



Can integrative physical education improve physical development of schoolchildren ? With a kind of emptiness ?

Ivanna Bodnar^{1ABC}, Tetiana Dukh^{1BC}, Oleh Martyniv^{2CD}, Larysa Hoshovska^{1CD}

¹Department of Theory and Methodological of Physical Education, Lviv State University of Physical Culture, Ukraine

²Department of Physical Education and Sport, Ivan Franko National University of Lviv, Ukraine

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Abstract

Elaboration of the concept of inclusive education demands the continuation of the research in order to clarify its effectiveness under various conditions and with different contingent. The research objective was to compare the effect of segregative and integrative physical education classes (PE) upon physical development indicators in the apparently healthy middle secondary school age students and the students with minor health problems. Two separate groups of schoolchildren (N=1417, aged 10-15) underwent a medical examination. One group of students attended segregative physical education classes, for the other group physical education classes were conducted integratively according to the students' health status. The ratio of the total number of physical development significant growth rates in the sets of segregative and integrative mode of PE classes indicates a slightly higher efficiency of integrated PE classes as compared to segregative ones, which was confirmed statistically.

Keywords: education, health, school.

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Address for correspondence: Ivanna Bodnar - Department of Theory and Methodology of Physical Culture, Lviv State University of Physical Culture, Lviv, Ukraine; e-mail: ivannabodnar@ukr.net

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INTRODUCTION

Integrated education is being gradually introduced in Ukrainian educational establishments. Currently the integrative physical education (PE) requires the elaboration of its conceptual bases [1]. It is necessary to continue further thorough research into various integrated PE aspects to formulate theoretical foundations of its development.

Scientific studies often focus on social, emotional and behavioural advantages of integrative education for schoolchildren with health distortions [2-5], upon benefits in academic achievements [6]. Other studies examine changes in motor characteristics of schoolchildren in integrated environment of education [7-9]. Characteristics of physical development have been less investigated. For example, present researches [10], what found out obstacles into that young people can run with autism spectrum disorder and strategy for overcoming of these barriers. Other researches [9] studied influence of the unconventional movable playing the change of behavior of children with behavior disorders. Specialists set that applications of unconventional motions and sporting playing the lessons of physical education had assisted the improvement of co-ordinating capabilities of children 7 - 10. Also behavior of the integrated children changed substantially. Relationships became better with peers. Children began to follow pointing of teacher and did not apply destructive behavior in classroom. There is a lack of empirical data on integrated education effect upon physical fitness characteristics.

The majority of scientific studies proved the efficiency of integrated education for schoolchildren with high morbidity level [11-15]. The influence of integrated education upon the students with minor health problems still needs its further study.

In the schools, which adopted the inclusive model of teaching students with different abilities, all the classes are conducted integratively. In such environment it is hardly possible to differentiate and single out the positive effect of PE classes in particular. Ukrainian schools mostly adhere to two models of maintaining physical educational process. Some educational establishments do not divide the class into separate groups depending on students' fitness level. In this case the teacher, utilizing his own experience, differentiates physical load for the students during the classes in view of their functional and reserve capabilities and the lesson objectives. Other schools choose to distribute the students of one form to different medical groups in view of the schoolchildren functional health status. The differences between medical groups are presented in the form of a table [16]. In this case PE classes are conducted by two teachers at separate gyms, otherwise one and the same teacher who gives lessons to healthy students conducts PE classes for schoolchildren with health problems at a different time (at the last lesson for example). Thus the Ukrainian schooling system creates an opportunity to compare the effectiveness of both segregative and integrative PE classes apart from the combined effect of the institution educational environment.

The aim of the study was to carry out a comparative analysis for the effect of segregative and integrative PE classes upon physical development indicators of the apparently healthy ten- to fifteen-year-old schoolchildren and their peers with minor health abnormalities. Identification of the conditions, under which integrative physical education might be efficient (i.e. the age, sex and level of functional and reserve capacities of the students), would enable to optimize physical education process.

