

Correction of the functional state of 5-9-grade students at rural schools selected for special medical groups due to articular manifestations of connective tissue dysplasia in Ukraine

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Published online: June 30, 2017

(Accepted for publication June 05, 2017)

DOI:10.7752/jpes.2017.02086

Abstract:

The most frequent signs of connective tissue dysplasia and its links with a general morbidity of pupils were summarized. Health problems and some means for physical education of Ukrainian rural school pupils that were classified to special medical group due to connective tissues dysplasia are described in the article. Based on obtained data we tried to develop a complex approach that can be used during school year to stimulate moving activity and to improve a functional state of cardio-vascular and respiratory systems of special medical groups pupils possessing joint hypermobility caused by connective tissue dysplasia. Then evaluation of the developed approach was done by studying pupil's heart rate and applying different tests such as Stange test, Hench test, indexes of Ruffier and Robinson, vegetative index of Kerdo. As a result, positive influence of the developed program on a physical state of pupils enrolled was confirmed. Thus, the developed program can be used in Ukrainian rural schools to teach pupils exhibiting connective tissue dysplasia in order to compensate their lack of physical activity and improve their functional state thus preventing morbidity and development of complications.

Key words: physical education, health, pupils, connective tissue dysplasia.

Introduction

During a past decade a morbidity of pupils in Ukraine increased by 26.8% (Bodnar I., 2013) and almost 90% of graduates possesses different health issues (Ivanova L., 2013). In many cases reduced level of children health is associated with connective tissue dysplasia (CTD) manifested as certain disorders of internal organs and musculoskeletal system. The most common markers of connective tissue dysplasia are articular manifestations (AMCTD) particularly hypermobility of joints (HMJ) (Bakuridze-Manina V., 2015; Soleyko O. et al, 2014; Tymochko-Voloshyn R., 2016).

There are many observations suggesting HMJ prevalence (presence of ≥ 4 points on Beighton scale) in children 6-15 years ranging from 8.8% to 64.6% (Clinch J. et al, 2011; Juul-Kristensen B. et al, 2009; Tymochko-Voloshyn R., 2016).

HMJ is often accompanied with other changes (articular manifestations) of musculoskeletal system related to CTD such as flatfoot, valgus deformity of the foot, posture defects, various changes of spinal curvature, instability of cervical spine, temporo-mandibular joint, appearance of audible "crunching" or "clicking" during the joint movements. These problems cause disharmonious changes in physical development and reduced capacity of cardiovascular and respiratory systems (Kopff B. & Rachkovski J., 2011; Luk'yanenko N., et al, 2015; Tymochko-Voloshyn R., 2016).

In Ukraine before starting a school year pupils undergo obligatory medical examination during which a doctor determines Ruffier index and accordingly to the results obtained distributes children into 3 groups: main, preparatory and special medical group (SMG).

Healthy children who possessed well balanced and sufficient level of physical development with high or above average level of both functional and reserve capacity of the cardiovascular system usually are selected to the main group. Also the main group includes children with minor variations in health with sufficient physical development and physical fitness. The preparatory group includes children in the rehabilitation period after an acute case of disease that does not require physical therapy course, as well as children with average level of functional and reserve capacity of the cardiovascular system together with children possessing minor variations in health or almost healthy children with insufficient physical development and low physical fitness. The SMG includes children keeping significant permanent or temporary health issues which do not preclude studying at

school but contraindicated regular physical education. The SMG also includes children with low or below average level of functional and reserve capacity (Bodnar I., 2013, Ivanova L., 2013).

Noting the actual increase of pupils in SMG in secondary schools in Ukraine, the disturbing situation concerning their physical education appears. So, pupils of SMG in urban and rural schools must be present at physical education classes where they are involved only in preparatory (~ 6-12 min) and final (~ 3-5 min) parts of a lesson.

