = 34.17$; $SD = 4.42$; $t = 0.57$; $p > 0.05$), number of children (group E: $M = 2.40$; $SD = 1.22$; group C: $M = 1.93$; $SD = 0.83$; $t = 1.73$; $p > 0.05$), education ($\chi^2 = 4.21$; $p > 0.05$), or occupation ($\chi^2 = 5.786$; $p > 0.05$).

The participants of group E took part in the six-month programme of aerobic exercise known as low-impact aerobics. This is a form of training that

stimulates cardiorespiratory endurance and develops muscular endurance. The classes were 60-minutes long and took place twice a week. The classes began with a 10-minute warm-up. The aerobic portion lasted 40 minutes and was characterised by moderate to high intensity. Then, the participants performed exercises shaping the abdomen and buttock muscles. The classes ended with five minutes of stretching. The exercise programme was implemented in group C a year later, and its effects were not monitored.

The UWIST Mood Adjective Checklist (UMACL) by Matthews, Jones and Chamberlain [18] in the Polish adaptation by Goryńska [19] was used to study mood. The scale measures three mood dimensions: tense arousal (TA), energetic arousal (EA), and hedonic tone (HT). The theoretical range in the scales of EA and HT spanned from 10 to 40 points. The theoretical range for the scale of TA spanned from 9 to 36 points. Tense arousal is anxious in nature. Energetic arousal determines the level of energy. Hedonic tone is a subjective feeling of pleasure.

Polish version of UMACL had good psychometric properties. Cronbach alpha varied from 0.83 to 0.90 in HT subscale, from 0.71 to 0.80 in EA subscale, and from 0.78 to 0.86 in TA subscale for men and women in different age groups. Validity was satisfactory.

Measurements were performed at four different points in time: in the first week of the programme (pre-test), after three months of exercising (halfway test), in the last week of the programme (post-test after six months of regular exercise), and six months after the programme's completion (follow-up).

Results

First, the pre-test measurements were compared using one-way analysis of variance (ANOVA). There were no significant differences between the groups with regard to the dimensions of mood (TA: $F(1, 58) = 1.36$, EA: $F(1, 58) = 1.29$, HT: $F(1, 58) = 1.52$, $p > 0.05$).

A repeated measures ANOVA (condition $\times$ time) was conducted in order to determine intergroup differences and changes over time. The main effects of group and time, as well as the interaction between them, were defined (Table 1). Significance of mood changes was determined for each group separately. Furthermore, significance of differences between the groups in the next three measurements was determined using one-way ANOVA.

Tense Arousal

Results of repeated measures analysis of variance indicated a significant main effect of group: levels of TA were significantly lower in group E. Comparisons of subsequent measurements for group E and group C showed that the results were significantly different only in the post-test ($F(1,59) = 17.63$; $p < 0.001$). The groups

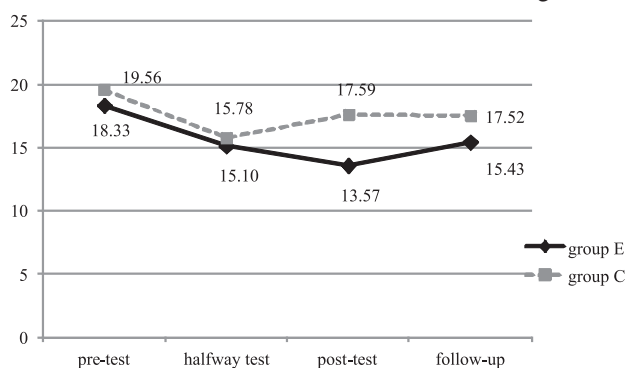
Table 1. *Mood according to Condition and Time*

Mood dimension	Condition		Time				ANOVA		
	E group M*	C group M*	Pre-test M (SD)	Halfway test M (SD)	Post-test M (SD)	Follow-up M (SD)	Condition F(1,59), p, η^2	Time F(3,56), p, η^2	Interaction F(3,56), p, η^2
Tense arousal	15.61	17.61	18.91 (4.31)	15.42 (4.54)	15.47 (4.42)	16.42 (5.22)	6.16, 0.02, 0.101	10.28, < 0.001, 0.368	2.34, 0.08, 0.117
Energetic arousal	32.22	29.81	30.39 (4.64)	31.16 (5.10)	31.68 (4.43)	31.11 (5.15)	8.20, 0.01, 0.130	0.81, ns	1.84, ns
Hedonic tone	32.64	30.45	30.18 (5.06)	32.02 (5.41)	32.58 (5.44)	31.65 (5.66)	5.30, 0.02, 0.088	2.34, 0.09, 0.112	2.12, ns