MATERIAL AND METHODS

Nine secondary educational establishments were involved in the investigation. Secondary school children from 5th to 9th forms (N=1417, aged 10-15) took part in the research. The experimental group (EG) were composed of 320 girls and 374 boys students (N=694). The control group (CG) were composed of 332 girls and 388 boys students (N=720). Each age/sex subgroup numbered at least 20 persons. The EG included the secondary school students taught according to the integrated system. Physical education classes in such schools were conducted simultaneously for children with different level of psycho-physical abilities (with individualization of tasks depending on the needs and abilities of each child). The CG comprised the students of those secondary schools, in

which physical education classes for apparently healthy students were conducted separately from the schoolchildren with minor psycho-physical deviations and rather poor physical fitness. Each group included apparently healthy students (with high and higher than average level of functional and reserve resources) and the students with minor health deviations (with average, below average and low level of functional and reserve resources).

Twenty nine physical development characteristics and indices were analyzed. Physical developmental indices were measured according to the accepted standards; integrated parameters, like age-and-weight Quételet index, were calculated. Parametric and nonparametric methods of mathematical statistics were applied. T-Student test for unrelated samples was used to clarify divergences reliability among the EG and CG students' parameters. The reliability of differences in the quantity of characteristics that had improved under educational experiment due the effect of both PE modalities was explored by means of χ^2 test (with N=290).

The protocol for the research project has been approved by a suitably constituted Ethics Committee of the institution within which the work was undertaken and that it conforms to the provisions of the Declaration of Helsinki. Subjects gave informed consent. Functional performance of the cardiovascular and respiratory systems, measured at rest, allow to assess the value of body functional reserves whereas the results of orthostatic test and Ruffier-Dickson and Robinson tests indicate the degree of body fitness developed during PE classes. To achieve the objectives we compared the indices of EG and CG schoolchildren obtained during the study according to one of the criteria (gender, age, functional and reserve capabilities degree). Therefore the changes that we analyze might indicate the advantages of one of the PE lesson model.

RESULTS

Comparison by gender

Significant gender differences were observed between EG and CG indices only in three physical development indicators. The efficiency of the segregative PE system appeared to be greater as for the rates of cardiovascular system functional reserves in the rest state. Thus the indices of the diastolic blood pressure were significantly lower, that is better, ($p<0.001$) in CG girls (67.17 ± 7.20 mm of merc.) as compared to EG (71.32 ± 7.47 mm of merc.). Nevertheless better respiratory system functional state parameters testified in favour of the integrative PE model. The indices of lungs vital capacity in EG girls (2268.18 ± 530.40 ml) significantly ($p<0.05$) exceeded similar indices in CG schoolgirls (1980.43 ± 171.78 ml). Timed inspiration capacity was significantly longer ($p=0.01$) in EG boys (45.25 ± 3.86 sec) as compared to CG (27.90 ± 7.92 sec). Thus on the whole in terms of physical development we were unable to find out the dominance of either integrative or segregative PE model in relation to children's gender.

Comparison based on age

Body mass of the EG grade 6 students (40.05 ± 6.43 kg) was significantly higher ($p<0.05$) than that of the CG students (36.67 ± 5.46 kg). In this regard, BMI of the EG grade 6 students (18.63 ± 2.72 kg/m²) is larger ($p=0.01$) than the same index in CG children (17.28 ± 1.85 kg/m²). BMI values of the EG students were within the normal range, whereas those of the CG students were slightly lower. In this case relative body mass parameters exhibit the benefits of the integrative PE model in view of all-round harmonious physical development of schoolchildren. Heart rate in relative calm with the EG grade 6 students (80.90 ± 10.94 str/min) was significantly lower ($p<0.01$) than with the CG (83.05 ± 13.18 str/min). The grade 5 students also showed lower values (77.00 ± 10.95 str/min in the EG as compared to 83.91 ± 10.85 str/min in the CG, $p=0.01$). Respiratory rate in the state of the relative calm with the EG grade 6 and grade 7 students (23.40 ± 3.99 resp.movem/min and 22.22 ± 5.13 resp.movem/min) was significantly lower ($p<0.001$) than with the CG students (28.45 ± 7.21 resp.movem/min and 25.14 ± 4.63 resp.movem/min).

