# INFLUENCE OF PHYSICAL EDUCATION MEANS UPON FUNCTIONAL STATE OF RESPIRATORY SYSTEM OF STUDENTS WITH CHRONIC LUNG DISEASE

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**Annotation.** The objective of the work was to study the dynamics of chronic lung diseases in students of the higher educational institutions and the influence of physical education means on the improvement of functional activity indices of respiratory system, indices of biological age (BA) and the level of physical fitness of first-year students. 94 students (56 of experimental and 38 of control group) subjected to different methods of physical education, participated in the experiment. Studies were conducted in 2006-2010. Peculiarities of physical load influence upon indices of timed expiratory and inspiratory capacity and vital capacity have been determined. Application of correlation, regression and factor analysis has permitted to determine the degree, the direction and the form of studied interrelations with biological age of students and present them in respective mathematical models.
**Key words:** chronic diseases, lungs, physical activity, study, society.

## Introduction

Due to recent development of clinical pharmacology and elaboration of new highly efficient technologies of therapy certain success has been achieved in treatment of patients with chronic lung diseases (CLD) {1, 2}. However, chronic character of pathology and increased apnea, decreased level of physical fitness of students with the given nosology of the disease result in restriction of functional capacities and condition the necessity of constant medical monitoring {3, 6, 7}. All these changes as well as decreased physical load tolerance, unsatisfactory psychoemotional state as a result of CLD exert influence on modification of diseased student way of life, which in its turn, initiates high degree of maladjustment of patients and decline of education quality and life.

According to recommendations of The World Health Organization (WHO) quality of life represents an individual evaluation by the person of his/her position in the society in relation to personal capabilities. Quality of life evaluation is also influenced by several factors such as, physical, psychoemotional and social, ability of patient to adapt to nosology of the disease and feel comfortably in this state. Therefore, besides clinico-laboratorial remission and pathology progress prevention, of great importance is also the improvement of well-being and all aspects of life quality.

Physical rehabilitation means such as, physical culture means, massage, physiotherapy, dietary nutrition, to name but a few, play a key role in improvement of the state of students with CLD and prevention of this disease. According to the latest mutual recommendations of American Thoracic Society (ATS) and European Respiratory Society (ERS) pulmonary rehabilitation is multidisciplinary, based on evidential base full-fledged system of measures, aimed at achievement of optimum indices of functional state, success in education and quality of life by students with chronic lung pathology {4, 8}.

The results of foreign {8, 10, 11} and national {6} studies demonstrate that the most efficient method consists in combining medication of students with CLD with physical exercise performance. In order to achieve the desired result the student should be clearly explained the objectives of physical exercise training and the necessity to exert maximal efforts so that to reach set goal. Of tremendous importance is also smoking cessation and training of proper application of inhalers.

## Objective, tasks, materials and methods.

*The objective of studies* was to reveal the impact of physical education means on the improvement of respiratory system functional activity and the level of physical fitness of students with nosology of chronic lung disease.

In the course of studies indices of biological age according to V.P.Voitenko (1991), vital capacity, timed inspiratory and expiratory capacity have been determined along with analysis of the results of medical examination in student polyclinic of the city of Kyiv.

## Results of studies.

Studies were conducted during 2009-2010 academic year with participation of 94 first-year students of the National University of Bioresources and Nature Management of Ukraine with respiratory system diseases (56 students of experimental group and 38 students of control group). Training sessions in experimental group were conducted according to experimental methods (during physical education sessions and individual performance of physical exercises besides general conditioning and special exercises, specially selected exercises for respiratory system, including recreational walking and running, were applied. Well-being status, peculiarities of disease nosology and physical fitness level were taken into account during physical exercise performance.

Physical education sessions in control group were conducted according to traditional methods used for students of special medical department.


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Analysis of statistical data of student polyclinic for 2006-2010 has demonstrated every year increase of the prevalence of respiratory system diseases among students. This is best illustrated in comparison with prevalence of cardiovascular system diseases (Table 1).