M* estimated edge mean

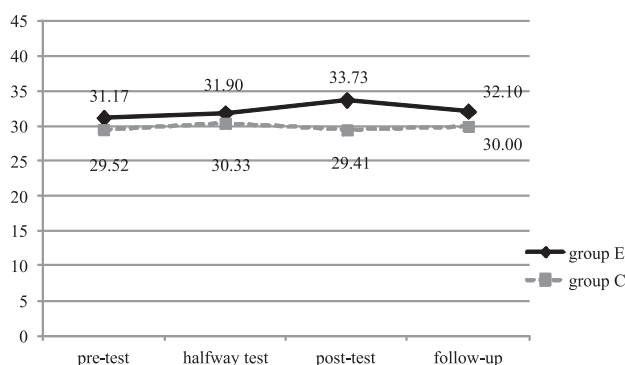
significantly differed neither in the halfway test ($F(1,59) = 0.77$) nor in the follow-up test ($F(1,59) = 2.32$).

There were significant changes in TA (main effect of time) in the entire group. They were significant both in group E ($F(3,26) = 13.042$, $p < 0.001$; $\eta^2 = 0.592$) and group C ($F(3,26) = 4.15$, $p = 0.02$, $\eta^2 = 0.342$). The direction of changes in the two groups differed: group x time interaction reached the level of a trend (Figure 1).

Figure 1. *Changes in tense arousal in experimental and control group*

Energetic Arousal

There was a significant main effect of group. EA reached higher level in group E. A comparison of the results in group E and group C in subsequent measurements indicated that the results were significantly different in the post-test ($F(1,59) = 18.91$, $p < 0.001$),

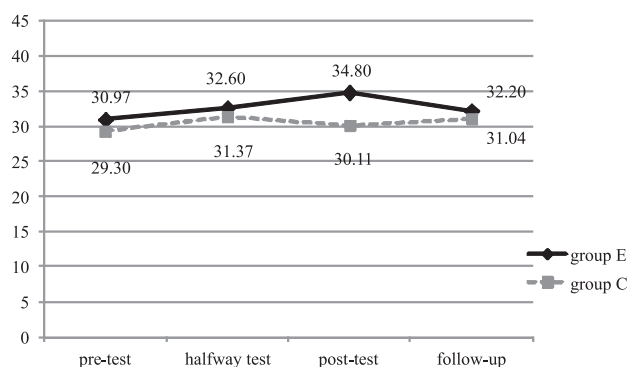
Figure 2. *Changes in energetic arousal in experimental and control group*

when EA level in group C was significantly lower. Neither of groups significantly differed with regard to EA ($p > 0.05$) in the halfway test ($F(1,59) = 1.86$) and the follow-up test ($F(1,59) = 2.42$) (Figure 2).

The main effect of measurement was also insignificant, as there were no significant changes in EA in the entire group. The changes in group E were statistically significant ($F(3,26) = 3.61$, $p = 0.03$, $\eta^2 = 0.286$). The changes in group C were not statistically significant ($F(1,29) = 0.27$, $p > 0.05$). There were no significant condition x time interactions.

Hedonic tone

HT level was significantly higher in group E (significant main effect of group). A comparison in the subsequent measurements indicated that the results were significantly different in the post-test ($F(1,59) = 14.14$, $p < 0.001$), when HT level in group C was significantly lower. Groups differed in their measurements neither in the halfway test ($F(1,59) = 1.58$) nor in the follow-up test ($F(1,59) = 0.59$) ($p > 0.05$) (Figure 3).

Figure 3. *Changes in hedonic tone in experimental and control group*

The main effect of measurement reached the level of a trend. HT changes were statistically significant in group E ($F(3,26) = 5.61$, $p = 0.01$, $\eta^2 = 0.384$) and insignificant in group C ($F(3,26) = 0.95$, $p > 0.05$). The interaction between the group and the measurement was not significant.

