

EVALUATION OF HEALTH STATUS OF CHILDREN ATTENDING PRIMARY SCHOOLS WITH DIFFERENT ORGANISATION OF PHYSICAL EDUCATION LESSONS

Oleksandra S. Kondratiuk, Maria M. Korshun, Serhii I. Garkavyi, Serhii S. Garkavyi

Bogomolets National Medical University, Department of Hygiene and Ecology No 3, Kyiv, Ukraine

ABSTRACT

Background. The mandatory swimming lesson in primary schools, equipped with swimming pools, was introduced without studying of its health-saving effectiveness.

Objective. The purpose of this study was to evaluate the health status of pupils studying in schools with different organization of physical education lessons.

Materials and Methods. Cross-sectional study was organized in two schools with different organization of physical education lessons. The experimental group (E) consisted of 408 children of 1-4 year of study (210 girls and 198 boys) who during one of the lessons of physical education were engaged in swimming in the school basin. Control group (C) consisted of 279 primary school children (210 girls and 156 boys) from a neighboring educational institution where all physical education lessons were organized in the gym. The health status was evaluated using classical method of complex assessment of the state of health with the subsequent assignment of each child to one of the health groups.

Results. In result of evaluation of state of health there was established that among pupils from E group the proportion of boys with harmonious anthropometric parameters is higher ($p < 0.05$), children from this group are stronger than C group ($p < 0.05$). The prevalence of diseases of the musculoskeletal system and the eyes among pupils in E group was lower comparing to the C group ($p < 0.01$). In the E group percentage of pupils assigned to health group I was significantly higher and lower for the II (children with some morpho-functional abnormalities) comparing to the C group.

Conclusion. Organization of one mandatory swimming lesson per week in primary school has positive effect on health status of children.

Key words: *child's health, primary school children, health status, swimming lessons, physical education lessons*

INTRODUCTION

The proclamation of the World Health Organization's Ottawa Charter for health promotion has contributed to the active implementation of the health promoting projects in the educational process. Programs focused on the problems of children's physical activity, adequate nutrition, etc. were designed and implemented in the educational process as part of the World Health Organization's (WHO's) Health Promoting Schools (HPS) framework [7]. European Network for Health Promoting Schools (ENHPS) was a pilot project, which started in 1991 in four countries of Central and Eastern Europe: Czech Republic, Hungary, Poland and Slovakia and has been expanded to 38 countries of all over Europe by 1997. Without a doubt, the effectiveness of health-saving programs

should be justified in the course of scientific research [1, 8]. A study of effectiveness of the implementations in the framework of ENHPS has shown evidence that projects aimed at achieving the target body mass index, reasonable physical activity, good physical shape, sufficient fruit and vegetable intake and prevention of smoking have some positive effects [7].

Since many decades in our country there has been a tendency to deterioration in the health of children over the years of schooling, the experience of developing and implementing measures aimed at preserving and strengthening of health has been adopted by Ukrainian educational institutions. The majority of studies indicate that mechanical loading is a key mechanism linking chronic disease development and increasing of inflammatory mediators [5]. That's why one among many health-saving projects was the introduction of

Corresponding author: Oleksandra S. Kondratiuk, Department of Hygiene and Ecology, Bogomolets National Medical University, Peremogy avenue, Kiev 03680, Ukraine, Tel. + 380 96 4112070, e-mail: aleksandra.kondratiuk@nmu.ua

a mandatory swimming lesson in primary schools equipped with swimming pools. The innovative organization of physical culture includes swimming lessons during one of the three classes of physical culture stipulated in the curriculum. Swimming has a great recreational potential, on the other hand recent studies showed that concentration of disinfection by-products, formed as a result of water chlorination (trihalomethanes), in the air exceeded the admissible norm (100 µg/L) [2]. The influence of this factor has not been adequately studied yet, which could lead to the children's health status declining.

The purpose of our study was to evaluate the health status of children studying in schools with different organization of physical education lessons.

