International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

PAPER ID: 10A16C

# MATHEMATICAL MODEL OF PSYCHO-PHYSIOLOGICAL ADAPTATION OF INTERNATIONAL STUDENTS THROUGH DOSED PHYSICAL ACTIVITIES

**Dmitrii Tumakov [a*], Elena Fazleeva [b], Alsu Valeeva [c], Roald Akberov [d,e]**

[a] *Institute of Computational Mathematics and Information Technologies, Kazan Federal University, Kazan, RUSSIA.*
[b] *Department of Physical Education and Sports, Kazan Federal University, Kazan, RUSSIA.*
[c] *Research Laboratory Modern Geoinformation and Geophysical Technologies, Kazan Federal University, Kazan, RUSSIA.*
[d] *Kazan Federal University, Kazan, RUSSIA.*
[e] *Kazan National Research Technological University, Kazan, RUSSIA.*

**ARTICLEINFO**

*Article history:*
Received 06 April 2019
Received in revised form 19 June 2019
Accepted 28 June 2019
Available online 16 September 2019

*Keywords:*
Hyperdynamia; Dosed physical load; Foreign student adaptation; International student psychophysiological adaptation; load optimization; Ordinary differential equation (ODE); Culture shock; Rate of change of the adaptation potential (RCAP); Adaptation coefficient (AC).

**ABSTRACT**

Adaptation to a foreign culture environment represents one of the major problems that international students encounter upon arrival in another country. From the very first days at a university, international students stay in an unfamiliar sociocultural, linguistic and ethnic environment, to which they must adapt within the shortest possible time. The adaptation process itself, in this case, is quite complicated and includes several types of adaptation: physiological, individual psychological, socio-psychological, ethno-psychological, cultural, communicative, etc. All these types of adaptation, especially at the initial stage of studying, manifest themselves simultaneously and represent serious obstacles in both cognitive and communicative activities. Therefore, the identification of factors contributing to an increase in efficiency and acceleration of the course of adaptation processes among international students is an integral part of solving the problem of adaptation of this contingent of students.

We consider psychophysiological adaptation as the most essential component of the entire adaptation process. In this paper, we propose a mathematical model, which represents a boundary value problem for an ordinary differential equation. Graphs explaining the main provisions of the model are presented. Cases of adaptation processes in the presence of cyclic processes are considered. The optimal physical activity promoting the most rapid adaptation is determined.



*Corresponding author (Dmitrii Tumakov). E-mail: dtumakov@kpfu.ru 

## 1. INTRODUCTION

System studies of the problems of social and psychological adaptation of international students appeared only after 1950. The combination of factors that influence the student's condition in a foreign culture environment is called "culture shock" (Furnham & Bochner, 1986; Furnham, 2004). The historical development of the "traditional" theories of culture shock has led to the emergence of modern theoretical approaches such as "culture learning", "stress and coping" and "social identification". These approaches formed the basis for the theoretical foundation of the ABC concept (affective, behavioral and cognitive) for overcoming the culture shock and adaptation by international students to new living and studying conditions (Zhou et al., 2008). Most scientific research in the field of adaptation by international students concerned precisely the pedagogical, psychological and social aspects of this problem (Gilla, 2007). Therefore, the basis of the principles of modeling of adaptation processes, as a rule, were various psychological and pedagogical conditions (Drozd & Hmurec, 2014).

The authors of this work distinguish psychophysiological adaptation from a variety of types of adaptation, considering it the most essential component of the entire adaptation process. Unlike most studies based on statistical analysis, the present paper proposes a mathematical model that is a boundary value problem for an ordinary differential equation. The model itself contains a small number of parameters, the determination of which depends on a specific personality, new and previous conditions of the student's life. These parameters characterize, in the first place, the resistance and reactivity of the organism to the new environment and various physical activities as well as the biological rhythms of the organism itself.

The work contains graphs explaining the main provisions of the model. Cases of adaptation processes in the presence of cyclic processes are considered. The optimal physical activity promoting the most rapid adaptation is determined.

## 2. PSYCHOPHYSIOLOGICAL ADAPTATION

Psychophysiological aspects of the adaptation of international students are mainly reflected in the works of Russian authors, and the decisive role of the psychophysiological sphere in the processes of adaptation of international students is considered as well-established (Sevrjukova, 2000). We believe that adaptation begins with the stages of biological (physiological) and psychological adaptation and social adaptation should be considered as the final stage of adaptation of an international student to studying in a foreign cultural environment.

