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Physiological Activity of Platelets in Men of the First Adulthood after Three Months of Fitness

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Abstract

To assess the effect of three months of fitness classes on platelet activity in men. The observation group was 25 clinically healthy men of the first mature age who were engaged in fitness for three months. The control group included 26 men of the first mature age who avoided physical culture and sports during their life. The physical condition was assessed using functional tests and platelet activity was determined by traditional methods. The results were processed by the methods of variation statistics. Regular physical activity in the course of fitness activities increased general physical capabilities in men of the first mature age and increased the accuracy of the movements. This was accompanied by a weakening of platelet aggregation activity, recorded in vivo and in vitro. The onset of physiologically beneficial changes in platelet function is associated with a decrease in the density of receptors on platelets in training men and an increase in the activity of the antioxidant system of platelets. In the control group, the level of physical fitness was significantly lower, and the functional capabilities of platelets were higher. Fitness classes in the first adulthood can optimize the level of platelet activity, transferring it to a more functionally beneficial level for the body. Three-month fitness classes increase the level of physical fitness in men of the first mature age and contribute to a decrease in platelet activity.

Keywords: First adulthood, Fitness, Men, Physical capabilities, Platelets, Primary hemostasis

Introduction

A regular increase in physical activity has a positive effect on all manifestations of the viability of a healthy person and with a disease (Mal *et al*., 2018b; Ibrahim & Abdelbasset, 2020; Makhov & Medvedev, 2020b; Permadi, *et al*., 2020; Karpov *et al*., 2021a; Medvedev *et al*., 2021). Against the background of systematic physical activity, the muscular system is strengthened and the functions of internal organs are activated at any age (Bespalov *et al*., 2018a; Zavalishina *et al*., 2021b). At the current stage of the development of society, it is very important to widely involve different strata of the population, especially young people, in systematic physical training of a health-improving orientation (Skoryatina & Zavalishina, 2017; Makhov & Medvedev, 2018c). This is because only under conditions of systematic muscular loads of a moderate nature in humans is it possible to develop many functionally beneficial changes in parameters in all vital organs and their systems (Makhov & Medvedev, 2018b; Karpov *et al*., 2020a). This is confirmed by various long-term studies of the effectiveness of physical training at different ages and because of various options for methods of physical culture training (Makhov & Medvedev, 2018a; Mal *et al*., 2018a). Modern society has formed an acute need to improve the methods of general health improvement of the body, with simultaneous effective socialization at any age and stable inclusion in labor activity (Medvedev & Zavalishina, 2016; Mal *et al*., 2020).

It was found that the use in the practice of different complexes of physical loads in the process of physical culture and sports activity in people suffering from various diseases and completely healthy, in all cases, form an increase in the adaptive potential of their body (Medvedev, 2018g; Makhov & Medvedev, 2020a; Zavalishina *et al*., 2021c).

Huge social significance is now attached to the health of men of mature age who complete the process of professional development and are involved in active labor activity (Bespalov *et al*., 2018b; Karpov *et al*., 2020b). Unfortunately, modern people of the first mature age have a low level of physical activity and, in this regard, do not have sufficient physical performance in all cases (Zavalishina *et al*., 2021a). In addition, with low physical activity, a gradual increase in the activity of homeostasis and especially of its primary link, platelets, was observed (Medvedev, 2018e). This impairs the processes of microcirculation and forms the risk of micro-and macrothrombosis in organs (Medvedev, 2018c). It is possible to correct the existing situation only by purposefully increasing the locomotor activity of these people and the general level of their physical development (Zavalishina, 2018c; Skoryatina & Medvedev, 2019).

