HORMONAL RESPONSES TO DIFFERENT-ORIENTATION POWER EXERCISES AND THEIR IMPACT ON PECULIARITIES OF HUMAN BODY ADAPTIVE REACTIONS

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Abstract
The article reflects the results of studies concerning the characteristics of changes in the cortisol and testosterone concentration in blood serum of untrained young men in terms of using particular frequency of different power load and intensity modes, which vary significantly in structure. One of the main objectives of this research was to examine the question of humans’ adaptive reactions dependence on the characteristics of data changes in steroid hormones concentration in blood serum applying different volume and intensity power loads training.

It was established that the studied hormones concentration in response to high intensity power fitness training (training mode=0.71 conventional units) increases by 10.2% (p<0.05) at the beginning of the experiment to 19.4% (p<0.05) at the end of training mesocycle. Using average intensity power loads training with large amount of work (training mode=0.64 conventional units) causes the opposite hormonal response that is manifested in reduced testosterone concentrations by 12.6% (p<0.05) and cortisol concentrations by 16.4% (p<0.05) in blood serum after motor activity compared to the pre-training state, but not beyond the norm. Herein, basal testosterone level decreases by 11.2% (p<0.05) during mesocycle when used in long-term high intensity mode that indicates certain manifestation of adaptive changes due to considerable growing dynamics in power abilities of the studied young men.

It was established that used in the beginning of our studies high intensity loads training with small workload in terms of a phased change of training regimes proved to be more efficient in long-term power fitness training. The research showed that regardless the hormonal response to acute power load in terms of different mode combinations, the participants’ body power abilities demonstrated positive dynamics of growth by 80.2% (p<0.05) throughout the study period in both groups. However, the most pronounced adaptive changes were established in terms of high intensity loads mode (training mode=0.71 conventional units).

Key words: adaptation, hormonal response, power loads mode, cortisol, testosterone, training process, power abilities, intensity.
Introduction
Physical activity is performed due to mechanisms, which let our body do various exercises and adapt to them. These mechanisms are directly related to the hormonal regulation of physiological systems together with acute and chronic adaptive changes [2, 7]. Different hormonal response while training is the result of testosterone and cortisol concentration change in blood serum that may be caused by the intensity of physical activity, amount of work and mode of exercise [2, 9]. Motor activity can call short-term increase or decrease of these hormones concentration in blood serum, depending on the combination of exercise parameters, conditions and duration of training sessions [12, 13].

At the same time, we can assume that short-term reduction in testosterone and cortisol concentration, is mainly manifested while increasing the duration and amount of training that contributes to possible fatigue against on the background of energy deficit [6, 10]. However, the impact of hormone changes on the human body in the training process, as well as physiological mechanisms of adaptive rearrangements, especially in frequency of certain modes of power load, have been insufficiently studied.

It is known that the optimal period of power exercises cannot exceed two or three months to achieve the most pronounced adaptive changes in the body of untrained persons in terms of muscle activity with the same parameters of physical activity, regardless of the intensity and scope of work [5, 6]. However, for further effective continuation of adaptive processes it is necessary to change the parameters of some components of the power mode or even full training activity mode. Not with standing, questions of adaptive-compensatory reactions peculiarities in conditions of phase mode switching power load (mesocycle) particularly among untrained people, have been hardly investigated.

The aim of this paper is to determine the changing characteristics of cortisol and testosterone concentration in blood serum of untrained young men in terms of frequency of certain modes of power load and its impact on human body adaptive reactions.

Research methods
Forty healthy not involved in power sports boys aged 20-21 were examined during this research. Two research groups (control and experimental) were formed. Each group used two completely different modes of power load alternately within six months of training in power fitness.

Thus, the control group research participants used medium intensity training mode and a large amount of work during the first three months of research (training mode=0,64 conventional units). This exercise consisted of four power exercises; each exercise had 4 series of 8 repetitions with intervals 1 minute for rest between series. Exercises’ speed rate was average (2 seconds in overcoming regime, and 4 seconds in a compliant regime). These exercises were carried out with full amplitude, weight charges were about 80-82% of maximum (weight charge is the weight of projectile which is used to perform only one repetition).

However, during next three months of research, members of the control group used high-intensity mode at low work amount (training mode=0,71 conventional units). They performed the following scheme of exercises: 4 power training; each exercise had 4 series of 4 repetition with 1 minute intervals for rest. Exercises’ speed rate was very slow (3 seconds in an overcoming regime, and 6 seconds in a compliant regime). Exercises are performed with partial amplitude (maximum 90%); weight charges here amounted to 65-68% of maximum.