Studies revealed that the period of psychophysiological adaptation (PPA) of international students consists of two periods: unstable (first or second years of study) and stable adaptation (starting from the third year) (Sevrjukova, 2000). Therefore, the search for tools that affect the time (rate) of stabilization of adaptation processes is one of the main tasks for research of this kind.

A literature review showed that practitioners underestimate the impact of physical activity on the adaptation processes of international students, even though it is where that the reserves of increasing the efficiency of the process of adaptation to learning are hidden. Physical education classes are a powerful means of restoring the psychophysical forces of international students, which helps to cope with the problems of social and individual psychological adaptation (Grucjak & Grucjak, 2010;

Fazleeva et al., 2016; Tumakov et al., 2018).

We believe that in order to achieve optimal indicators of the rate of PPA processes, the motor regime of international students should be represented by at least three types of physical activity: group-wide training sessions, individual (self-directed) sessions and sports sessions (participation in sports competitions). Herewith, in the process of group-wide physical classes with international students, motor activity in the form of moderate-intensity cyclic physical exercises should dominate together with a joint group activity of students, especially in the form of mobile and sports games (Grucjak & Grucjak, 2010).

It is known that in achieving stable adaptation, an important role is played by the factor of the rate of mobilization of physiological reserves and adaptive mechanisms. Therefore, the slower the increase in physical activity, the easier the body will adapt to them. This is what we take into account when choosing the regime and form of physical activity classes since, with a sharp change in the duration or intensity of physical activity, the development of maladaptation is possible (Oparina & Kochetkova, 2013).

The adaptive capabilities of the body also depend on the corresponding cyclic fluctuations in changing the rates of biological reactions (biological rhythms). This is important to consider when building a mathematical model of psychophysiological adaptation. Knowing the laws of biological rhythms, it is possible to prevent or reduce negative adaptive shifts that can occur during physical education classes and sports exercises.

When constructing our mathematical model, we relied on studies examining both special cases of constructing adaptation models and some aspects of modeling in the field of physical education (Berestneva & Sharopin, 2004; Romanov, 2011; Gerget et al., 2018).

In our opinion, the construction of a mathematical model of the influence of physical education classes on the psychophysiological adaptation of international students to studying is a new and promising direction in improving the pedagogical process. This allows one to create an algorithm for the total physical activity of students, ensuring the optimal course of adaptation processes.

## 3. MATHEMATICAL MODEL OF PSYCHOPHYSIOLOGICAL ADAPTATION IN THE SIMPLEST CASES

We outline the general principles necessary for constructing an adaptation model (Tumakov et al., 2017). Following the work of Il’in (2005), we believe that the level of psychophysiological adaptation is assessed by adaptation potential (AP) and its values vary in the interval $u(t) \in (1, 7)$. A value of $u(t)$ near unity corresponds to a state of complete maladaptation of a person, and value of $u(t)$ close to seven corresponds to maximum adaptation (in this state, the body is fully adapted to new conditions).

We will assume that the rate of change of the adaptation potential (RCAP) decreases as the AP approaches its boundary values (one or seven). In fact, this means that the more unbalanced the organism or, on the contrary, the more adapted the organism, the more difficult it is to get it out of this state (Tumakov et al., 2017).

A similar relationship between RCAP and AP can be described by

$$u'(t) = a(t)(u(t) - 1)(7 - u(t)) \quad (1),$$

where $a(t)$ is a coefficient representing the adaptive properties of the organism and, in the general case, depending on time and current state of the person to be adapted. If $a(t) = a_0/6$, where $a_0$ is a constant, then equation (1) can be solved analytically

$$u(t) = \frac{7\exp\{a_0 t\}+C}{\exp\{a_0 t\}+C} \quad (2),$$

where $C$ is some constant, which is determined from an initial condition. For the initial condition, it is convenient to set the AP value at the zero time moment $u(0) = u_0$. Note that the behavior of AP near its boundaries may differ. In this case, on the right-hand side of equation (1) we obtain power-law expressions (Tumakov et al., 2018).

Figure 1 depicts the graphs $u(t)$ for various values of the adaptation coefficients $a(t) = a_0$. All curves change monotonically from their initial value of the adaptation potential $u_0 = 4$ to the final value $u_0 = 1$ or 7. Moreover, a larger value of the parameter $a_0 > 0$ (dashed line) leads more rapidly to full adaptation $u(t) = 7$, while a negative value leads to maladaptation $u(t) = 1$ (dotted line).