Table 1. Schoolchildren physical development parameters that underwent significant positive changes in the integrative (i) and segregative (s) physical education classes

| Parameters* | Criteria for comparison | | | | | | | | | |
|-------------------------------|-------------------------|---|----------------------------------------------|------------------------------|-------|--------------------------|---|---|---|---|
| | Sex | | Degrees of functional and reserve capacities | | | Year of education, grade | | | | |
| | g | b | H, HA | A | LA, L | 5 | 6 | 7 | 8 | 9 |
| | | | apparently healthy | with minor health deviations | | | | | | |
| BMI | - | - | s | - | - | - | i | - | - | - |
| Slouch index | - | - | - | - | i | - | - | - | - | - |
| Hand strength (stronger hand) | - | - | - | - | - | s | - | s | - | - |
| Hand strength (weaker hand) | - | - | - | - | - | i | - | i | - | - |
| VC | i | - | - | i | - | i | - | - | i | - |
| Breath-holding spell | - | i | - | i | - | i | i | - | i | - |
| Breathing rate | - | - | - | - | - | - | i | i | - | - |
| Heart rate | - | - | - | - | - | i | i | - | - | - |
| Orthostatic test | - | - | - | - | - | - | - | - | i | - |
| Blood pressure (diastolic) | s | - | s | - | - | - | - | - | - | - |
| Robinson index | - | - | - | - | - | - | s | - | - | s |
| Ruffier index | - | - | - | - | - | - | - | s | - | - |

Note: * - meanings of the parameters and the degree of reliability of differences are given in the text; H - high, HA - higher than average, A - average, LA - lower than average, L - low degrees of functional and reserve capacities.

Lungs vital capacity in the EG students was higher for two age groups (for grade 5 pupils and for grade 8 pupils it was 2268.18 ± 530.40 ml and 2040.00 ± 343.97 ml accordingly) as compared to the CG pupils (2108.70 ± 395.33 ml and 1966.67 ± 329.27 ml accordingly). Stange test values prevailed significantly ($p < 0.001$) in the EG schoolchildren (42.00 ± 3.87 sec; 42.20 ± 2.68 sec and 43.75 sec accordingly) in three age groups of grades 5, 6 and 8 as compared to the CG pupils parameters (33.36 ± 9.99 sec; 30.22 ± 6.59 sec and 26.78 ± 5.93 sec). Hence the schoolchildren trained in the integrative setting exposed significantly higher respiratory system parameters. Heart rate growth after rising during orthostatic test in grade 8 EG (13.25 ± 3.09 str/min) was lower ($p < 0.05$) than in the CG (14.71 ± 2.00 str/min). The results of the orthostatic test accomplished by the students of both groups pointed to dynamic equilibrium of sympathetic and parasympathetic divisions of the autonomic nervous system. Nevertheless, the difference in terms of heart rate after rising with the EG children was closer to the lower limit (12 str/min). Robinson index of the EG grade 6 children (82.92 ± 10.82 s.u.) and grade 9 children (86.12 ± 11.11 s.u.) was by far less ($p < 0.05$) than that of the CG (84.90 ± 11.55 s.u. and 87.47 ± 11.88 s.u. in grade 6 and grade 9 accordingly). Ruffier index was significantly higher ($p < 0.05$) in grade 7 schoolchildren of the EG (10.44 ± 1.62 s.u.), which indicated lower cardiovascular efficiency level as compared the CG (10.05 ± 1.73 s.u.). The strength of a stronger hand was higher ($p < 0.001$) in the CG students of grades 5 and 7 (22.13 ± 6.86 kg and 21.04 ± 5.84 kg) as compared to the EG (21.77 ± 4.94 kg and 20.77 ± 5.25 kg). At the same time the weaker hand parameters were higher ($p \leq 0.01$) in the EG (17.05 ± 4.53 kg and 17.05 ± 5.08 kg accordingly in grade 5 and 7) as compared with the CG (16.83 ± 6.82 kg and 16.00 ± 5.45 kg).

Comparison based on the level of functional and reserve capacities

Despite the fact that the absolute values of body length and weight of the EG and CG representatives exposed no difference, the values of relative body weight of the apparently healthy students from the EG (15.80 ± 2.06 kg/m²) were slightly but significantly ($p < 0.05$) lower than those of the CG students (16.97 ± 2.40 kg/m²). BMI values characterized relative body weight of all the schoolchildren as deficient with minor deviations from the norm within the age-related changes. Reliable differences ($p \leq 0.01$) between the slouch parameters of the students with minor health

deviations and with low levels of functional and reserve capacities from the EG (93.06 ± 3.30 s.u.) and from the CG (91.33 ± 4.83 s.u.). Diastolic blood pressure values in the CG apparently healthy students (68.48 ± 7.90 mm of merc.) were lower ($p < 0.05$) than in the EG (71.32 ± 7.47 mm of merc.). As for the respiratory system functional status the EG students with average functional and reserve level displayed better results than the CG students. So VC of the EG students (2675.00 ± 393.20 ml) was larger ($p < 0.05$) than that of the CG students (2880.95 ± 574.99 ml). Breath-holding spell of those EG students (23.50 ± 3.54 sec) was longer ($p < 0.001$) than in the CG (30.88 ± 9.66 sec). All described comparison were presented in Table 1.

