

AGE AND EXERCISE DURATION AS DETERMINANTS OF THE EFFECT OF SINGLE BOUT OF EXERCISE ON STATE ANXIETY IN WOMEN

DETERMINANTS OF ACUTE EFFECT OF EXERCISE ON STATE ANXIETY IN WOMEN

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Abstract

Introduction: Anxiolytic effect of one-time physical exercise was confirmed in many experimental researches. Determinants of this effect are yet still not fully recognized. The aim of this study was to see whether the influence of one-time physical exercise on women state of anxiety differs with regard to age of trainees and duration of the exercise session.

Materials and Methods: Natural field research involved 163 women aged 16-56 who participated in various forms of physical exercise in Warsaw fitness clubs. Spielberger and colleagues State-Trait Anxiety Inventory along with author's own-design questionnaire on physical activity and type and duration of the exercises included in the research were applied. Measurement of the state anxiety was carried out immediately before starting the fitness session and 10 minutes after completing the exercise.

Results: Research results let us claim significant decline of the state anxiety in case of younger women (aged 16-34), while for the oldest group of trainees (aged 35-56) no significant changes were observed. The highest anxiety decline was noticed in the 24-34 years of age group. Anxiolytic effect was the strongest for exercise session lasting 45-60 minutes and less evident for 30 minutes exercise session. It diminished completely in case of exercise sessions lasting more than an hour. Therefore, age of trainees and duration of training session should be considered important determinants of decline of the state anxiety.

Conclusions: Research results enable to claim, that duration of training sessions should be adjusted individually according to the age of trainees (also for early and moderately maturity age) and that there is an optimal for positive psychological effects time of training sessions. The subject of further research should be both the lowest and highest time limit for which anxiolytic effect is observed.

Key words: *exercise, women, anxiety*

Introduction

The beneficial impact of physical exercise on human mental life was well documented in much research, both experimental and correlational. In reviews and meta-analyses (1, 2) the highest scientific value is expected from results of lab experiments, where randomisation and control over confounding variables is assured, and precise measurement means (especially for physiological indicators) may be applied. Yet, recently ecological accuracy of such research is discussed and questioned. Research samples consist of volunteers who are randomly allotted to experimental and control group, execute training tasks or participate in one-time training sessions according to the experimental design. They do not have any influence on the type of experimental exercise and its intensity. We know from the research, that fitness clubs trainees undertake physical training of intensity lower than in lab experiments and that their training is usually more diversified. Moreover, experiment participants do feel

investigated and this also distorts research results (the will of being "good trainee" or following suggestions of an experimentator and overdoing).

Natural field experiment does not enable full control over all key variables. The sample also includes volunteers, but they come to the gym or fitness hall regardless to our experimental plans, of their own will, for the classes they chose and duration and intensity of exercise that they accept. They must only agree on filling in questionnaires. In such a case, scientist must rely on validity of answers concerning duration of the exercise session, their intensity or type of physical effort, and he/she does not have a chance to manipulate these variables. The price for ecological accuracy is reduction of control capacity over terms and validity of measurement.

In the research on acute anxiolytic effect of physical exercise, i.e. the impact of one-time physical effort on human psyche, the subject of investigation is often the state anxiety. Decline of the level of the state anxiety

after one-time physical exercise was observed in many researches both for aerobic (1, 3, 4) and strength efforts (5-8), although in later case results were less unequivocal (3, 9, 10).

In case of our research, decline of the level of the state of anxiety was noticed after classical aerobic training (11-13), aqua aerobic (14), yoga (15, 16), exercise bike training, body shape class, TBC (17), and for women from slimming program class (18). These exercises were either aerobic or mixed physical efforts. No decline of the state anxiety was observed for women involved in strength exercise.

Scientists are also looking for factors that determine the scope of anxiolytic effect among effort parameters (such as type of effort, intensity and duration) and features of trainees (age, gender, physical fitness level, experience, selected personality features). Early analyses focused on the type of effort and trainees' experience. The strongest anxiolytic effect was recorded for women involved in mixed type of efforts and practising from 2 to 3 month (19).