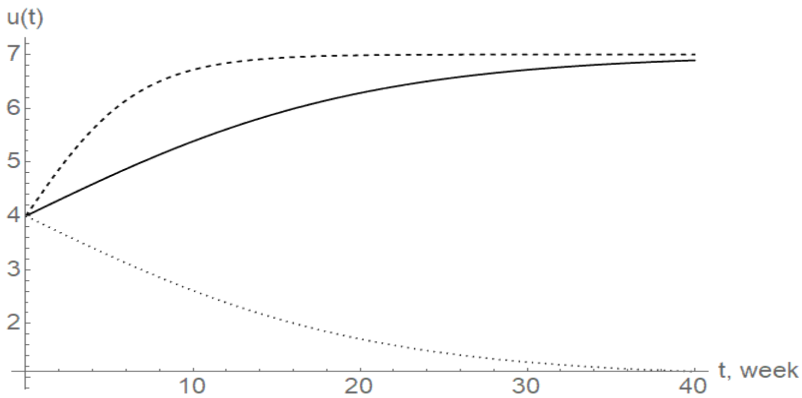


**Figure 1**: Dependence of $u(t)$ on time $t$ for the case of a constant adaptation coefficient $a_0$. Initial adaptation potential $u_0 = 4$. The solid curve corresponds to the case $a_0 = 0.1$, the dashed curve corresponds to $a_0 = 0.3$ and the dotted curve corresponds to $a_0 = -0.1$.

Let us consider a situation where a person and, accordingly, his/her adaptive properties $a(t)$ are subjected to cyclic fluctuations. Then the adaptation coefficient can be chosen in the following form: $a(t) = (a_0 + b \sin ct)/6$. In this case, equation (1) can be solved analytically:

$$u(t) = \frac{7\exp\left\{a_0 t - \frac{b}{c}\cos ct\right\}+C}{\exp\left\{a_0 t - \frac{b}{c}\cos ct\right\}+C} \quad (3).$$

The parameter $c$ can be chosen equal to $c = \pi/2$ (week$^{-1}$), which corresponds to a four-week cycle.

We turn to a more general case that takes into account the time shift during cyclic oscillations. Then equation (1) takes the form

$$u'(t) = \frac{a_0 + b\sin c(t+d)}{6}(u(t) - 1)(7 - u(t)) \quad (4),$$

whose analytical solution is

$$u(t) = \frac{7\exp\left\{a_0 t - \frac{b}{c}\cos c(t+d)\right\} + C}{\exp\left\{a_0 t - \frac{b}{c}\cos c(t+d)\right\} + C} \quad (5).$$

The boundary condition of the kind $u(0) = u_0$ determines the values of $C$ as

$$C = \frac{7-u_0}{u_0-1}\exp\left\{-\frac{b}{c}\cos cd\right\}.$$

We present in Figure 2 the graphs of the calculation results for equation (5) with the initial condition $u(0) = 2$ for cases of the identical influence of cyclic oscillations on adaptation; the graphs differ only in the values of $a_0$.

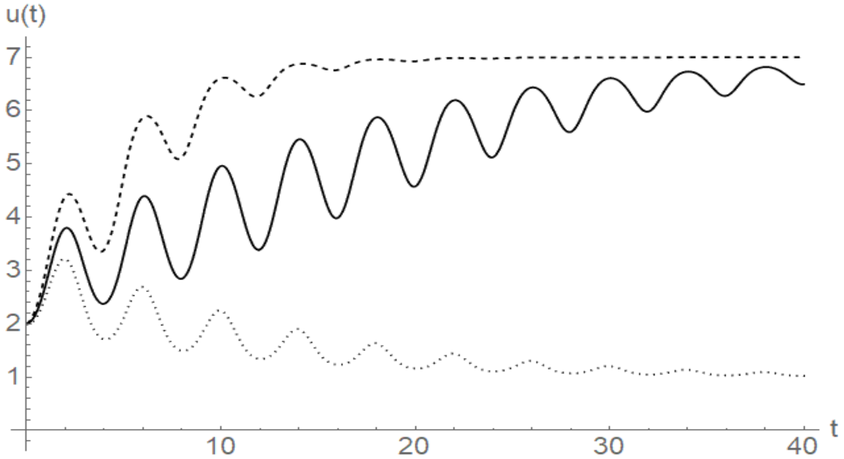


**Figure 2**: Dependence of adaptation $u(t)$ on time $t$ for the case of an oscillating adaptation coefficient $a(t) = a_0 + b\sin c(t+d)$. Parameters: $b = 1$; $c = \pi/2$; $d = 0$. The solid curve corresponds to the case $a_0 = 0.1$, the dashed curve corresponds to $a_0 = 0.3$ and the dotted curve corresponds to $a_0 = -0.1$.