DISCUSSION

In terms of comparison of both groups by a gender, participants physical development indicators levels differs, once in favour for boys, and the second time for girls. This makes inconclusive, whether model of PE is domination in gender comparison (Table 1). However integrative PE classes promote substantial improvement of—larger number of physical development indicators in the schoolchildren with minor health deviations accompanied with low and lower than average levels of functional and reserve capacities as compared to the segregative model (3 against 2).

Both segregative and integrative PE classes increase considerably functional reserves of the schoolchildren neuromuscular system. The comparison of both PE models based on the schoolchildren age was in favour of the integrative PE, which had a positive impact upon much larger number of the parameters of physical development as compared to the segregative model impact. While integrative PE classes significantly improve somatometric and functional indicators of the junior age schoolchildren (grade 5 and 6), both PE models produce an equal effect upon physical development characteristics of 7-graders, whereas for 9-graders only one parameter – that of double product – increased significantly in segregative setting. Thus, it is safe to assume that the effectiveness of integrative PE classes decreases with schoolchildren age. To support this statement, a few indicators were higher in favour to integrated model.

Firstly, participants shown higher cardiovascular reserves in the integrative conditions of PE process in comparison with those students who trained in segregative settings. Also, number of schoolchildren with higher respiratory system reserves was larger at those schools that had introduced the integrative model of PE system. Integrative PE possesses stronger potential for developing respiratory system functional reserves as compared to the segregative PE model. The systolic capacity of heart muscle, reserves value and the degree of cardiovascular functions economization are higher in those students who trained in segregative settings. Nevertheless, integrative classes produce a pronounced positive effect upon the strength of a weaker hand, thus helping to balance the level of strength of both hands and harmonizing students' physical development. Moreover, significantly better respiratory system functional status were shown for those students who were trained in the integrative PE setting. This setting also shown advantages concerning correct posture shaping, since these indicators were closer to ideal (100 s.u.).

Ukrainian schoolchildren aged from 10 to 15 on average are growing faster in comparison to gaining weight. Mean value of relative body weight in EG students were closer to insufficient BMI values boundary. This means that those schoolchildren who attended integrative PE classes were less harmoniously developed than those students who trained in segregative settings. This testifies to the benefit of segregative PE.

It should be noted that our findings (Table 1) abundantly proof that integrative PE contribute to significant improvement of physical development parameters in the students with minor health deviations, whereas segregative PE is more efficacious for the apparently healthy students. On the whole with regard to the students' level of functional and reserve capacities the integrative PE model turns to be more effective as compared to the segregative one.

Reliable differences of physical development parameters were rather scarce: 12 out of 29 analyzed values and 26 out of 290 possible cases. It could be explained by a significant genetic determinism of somatic indices and small influence of such external factors as the way of PE classes organization. Overall, the number of significant changes in physical development indicators was

larger in the integrative PE setting (at a ratio 18:8, $p>0.05$). Thus, we can clearly assert that the integrative model of PE classes has a more profound effect upon students' physical development parameters as compared to the segregative PE model. The integrative model of physical education appears to be more effective for certain indicators and in certain settings, which demand further studies.

Our further research would be devoted to the comparative analysis of the impact of integrative and segregative forms of physical education management upon students' physical fitness characteristics.

CONCLUSIONS

1. Comparing the whole range of indicators reflecting the effects of PE classes upon physical development of the body revealed significantly higher efficiency of the integrated PE classes in comparison to the segregative ones.
2. We recommend introducing integrative model of physical education in schools in Ukraine. However, certain weak points disclosed in this model should be taken into account.
3. In order to optimize integrative physical education system it is worthwhile to consider the ways and means how to improve the effectiveness of physical education classes for the students with high level of capacities or arrange additional training sessions for them. It is also worth taking into account the reduction of integrative physical education efficiency with age.
4. It is necessary to continue studying the conditions and characteristics which the integrative approach to PE at secondary school appears more effective.

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