

STUDY ON ATHLETES WHO UNDERWENT AN ATHLETIC TRAINING PROGRAM AT ALTITUDE IN ORDER TO INCREASE THEIR PULMONARY CAPACITY, TO IDENTIFY PSYCHOLOGICAL CHANGES REGARDING ATTENTION AND CONCENTRATION, THE PERSISTANCE OF MOTIVATION AND THE CORELATIONS BETWEEN THE TWO

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ABSTRACT. Introduction. Improving the sports performance of an athlete it depends on his or hers internal factors and the external factors. An environmental change or a new challenge may have effects on the psyche of the athlete and can lead to changes in motivation and concentration. **Objectives.** The aim of this study is to analyze the effects on the psyche following a specific program of preparation, which involves major changes in the athlete's routine. In this study we analyze athletes who follow a program of athletic training at altitude to increase lung capacity, and will test whether psychological experience changes in terms of attention and concentration, persistent motivation, and the correlation between the two. **Material and methods.** In this observational study took part two groups of athletes, 44 female judokas. Control group 1 with 22 athletes, and group 2 with 22 athletes who have undergone a specific training at altitude (1020 m, 677 mmHg) for three months in order to increase lung capacity. For collecting statistics on psyche regarding motivational persistence and concentration of attention, SPM questionnaire and ACC test were used. **Results.** Analysis of the results of the study showed only one significant difference between the two groups. Group II showed an acceptable and similar correlation between long term pursuing purposes (LTPP) and recurrence of unattained purposes (RUP), which was not found in group I. All other indicators showed no difference between the two groups of athletes. **Conclusion.** In terms of motivation, attention span and the correlation between the two, no mental changes were found in athletes who have undergone specific training at altitude for three months.

Key words: *altitude training, physical preparation, judo, concentration.*

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REZUMAT. *Studiu asupra sportivilor care urmează un program de pregătire athletică la altitudine pentru creșterea capacității pulmonare pentru a identifica modificări psihologice în ceea ce privește atenția și puterea de concentrare, persistența motivației și corelația dintre cele două.* **Introducere.** Îmbunătățirea performanței în sport al unui sportiv depinde de factorii lui interni la fel și de factorii externi. O schimbare de mediu sau o nouă provocare ar putea avea efecte asupra psihicului sportivului și poate duce la schimbări în motivație și concentrare. **Obiective.** Scopul acestui studiu este de a analiza efectele asupra psihicului ca urmare a unui program specific de pregătire, care implică schimbări majore în rutina sportivului. În acest studiu analizăm sportivii care urmează un program de formare sportivă la altitudine pentru a crește capacitatea pulmonară, și se va testa dacă experiența psihologică se modifică în ceea ce privește atenția și concentrarea, persistența motivației, și corelația dintre cele două. **Materiale și metode.** În acest studiu observațional au participat două grupe de sportive, 44 judoka de sex feminin. Lotul I, grupa de control cu 22 de sportivi, iar lotul II, cu 22 de sportivi, care au fost supuse unui antrenament specific la altitudine (1020 m, 677 mm Hg) timp de trei luni, cu scopul de a crește capacitatea pulmonară. Pentru colectarea de date statistice privind psihicul în ceea ce privește persistența motivațională și concentrarea atenției, s-au folosit chestionarul SPM și testul ACC. **Rezultate.** Analiza rezultatelor studiului a arătat doar o diferență semnificativă între cele două grupe. Grupa a II-a arătat o corelație acceptabilă și similară între urmărirea scopurilor pe termen lung (LTPP), și recurența scopurilor nerealizate (RUP), care nu au fost găsite la grupa I. Ceilalți indicatori nu au arătat nici o diferență între cele două grupe de sportivi. **Concluzii.** În ceea ce privește motivația, durata atenției și corelația dintre cele două, nu s-au găsit modificări mentale la sportivii care au urmat o formare specifică la altitudine, timp de trei luni.

Cuvinte cheie: *antrenament la altitudine, preparare fizică, judo, concentrare.*

Introduction

To be successful in international competitions, judo athletes must achieve an excellent level of physical fitness and physical condition during training (Franchini, 2011). The development of emotional excitability in athletes with different level of sensory-movement reaction occurs for elite athletes via different strategies perception and information processing (Korobeynicov et al., 2017).