One of the most promising options for increasing physical activity in persons of the first mature age can be considered regular fitness classes under the guidance of an experienced trainer (Karpov *et al*., 2021b; Makhov & Medvedev, 2021). At the same time, its effect on the organs and systems of a physically insufficiently trained organism, including on various blood parameters, cannot be considered definitively clarified. It is of

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great interest to study the influence of the beginning of fitness classes in the first adulthood on the body of physically untrained people of the first mature age, and especially on the functional properties of their platelets, recorded not only in vitro but also in vivo.

Purpose of the work: to evaluate the effect of three months of fitness classes on platelet activity in men of the first mature age.

Materials and Methods

For the study, a group of 51 men of the first mature age (average age 30.2±1.3 years), clinically healthy, previously not involved in sports and physical education, was recruited. Two observation groups were formed from them. The first group was named the group of trainees (25 men). They volunteered to start regular fitness classes according to the author's scheme. The second group of men was called the control group (26 people). It consisted of men who decided to lead the former inactive lifestyle and not engage in physical education and sports. The physical activity that they experienced corresponded to the stress in everyday life. The examination of both groups was carried out at the end and after three months of observation. When performing this study, many generally accepted functional tests were carried out to assess the existing level of physical development.

The state of lipid peroxidation inside platelets was assessed in all examined patients by the concentrations of malondialdehyde in them and by the level of acyl hydroperoxides in them by standard methods (Zavalishina, 2018f). Traditionally, the levels of functional activity of intraplatelet enzymes catalase and superoxide dismutase were assessed.

In both study groups, the number of platelets in capillary blood was determined using a Goryaev camera. The state of platelet aggregation in vitro was determined using the traditional visual micro method (Medvedev *et al*., 2009), using ADP (0.5×10^{-4} M) and collagen (1:2 dilution of the main suspension) manufactured by Renam, Russia as inducers. The activity of platelet aggregation in vivo was assessed by the state of intravascular platelet activity using a phase-contrast microscope using a standard method (Medvedev *et al*., 2009).

Statistical processing of the values of indicators found during the study in both observation groups was carried out using the methods of variation statistics using the program "StatSoft, Inc." USA. The statistical significance of the differences recorded in the study of signs in both observation groups was recorded during the application of the Student's test (t). The search for a correlation was carried out in the course of calculating the value of the Pearson correlation coefficient.

Results and Discussion

When the subjects were taken into the study, all men showed a low level of physical capabilities **(Table 1)**. At the beginning of the observation, they had small speed-power capabilities. This was indicated by the results of their tests: running at a distance of 30 m (6.1±0.13 s and 6.2±0.72 s), running at a distance of 60 m (14.1±0.54 s and 19.6±0.65 s), length of the jump performed in length (1.44±0.14 m and 1.42±0.18 m). Initially, the men recruited into the study groups had low endurance. This was indicated by the short distance that they were able to cover by running for 6 minutes. Also, in both groups of observation, there were weak power capabilities: the number of pull-ups performed on the crossbar turned out to be low, amounting to 3.5±0.26 and 3.6±0.38 repetitions, respectively. The unexpressed initial development of their coordination parameters as indicated by the results of their 4x9 shuttle run and a small number of jumps, which they were able to perform with the help of a rope in 25 s.

At the beginning of fitness classes in a group of trainees, strength exercises, jogging at high speed along a straight trajectory of movement, running along a straight trajectory with an abrupt start and a sudden stop, performing trunk lifts from a prone position, maintaining the correct breathing rhythm and accuracy of the movements were very difficult to master. in the course of jumping rope.

At the beginning of fitness classes, the group of trainees showed an early onset of a feeling of fatigue, which was accompanied by a large number of errors during exercise, decreased attention level, and inhibition of any movements during exercise.