The solid line in Figure 2 corresponds to the case $a_0 = 0.1$. In this case, the adaptation process lasts the longest, and the AP oscillations are more pronounced. It can be seen that when the AP approaches its limiting values, the influence of cyclic oscillations decreases. This indicates an increase in the “stability” of the organism upon reaching the states of adaptation or maladaptation.

## 4. INFLUENCE OF PHYSICAL ACTIVITY ON THE COEFFICIENT OF ADAPTATION

To demonstrate the relationship between the state of adaptive capabilities and the weekly amount of physical activity, it is necessary to introduce additional clarifying parameters. By the weekly amount of physical activity, we imply the total number of hours spent on physical activities of various types: group-wide and individual physical activity in the allotted time, sports (participation in competitions) as well as types of physical activity that have a quick effect on the state of the organism: morning physical exercises, gymnastic and relaxation exercises during the day. The required weekly amount of motor activity is a rather arbitrary parameter and is adjusted taking into account the individual characteristics of each individual. For individuals with sufficiently high adaptive indicators (“satisfactory adaptation”), a temporary decrease in physical activity to less than 3 hours per week does not lead to a rapid increase in symptoms of physical inactivity and a decrease in adaptation potential. Exceeding (short-term or episodic) the weekly classes to a load of more than 14 hours per week will also not lead to negative dynamics of the indicators. Long-term excess of the optimal (training) mode can lead, first, to the stress of adaptation systems, and then to the failure of adaptation reserves.

In individuals who have initially low indicators of the adaptive capabilities of the organism, a decrease in the motor regime below the minimum will cause a deterioration in psychophysiological parameters. Exceeding (short-term, one-time) the weekly amount of physical activity to over 14 hours per week will cause an increase in symptoms of over-fatigue and a sharp slowdown in the rate of recovery processes in the organism.

Let us now consider the positive effect of physical activity on the adaptation coefficient $a(t)$ in the framework of our model. We assume that at zero activity the influence is also zero, and with an increase in load, the adaptation coefficient (AC) increases, reaching a given maximum value. The achieved maximum effect (maximum value of AC), as well as the absence of influence from physical activity, depending on the current state of the AP.

Figure 3 presents graphs depicting the positive effect on the AC ($A^{+}$) for various levels of AP. The dotted line presents a graph for a maladaptive person: an increase in the positive effect takes place at minimal physical activity; the increase in the effect of physical activity stops near the amount of 10 hours per week. The dashed line corresponds to a person with an average AP; visible AC growth here is observed from 5 to 15 hours per week. The solid line is for an adapted person; here the AC growth interval varies between 8 to 18 hours of physical activity per week.

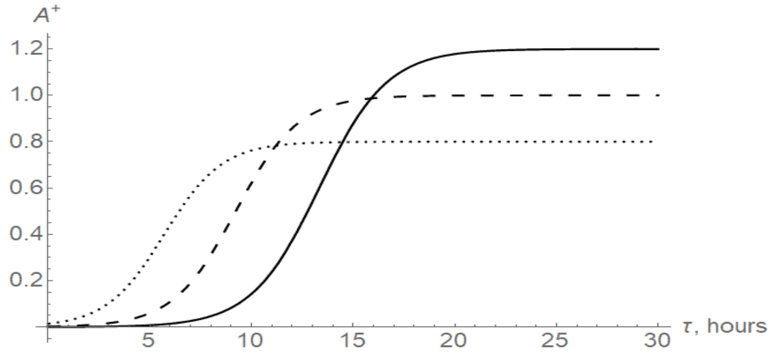


**Figure 3.** Functions of a positive effect on the AC. The solid line corresponds to a fully adapted person ($u \to 7$); the dashed line corresponds to a person with an average state of AP ($u = 4$), and the dotted line corresponds to a completely maladaptive person ($u \to 1$).

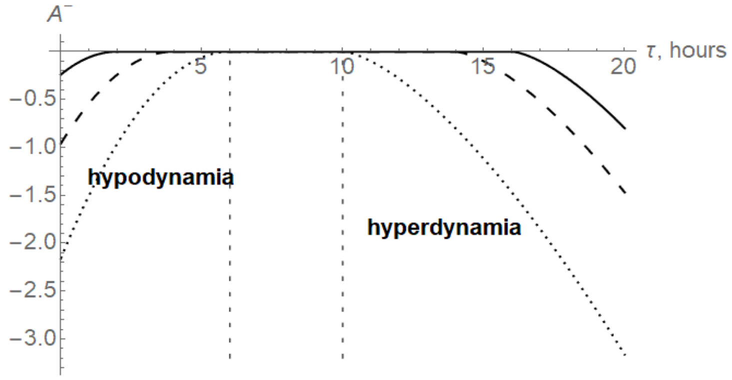


**Figure 4**: Functions of the negative effect on AC. The solid line corresponds to a fully adapted person ($u \to 7$), the dashed line corresponds to a person with an average state of AP ($u = 4$), and the dotted line corresponds to a completely maladaptive person ($u \to 1$). The left side corresponds to the area of hypodynamia, whereas the right side corresponds to the area of hyperdynamia.