Modern sporting activity is characterised by higher psycho-emotional and physical tension which influence the accuracy of motor skill leading to a deficit of time reaction. Progress in sporting activity is accompanied by a broad introduction to sports psychology, and practically to modern technologies. The

basics of this approach is understood by the particular personality peculiarities of athletes, including the individual-typological characteristics of higher nervous activity (Korobeynikov et al., 2017).

Improving the sports performance of an athlete it depends on his or hers internal factors and the external factors. An environmental change or a new challenge may have effects on the psyche of the athlete and can lead to changes in motivation and concentration. The external factors may influence internal factors. Methods to improve performance are diverse and most of the time are controlled and measured, but uncontrollable changes also can occur. Methods for improving performance can have unanticipated side effects on the psyche, and on the power of self-motivation. Motivation stimulates the activity, it triggers it, supports it and direct it. It is a source of energy in the effort to achieve the goal. Achievement motivation has a broad research history that provides us with psychological interpretations applicable to sports activity. Competition is the most common situation of achievement in sport.

The functional states of psychophysiological functions in higher qualification athletes characterize the functional system responsible for the results of sport. The optimization of the perception and information processing using the short-term memory reflects the psychophysiological compensatory mechanisms of a decline of visual perception and information processing capability in athletes (Korobeynicov et al., 2006).

Altitude plays an important role in cardiovascular performance and training for athletes. Whether it is mountaineers, skiers, or sea-level athletes trying to gain an edge by training or living at increased altitude, there are many potential benefits and harms of such endeavors. Echocardiographic studies done on athletes at increased altitude have shown evidence for right ventricular dysfunction and pulmonary hypertension, but no change in left ventricular ejection fraction. In addition, 10% of athletes are susceptible to pulmonary hypertension and high-altitude pulmonary edema (Shah & Coplan, 2016). The aerobic fitness of elite judokas may be improved by adding aerobic routines to the normal training enhancing the recovery capacity (Bonato et al., 2015).

Training at moderate altitude for 14 days induces an increase in aerobic exercise capacity in athletes specialized in anaerobic exercise. Biochemical changes occur rapidly, after exposure to environmental prooxidant factors (Ugron, 2012; Ugron & Tache, 2012).

The hypoxia-induced hyperventilation at altitude paradoxically reduces arterial CO_2 (PaCO_2). A reduction in PaCO_2 results in vasoconstriction of the blood vessels of the brain and thus in local hypoxia. The local hypoxia likely affects cognitive function, which may result in reduced performance and altitude accidents. Quackenbush et al. (2016) publications have demonstrated that

voluntary isocapnic hyperventilatory training of the respiratory muscles (VIHT) can markedly enhance exercise endurance as it is associated with reduced ventilation and its energy cost. VIHT may be useful in blunting the altitude-induced hyperventilation leading to higher P_{aCO_2} and improved cognitive function. VIHT improved processing speed and working memory during exercise at altitude (Quackenbush et al., 2016).

Long-term living at high altitudes causes significant impairment of psychological and cognitive function. Cerebral hypoxic extent, sleep quality and biochemical dysfunction are major influencing factors (Gao et al., 2015).

Malle C. et al. (2013) in their study suggest: the working memory is impaired by acute hypobaric hypoxia (Malle et al., 2013).

The results of the Garbouj et al study (2016) showed that the Special Judo Fitness Test (SJFT) produced high levels of blood lactate, which were not correlated with SJFT performance (Garbouj et al., 2016).

Objectives

The aim of this study is to analyze the effects on the psyche following a specific program of preparation, which involves major changes in the athlete's routine. In this study we analyze athletes who follow a program of athletic training at altitude to increase lung capacity, and will test whether psychological experience changes in terms of attention and concentration, persistent motivation, and the correlation between the two.

Materials and methods

In this observational study took part two groups of athletes, 44 female judokas. They were informed about the risks of the study before giving their written consent, and all procedures were approved by the Local University Research Ethics Committee according to the Declaration of Helsinki 1975. Control group 1 (lot I) with 22 athletes, and group 2 (lot II) with 22 athletes who have undergone a specific training at altitude (1020 m, 677 mmHg) for three months in order to increase lung capacity.

The results of group no. 2 (lot II) athletes who underwent the athletic training at altitude program were compared with the statistical results of the control group.

Statistical processing was performed with software v.2.7.2 StatsDirect with OpenEpi v.3.03 application and Excel (Microsoft Office 2010). The graphical representation of the results was done with Excel (Microsoft Office 2010).

