

Psychophysiological and affective reactions of female students to short high-intensity interval training with own body weight

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Abstract

Objective of the study was to objectify the psychophysiological and affective reactions of recreationally inactive female students to short high-intensity interval training with their own body weight (whole-body HIIT).

Methods and structure of the study. 10 recreationally inactive healthy students of Pskov State University took part in the experiment. Subjects were asked to perform a short whole-body HIIT workout consisting of 10 stimuli lasting 30 seconds, alternating with 30 seconds of passive rest. After each stimulus, individual perception of the load and affective valence were assessed. The performed motor cycles were counted. Heart rate was recorded throughout the workout.

Results and conclusions. Affective valence during training decreased on average in the group from 3.9 ± 1.1 and 0.5 ± 2.6 points, and individual perception of the load linearly increased on average in the group from 3.3 ± 0.8 to 6.6 ± 1.3 points, in the absence of a significant decrease in physical performance. The reaction of the cardiovascular system during the implementation of the experimental protocol objectively corresponded to the parameters of high-intensity training, at the same time, the results of the analysis of affective reactions suggest that for the majority of recreationally inactive female students this protocol will be comfortable enough to perform.

Keywords: *affective valence, high-intensity interval training, recreationally inactive female students.*

Introduction. High-intensity interval training (HIIT) is one of the top 10 most popular fitness trends in the world [9]. A systematic review of scientific publications over the past 15 years has shown [1] that some HIIT models are used for non-sporting contingent, as well as people who previously led a sedentary lifestyle, in order to maintain and improve health.

HIIT seems to achieve similar results as more traditional fitness programs, but with less time [3, 11], which is an important advantage of this training concept, since one of the main factors preventing the adoption and maintenance of more physically active lifestyle is the lack of time for physical training [4]. On the other hand, the performance of repetitive high-intensity stimuli may require a high level of motivation,

discomfort due to high physical activity and cause negative affective reactions [5]. Affective reactions during physical exercise are considered an important factor that can affect future behavior associated with physical activity, in particular adherence to it, which is quite well described by the affective-reflexive theory of a sedentary lifestyle and aversion to physical exercise [7].

The results of the study of the physical activity of students of Pskov State University (hereinafter referred to as PskovSU) showed that, for various reasons, classes in disciplines (modules) in physical culture and sports are the only source of intense and moderate physical activity for 35.38% and 30.26% of students, respectively [2].



The most accessible for a wide range of people is high-intensity interval training with its own body weight (whole-body HIIT), developed by A. Machado [10]. It does not require sports equipment and can be recommended for healthy adults to improve the parameters of the main health-related components of physical fitness: aerobic performance, body composition (composition), maximum strength and strength endurance [11]. However, there are currently no studies evaluating psychophysiological and affective responses during short whole-body HIIT protocols in individuals who are not recreationally active.