Table 2. *Changes in Mood in Experimental Group*

	Comparisons (1 pre-test; 2 halfway test, 3 post-test, 4 follow-up)					
	1-2 F(1, 29), p, η^2	2-3 F(1, 29), p, η^2	3-4 F(1, 29), p, η^2	1-3 F(1, 29), p, η^2	1-4 F(1, 29), p, η^2	2-4 F(1, 29), p, η^2
Tense arousal	16.08, > 0.001, 0.367	3.34, 0.08, 0.103	5.95, 0.02, 0.170	36.65, > 0.001, 0.558	10.32, 0.01, 0.263	0.22, ns
Energetic arousal	0.54, ns	5.54, 0.03, 0.160	3.52, 0.07, 0.108	8.88, 0.01, 0.234	0.85, ns	0.05, ns
Hedonic tone	3.93, 0.06, 0.119	6.63, 0.01, 0.186	7.67, 0.01, 0.209	17.65, < 0.001, 0.378	1.87, ns	0.26, ns

Dynamics of changes in the dimensions of mood

All measurements were compared with each other in order to determine the dynamics of mood changes in group E (Table 2). Level of TA significantly decreased during the first three months, the decline reached the level of a trend in the next three months, and, afterwards, there was an insignificant increase. Level of TA in the follow-up was similar to that observed in the halfway test; however, significantly lower than in the pre-test.

Level of EA did not change significantly for the first three months, while it significantly increased in the next three months. After the programme's completion, there was a slight decrease in EA, while the level of EA in the follow-up were similar to those observed in the first two measurements.

Moreover, dynamics of HT was different, too. There was a slight increase in HT level in the first three months and a significant increase in the next three months, whereas after the completion of the programme, there was a significant decrease in HT levels. The level of HT in the follow-up was similar to the levels in the pre-test and the halfway test.

Throughout the six-month programme, the biggest change occurred in TA; the smallest, in EA. The benefits seen in TA and HT significantly diminished over the next six months. EA and HT returned to the initial levels. TA slightly increased, but TA level was lower than in the pre-test.

Discussion

The research results demonstrated an improvement in mood of women who participated in the six-month aerobic exercise programme, whereas such changes did not occur in group C. Differences between the groups were statistically significant in the post-test in all three dimensions of mood. Measurements carried out after three months of exercising showed no differences. This suggests that emotional benefits appear after a certain time. Previous studies indicate that the duration of a programme is one of the moderators of the effects of exercise in the case of both negative and positive affect [9,10]. Most research indicates 10 weeks as the minimum period for the emergence of benefits [e.g. 20].

Perhaps the time necessary for the occurrence of emotional benefits would have been shorter if classes had been more often than twice a week. Reviews and meta-analyses have suggested that effects are the greatest when classes are held at least three times a week [9,10]. The participants of the present study most often declared a willingness to take part in classes twice a week. Thus, an increased number of classes could lower the rates of attendance and, consequently, reduce benefits [21].

Other factors influencing the effects are the nature and intensity of effort. The improvement in mood occurred most often after aerobic exercise of moderate intensity lasting 45-60 minutes [7,9,10]. That is the nature of a low impact aerobics; therefore, larger effects of participation in the programme could have been expected. However, due to the combination of moderate intensity and low frequency, participants might have given a dose that was too small [3]. It is worth remembering that there is also an interaction between dose size and fitness and physical endurance, as well as the experience of the participants in training [7,10,22]. The importance of socio-demographic factors (gender, age, place of residence, and family situation) cannot be excluded [23].

The initial levels of mood were also significant. An average measurement of TA noted in group E in the pre-test was at a sten score of six; the average measurement of EA and HT was a sten score of five. When starting the programme, participants characterised by moderate tense arousal, as well as by vigour and subjectively felt enjoyment. Previous studies have indicated that emotional benefits are more visible in people with elevated rates of negative affect or suffering from emotional disorders, because it provides more "space" for change [24]. "Floor effect" occurs in people with very low levels of negative states. "Ceiling effect" occurs in the case of people with high levels of positive states [6,10].

The study was conducted in natural conditions, which increased their ecological validity, but made it difficult to control potential moderators of the impact of exercise on mood. Tracking their significance is much easier when acute effects are examined, especial-

ly in a laboratory. These issues are worth considering. The relationship between the characteristics of an individual, environment, parameters of effort, and the effects in studies of chronic effects should be further investigated as well.