Table 1. Recorded indicators in the surveyed men

Indicators of physical condition	Group of exercising, M±m, n=25		Control group, M±m, n=26	
	at the beginning of the observation	at the end of the observation	at the beginning of the observation	at the end of the observation
Long jump from a spot, m	1.44±0.14	1.63±0.17 p<0.05	1.42±0.18	1.41±0.22
Distance for 6 minutes of running, m	907.3±32.60	989.2±42.53 p<0.05	912.4±36.18	911.8±36.16
Pull-up on the bar, reps	3.5±0.26	4.2±0.12 p<0.01	3.6±0.38	3.7±0.29
Lifting the trunk from a prone position in 1 minute, reps	22.0±0.83	25.3±1.06 p<0.05	21.2±1.28	20.9±1.35
Shuttle run 4x9, s	12.6±0.63	11.1±0.45 p<0.05	12.4±0.75	12.3±0.64
Jumping rope in 25 s, reps	25.3±0.68	28.6±0.92	26.2±0.72	26.0±0.69

		p<0.05		
30m running, s	6.1±0.13	5.5±0.12 p<0.05	6.2±0.22	6.1±0.25
60m running, s	14.1±0.54	12.6±0.46 p<0.05	13.6±0.65	13.4±0.57
Aggregation of platelets with ADP, s	41.3±0.23	45.2±0.32 p<0.05	40.9±0.29	41.0±0.32
Aggregation of platelets with collagen, s	36.3±0.19	40.6±0.17 p<0.05	37.0±0.21	36.9±0.24
Platelets-discocytes, %	83.8±0.25	85.2±0.16	84.1±0.15	84.0±0.14
The sum of active forms of platelets, %	16.2±0.18	14.8±0.24 p<0.05	15.9±0.19	16.0±0.17
Platelet count in aggregates, %	5.4±0.13	4.9±0.08 p<0.05	5.3±0.16	5.3±0.18
The number of small platelet aggregates, per 100 free-lying platelets	2.6±0.19	2.3±0.14 p<0.05	2.7±0.21	2.7±0.22
The number of medium and large platelet aggregates, per 100 free-lying platelets	0.07±0.012	0.06±0.016 p<0.05	0.07±0.018	0.07±0.015

Note: p - the statistical significance of changes in indicators.

After three months of observation, no statistically significant dynamics of the values of the considered indicators were revealed in those who made up the control group. After three months of regular fitness training, the group of trainees managed to achieve a decrease in the degree of physical fatigue. This was indicated by an improvement in subjective sensations in trainees and a decrease in the value of their pulse during fitness classes (the value of the pulse under load conditions at the end of observation was 119.6 ± 9.7 beats per minute).

After three months of regular physical activity in the group of trainees, the level of physical development increased **(Table 1)**. This was evidenced by an increase in speed-strength characteristics (a 10.9% reduction in the running time by 30m, an 11.9% decrease in the 60m run time, an increase of 13.2% in the long jump distance), an increase in strength capabilities (an increase by 20.0% of the number of performed pull-ups on the crossbar, an increase by 15.0% in the number of body lifts performed from a supine position in 1 minute), improvement of coordination characteristics (a decrease by 13.5% of the shuttle run time, an increase of 13.0% in the number of jumps performed with the help of a sports rope for 25 seconds), as well as an increase in the degree of endurance (an increase of 9.0% in the distance run for 6 minutes).

The number of acyl hydroperoxides in platelets of both groups examined in the outcome was slightly increased and amounted to 2.36±0.24 D_{233} /10^9 platelets and 2.39±0.32 D_{233}/10^9 platelets. The initial level of malondialdehyde in platelets of the examined patients was also somewhat excessive 0.79±0.15 nmol/10^9 platelets and 0.77±0.18 nmol/10^9 platelets, respectively. As a result of fitness classes in the group exercising, the number of acyl hydroperoxides and malondialdehyde decreased to 2.08±0.33 D_{233}/10^9 platelets ($p<0.05$) and to 0.70±0.20 nmol/10^9 platelets ($p<0.05$), respectively. In the control group, no significant dynamics of the considered indicators of lipid peroxidation in platelets were found.