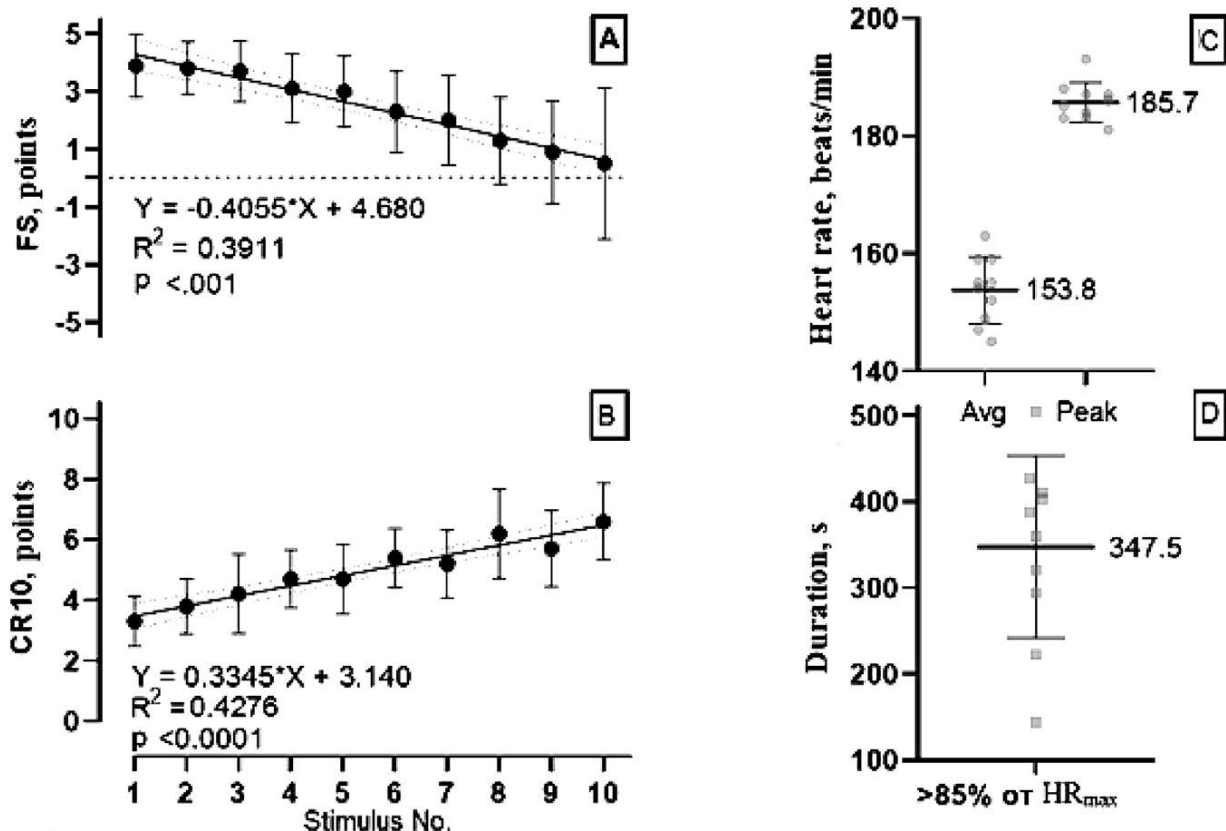
In this regard, the research problem is the need to justify the applicability of short whole-body HIIT protocols to achieve the goals of maintaining and improving the health of recreationally inactive students from psychological and physiological positions.

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Methods and structure of the study. Information about the experiment, its goals and procedure was distributed through the official communities of PskovSU in social networks. Potential subjects were asked to follow the link to the Yandex.Forms service to check their compliance with the inclusion criteria (the main group for physical education; age from 18 to 24 years; physical training ≤ 1 time per week over the past two months; confirmation of voluntary consent to participation in the study). During the deadline, 16 applications for participation in the study were received, of which three were filled out incorrectly and excluded. At the appointed time, three students did not appear for the study. Thus, the study involved 10 female students aged 19.1 ± 1.0 years who met the inclusion criteria.

The experimental whole-body HIIT protocol was developed based on the recommendations [10] and



Avg - average heart rate in the main part of the workout, **Peak** - peak heart rate in the main part of the workout, **Format:** $\bar{x} \pm SD$; **Dashed lines** - 95% CI models

Psychophysiological and affective reactions in the main part of the experimental protocol (A - affective valency; B - individual perception of physical activity; C - average and peak values of heart rate; D - duration of work in a high-intensity heart rate zone)



was a 20-minute workout. The main part of the training, lasting 10 minutes, consisted of alternating 10 stimuli of total intensity and passive rest with a ratio of 1:1 for 30 seconds. The complex included two exercises: Jumping Jack and squats. Odd stimuli are Jumping Jack, and even stimuli are squats.