Table 1

*Comparative characteristics of the dynamics of some disease nosology in 2006-2007 – 2009-2010 academic years, %*

| Disease nosology | Academic year | | | |
|---|---|---|---|---|
| | 2006-2007 | 2007-2008 | 2008-2009 | 2009-2010 |
| Cardiovascular system | 3,9 | 4,0 | 4,2 | 4,7 |
| Respiratory system | 3,3 | 3,9 | 2,8 | 5,1 |

For instance, prevalence of cardiovascular system diseases at the beginning of 2009-2010 academic year as compared to 2006-2007 has increased by 0,8 %, whereas that of respiratory system has increased by 1,8 % during the same period, i.e. more than twofold. In general education institutions, as a rule, the pupils with health problems are hardly involved in physical culture classes; they are lacking elementary knowledge about physical exercise impact on enhancement of the body system functional activity, health promotion and improvement of feeling. Thus, only after admittance into higher educational institutions this category of students begins to become familiar with physical culture.

To reveal the impact of physical exercise training upon functional activity of students with CLD, studies were carried out aimed at determining physical exercise influence on respiratory system and correlation between respiratory system indices and biological age. Although well-known methods of biological age determination fail to measure the degree of molecular genetic "wear and tear" induced by deteriorated functional activity of human body, while the differences in conditions and ways of life of the various strata of society "wash out" conformities between markers of aging and vitality (V.P.Voitenko, 1991), biological age, nevertheless, remains one of the most probable indices of human body vital activity.

Analysis of the results of study carried out during academic year has indicated significant differences in athletes of different groups. For instance, data of young females of experimental special medical group (SMG) have significantly differed from those of control group. For instance, by the end of academic year the indices of vital capacity of young females of experimental SMG group have increased statistically significant by 165,4 ml ($p<0,01$), whereas those of the subjects of control group have decreased by 121,8 ml, although statistical significance has not been confirmed ($p>0,05$). Besides, the increase of negative correlation (r) between the value of vital capacity (VC) and biological age (BA) from $r= –0,321$ ($p<0,01$) to $r= – 0,444$ ($p < 0,002$) has been revealed in young females of experimental SMG group.

Negative correlation between the value of VC and BA of young females of experimental SMG group may be presented in the form of the following equation of linear regression:

$$\mathbf{y = 46,0321 – 0,0039*x,}$$

where: y – biological age, years, x – vital capacity, ml.

Graphical model of this dependence is presented in Figure 1. Mathematical and graphical models indicate BA decrease along with VC increase and vice versa. However, calculated coefficient of determination ($d = 0,197$) at this correlation shows that prognostic significance of this model constitutes 19,7 % ($p < 0,002$), that is, about 1/5 of BA variation of young females of EG depends on VC value.

Similar tendency is peculiar for indices of timed expiratory capacity too.

As concerns alteration of indices of timed inspiratory capacity, the studies have shown their increase by 7,6 s in young females of experimental SMG by the end of academic year confirmed by high degree of statistical probability ($p<0,001$), whereas in the subjects of control SMG only the tendency to improvement by 1,7 s ($p>0,05$) has been observed (Fig. 2).