Elements of descriptive statistics were calculated, data is presented using indicators of centralization, location and distribution.

Shapiro-Wilk test was used to test the normal distribution, and the variance was tested with test F.

Nonparametric Mann-Whitney test (U) and χ^2 (Chi2) were used for statistical processing of data. The significance threshold for the tests used was $\alpha = 0.05$ (5%), $\alpha = 0.01$ (1%) or $\alpha = 0.001$. For collecting statistics on psyche regarding motivational persistence and concentration of attention, SPM questionnaire, and ACC test were used.

SPP results of group 1 were analyzed compared with group 2, also the ACC results, and correlation between PMS and ACC results. To detect the correlation between two quantitative variables continue (items SPM, ACC). Pearson correlation coefficients (r) and Spearman (ρ) were used. Analysis of correlation coefficients was carried out using Colton's empirical rules. Polynomial regression method was used to derive the mathematical equation of dependence on a continuous variable to another variable.

A measure of the relationship between an event and the presence of a risk factor, where the risk factor supposedly has influence on the event, is the relative risk or Risk ratio (RR). The probability of the event in an individual exposed to the risk factor is represented by those exposed to the risk (RE); the probability of the event in an individual unexposed to the risk factor is the risk of those not exposed (RN). RR is the ratio between RE and RN.

Results

SPM questionnaire results for the two groups were analyzed and compared in Table I and graphed in Chart 1 and Chart 2.

Table 1. Motivational persistence scale at studied groups and the statistical significance

| Indicators | Lot | Average | ES | Median | DS | Minimum | Maximum | Statistical significance (p) |
|------------|-----|---------|--------|--------|--------|---------|---------|----------------------------------|
| PM | I | 6,32 | 0,5238 | 5,5 | 2,4570 | 2 | 10 | 0,4827 |
| | II | 5,73 | 0,5892 | 5,5 | 2,7634 | 1 | 10 | |

| Indicators | Lot | Average | ES | Median | DS | Minimum | Maximum | Statistical significance (p) |
|-------------|-----------|---------|--------|--------|--------|---------|---------|------------------------------|
| LTPP | I | 6,14 | 0,6112 | 6 | 2,8668 | 1 | 10 | 0,7968 |
| | II | 5,86 | 0,6389 | 6 | 2,9968 | 1 | 10 | |
| CPP | I | 5,05 | 0,5324 | 4,5 | 2,4972 | 1 | 9 | 0,233 |
| | II | 4,27 | 0,4753 | 4 | 2,2293 | 2 | 9 | |
| RUP | I | 6,23 | 0,5463 | 6 | 2,5622 | 2 | 10 | 0,8522 |
| | II | 6,00 | 0,6774 | 6 | 3,1773 | 1 | 10 | |

At the statistical analysis of the values for pursuing long-term goals (LTPP - Long Term Pursuing Purposes) no statistically significant differences were observed between the two groups ($p > 0.05$).

At the statistical analysis of the values for tracking current tasks (CPP - Pursuing Current Purposes) no statistically significant differences were observed between the two groups ($p > 0.05$).

At the statistical analysis of the values for the recurrence of unattained purposes (RUP – recurrence of unattained purposes) no statistically significant differences were observed between the two groups ($p > 0.05$).

As expected, the statistical analysis of the motivational persistence score values (PM) granted under the three previous items, no statistically significant differences were observed between the two groups ($p > 0.05$).