In the analyses based on literature reviews, it is usually underscored that emotional benefits emerge when physical exercise lasts at least 20 minutes (1, 2). There are some exceptions. In the research of Petruzzello and Landers (20) state anxiety reduction was observed for treadmill session both after 15 and 30 minutes following the exercise. Investigated individuals usually exercise for 45-50 minutes (5, 21-23), and this is the usual duration of group fitness class in fitness clubs.

Scientists are more interested in minimal time of effort that causes emotional benefits than in whether there is an upper time limit after which positive effects decrease or diminish. It is even quite probable that too long exercise, especially of high intensity, instead of improving state of mind through the reduction of the state anxiety, bring about deterioration of mind as a result of fatigue. This was observed with women involved in aerobic, high intensity stepping efforts, for TBC classes (16), and with trainees executing exhausting tasks on exercise bike (24).

Important variable is also age of trainees. Meta-analyses of research (2) showed that anxiolytic effect level for people aged 31-45 was almost twice high than for the group aged 18-30. In many research reviews and meta-analyses (1, 25), authors claim that effects are independent from age and gender of trainees, while this issue is quite seldom investigated. Some results nevertheless suggest, that age is a variable moderating importance of effort intensity. With older trainees, psychological benefits appeared most often after lower intensity exercise, while with school-age youth this results was observed after high intensity exercise (26).

The aim of our research was to determine whether the impact of one-time physical exercise on females'

state anxiety depends on the age of trainees and duration of exercise.

We put following research questions:

1. Does age of trainees differentiate the anxiolytic effect of one-time physical exercise?
2. Does exercise duration differentiate this effect?

We presumed that:

1. The age of trainees does not differentiate anxiolytic effect of one-time physical exercise.
2. Anxiolytic effect is the strongest for exercise session lasting 45-60 minutes.

Materials and Methods

Natural field research was carried out. The research involved 163 women aged 16-56 ($\bar{x}$ =29.28; SD=8.782) who participated in various forms of physical exercise in Warsaw fitness clubs. They were all encountered before the exercise in their clubs and declared willingness to participate in the research.

Directly before the exercise, investigated women filled in the state anxiety scale of State-Trait Anxiety Inventory (STAI) of Spielberger's and colleagues (27). Next, after completing their group or individual training session, trainees were interviewed and asked about their regular physical activity and type and duration of analysed fitness training. Following this, they filled in the trait anxiety scale and again the state anxiety scale of STAI. Subsequent measurement of the state of anxiety took place 10 to 12 minutes after finishing the exercise.

Investigated women participated in group sessions and individual trainings of various types: aerobic exercises (individual exercise on treadmill, exercise bike, stepper, group aerobic exercises such as aerobic, step, fat burning; n=46); strength exercises (individual strength exercise with weights and bars; n=21) and mixed exercises (body reinforcing and shaping – ABT, TBC; n=96). Research results analysed with regard to the type of physical effort were presented in earlier paper (19).

Based on questionnaire data, investigated women were divided into three age groups:

- Group one: trainees aged 16-23, i.e. late adolescents ($\bar{x}$ =21.12; SD=2.007; n=50);
- Group two: trainees aged 24-34, i.e. early maturity age ($\bar{x}$ =28.56; SD=3.043; n=82);
- Group three: trainees aged 35-56, i. e. moderate maturity age ($\bar{x}$ =44.32; SD=6.220; n=31).

Moreover, three groups were defined with regard to the duration of research exercises:

- about 30 minutes (n=20);
- 45-60 minutes (n=116);
- over 60 minutes (n=27).

The groups are significantly different with regard to their size, due to natural character of the experiment, not interfering with the time of training session but just recording the time of trainees' training.

Age groups did not vary significantly as far as the type of physical effort ($\text{Chi}^2=4.302$; $P=0.367$ respectively) and training session duration ($\text{Chi}^2=4.261$; $P=0.372$) were concerned. Different types of physical efforts was observed for exercise time difference based groups ($\text{Chi}^2=53.480$; $P<0.001$). In the shortest exercise time groups, majority of women executed strength (52.4%) and aerobic (36.8%) efforts. Trainees who practiced for 45-60 minutes were most often engaged in either mixed (70.7%) or aerobic (25.9%) type of effort. The longest training sessions' group was very heterogeneous with regard to type of physical effort: mixed – 44.4%; aerobic – 33.3%; strength – 22.3%.