We now touch upon the negative impact of processes associated with physical activity on adaptation characteristics ($A^{-}$). The first is hypodynamia: with a lack of movement, we get a minus in AC. In addition, as in the case of a positive effect, the dotted line corresponds to a maladaptive person – a load of fewer than 6 hours per week has a negative effect. In contrast, a fully adapted person has enough load of more than 2 hours per week to eliminate the effects of physical inactivity. The complete lack of physical activity has a stronger negative effect on a poorly adapted person.

The second negative effect is physical fatigue. For a person with a maximum level of adaptation (solid line), negative effects occur starting from the load of 16 hours per week. For a maladaptive person, these effects occur after the physical activity of 10 hours per week. For example, in the case of 20 hours of training per week, the AC is less than –3 for a maladaptive person versus –1 for a well-adapted person.

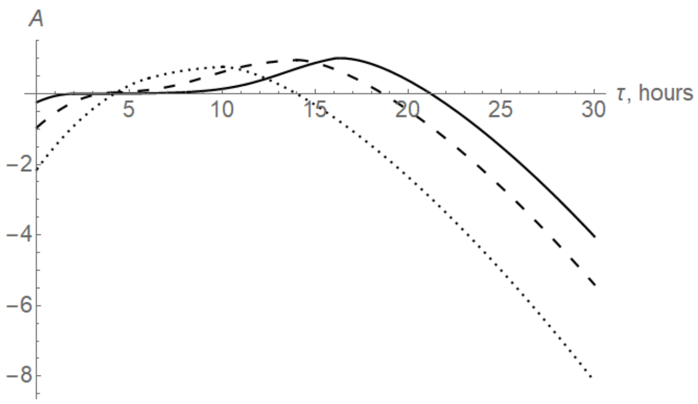


**Figure 5**: Dependence of AC on physical activity. The solid line corresponds to a fully adapted person ($u \to 7$), the dashed line corresponds to a person with an average state of AP ($u = 4$), and the dotted line corresponds to a completely maladaptive person ($u \to 1$).

The combination of positive and negative factors of physical activity can be represented in the form $A = A^{+} + A^{-}$. Graphs for various levels of AP are shown in Figure 5.

Let us describe the AC using the following expression:

$$a(t;\tau,y) = \frac{1}{15}\frac{11+y}{1+\exp\left\{\frac{10+2y}{3}-\frac{43-y}{60}\tau\right\}} + \begin{cases} -a_1\left(\tau-\frac{20-2y}{3}\right)^2, & \tau < \frac{20-2y}{3}, \\ -a_2\left(\tau-\frac{74+17y-y^2}{9}\right)^{3/2}, & \tau > \frac{74+17y-y^2}{9} \\ 0, & otherwise. \end{cases} \quad (6),$$

Here, the load is $\tau > 0$, and the parameter $y$ representing the AP, as said above, varies from 1 to 7. The coefficients $a_i$ corresponding to Figures 3–5 are hereinafter chosen as $a_1 = 0.06$, $a_2 = 0.1$.

## 5. MATHEMATICAL MODEL OF PSYCHOPHYSIOLOGICAL ADAPTATION THROUGH PHYSICAL ACTIVITY TAKING INTO ACCOUNT THE ADAPTATION POTENTIAL

Let us consider the adaptation process for the case when the current state of a person to be adapted is taken into account. In this case, the AC is described by expression (6). Figure 6 presents the dynamics of adaptation at the physical activity of 11 hours per week $u_1$ taking into account the AP (solid line) and $u_2$ and $u_3$ without taking into account the AP (dashed and dotted lines).