The initial functional activity of platelet catalase (2500.0±186.3 and 8600.0±201.4 IU/10^9 platelets) and superoxide dismutase (1620.3±10.3 and 1630.0±11.4 IU/10^9 platelets) in the subjects of both groups taken into the study was comparable. At the end of the study, significant differences were found in the activity of the considered antioxidant enzymes of platelets. In the training group, their activity was 8900.0±231.5 IU/10^9 platelets, 7750.0±12.6 IU/10^9 platelets. In the control group, the activity of catalase (8600.0±224.5 IU/10^9 platelets) and superoxide dismutase (1620.0±19.34 IU/10^9 platelets) was lower ($p<0.05$).

In the outcome of both examined groups, a comparable severity of platelet aggregation was recorded. Platelet aggregation occurred earlier under the influence of collagen in 36.3±0.19 s and 37.0±0.21 s, which was close to the lower limit of the norm. In the survey, the outcome also showed a short duration of the onset of platelet aggregation under the influence of ADP. During the observation period in the control group, platelet aggregation did not have significant dynamics. In the group of trainees, the duration of platelet aggregation in response to collagen increased by 11.8%, in response to ADP, it increased by 9.4% within normal limits. Initially, the total number of active forms of platelets in both observation groups was slightly increased **(Table 1)**. In the blood of the observed mean of the first mature age, when taken into the study, the levels of free-circulating platelet aggregates of small and large sizes were at the upper limit of the norm. The content of platelets included in the aggregates when taken into the study in both groups was comparable and was within the normal range, amounting to 5.4±0.13% and 5.3±0.16%, respectively.

The number of discoid platelets in the blood observed at the end of the study in the training group tended to increase and remained unchanged in the control group **(Table 1)**. The total content of active forms of platelets in the blood of men from the training group decreased by 9.4% but remained unchanged in the control group. In the blood of men doing fitness according to the author's scheme, the number of freely circulating small and large platelet

aggregates significantly decreased by 13.0% and 16.7%, reaching 2.3 ± 0.14 and 0.06 ± 0.016 per 100 free-flying platelets, respectively. The indices of intravascular platelet activity in the control group for the entire observation period remained without significant dynamics, corresponding to the level of the outcome by the end of the observation.

In men of the first mature age who had been engaged in fitness for 3 months, there was a significant correlation between the results of shuttle running and the running distance for 6 minutes, the number of lifting the trunk from the supine position on one side and the aggregation of platelets with collagen on the other side ($r = -0.522$; $p < 0.05$, $r = 0.547$; $p < 0.05$ and $r = 0.536$; $p<0.05$, respectively). A significant correlation was also found between the blood content of men involved in fitness, the number of medium and large aggregates with the time of shuttle running ($r = 0.623$; $p<0.05$), the distance run in 6 minutes ($r = -0.529$; $p<0.05$) and the number of body lifts from the prone position ($r = -0.607$; $p<0.05$).

Currently, physical activity is rightly considered an environmental factor that significantly affects all systems of the human body, including blood (Medvedev, 2018a; Tkacheva & Zavalishina, 2018a). All those taken into the study initially demonstrated low physical fitness and an insufficient degree of development of their physical capabilities. This made it possible to trace the influence of an increase in physical activity in the group of trainees on the indicators taken into account.

A pronounced positive effect in the course of physical training was noted in the case of their systematic implementation. In many respects, the achievement of a pronounced positive result from them is facilitated by their general positive emotional background and the lack of strict regulation of the performance of the load (Dembo & Zemtsovsky, 1989). In the group of trainees, after three months of fitness classes, the accuracy of movements increased, including during running, performing jumps, and the effectiveness of the pull-up process on the bar increased. The results obtained are associated with an increase in the level of development of their muscular system in men with a significant acceleration of metabolic processes and neuromuscular transmission (Medvedev, 2018b; Tkacheva & Zavalishina, 2018c).