At the same time, experimental group representatives used the highly intensive regime of training with low work volume comparing with the control group participants during the first three months. Next three months of training were held in the average regime with a large work volume.
Power loads were assessed in terms of training components value used in training sessions of power fitness. For this purpose, we used the method of determining the training load index [3]. Parameters denoting maximum power capacity of participants while performing given power exercises were recorded in the process of control testing, and value of the power load was calculated afterwards. The studied parameters control was carried out prior to the use of a particular mode power load (output indicators 1st and 5th stages) and after every 30 days of regular power fitness exercises during 6 months.

The research participants underwent laboratory studies of testosterone and cortisol concentration changes in blood serum 8 times within 6 months of training force fitness with intervals of one month. Two blood collections (before the training and immediately after it) were conducted every month. Vein blood samples were taken by a nurse under a doctor’s medical supervision to meet all the required standards of sterility and safety. The testosterone and cortisol concentration in blood serum was determined by immune fermented analysis method in a certified medical laboratory.

Mathematical processing of the research results was carried out by the software package of Microsoft Excel 2010 and IBM SPSS Statistics 20 using conventional methods.

**Research results discussion.**

**Table** shows the control testing of power values of both groups fixed during the research periodin the exercise “bench press a heavy weight of the chest lying” (as an example) in terms of an application mode variations in power load. A similar dynamic performance in the control testing was found while doing other power training: pulling the block to the head, a French press, and leg press on the block, hammers and others.

**Figures 1 and 2** graphically show cortisol and testosterone values in blood serum of boys in the control group at rest, and after exercise during six months of power fitness training in periodic use of prescribed modes of power load (changing of regimes takes place after 3 months of regular exercise).

The results, established during the first 3 months of research with the average intensity training mode and a large amount of work, show a decrease of cortisol concentrations in blood serum of the control group members in the beginning of training for 8.3% (p<0.05) compared with the period of rest, and to 5.7% (p<0.05) in the end of training period. The same results are observed in testosterone concentration value – it decreased in the range of 11.2% (p<0.05) in the beginning of training as opposite to the period of rest, and to 14.3% (p<0.05) in the end of training period (fig.1-2). However, a significant increase of maximum muscle strength was observed during test exercise performance on 42.3% (p<0.05) (**Table**).
Table
Changing boys’ power capacity during the exercise “bench press a heavy weight of the chest lying” depending on the variability of using different modes of load, n = 40

<table>
<thead>
<tr>
<th>Research groups</th>
<th>Power loads</th>
<th>Control phases</th>
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<td>Initial data, 1 training mode, kg</td>
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<tr>
<td>Control</td>
<td>Average intensity and large amount</td>
<td>63,25±1,91</td>
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<tr>
<td>Experimental</td>
<td>High intensity and small amount of</td>
<td>63,41±2,56</td>
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Changing the power load regime in the research groups after three months of training

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<th>Power loads</th>
<th>Control phases</th>
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<td>5-th</td>
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<td></td>
<td>Initial data, 4th month of training</td>
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<tr>
<td>Control</td>
<td>High intensity and small amount of</td>
<td>90,03±2,99</td>
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<td></td>
<td>work</td>
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<tr>
<td>Experimental</td>
<td>Average intensity and large amount</td>
<td>101,56±2,5</td>
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Note: * – p<0.05 comparing with the previous month values

At the same time, using a new regime of power load after 3 months of power fitness training with high-intensity and small amount of work (training mode = 0.71 conventional units) also caused significant decrease in cortisol concentrations by 18.7% (p<0.05) in blood serum in response to exercises, but contributed to the parameters of testosterone index by 3.2% (p<0.05).

However, even after the first month of this training mode we observed cortisol concentrations increasing by 7.3% (p<0.05) and testosterone by 11.2% (p<0.05) after acute power load compared to the before training state.

This dynamic of hormone response (increase of studied blood parameters) to this exercise in the regime of high intensity training and a small amount of work, was observed within control group participants during next two months of regular power fitness exercise. This phenomenon was watched in a growing progression (cortisol – 19.7% (p<0.05), and testosterone – by 19.1% (p<0.05) (Fig. 1). Moreover, indicators of maximum muscle strength show a further increase by 26.8% (p<0.05).

Consequently, the results of our research of the hormonal response indicators to acute power load within six months of power fitness training in terms of gradual regime change showed that increasing of the intensity load parameters and reducing the workload enhance cortisol and testosterone concentrations in
blood serum compared to the medium intensity regime and greater amount of work. Herein power rates continue to rise with almost the same progression as in the beginning of research.