Results

Figure 1 shows results of state anxiety level measurement before and after the exercise in defined age research groups. Measurement differences significance was determined with a non-parametric Wilcoxon signed-rank test. Additionally, for significant differences effect size was calculated according to the following formula: $\text{ES} = (M_{\text{before}} - M_{\text{after}}) / \text{SD}_{\text{before}}$ (where M – mean, SD – standard deviation). Value less than 0.39 was considered small (i.e. indicating small effect

of exercise), value 0.40 to 0.69 was considered moderate, while rates exceeding 0.70 was considered high. Moreover, for each group, change coefficient value was calculated deducting post-exercise measurement result from pre-exercise result. Hence, positive value of the coefficient indicates decline of state anxiety level after physical exercise.

Between-group differences of pre- and post-exercise anxiety level and change coefficient were also determined with Kruskal-Wallis test.

For the group of late adolescents (aged 16-23) significant decline of anxiety level following the exercise was observed ($Z=3.368$; $P=0.001$). ES rate reached 0.49, which show moderate anxiolytic effect.

Also for the early maturity group (aged 24-34) significant decline of state of anxiety level after physical exercise was observed ($Z=4.879$; $P<0.001$). ES rate of 0.59 allows defining it as moderate, but is higher than in youngest research group.

For female trainees over the age of 34, no significant change of the state of anxiety after the exercise was observed ($Z=1.448$; $P=0.148$).

Between-group comparisons show that age groups do not differ significantly with regard to state anxiety

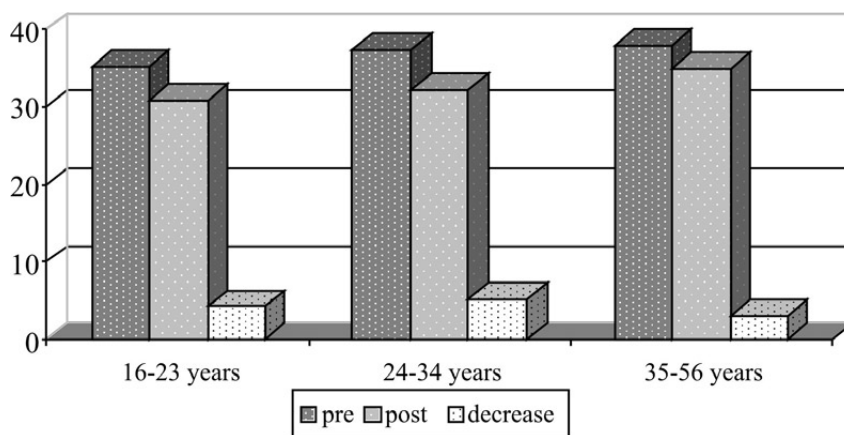


Fig.1. State anxiety level before and after exercise in defined age groups

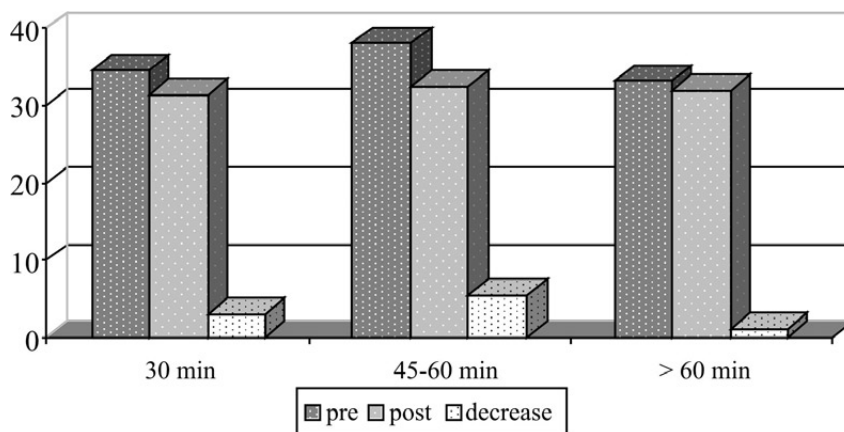


Fig.2. State anxiety level before and after exercise in three different exercise time groups

before ($\chi^2 = 2.494$; $P = 0.287$) and after physical exercise ($\chi^2 = 4.613$; $P = 0.100$) and are similarly prone to react with states of anxiety ($\chi^2 = 1.736$; $P = 0.420$).