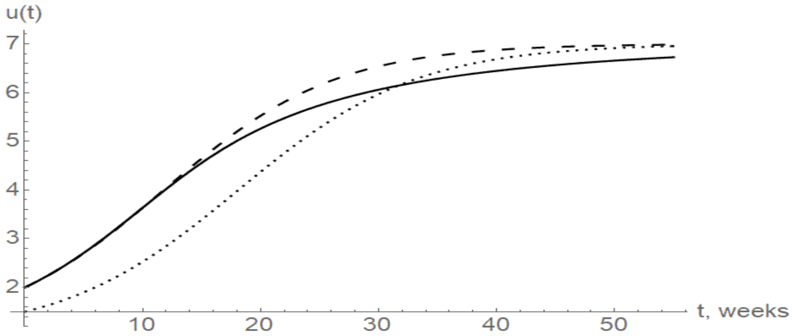


**Figure 6**: Curves of changes in the AP at a fixed load of 11 hours per week. The solid line corresponds to the model taking into account the AP, the dashed and dotted lines are for the model not taking into account the AP with different initial conditions.

It is clearly seen that in the initial period (about 10 weeks) $u_1$ and $u_2$ increase approximately in the same way. Then, the growth of $u_1$ is slowed down so that in the thirtieth week ($t \approx 32$) $u_3$, which started from a lower value $u_3(0) = 1.5$ (dotted line), reaches the value of $u_1$.

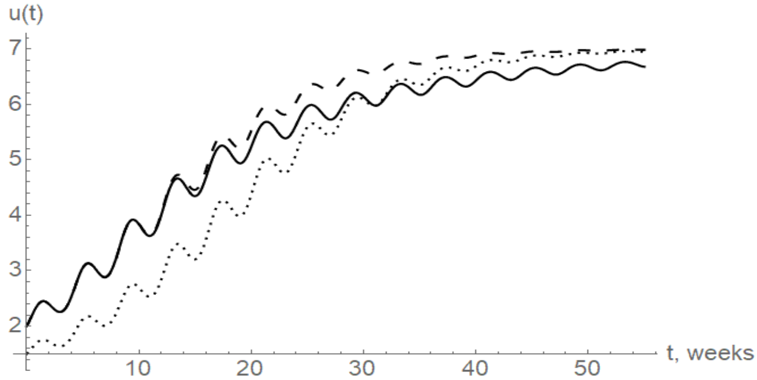


**Figure 7**: Curves of changes in the AP at a fixed load of 11 hours per week, and with oscillations. The solid line corresponds to the model taking into account the AP, the dashed and dotted lines are for the model not taking into account the AP with different initial conditions.

Now let us consider adaptation with 4-week cycles (Figure 7). Here the picture is identical to the situation shown in Figure 6. The AP curve, taking into account the potential (solid line), behaves similar to the curve also represented by the solid line in Figure 6 with respect to curves for models without AP (dashed and dotted lines).

Note that the load in the considered examples was fixed at $\tau = 11$ hours. However, it is evident that the adaptation process can be accelerated by optimizing physical activity. We consider the adaptation process with an optimized load in the next section.

## 6. OPTIMIZATION OF PHYSICAL ACTIVITY FOR ACCELERATING SUCCESSFUL PSYCHOPHYSIOLOGICAL ADAPTATION

Now let us move on to the process of adaptation, taking into account the AP at optimal physical loads. Analyzing the graphs in Figure 3, it can be expected that it is desirable to increase physical activity by increasing the AP. This will provide more rapid adaptation. From a mathematical point of view, at every moment in time it is necessary to find a maximum for the AC as a function of the parameter $y$. Thus, equating the derivative of the AC to zero for fixed $t$ and $y$ will give

$$\frac{da(t;\tau,y)}{d\tau} = 0 \quad (7).$$

The solution to this equation $\tau^*$ represents the optimal load at time $t$ at the current state of the AP $y$.

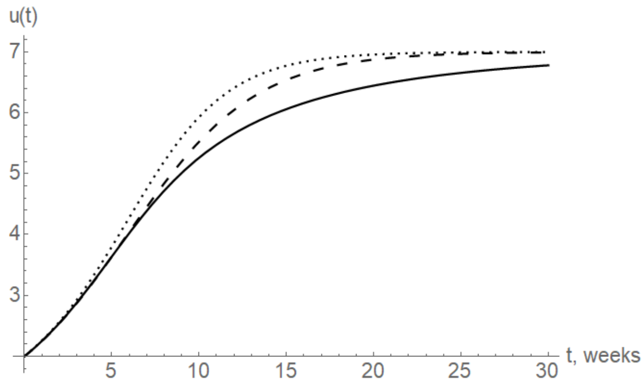


**Figure 8.** Curves of changes in the AP. The solid line corresponds to the model taking into account the AP, the dashed line is for the model not taking into account the AP. Solid and dashed lines are for a fixed load of 11 hours per week. The dotted line corresponds to the AP with the optimized load presented in Figure 10.