![Graph showing cortisol concentration over time](image)

**Fig. 1.** Dynamics of serum cortisol concentration in the experimental group (untrained boys) depending on the particular frequency of different power load modes usage, n = 20

**Note:** * - p<0.05, compared to the pre-training state; ** - p<0.05 compared with the previous month.

Results of the hormonal response to high intensity training mode and small amount of work fixed in the experimental group boys before the study (the first stage) demonstrate a significant decrease in cortisol concentrations in blood serum by 21.4% (p<0.05) (**Fig. 3**), and no changes in the testosterone concentration in blood serum compared to the before training state (**Fig. 4**).
Fig. 2. Dynamics of serum testosterone concentration in the control group (untrained boys) depending on the particular frequency of different power load modes usage

Note: * - p <0.05, compared with before training state

This fact indicates a possible energy shortage caused by the stress load. However, within three months of training (Fig. 3-4, 2-4 stages) in high intensity mode and small amount of work (training mode = 0.71 conventional units), studied hormones increase significantly their concentrations in blood serum. Thus, the cortisol concentration increased by 6.5% (p <0.05) and sometimes by 31.6% (p<0.05), while the testosterone concentration went up from 9.9% (p <0.05) to 23.2% (p <0.05) after acute loads compared to rest state. We also observed very significant increase of young men maximal muscle strength in this group by 60.2% (p <0.05), underscoring the efficiency of this training mode.

The power load change (decrease of intensity and significant increase of workload) caused a decline of studied hormones concentrations in blood serum on average by 9.5 % (p<0.05) after training compared to pre-training state. These results were recorded after three months of high intensity training and small amount of workload. Similar cortisol concentration decrease by 12.7 % (p<0.05) and testosterone concentration decrease by 14.2 % (p<0.05) in blood serum were observed during next three months of training (Fig. 3-4, 5-8 stage of research).
Fig. 3. Dynamics of serum cortisol concentration in the experimental group (untrained boys) depending on the particular frequency of different power load modes usage

Note: * - p < 0.05, compared to pre-training state; ** - p<0.05 compared with the previous month.

We can assume that this hormonal response was caused by the participants’ body fatigue in terms of acute training regime that can also cause a state of overstrain or overtraining in young men if used long time in power fitness training.

At the same time, this group representatives showed maximum muscle strength indicators that continued increasing positively, but with significantly smaller progression (in total by 15.2 % (p<0.05) (table 1), which is practically impossible in a chronic fatigue state.

Thus, the results of the cortisol and testosterone concentration changes in blood serum of untrained boys in terms of frequency of different power load modes in power fitness showed that even a slight deviation in load component values could significantly affect the hormonal response nature, despite the increase in the level of resistance to physical modes in adaptation process.

At the same time, it is proved that high intensity loads and small amount of work regime should be better used in the long-term power fitness training, as they significantly influence the long-term adaptation processes.
Based on the studies of peculiarities of the cortisol and testosterone concentration changes in blood serum of untrained young men in terms of frequency of different power load modes in power fitness, it is possible to make the following generalizations:

The dynamics of the testosterone and cortisol concentrations in blood serum of untrained young men in the regime of acute power load of various character, testify the divergent hormonal responses manifestation that was recorded during the study period. The growing level of studied hormones in the untrained young men blood occurred in response to high intensity training with a small amount of work. At the same time, average intensity power load with large amount of work reduced the testosterone and cortisol concentrations in the blood serum compared to the pre-training state.

The research also revealed, that hormonal response to acute power load becomes more pronounced within each next month of power fitness training especially in terms of using high intensity training mode. On the contrary, the long-term adaptation results of power fitness training are characterized by slow increase in maximal muscle strength compared to the data set after the first month of training, due to the increased level of body resistance to physical stress. However, changing the load mode also contributes to the growth of maximum muscle strength parameters.

The conducted study showed the priority and effectiveness of power fitness training performed in terms of a phased training regimes change with high intensity loads and small workload (as it was applied in the beginning of our research) in the long period trainings. At the same time, using this power fitness-training mode prevents anyphysical fatigue manifestation and, consequently, does not cause a state of overtraining despite a significant productivity growth.
The lack of data concerning the nature and extent of changes in the cortisol and testosterone concentrations in blood serum of young men in response to acute physical activity, during long-term power fitness training with a phased training regimes change, does not let us control the training process precisely, especially blood hormones concentration that may contribute to disruption of homeostasis. Accordingly, the prospect of establishing regularities and disclosing relationships between the levels of studied hormones, training loads volume and intensity, as well as the dynamics of performance indicators, will provide us with an opportunity for the scientific justification of such processes as planning, control, and management of long-term training process in power fitness and other sports.

References


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