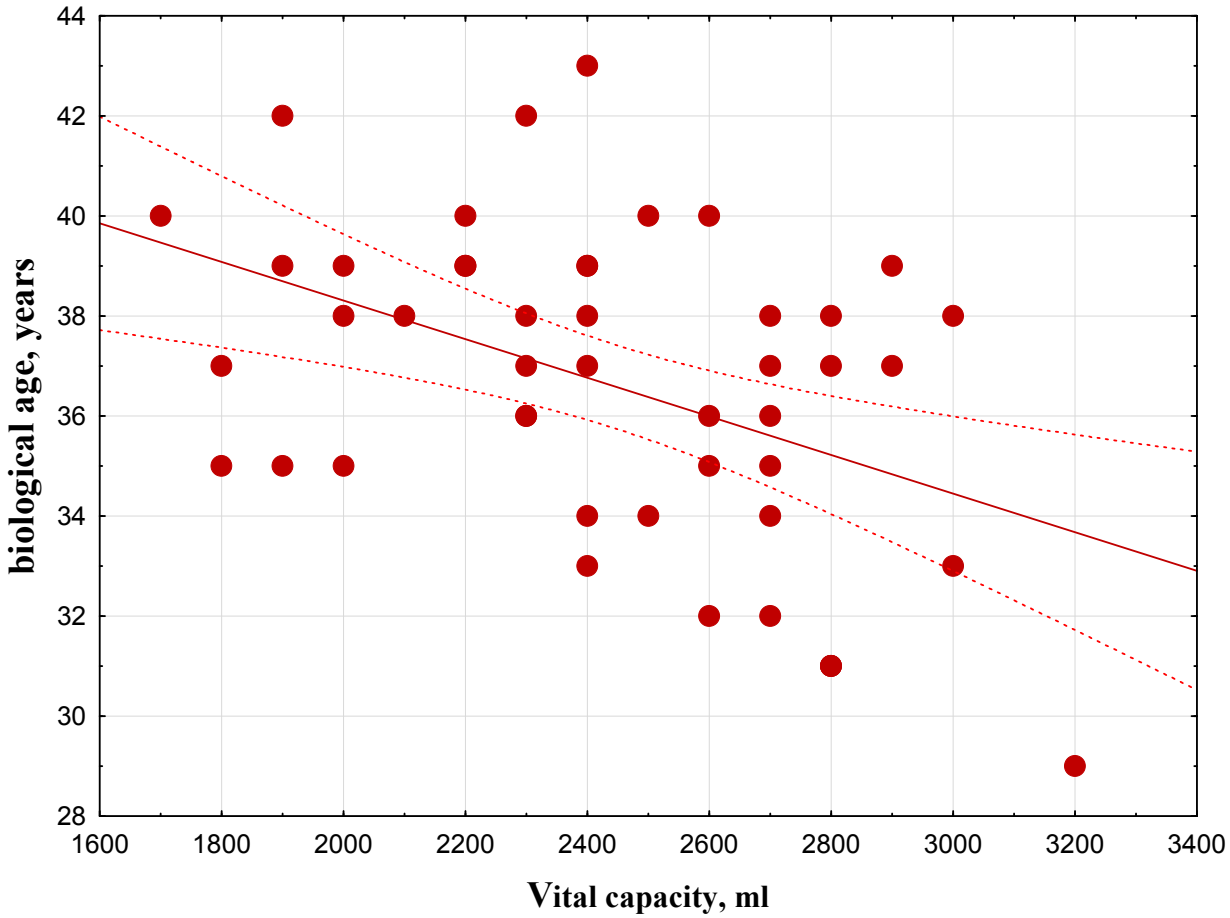


*Fig. 1. Graphical model of biological age dependence on VC of young females of experimental special medical group by the end of 2009/2010 academic year.*