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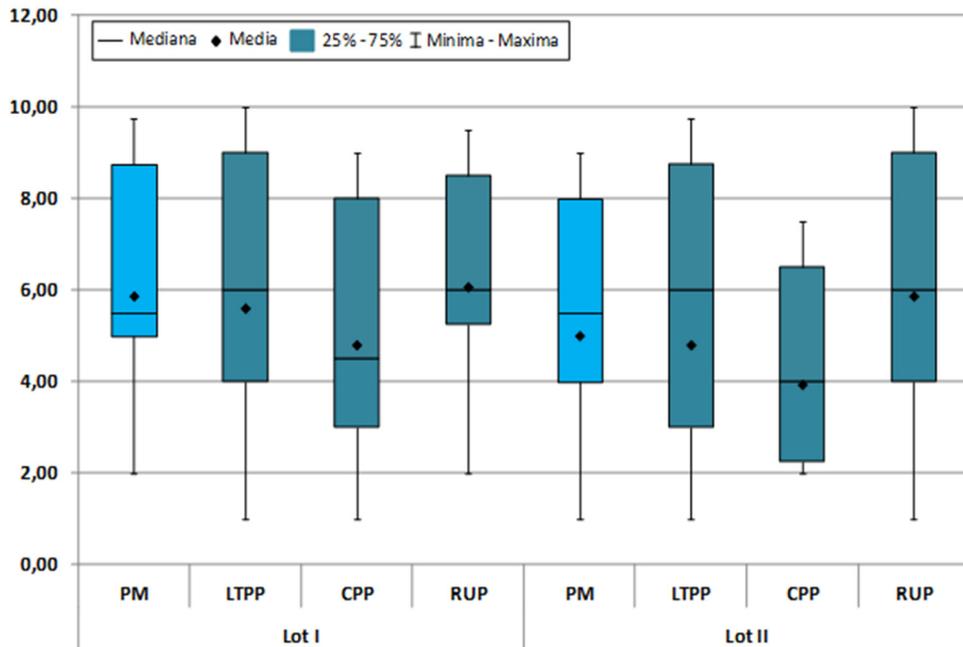


Chart 1. SPM items at the studied groups

At the Persistence Motivational scale (SPM) scores are grouped into 5 categories: very low (score 1 and 2), low (score 3 and 4), medium (score 5 to 6), good (score 7 and 8) and very good (score 9 and 10).

In the I group 45,45 % of LTPP subjects had have achieved good and very good scores, 36.36% of CPP subjects and 36.36% of the RUP subjects, such that the motivational persistence score (PM) were good and very good at 36.36% of the subjects.

The situation was almost similar to group II, where good and very good scores were achieved in 45.45% of LTPP subjects, 27.27% of CPP subjects, and 45.45% of RUP subjects, such that the values of the motivational persistence (PM) scores were all good and very good at 36.36% of the subjects.



Chart 2. SPM items at the studied groups - percentage values according to the grouping of the scores category

Grouping categories of scores in two large groups (low and very low vs. medium, good or very good) showed no statistically significant association between low and very low scores at the SPM items with any of the groups studied ($p > 0.05$).

Table 2. Motivational persistence scale at studied groups and the statistical significance

| PM | Gr. I | Gr. II | <i>p</i> | RE (%) | RN (%) | RR |
|-----------------------------------|--------------|---------------|-----------------|---------------|---------------|-----------|
| Very low and Low | 3 | 7 | 0,2818 | 30,00 | 55,88 | 0,5368 |
| Medium, Good and Very good | 19 | 15 | | | | |
| LTPP | Lot I | Lot II | <i>p</i> | RE (%) | RN (%) | RR |
| Very low and Low | 7 | 10 | 0,5358 | 41,18 | 55,56 | 0,7412 |
| Medium, Good and Very good | 15 | 12 | | | | |
| CPP | Lot I | Lot II | <i>p</i> | RE (%) | RN (%) | RR |
| Very low and Low | 11 | 15 | 0,3576 | 42,31 | 61,11 | 0,6923 |
| Medium, Good and Very good | 11 | 7 | | | | |
| RUP | Lot I | Lot II | <i>p</i> | RE (%) | RN (%) | RR |
| Very low and Low | 5 | 7 | 0,735 | 41,67 | 53,13 | 0,7843 |
| Medium, Good and Very good | 17 | 15 | | | | |