In the process of doing fitness, the time of the distance covered by jogging decreased. The achieved effect was based on an increase in the volume of skeletal muscles, an improvement in their vascularization, and, apparently, the blood flow rate in them (Zavalishina, 2018a). In the group of men training, after three months of fitness training, it was possible to achieve an increase in locomotor stability in the process of implementing sports and domestic motor actions. This circumstance can be explained by an increase in the functional capabilities of exercising vestibular mechanisms and hypertrophy of muscles involved in maintaining body position in space during movement and at rest (Tkacheva & Zavalishina, 2018b; Zavalishina, 2020).

A weakening of the processes of lipid peroxidation as a result of an increase in the level of activity of antioxidant enzymes found in platelets was found in those who regularly went in for fitness. Lack of physical activity in the control group retained the initial level of indicators of antioxidant protection of platelets and a slightly increased activity of the formation of lipid peroxidation products in them (Medvedev, 2021). Assessment of the development time of platelet aggregation with strong and weak inducers in the patients in the initial state revealed a tendency to accelerate this process. Regular fitness exercises were accompanied by inhibition of the development of platelet aggregation with a strong inducer of collagen, which is associated with a decrease in the functional capabilities of platelet phospholipase C, which controls the phosphoinositol pathway of platelet activation, a decrease in the level of phosphorylation of actin and myosin, and a weakening of Ca^{2+} release from platelet stores (Zavalishina, 2018b; Glagoleva & Medvedev, 2020). The increase in the development time of platelet aggregation with a weak ADP inducer was largely due to the weakening of the expression of fibrinogen receptors (GPIIb-IIIa) and the weakening of phospholipase A_2, which releases arachidonic acid from the composition of membrane phospholipids, for the synthesis of thromboxane A_2 (Medvedev, 2018d; Zavalishina, 2018g). In addition, in those who started regular fitness training, the found a weakening of the severity of platelet aggregation capacity concerning all inducers is largely due to the weakening of receptor sensitivity to the main inducers of aggregation on the surface of platelets, contributing to a decrease in their functional manifestations in vivo (Glagoleva *et al*., 2018; Zavalishina *et al*., 2018). Lack of physical activity kept all these mechanisms in the control group at a level close to the initial one.

The optimization of intravascular platelet activity in men of the first mature age achieved against the background of fitness classes indirectly confirmed the assumption of a decrease in the blood concentrations of various aggregation inducers in the blood studied and a decrease in the number of receptors to them on the outer membranes of platelets under physical stress (Medvedev, 2018h; Zavalishina, 2018e). At the same time, a tendency towards an increase in the number of discoid platelets develops in the blood of individuals of the group exercising due to a weakening of the activity and a visible decrease in the number of their receptors capable of interacting with the fibrinogen molecule (GPIIb - IIIa) during the direct implementation of the platelet aggregation process (Medvedev, 2018f; Zavalishina, 2018d).

Thus, in men of the first mature age, who started regular fitness classes, after 3 months of training, a small but reliable physiologically beneficial decrease in platelet activity is achieved, which improves their conditions for the realization of microcirculation.

Conclusion

Modern researchers recognize the great benefits for the whole body of regular exercise, which has a stimulating effect on the physical performance of the trainees. In the study, as a result of

regular fitness exercises according to the author's scheme, physically untrained men of the first mature age experienced an increase in motor capabilities. Against the background of three-month fitness classes, they had an increase in the level of development of their strength characteristics, coordination, speed-strength indicators, and the level of general endurance. The activity of the mechanisms of platelet aggregation and the severity of this process in vitro and in vivo decreased in men of the first mature age who began regular fitness training. The continuation of a little physically active lifestyle in men of the first mature age retained all their strength, speed, and coordination capabilities at the initial level. In addition, they have an excess of platelet aggregation. It can be argued that regular fitness exercises in men of the first mature age lead to a physiologically beneficial increase in their physical and locomotor capabilities and a weakening of platelet activity.

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