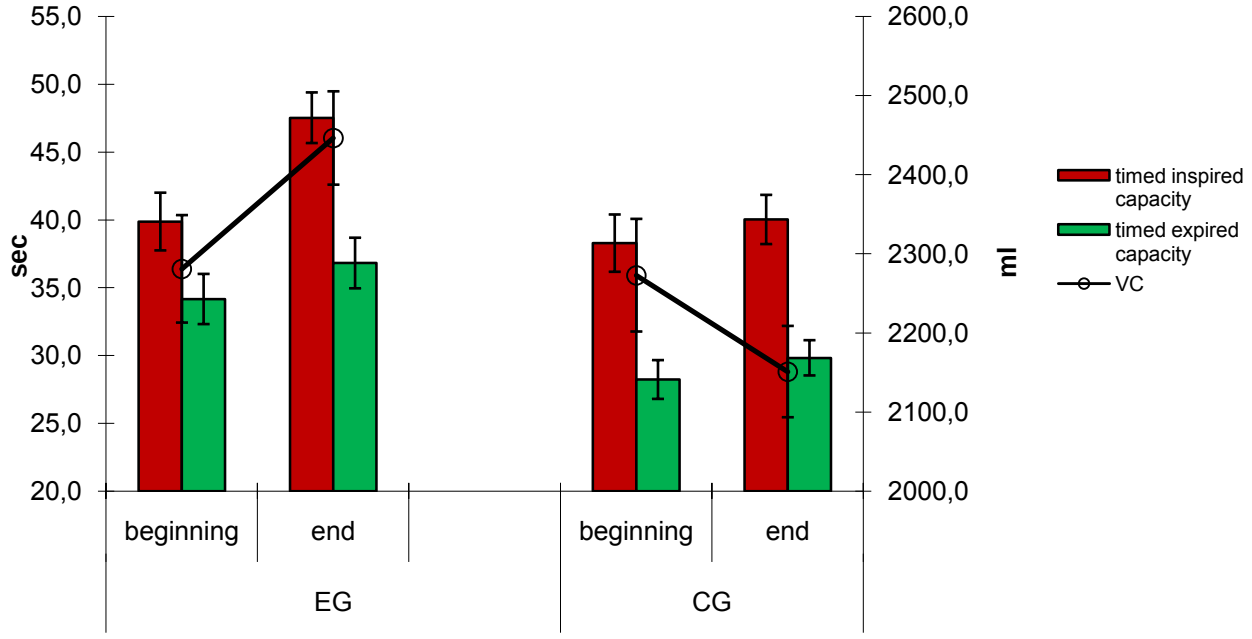


*Fig.2. Dynamics of respiratory system indices of young females of the first year of special medical group depending on the model of health protective technology during 2009/2010 a.y.*

Indices of timed expiratory capacity have been almost similar. They have increased by 2,6 s and 1,6 s in young females of experimental SMG and control group, respectively. Study of increase of these indices has indicated the tendency which is not confirmed by statistical probability ($p>0,05$).

Below is given mathematical model in the form of multiple regression equation, which reflects dependence of BA of young females of EG on indices of their physical development:

$$y = 38,288 + 0,08x_1 + 0,138\ x_2 + 0,307x_3 – 0,005x_4 – 0,126x_5 – 0,048x_6,$$

where: y – BA of young females, $x_1$ – body mass, kg, $x_2$ – VC/bm, $x_3$ – left hand strength, kg, $x_4$ – VC, ml, $x_5$ – strength index, $x_6$ – timed expiratory capacity, s., ($r = 0,643$, $p < 0,001$, $d = 0,413$).

Among model parameters the most influence upon BA is exerted by: VC/ml, $x_3$ – left hand strength, $x_4$ –VC, $x_5$ – strength index. Body mass and timed expiratory capacity effect BA to a lesser extent, although their ratio is of some importance for the final result of the model. The impact of this multiple regression model may be explained by alteration of 41,3 % of BA values in young females of EG by the end of the experiment.

The highest increase of statistically average value in young males has been noted in subjects of control SMG (308,3 ml). In young males of experimental SMG the increase of vital capacity by the end of academic year has constituted 210,7 ml, whereas in subjects of the basic medical group – only 159,1 ml.

Analysis of timed inspiratory capacity indices has revealed significant differences in indices of young males of experimental SMG as compared to subjects of other groups. For instance, by the end of academic year the increase of timed inspiration capacity indices in experimental group has constituted 14,3 s ($p<0,01$), whereas in control group it has decreased by 4,2 s as compared to that at the beginning of academic year (Fig. 3).

In young males of basic medical group indices have also decreased by 5,4 s. Meanwhile, decrease of timed inspiratory capacity results in the last two groups indicates the tendency to deterioration of indices, while statistical probability is not observed ($p>0,05$).

To reveal the influence of physical education process as well independent physical exercise performance on respiratory system, students of special medical group were divided into subgroups according to disease nosology.

The first subgroup included students with diseases of cardiovascular and respiratory system.

The second subgroup included students with diseases of gastrointestinal tract, liver, urogenital and endocrine system.

The third subgroup included students with diseases of visual organs, locomotorium and surgical disorders, neurological diseases and disorders of the ear, nose, and throat.