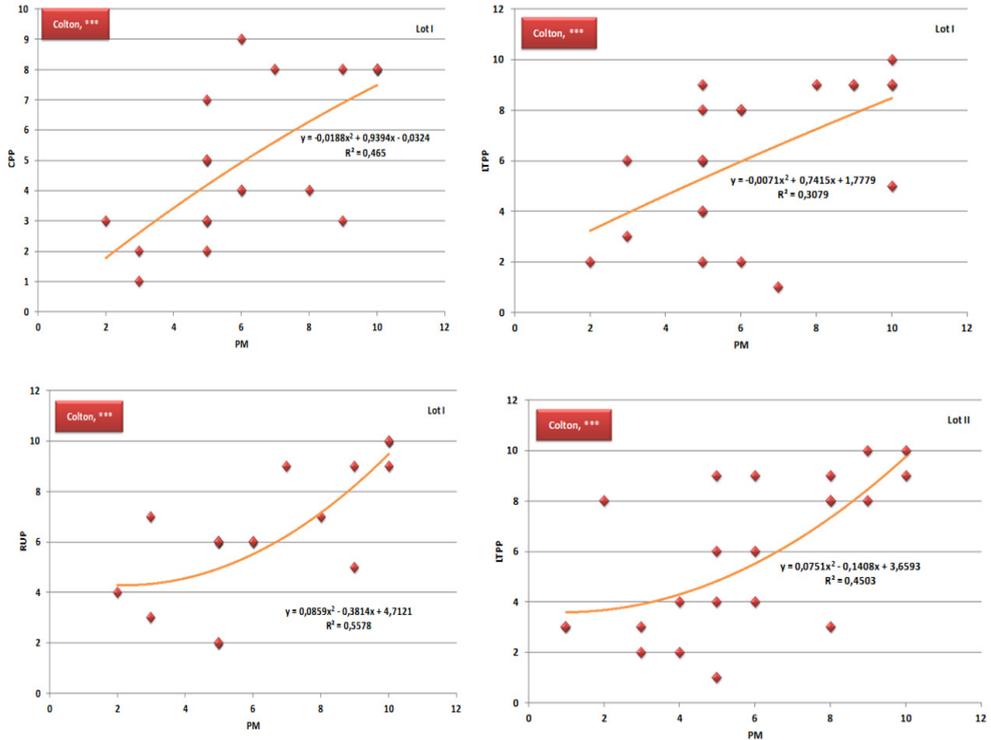
Statistical analysis of the correlation between the values of SPM items showed in group I:

- a good and similar correlation between-PM-LTPP, PM-CPP and PM-RUP;
- an acceptable and similar correlation between CPP-RUP in group II;
- a very good and similar correlation between PM-RUP;
- good and similar correlation between PM-LTPP, PM-CPP;

- an acceptable and similar correlation between LTPP-RUP, RUP CPP.

The only significant difference between the two groups is the acceptable and similar correlation between LTPP-RUP in the group II, and a lack of correlation of group I.

Table 3. Statistical analysis of the correlation between the values of items and scores of SPM



| Group I | PM-LTPP | 0,5517 | *** | Group II | PM-LTPP | 0,6729 | *** |
|---------|----------|--------|-----|----------|----------|--------|------|
| | PM-CPP | 0,7025 | *** | | PM-CPP | 0,6583 | *** |
| | PM-RUP | 0,7067 | *** | | PM-RUP | 0,8504 | **** |
| | LTPP-CPP | 0,2152 | * | | LTPP-CPP | 0,1988 | * |
| | LTPP-RUP | 0,1478 | * | | LTPP-RUP | 0,3393 | ** |
| | CPP-RUP | 0,2677 | ** | | CPP-RUP | 0,4585 | ** |

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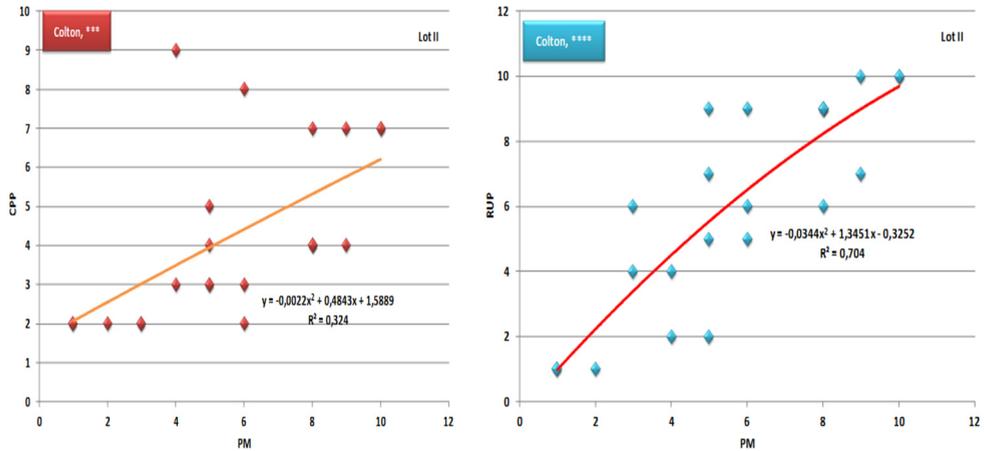


Chart 3. Very good and good correlations between SPM items at the studied groups

At the statistical analysis of the values for focused attention (ACC) no statistically significant differences were observed between the two groups ($p > 0.05$).