MATERIALS AND METHODS

Cross-sectional study was organized in two schools in Kyiv with different organization of physical education lessons. Schools of one of the sleeping areas of the city were built according to a standard design and differed only by the presence of a swimming pool in one of them. The experimental group (E group) consisted of 408 pupils (210 girls and 198 boys) of 1-4 year of study who during one of the lessons of physical education were engaged in swimming in the school basin. Control group (C group) consisted of 279 primary school pupils (210 girls and 156 boys) from a neighboring educational institution where all physical education lessons were organized in the gym. Using designed by us questionnaire we interviewed parents and children from equal research groups. The questionnaire revealed information about level of physical activity, leisure activities, well-being during the day. The block of questions that characterized social state of families helped to reduce socio-economic differences between children in research groups. Pupils who attend sport sections were excluded from the research.

The health status was evaluated using classical method of complex assessment of the state of health with the subsequent assignment of each child to one of the health groups [3]. The method includes an assessment of 4 mandatory health indicators: 1) the level and harmony of physical development (PD); 2) the functional state of individual body systems; 3) the degree of resistance to unfavorable environment factors; 4) the presence or absence of chronic diseases at the time of examination.

The level of PD was determined by comparing the growth of the child using the evaluation tables of physical development [3]. To assess the harmony of development, the correspondence of body weight and chest circumference (CC) to growth was studied according to the same tables.

For the evaluation of functional state of the respiratory system, the vital capacity of the lungs (VCL) was assessed using a dry portable spirometer according to the standard method [3]. Except absolute values of VCL, the Respiratory Indexes was calculated. Respiratory index is a ratio of VCL to the body weight. The functional state of the muscular system was assessed by hand dynamometry using a manual dynamometer [3]. In addition to the absolute values of hand strength in kg, the relative parameter to the mass of the body is calculated, expressed as a percentage - the strength index (SI).

Chronic pathology data and information about frequency and nature of acute illnesses were obtained from the „Medical card of the child” (form 026/o), in addition the data of class journals on school absences due to illness were also used.

On the basis of an individual assessment of 4 mandatory health indicators, each child was assigned to one of five groups of health: I – healthy children; II – children who do not have chronic diseases, but with some morpho-functional abnormalities; III – children suffering from chronic diseases in a state of remission; IV – children suffering from chronic diseases in active stage with incomplete compensation of functional abilities, V – children suffering from chronic diseases with rare remissions and significant decompensation of the body's functional capabilities. A more detailed description of each of the health groups is given in [3].

The differences between research groups for indicators corresponding to the normal distribution law were assessed according to the *Student's* t-criterion. Reliability of differences in the prevalence of diseases in the C and E groups was assessed by the *Pearson* χ^2 criterion. Calculations, visualization and analysis of data were carried out using IBM SPSS Statistics Base v.22, Microsoft Office Excel 2007. The study was performed in Bogomolets National Medical University as a part of independent research work “Hygienic evaluation of the operation conditions of the swimming pools in educational institutions” (number of State registration 0113U000673).

RESULTS AND DISCUSSION

The distribution of children from C and E groups according to the body length (high, above average, average, below average, low) is not significantly different ($\chi^2 = 4.64$, $p > 0.05$). The majority of pupils have average growth: 60.29 % in the C and 64.87 % in the E group respectively.

Evaluation of body weight and chest circumference correspondence to the body length shows that there are no children with sharply disharmonic physical development (Table 1, 2). There were no significant differences in the distribution of children (boys +

girls) in C and E groups, depending on the degree of correlation of body weight to body length. ($\chi^2=4.64$, $p>0.05$), but distribution of boys differs at the trend level ($\chi^2=5.73$, $0.05<p<0.1$). A detailed analysis revealed that the proportion of harmonically developed boys in the E group (59.61 %) is significantly higher in comparison with the C group (47.62 %, $t=2.29$, $p<0.05$) (Table 1).

Evaluation of chest circumference (CC) correspondence to the body length has shown the significant difference in the distribution of pupils from C and E groups according to this parameter ($\chi^2=8.17$, $p<0.05$) (Table 2).

Portion of harmoniously developed pupils according to the CC in the E group (64.87 %) is significantly higher compared with the C group (54.9 %, $t=2.05$, $p<0.05$). This is achieved mainly because of boys: portion of harmoniously developed boys according to the CC in the E group (68.59 %) is significantly higher compared with the C group (57.14 %, $t=2.45$, $p<0.05$).