Lack of intergroup differences in the follow-up suggests that the effects of physical exercise in the sphere of mood are limited in time. Levels of positive affective states in group E in the follow-up did not differ significantly from the levels in the pre-test. Only in the case of TA did some effects remain. The levels of TA in the post-test were lower than in the pre-test, and similar to those observed in the halfway test. It is necessary to exercise regularly in order to maintain benefits. Similar conclusions can be drawn on the basis of other studies [13].

There is some evidence suggesting that the tendency to respond with negative emotional states declines in people who exercise regularly. Decreases in trait anxiety have been reported most frequently [6,9]. It is even possible to indicate potential psychoneurophysiological mechanisms that could be responsible for such changes (for example, decrease in the reactivity of the hypothalamic-pituitary-adrenal axis) [25]. However, such effects, expressed with a decrease in negative emotionality rather than an increase in positive emotionality, were not clearly confirmed in our study.

The research results also provide information on the dynamics of changes in various dimensions of mood. The effects in TA appeared earlier than in the positive states. Although group E in the halfway test did not differ from group C with regard to TA, the decrease in the first three months was statistically significant. The dynamics of changes decreased later. The changes in dimensions of positive affect over the first three months were not significant when compared both between the groups and within group E. Emotional benefits were only seen after six months of exercise. After the cessation of exercise, the withdrawal of effects was more visible: the levels of EA and HT lowered to the levels in the first two measurements. The differences in the effects of physical exercise depending on the valence of affect were also put forward by Reed and Buck [10]. Undoubtedly, this should be a subject of future research.

The research presented in the paper has some constraints. The first limitation results from the sampling applied. The study was intentionally conducted with a group of mothers of school-age children from rural environments. The women had led sedentary lifestyles prior to the exercise program. Dependences found apply to this group, thus researchers should be careful when generalising them to other groups of different demographic characteristics.

Further, the restrictions mentioned above are imposed by the method of natural experiment. However, we are convinced that lesser methodological rigour is

balanced by the advantages associated with examining people in their natural environment.

The fact that the participants could not freely choose the form of physical activity, but instead had to take part in the exercise programme of imposed form, intensity, frequency, and duration reduced the ecological accuracy of the research. Exercise in accordance with individual preferences could yield greater benefits.

In conclusion, the present study has confirmed that regular aerobic exercise brings time-limited affective benefits in the sphere of both negative and positive affect, while the dynamics of change varies depending on the dimension of mood.

Declaration of interest

The authors report no conflicts of interest.

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ZMIANY NASTROJU U KOBIET UCZESTNICZĄCYCH W PROGRAMIE ĆWICZEŃ TLENOWYCH

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Streszczenie

Cel: Celem badań było ustalenie wpływu udziału w sześciomiesięcznym programie ćwiczeń tlenowych na nastrój.

Metoda: Zastosowano metodę eksperymentu w warunkach naturalnych. Badaniem objęto 60 kobiet w wieku 24-45 lat, które zostały losowo przydzielone do grupy eksperymentalnej i kontrolnej. Badane z grupy eksperymentalnej brały udział w sześciomiesięcznym programie ćwiczeń fizycznych (low impact aerobics). Zajęcia trwały 60 minut i odbywały się dwa razy w tygodniu. Nastrój badano za pomocą Przymiotnikowej Skali Nastroju UMACL. Przeprowadzono cztery pomiary: w pierwszym tygodniu programu (pretest), po trzech miesiącach ćwiczeń, w ostatnim tygodniu programu (posttest - po 6 miesiącach regularnych ćwiczeń) i w pół roku po zakończeniu programu.

Wyniki: W grupie eksperymentalnej zanotowano niższy poziom pobudzenia napięciowego (PN) i wyższy poziom pobudzenia energetycznego (PE) oraz tonu hedonistycznego (TH) jedynie w postteście. U kobiet uczestniczących w programie ćwiczeń nastąpił istotny spadek PN po trzech miesiącach ćwiczeń i w postteście oraz istotny wzrost PE i TH w postteście. Zmiany takie nie wystąpiły w grupie kontrolnej.

Wnioski: Wyniki potwierdzają, że regularna aktywność fizyczna przynosi ograniczone w czasie korzyści w sferze afektywnej, a dynamika zmian zależy od wymiaru nastroju.

Słowa kluczowe: nastrój, ćwiczenia fizyczne, aerobik, kobiety

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