Taking into account exercise duration, research show that for trainees practicing for about half an hour, significant decline of state of anxiety was observed ($Z = 2.286$; $P = 0.022$). The scope of decline may be defined as moderate ($ES = 0.44$). 45-60 minutes exercises also led to significant decline of state of anxiety ($Z = 5.553$; $P < 0.001$). While anxiolytic effect in this case was also moderate ($ES = 0.60$), it was stronger than the one observed for shorter exercise. Exercises lasting over an hour, did not significantly decreased state of anxiety level ($Z = 1.003$; $P = 0.316$) (Fig. 2).

Between-group comparisons prove that groups did not differ with regard to the trait anxiety feature ($\chi^2 = 3.195$; $P = 0.202$) and state of anxiety level following the exercise ($\chi^2 = 1.323$; $P = 0.516$). Default state of anxiety (prior to the exercise) was nevertheless different ($\chi^2 = 11.484$; $P = 0.003$) – it was the highest with 45-60 minutes sessions trainees and the lowest for over-an-hour trainees.

Final stage of data analysis was step-by-step regression analysis with anxiety change rate after the exercise introduced as dependant variable (anxiety change = anxiety_{before} – anxiety_{after}), and trainees age, training experience, type of physical effort, training session duration and trait anxiety considered as change determinants. Results of this analysis are presented in table 1.

Table 1. Last step of step-by-step regression analysis for the change rate of state anxiety

Predictors	beta	t	P
Exercise duration	-0.351	4.073	0.000
Training experience	0.288	3.309	0.001
Type of exercise	-0.206	2.354	0.020
Age	-0.199	2.359	0.020
Model	$R^2 = 0.212$; $F = 8.881$; $P < 0.0001$		

The importance of training experience and type of physical effort (mixed, aerobic, strength) were discussed in detail in our earlier publication (19). Hence, in this paper we focus on remaining predictors of state of anxiety change after physical exercise (higher value of an indicator informs on higher anxiolytic effect). Training session time and age of trainees seem good predictors of such a change. Higher decline of state of anxiety should be expected for younger women engaged in shorter training sessions (training session time and age are negative predictors). All four predictors enable to foresee the change of state of anxiety level after physical exercise in little over 20%. Quite interestingly, trait anxiety is not a significant predictor

of the decline of the state of anxiety following physical effort.

Discussion

Research results confirm well described in the literature decline of the state of anxiety after one-time physical exercise (2-8). But they also show strong variability of anxiolytic effect depending on the age of female trainees, which is contradictory to some research evidence and conclusions emerging from research reviews and metaanalyses (1, 25). The highest decline was observed with early maturity age women, it reached a little lower value for the younger group and did not occur at all in case of the oldest group. Our first hypothesis was not confirmed.

The significance of age as a factor determining anxiolytic effect of one-time physical exercise is revealed by regression analysis – age is a negative predictor of the rate of state anxiety decline following the exercise. It may be assumed that relationship between the age and size of anxiolytic effect is curvilinear – first we notice its small increase along with growing age of trainees, and then significant weakening of this effect.

Due to the differences in age group boundaries, it is quite difficult to refer our results to these presented in Petruzello and co-authors meta-analysis (2), where significant, and two times bigger anxiolytic effect was observed for the older group of women (aged 31-45) in comparison to the group aged 18-30. Increase of anxiolytic effect does not have to cease at the stage of early maturity (age 35).