The distribution of girls depending on the degree of PD harmoniousness in the E and C groups is not significantly different ($p>0.05$), although CC appeared to be more sensitive to physical loads in the basin ($\chi^2=4.81$) than body weight ($\chi^2=0.44$) (Table 1, 2).

Thus, children in schools with different organization of physical education do not differ in their growth. However, among pupils attending one swimming lesson per week, the proportion of boys with harmonious anthropometric parameters is higher, as well as the proportion of children of a gender-mixed group with harmonious CC and body length.

Functional capacity assessment is obligatory part of children's health status evaluation. The data obtained during dynamometry indicate that among children of the E group the functional capabilities of the muscular system are higher in comparison with the C group in terms of the absolute value of the wrist muscle strength and relative to the body mass parameter – strength index (Table 3).

There was no significant difference between the indices VCL and RI among schoolchildren studying at schools with different physical education organizations ($p>0.05$).

During evaluation of disease prevalence, premorbid states were taken into account as well. For instance, at the chapter "Diseases of the musculoskeletal system and connective tissue" disorders of posture were included.

Table 1. Distribution of primary school pupils with different organization of physical education according to the correspondence of the body weight to the body length

Harmoniousness of physical development	n	Boys + girls		Boys		Girls	
		C	E	C	E	C	E
		408	279	210	156	198	123
Harmonic	abs.	203	160	100	93	103	67
	%	49.75	57.35	47.62	59.61*	52.02	54.47
Disharmonic due to the body overweight	abs.	84	55	44	29	40	26
	%	20.59	19.71	20.95	18.59	20.20	21.14
Disharmonic due to the deficiency of the body weight	abs.	121	64	66	34	55	30
	%	29.65	22.94	31.43	21.79	27.78	24.39
χ^2		4.64		5.73		0.44	

Note: C – control group, E – experimental group

* - statistically significant differences in comparison with the C group by *Student's* t-test, $p<0.05$.

Table 2. Distribution of primary school pupils with different organization of physical education according to the correspondence of the chest circumference to the body length

Harmoniousness of physical development	n	Boys + girls		Boys		Girls	
		C	E	C			C
		408	279	210			408
Harmonic	abs.	224	181	120	107	104	74
	%	54.90	64.87*	57.14	68.59*	52.52	60.16
Disharmonic due to excessive chest circumference	abs.	85	54	46	26	39	28
	%	20.83	19.35	21.90	16.66	19.69	22.76
Disharmonic due to insufficient chest circumference	abs.	99	44	44	23	55	21
	%	24.26	15.77	20.95	14.74	27.77	17.07
χ^2		8.71		5.02		4.81	

Note: C – control group, E – experimental group

* - statistically significant differences in comparison with the C group by *Student's* t-test, $p<0.05$.

Table 3. Physiometric indicators of pupils studying at schools with different organization of physical education

Indicator		C		E		Boys		Girls	
		Boys	Girls	Boys	Girls	t	p	t	p
Wrist muscle strength, kg	right hand	8.05 ±0.12	7.39 ±0.11	8.43 ±0.18*	8.91 ±0.26*	3.15	<0.001	5.21	<0.001
	left hand	7.69 ±0.10	7.09 ±0.11	8.30 ±0.22*	8.75 ±0.25*	2.10	<0.05	6.05	<0.001
Strength Index, %	right hand	26.22 ±0.46	25.16 ±0.52	29.94 ±0.72*	29.04 ±0.75*	4.07	<0.001	4.60	<0.001
	left hand	25.24 ±0.45	24.16 ±0.46	29.25 ±0.72*	28.62 ±0.73*	4.30	<0.001	5.11	<0.001
Vital capacity of the lungs, ml		1586.20 ±17.02	1469.90 ±18.27	1523.89 ±24.60	1484.46 ±22.74	1.90	>0.05	0.49	>0.05
Respiratory Index, ml/kg		52.91 ±0.68	50.30 ±0.74	51.52 ±1.06	50.18 ±1.01	0.47	>0.05	0.14	>0.05

Note: C – control group, E – experimental group

* - statistically significant differences comparing to the C group, t - *Student t*-test, p – significance level.