Figure 8 presents the dynamics of the AP in time. The solid and dashed lines correspond to the AP with a fixed load for models with and without accounting for the AP, respectively. The dotted line corresponds to the curve for the model taking into account the AP at an optimal load. As seen in Figure 8, optimization carried out already in the early stages accelerates the adaptation process.

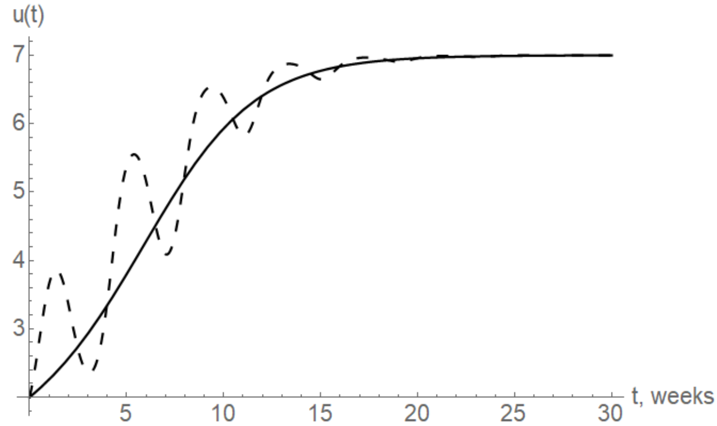


**Figure 9.** Curves of changes in the AP. The solid line is plotted for adaptation without oscillations; the dashed line is for adaptation with oscillations.

Now let us compare the "optimal" adaptation without cycles and with cycles. The graphs are shown in Figure 9. It is worth noting that adaptation is achieved at approximately the same time. The change in the "optimized" physical load with time is shown in Figure 10.

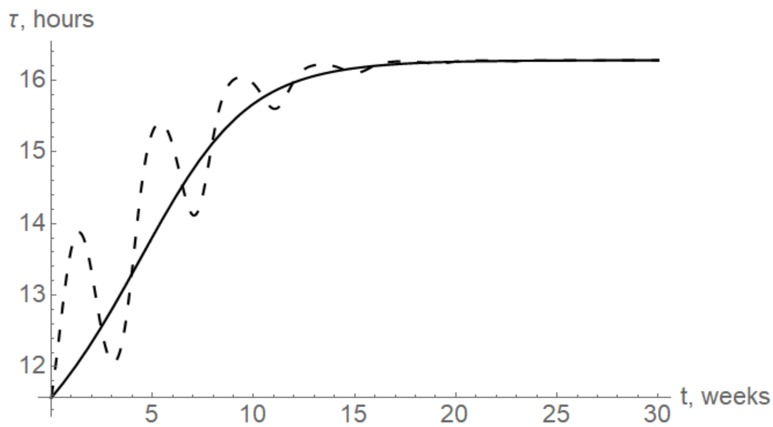


**Figure 10**: Change in optimal load per week during the adaptation process. The solid line is plotted for adaptation without oscillations; the dashed line is for adaptation with oscillations.

Note that the solutions to Equation (7) are obtained numerically. However, for adaptation without cycles (solid curve in Figure 10), the dependence of the optimal load $\tau$ on the AP $y$ can be approximated with a high degree of accuracy by

$$\tau = 8.35 + 1.8\,y - 0.095\,y^2 \quad (8).$$

## 7. CONCLUSION

Our study confirmed the initial hypothesis that the optimal mode of physical activity for international students will optimize the process of psychophysiological adaptation to new conditions of the studying environment. The constructed mathematical model will help determine the number of loads and the duration of physical activity and sports exercises for international students with different initial levels of adaptation indicators.

For achieving positive dynamics of adaptation indicators, the students with a low initial level are recommended to gradually increase the number of hours of physical activity per week. Students with a sufficiently high level of adaptation need, within the framework of the optimal motor regime, to alternate the motor load both quantitatively (in time) and qualitatively (in intensity and type of motor activity).

The result of the study can be used by the ministries of health, education, and sports in the selection of curricula that take into account the adaptation characteristics of international students.

## 8. DATA AND MATERIAL AVAILABILITY

Information regarding this study can be requested to the corresponding author.


## 9. ACKNOWLEDGEMENT

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.


## 10. DATA AND MATERIAL AVAILABILITY

For information related to this study, please contact the corresponding author.

## 11. REFERENCES


Berestneva, O. G., & Sharopin, K. A. (2004). Postroenie modelej adaptacii studentov k obucheniju v vuze, Izvestija Tomskogo politehnicheskogo universiteta, 5(307), 131-135. [In Russian].