Based on our research results it is not possible to claim that reduction of anxiolytic effect with the older group is the sole effect of the age, age-correlated factors (such as physical capacity and fitness) or relationships between them and other physical effort parameters. Significant number of investigated trainees participated in group session which precluded individual adjustments of training loads. One training session may therefore have intensity suitable for younger women and too high for older trainees. Clearing these issues requires experimental design with higher control over variables impacting the size of anxiolytic effect.

Results concerning aerobic efforts are not equivocal with regard to this issue. They show beneficial effects regardless to the intensity of the exercise. The example may be step training where release of tension, depression, fatigue and anger along with increase of vigour was observed after 50-minutes long training sessions of both low and high intensity (23). On the other hand, Koltyn et al. (24) did not observe any significant changed in the state anxiety level and negative moods after exhausting short-lasting exercise bike session. The only thing they have observed was increase of fatigue and decline of vigour. Most often, moderate intensity of exercise is recommended (2).

Research results indicate that exercise duration may be an important determinant of the decline of state anxiety after one-time physical exercise. The most emotional benefits were obtained by female trainees practicing 45 to 60 minutes and significantly weaker effects were observed to shorter training sessions. Our second hypothesis was confirmed. With people practicing over an hour not significant decline of the anxiety level was noticed. Between-groups comparisons again suggest curvilinear relationship between variables – along with the increase of the time of exercise anxiolytic effect initially increases and then declines. Based on these data we may conclude that optimal duration of training session would be 45 to 60 minutes, i.e. the time of regular group fitness session. In experimental research training time very seldom exceeds 60 minutes because lower limit (the shortest time revealing anxiolytic effect) seems much more interesting than upper limit after which the effect diminishes (5, 21-23). Many scientists suggest that to see any emotional benefits we need at least 20 minutes long exercise (1, 2).

Interpretation of our research results is made somehow difficult by the fact, that trainees engaged in the longest training session revealed the lowest default level of the state anxiety before the exercise; it was the highest with the women practicing for 45-60 minutes. It is well known, that default state anxiety to some extent determines the scope of its change after the exercise. When default value is moderate or low, possibility of significant decline after the exercise is lower comparing to persons experiencing strong anxiety prior to the exercise. In many experimental researches various stimuli (e.g. caffeine) are applied in order to increase the state anxiety level prior to the exercise (28, 29). Not many research involve clinical populations. Breus and O'Connors (30) observed significant decline of the state anxiety after 20 minutes of low intensity aerobic exercise with group of female students of above the norm rates of the state anxiety.

Research limitation is also the minimal result in the applied measurement scale, sometimes defined as so called "floor effect". One should not expect people of very low default anxiety to experience anxiety decline after the exercise (1).

In other research (5) individuals of high default anxiety level experience its stronger decline after 50-minutes long aerobic step exercise. With these of lower default anxiety level, the decline was less significant, yet visible. It means that exhausting aerobic exercise may bring about psychological benefits also to people not experiencing strong anxiety.

The fact, that problems undertook in natural field research were not clearly explained, in our view does not undermine the value of such research, which seem to be very valuable at the initial stage of investigating the problem. They certainly enable to point out direc-

tions of further analyses, which shall be carried out in well controlled experimental conditions enabling assessment of the impact of variables noticed as important in natural field research.

Research results provide us also some practical advice. First, one should underscore the necessity of individualisation of training process based on the age of trainees if one expects also positive psychological results. The exercise that is beneficial to the young, does not necessarily have to improve state of mind of older trainees.

Secondly, time of training session is an important factor, which should be taken into account when analysing psychological outcomes of physical exercise. Relationship between the "dose" of physical effort and positive psychological outcome seems to be rather curvilinear than linear, just like in case of the physical health. "More" does not mean "better" and the happy medium compromise rule may be valid also in this case.

Acknowledgement

Research prepared within the framework of the research problem „Physical activity of young women and their psychological well-being and stress management“ – statutory project of the Jozef Pilsudski University of Physical Education, Warsaw, Poland (DS 99) financed by the Polish Ministry of Science and Higher Education.

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Received: April 07, 2009

Accepted: June 10, 2009

Published: June 18, 2007

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