It is established that prevalence of diseases of the musculoskeletal system and connective tissue among pupils that attended one swimming lesson per week (23.7 %) was lower comparing to the C group (34.2 %, $\chi^2=9.65$, $p<0.01$), (Table 4). There were no significant differences in the prevalence of diseases in the first two classes between C and E groups. On the third and fourth years, prevalence of diseases of the musculoskeletal system and connective tissue among pupils attending swimming pool (21.0 % и 14,0 % respectively) was lower comparing to C group ($\chi^2=4.82$, $p<0.05$ and $\chi^2=10.84$, $p<0.01$ respectively). Therefore, musculoskeletal system relief at weightlessness condition during swimming lessons prevents the development of pathological conditions.

Also, the prevalence of the eye and adnexa diseases is lower among pupils from E group compared with C group (7.3 % vs. 15.4 %, $\chi^2=11.55$, $p<0.01$). Significant differences between C and E groups were founded at 3rd and 4th years of study ($\chi^2=6.52$, $p<0.05$ и $\chi^2=14.67$, $p<0.01$ respectively). It is known that on the way of visual system pathology formation such prenosological states as spasm of accommodation and violation of contrast vision are formed [6]. The lower prevalence of eye diseases among children that attended swimming lessons compared to the C group could result from relaxing effect of exercises in water. In our previous studies based on the analysis of functional state of organism and state of vegetative nervous system, the relaxing effect of swimming lessons was evidenced: among children from group C the tone of the sympathetic nervous system prevailed while schoolchildren that attended swimming lessons were in a state of vegetative balance [4].

At the finale stage of the research an individual assessment of health status of schoolchildren was carried out. It was found that in a school were schoolchildren (1-4 classes) attended one swimming lesson the distribution of children by health groups is statistically significantly different compared to the C group ($\chi^2=24.09$, $p<0.01$) due to a higher proportion of children belonging to group of health I ($t=2.96$, $p<0.05$), and lower – to group II ($t=5.06$, $p<0.01$) (Table 5).

The distributions of pupils of C and E groups for health groups in the first and second classes do not differ ($p>0.05$). Significant differences were revealed in the 3rd and 4th classes ($\chi^2=14.56$ and 16.39 respectively, $p<0.01$). In the 3rd class, the proportion of pupils from group E in health group I (healthy children) was higher than in group C ($t=2.85$, $p<0.05$) due to the fact that the C group had more children assigned to health group II ($t=4.29$, $p<0.01$). In the 4th class the same differences were found: in the group E the percentage of pupils assigned to health group I was significantly higher and lower for the II health group ($t=2.85$, $p<0.05$ and $t=4.26$, $p<0.01$ respectively). This observation shows that with the increase in swimming experience, the health effect of one swimming lesson per week increases.

Thus, by the end of primary school education, with the organization of one swimming lesson per week, the proportion of children who have passed to group II of health – an intermediate category between healthy children and those suffering from chronic diseases - was lower compared to schoolchildren who were engaged only in traditional physical education classes.

Table 4. The prevalence of chronic diseases of children studying at schools with different organization of physical education lessons, %

ICD 10 chapter	Years of study									
	1		2		3		4		1 - 4	
	C	E	C	E	C	E	C	E	C	E
XIII Diseases of the musculoskeletal system and connective tissue	31	26	33	30	39	21*	36	14**	34.2	23.7**
VII Diseases of the eye and adnexa	6	5	9	12.5	18	3*	30	7**	15.4	7.3**
X Diseases of the respiratory system	12	11	16	16	21	17	13	13	13.8	14.07
XI Diseases of the digestive system	9	14	11.2	6.8	18	22	13	6	12.3	11.7

Note: C – control group, E – experimental group

the differences are reliable according to the *Pearson* chi-squared criterion * – $p < 0.05$; ** – $p < 0.01$

Table 5. Distribution of primary school pupils with different organization of physical education by health groups