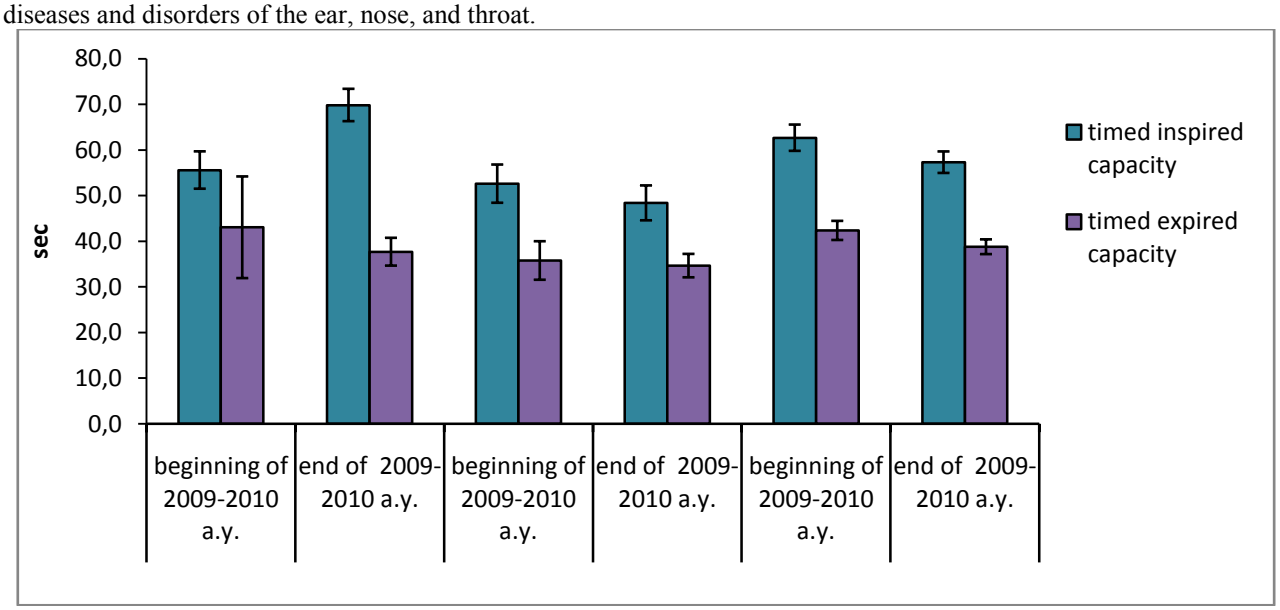


*Fig. 3. Dynamics of the indices of respiratory system of young males of the I year of study of special medical group depending on the model of health protective technology during 2009/2010 academic year.*

The findings are indicative of the increase of vital capacity indices in all groups of experimental group of young females. The best result has been noted in young females of the first subgroup (236,9 ml) which is confirmed by statistical probability ($p<0,01$). Increase of indices by 147,1 ml and 135,7 ml has been also observed in the second and the third group, respectively. However, only the tendency to improvement has been noted; statistical probability has not been observed (Table 2).

In young females of control SMG an improvement of VC indices by 52,6 ml as compared to the value at the beginning of academic year has been noted only in the third group. In the first group VC indices have been decreased by 119,3 ml, which is not, however, confirmed by statistical probability ($p>0,05$). The result of young females of the second group has been decreased by 293,8 ml, which is confirmed by statistical probability ($p<0,01$) (Table 3).

Table 2

*Average statistical indices of respiratory system of young females of experimental special medical group of the first year of study in 2009/2010 academic year*

| Entry | Groups of study | Stat. ind. | Estimation criteria | | |
|---|---|---|---|---|---|
| | | | VC, ml | Timed inspiratory capacity, sec | Timed expiratory capacity, sec |
| Beginning of academic year | | | | | |
| 1. | Diseases of cardiovascular and respiratory system | M | 2321,0 | 40,6 | 34,6 |
| | | ± m | 102,5 | 2,89 | 3,08 |
| 2. | Diseases of gastrointestinal tract, liver, urogenital and endocrine system. | M | 2152,9 | 38,7 | 32,9 |
| | | ± m | 93,8 | 3,67 | 3,00 |
| 3. | Diseases of visual organs, locomotorium and surgical disorders, neurological diseases and disorders of the ear, nose, and throat. | M | 2407,1 | 40,2 | 34,8 |
| | | ± m | 81,1 | 4,59 | 3,25 |
| End of academic year | | | | | |
| 1. | Diseases of cardiovascular and respiratory system | M | 2557,9 | 48,9 | 35,2 |
| | | ± m | 66,2 | 2,80 | 1,77 |
| | | t | 2,81 | 2,92 | 0,24 |
| | | p | **< 0,01** | **< 0,01** | > 0,5 |
| 2. | Diseases of gastrointestinal tract, liver, urogenital and endocrine system. | M | 2300,0 | 43,9 | 34,0 |
| | | ± m | 87,0 | 2,15 | 1,43 |
| | | t | 1,62 | 1,78 | 0,49 |
| | | p | > 0,2 | > 0,1 | > 0,5 |
| 3. | Diseases of visual organs, locomotorium and surgical disorders, neurological diseases and disorders of the ear, nose, and throat. | M | 2542,8 | 49,9 | 35,4 |
| | | ± m | 135,1 | 4,27 | 2,70 |
| | | t | 1,25 | 2,18 | 0,20 |
| | | p | > 0,5 | **< 0,05** | > 0,5 |

Analysis of timed inspiratory capacity indices has shown the following. In all groups of young females of experimental group the indices have increased from 5,2 s to 9,7 s by the end of academic year, however statistical probability of result improvement has been observed in the first group ($p<0,01$) and the third subgroup ($p<0,05$). Only the tendency to result increase by the end of academic year has been noted in the second group ($p>0,01$).