Estimated parameters. *Body mass index (BMI)* was calculated using a standard formula after measuring body length with a stationary stadiometer and body weight with Huawei Scale 3-527 scales (Huawei Technologies, China, 2021). Weekly energy expenditure was calculated in metabolic equivalents (MET) from analysis of the short version of the physical activity self-report (IPAQ-SF). *Individual perception of physical activity* was assessed immediately after the execution of each stimulus using the 10-point Borg scale (CR10) [10]. *Affective valence* was assessed at 15 seconds of each rest period using an 11-point bipolar (pleasure/displeasure) sensation scale (FS) [8]. *Heart rate (HR)* was recorded using a Polar H9 chest heart rate monitor (Polar Electro, Finland, 2020) in conjunction with a smartphone and the installed Polar Beat v 3.5.5 application (Polar Electro, Finland). We calculated the average, peak heart rate values in the main part of the training and the duration of stay in the heart rate zone $>85\%$ of the theoretically predicted maximum heart rate value (HRmax). *External parameters of physical activity* were evaluated by counting the number of motor cycles performed during each stimulus.

Statistical processing, data analysis, and visualization of the obtained results were carried out using GraphPad Prism 8 (GraphPad Software, USA). The D'Agostino-Pearson test was used to check the normality of the data distribution. The dynamics of the measured parameters was assessed by regression analysis. Data are presented in the format \pm SD. Statistical significance was taken at $p \leq 0.05$.

Results of the study and their discussion. BMI and volume of weekly physical activity in the sample were 23.6 ± 3.1 units and 2313.0 ± 989.0 MET, respectively. The main results of the study are shown in the figure.

The group mean value of affective valency in the first and last periods of recovery was 3.9 ± 1.1 and 0.5 ± 2.6 points, respectively. Individual perception of physical activity of the first and last stimulus averaged 3.3 ± 0.8 and 6.6 ± 1.3 points, respectively. The affective valence regression model shows a significant differ-

ence of the slope from zero ($p < 0.001$), as in the case of the individual load perception model ($p < 0.0001$). The coefficient of determination of models A and B was 0.3911 and 0.4276, respectively.

The group mean heart rate in the main part of the experimental protocol was 153.8 ± 5.7 beats/min, and the peak value was 185.7 ± 3.4 beats/min. The duration of the main part of the training in the HR zone above 85% of HRmax averaged 347.5 ± 105.8 s for the sample.

The average number of motor cycles for the sample in the Jumping Jack exercise was 37.1 ± 4.4 and 36.4 ± 3.4 for the first and last stimulus, respectively, and when performing squats - 20.7 ± 1.7 and $20, 2 \pm 3.0$. The regression model describing the dynamics of the number of motor cycles of both exercises did not show significant differences in slope from zero ($p = 0.6110$) and ($p = 0.6023$).

The main results of the study are the data that the experimental whole-body HIIT protocol is well tolerated by recreationally inactive female students. After the first stimulus, the subjects rated their feelings on average between "Very good" and "Good", and after the final stimulus, "Neither good nor bad." Nevertheless, the last two stimuli, in exceptional cases, caused discomfort ("Rather bad", "Bad").

The absence of a significant decrease in physical performance during the implementation of the experimental protocol indicates adequately selected training variables that correspond to the specifics of high-intensity interval training and the selected contingent. At the same time, the individually perceived load increased linearly, the first stimuli were rated by the subjects on average as "moderate", and the latter more often as "heavy", which indicates the development of compensated fatigue.

The response of the cardiovascular system during the implementation of the experimental protocol is objectively consistent with the parameters of high-intensity training, suggesting significant health benefits. At the same time, the results of the analysis of affective reactions suggest that for the majority of recreationally inactive female students, this protocol will be comfortable enough to perform.

Conclusions. Short whole-body HIIT workouts can be used in groups of recreationally inactive healthy female university students for the purposes of maintaining and promoting health as a first practical experience of HIIT.



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