Class	Research group	n	Health group								χ^2	p
			I		II		III		IV			
			Abs.	%	Abs.	%	Abs.	%	Abs.	%		
1	C	109	32	29.36	49	44.95	27	24.77	1	0.91	1.53	>0.05
	E	99	37	37.37	39	39.39	22	22.22	1	1.01		
2	C	133	53	39.85	62	46.62	18	13.54	-	-	7.19	>0.05
	E	60	24	40	19	31.66	17	28.33	-	-		
3	C	94	24	25.53	49	52.13	21	22.34	-	-	14.56	<0.01
	E	51	23	45.09*	10	19.61*	18	35.29	-	-		
4	C	72	21	29.16	44	61.11	6	8.33	1	1.38	16.39	<0.01
	E	69	36	52.17*	19	27.53*	13	18.84	1	1.44		
1-4	C	408	130	31.86	204	50.00	72	17.65	2	0.49	24.09	<0.01
	E	279	120	46.01*	87	31.18**	70	25.09	2	0.71		

Notes: * $p < 0.05$, ** $p < 0.01$ by the *Student's* test.

CONCLUSIONS

Organization of one mandatory swimming lesson per week in primary school has a positive effect on children health status. In result of complex assessment the following findings has been established.

1. The proportion of boys attended one swimming lesson per week with harmonious physical development was higher ($p < 0.05$), compared to the control group.

2. Children attended lessons in swimming pool had higher functional capabilities of the muscular system than in control group: the strength of the muscles of both hands in boys and girls was higher in absolute and relative indices ($p < 0.05$). Functional capabilities of the respiratory system of children of control and experimental groups did not differ significantly ($p > 0.05$).

3. Among primary school pupils of experimental group the incidence of diseases of the musculoskeletal system and the pathology of the eye were lower than in the control group ($p < 0.01$).

4. In the school with one swimming lesson per week, the percentage of junior schoolchildren belonging to the health group I (healthy children) was

higher ($p < 0.05$) and lower – to the II group (children with functional deviations) compared with pupils who didn't attend the swimming pool.

Acknowledgement

The study was performed in Bogomolets National Medical University as a part of independent research work "Hygienic evaluation of the operation conditions of the swimming pools in educational institutions" (number of State registration 0113U000673).

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

1. Blair M., De Bell D.: Reconceptualising health services for school-age children in the 21st century. *Arch Dis Child* 2011; 96 (7): 616 - 618.
2. Bozym M., Wzorek M., Klosok-Bazan I.: Health risk as a consequence of exposure to trihalomethanes in swimming pool water. *Rocz Panstw Zakl Hig* 2017; 68(4): 331-337

3. *Ivakhno O.P., Kozyarin I.P., Nyemtsova Yu.V.*: Methods of assessment of physical development and health status of child population: study guide. Kyiv, Shupyk National Medical Academy, 2012 (in Ukrainian).
4. *Kondratiuk O.S., Korshun M.M., Garkavyi S.I.*: Adaptive capacity assessment of primary school children in case of various forms of organization of physical training classes. *Deutscher Wissenschaftsherold German Science Herald* 2017; 3:12-14, doi:10.19221/201734.
5. *Majorczyk M., Smoląg D.*: Effect of physical activity on IGF-1 and IGFBP levels in the context of civilization diseases prevention. *Rocz Panstw Zakl Hig* 2016; 67(2): 105-111
6. *Podrygalo L.V.*: Study of the levels of body functions at the assessment and prediction of donosologic health states in the children, adolescents and youth. *Environment and Health* 2013; 3(62): 69-74 (in Ukrainian).
7. The WHO Health Promoting School framework for improving the health and well-being of students and their academic achievement. *Cochrane Database of Systematic Reviews*. Available at: http://www.cochrane.org/CD008958/BEHAV_the-who-health-promoting-school-framework-for-improving-the-health-and-well-being-of-students-and-their-academic-achievement. (Accessed 27.12.2017)
8. *Vanaelst B., Huybrechts I., De Bourdeaudhuij I., Bammann R., Hadjigeorgiou C., Eiben G., Konstabel K., Michels N.*: Prevalence of negative life events and chronic adversities in European pre- and primary-school children: results from the ID EFICS study. *Arch Pub Health* 2012; 70: 26 doi:10.1186/0778-7367-70-26.

Received: 28.12.2017

Accepted: 19.03.2018