Table 3

*Average statistical indices of respiratory system of young females of control special medical group of the first year of study in 2009/2010 academic year*

| Entry | Groups of study | Stat. ind. | Estimation criteria | | |
|---|---|---|---|---|---|
| | | | VC, ml | Timed inspiratory capacity, sec | Timed expiratory capacity, sec |
| Beginning of academic year | | | | | |
| 1. | Diseases of cardiovascular and respiratory system | M | 2300,0 | 41,8 | 28,5 |
| | | ± m | 100,0 | 3,30 | 1,60 |
| 2. | Diseases of gastrointestinal tract, liver, urogenital and endocrine system. | M | 2300,0 | 37,4 | 32,3 |
| | | ± m | 141,2 | 3,38 | 3,27 |

| | | | | | |
|---|---|---|---|---|---|
| 3. | Diseases of visual organs, locomotorium and surgical disorders, neurological diseases and disorders of the ear, nose, and throat. | M | 2216,6 | 33,0 | 26,1 |
| | | ± m | 153,3 | 2,90 | 2,06 |
| End of academic year | | | | | |
| 1. | Diseases of cardiovascular and respiratory system | M | 2180,7 | 38,1 | 31,5 |
| | | ± m | 93,6 | 2,36 | 1,48 |
| | | t | 1,23 | 1,30 | 1,94 |
| | | p | > 0,5 | > 0,2 | > 0,1 |
| 2. | Diseases of gastrointestinal tract, liver, urogenital and endocrine system. | M | 2006,2 | 40,1 | 30,6 |
| | | ± m | 83,6 | 2,62 | 2,25 |
| | | t | 2,61 | 0,90 | 0,61 |
| | | p | < 0,01 | > 0,5 | > 0,5 |
| 3. | Diseases of visual organs, locomotorium and surgical disorders, neurological diseases and disorders of the ear, nose, and throat. | M | 2269,2 | 37,9 | 29,3 |
| | | ± m | 93,9 | 2,25 | 1,42 |
| | | t | 0,42 | 1,90 | 1,83 |
| | | p | > 0,5 | > 0,1 | > 0,1 |

The results of timed expiratory capacity in young females of experimental and control SMG have been characterized by some differences.

For instance, in all groups of diseases of young females of experimental SMG insignificant increase of indices from 0,6 s to 1,1 s has been observed by the end of academic year. This increase has been statistically improbable with only the tendency being noted.

In young females of control SMG, except for the third group of diseases, insignificant decrease of timed expiratory capacity indices has been observed by the end of academic year as compared to the beginning from 1,7 s in the second group to 3,0 s in the first one. However, this tendency has been improbable both in control and experimental group (from p>0,05 to p>0,01).

In experimental groups of both young males and females improvement of VC indices by the end of academic year has been also noted. For instance, in the first and the third group the results have increased by 80,0 ml and 250 ml, respectively, whereas in young males of the second group of diseases they have significantly increased by 540 ml. However, indices of young males of all groups of diseases concerning improvement of VC indices by the end of academic year have not been confirmed by statistical probability and remained within the range of p>0,05 - >0,01. Thus, we may only speak about the tendency to improvement of the results of VC.

**Conclusions.**

Therefore, application of physical education means during studying at the higher educational institution of students with CLD is the important and integral constituent, which significantly improves the outcomes of treatment, increases physical load tolerance, decreases the degree of dyspnea, enhances quality of life, reduces the number of hospitalizations, contributes to development of motivation to use physical exercises in order to strengthen health. Ignoring this aspect of rehabilitation measures will naturally result in increase of pharmaco-economic expenditures and reduced motivation of students to active participation in disease control, leading to decrease of academic achievements.

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