Drozd, L. N., & Hmurec, L. B. (2014). Models of culture shock and adaptation. Materialy v mezhdunar. nauch.-prakt. konf.:"Mir yazykov: rakurs i perspektiva". 1, 13-31. [In Russian].

Fazleeva, E., Rahimov, M., Pasmurov, G., & Shalavina, A. (2016). Physical training at university as a means of adaptation of foreign students to the study in different cultural environment. The Social Sciences, 11, 500-501.

Furnham, A. (2004). Education and culture shock. Psychologist, 17(1), 16.

Furnham, A., & Bochner, S. (1986). Culture shock. Psychological reactions to unfamiliar environments. Culture shock. Psychological reactions to unfamiliar environments.

Gerget, O. M., Kochegurov, V. A., & Titarenko, E. J. (2018). Simulation of adaptation processes, Sovremennye problemy nauki i obrazovanija, 3, 8 p. [In Russian].

Gilla, S. (2007) Overseas students' intercultural adaptation as intercultural learning: a transformative framework, A Journal of Comparative and International Education, 37(2), 167-183.

Grucjak, N. B., & Grucjak, V. I. (2010). Fizicheskaja kul'tura kak moshhnyj faktor, sposobstvujushhij adaptacii inostrannyh studentov v VUZe. Fizicheskoe vospitanie studentov, 2, 37-39. [In Russian].

Il'in, E. P. (2005). Psychophysiology of Human. Saint Petersburg: Piter Publishing House. State. [In Russian].

Oparina, O. N., & Kochetkova, E. F. (2013). Funkcional'nye rezervy adaptacii, Mezhdunarodnyj nauchno-issledovatel'skij zhurnal, 12-1(19), 32-33. [In Russian].

Romanov, D. A. (2011). Matematicheskoe modelirovanie v strukture informatizacii fizicheskogo vospitanija, Uchenye zapiski universiteta imeni P.F. Lesgafta, 1(71), 90-95. [In Russian].

Sevrjukova, G. A. (2000). Psihofiziologicheskie kriterii adaptacii zarubezhnyh studentov k uslovijam obuchenija i prozhivanija v Rossii: Dis. kand. biol. nauk. – Volgograd, [In Russian].

Tumakov, D., Fazleeva, E., Akberov, R., & Valeeva, A. (2018). Adaptation to physical activities by international students at a Russian university. South African Journal for Research in Sport, Physical Education and Recreation, 40(1), 157-166.

Tumakov, D., Fazleeva, E., Valeeva, A., & Akberov, R. (2017). A mathematical model for influence of physical exercises on psychophysiological adaptation of international students to learning performance at universities. Journal of Pharmacy Research, 11(11), 1330-1335.

Tumakov, D., Godovykh, C., & Valeeva, A. (2018). Mathematical model of socio-psychological adaptation through a person's interaction with the environment, Herald National Academy of Managerial Staff of Culture and Arts, 3, 310-318.

Zhou, Y., Jindal-Snape, D., Topping, K., & Todman, J. (2008). Theoretical models of culture shock and adaptation in international students in higher education. Studies in higher education, 33(1), 63-75.

**Dr.Dmitrii Tumakov** is an Associate Professor at the Department of Applied Mathematics, Institute of Computational Mathematics and Information Technology, Kazan Federal University, Kazan, Russia. He got a PhD in Mathematics. He is interested in Electromagnetic Waves, Elastic Waves, Numerical Methods, Parallel Computing.

**Dr. Elena Fazleeva** is an Associate Professor at the Department of Physical Education and Sports, Kazan Federal University, Kazan, Russia. She is a Candidate in Pedagogical Sciences. She does research in Student Acitivity, and Sport Sciences.

**Alsu Valeeva** is a Junior Researcher at the Research Laboratory Modern Geoinformation and Geophysical Technologies, Kazan Federal University, Kazan, Russia. Her research focuses on Spatial Sciences and Modern Technology.

**Dr. Roald Akberov** teaches and conducts research at Kazan National Research Technological University and Kazan Federal University (Kazan, Russia). He had his bachelor degree in Aerospace Engineering from Kazan National Research Technical University, Kazan, Russia. He had an M.S. in Mechanical Engineering from University of Nevada at Las Vegas (UNLV), USA, and got an M.S. in Mechanical and Aerospace Engineering from Rutgers University (USA). He earned a Ph.D. in Chemical Engineering from Kazan National Research Technical University, Kazan, Russia. His research encompasses Multidisciplinary Engineering and Applications.