Table 4. Concentration attention at the studied groups and the statistical significance

| Indicators | Gr. | Average | ES | Median | DS | Minimum | Maximum | Statistical significance (p) |
|------------|-----|---------|--------|--------|--------|---------|---------|------------------------------|
| ACC | I | 74,23 | 3,2613 | 78 | 15,296 | 37 | 93 | 0,0854 |
| | II | 68,36 | 2,6860 | 68 | 12,598 | 48 | 90 | |

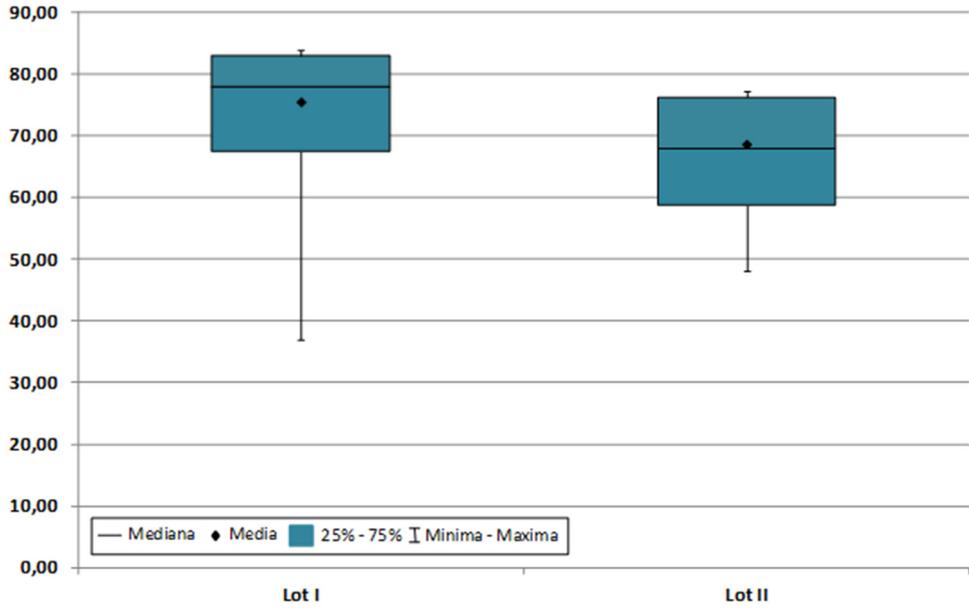


Chart 4. Concentration attention at the studied groups

At the statistical analysis of the correlation between the values of SPM and ACC items, no correlation between ACC and SPM could be observed.

Table 5. Statistical analysis of the correlation between the values of SPM and ACC items

| Group | Group I | | Group II | |
|----------|---------|--------------|----------|--------------|
| | Value | Significance | Value | Significance |
| ACC-PM | -0,0052 | * | 0,09872 | * |
| ACC-LTPP | 0,0984 | * | 0,1123 | * |
| ACC-CPP | 0,0124 | * | -0,0806 | * |
| ACC-RUP | -0,0756 | * | -0,0237 | * |

Conclusion

Analysis of the results of the study showed only one significant difference between the two groups. Group II showed an acceptable and similar correlation between LTPP and RUP, which was not found in group I. All other indicators showed no difference between the two groups of athletes.

In terms of motivation, attention span and the correlation between the two, no mental changes were found in athletes who have undergone specific training at altitude for three months.

Korobeynicov et al. (2011) obtained data show that different combinations of levels of motivation to achieve success and motivation to avoid failure provoke different psychophysiological states. Conducted experiment revealed that combination of high levels of both motivation to achievement of success and motivation to avoid failure provides better psychophysiological state in elite wrestlers compared to other groups with different combinations of motivational variables. Conducted experiment revealed that motivation to avoid failures had been formed as a personality formation, which compensates excessive tension, caused by high level of motivation to achieve and regulate the psychophysiological state. This can be viewed as an effect of training in athletes (Korobeynicov, 2011).

In conclusion, judo training and judo-specific exercise should be manipulated to maximize training response and competitive performance. Understanding the physiological and psychological response to the most common judo training modalities may help to improve the prescription and monitoring of training programs (Franchini, 2014).

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