Besides, accordingly to SMG school program they should take special physical classes extra at least 2 times per week (Mayyer V. & Derevyanko V., 2008). Unfortunately, these additional classes in rural areas frequently are missed due to limited facilities.

Due to growing intensity of the studying process that is clearly seen in 5 – 9 classes, mental stress and the lack of children motor activity both are increasing. Thus, the already bad situation with low physical activity of pupils (Tymochko-Voloshyn R., 2016) is further deteriorating in the case of children with health issues disabilities in.

Prevention of morbidity by strengthening the children health is a priority way of national importance and is regulated by the Constitution of Ukraine, the Laws of Ukraine "Basic laws on health care", "About physical culture and sport", "About education" and other legal documents. Preserving and strengthening children's health are the most important tasks of the subject "Physical education" in secondary schools.

Therefore, considering a high prevalence of AMCTD in Ukraine we developed a set of measures (program) will promote increasing a motor activity and improving the functional state of cardio-respiratory system of SMG pupils who suffer AMCTD. Moreover, this will promote prevention, reducing the morbidity and complications in this category of children.

Materials and methods

Organization of research: measurement and determination of initial data of functional profile were performed at the beginning of the school year after the approval of pupils' lists of 5 – 9 classes referred to SMG. After the distribution of the selected contingent of children (SMG pupils with AMCTD of 5 – 9 classes of rural schools) to the main and control group, the author's program of physical education was implemented in studying process for 26 weeks (Tymochko-Voloshyn R., 2017). Control measurement of indicators of the functional state was performed at the end of the school year – after ending the cycle of implemented program. The research involved 42 SMG pupils with AMCTD of 5 – 9 classes that are studying in rural schools in Lviv region.

Methods: theoretical analysis and generalization of scientific data and instructional materials, biomedical research methods, method of pedagogical experiment, methods of mathematical statistics. Statistical analysis of the results was performed by using Microsoft Excel 2007 and a package IBM SPSS Statistics Version 22. Determining the authenticity of changes in the indicators of functional state was conducted by using nonparametric criteria: Mann-Whitney (for independent samples) and Wilcoxon (for dependent related samples).

Results and discussion

Before the implementation of the author's program, adaptation and spare capacity (ASC) of pupils involved was determined based on the calculated index of Rorer, index of Robinson, vegetative index of Kerdo (Pol'ka N. et al, 2013). So, 20 SMG pupils with AMCTD of 5 – 9 classes (47.6%) possess level of ASC defined as critically low - "failure of adaptation" (sharp decline in functional capacity of the body). In 50% of pupils (21 pupils) was low ASC - a significant stress of regulatory mechanisms (poor adaptation). Only 1 pupil (2.4%) possessed average level of ASC that corresponds to moderate stress of regulatory mechanisms. These results confirmed again the necessity for additional measures that would improve a functional state of this category of children. In addition, we studied both glycosaminoglycans and oxoproline content in daily urine which are direct markers of CTD before the children were enrolled in the author's program (Soleyko O. et al, 2014, Luk'yanenko N. et al, 2015).

Qualitative analysis established the presence of oxyproline in urine in 25 children (out of 42) and exceeded the age norm of glycosaminoglycans in daily urine of 10 children. Obtained biochemical results could suggest subcompensation or even decompensation of dysplastic changes in connective tissue on a tissue and cellular levels.

As a result we determined average initial and final values of the indicators of the functional state of the cardiovascular and respiratory systems of main group and control group children that additionally were divided by the age into 3 groups: 10-11 years, 12-13 years, 14 -15 years correspondingly. Initial values of the indicators of the functional state of main group and control group did not differ significantly before the program implementation ($p>0.05$) (Table 1, 2).

Table 1. Changes in the indicators of the functional state of the main group of SMG pupils with AMCTD of 5-9 classes of rural schools before and after the author's program

Indicator of the functional state		Average meanings of indicators in age subgroups					
		10-11 years (n=7)		12-13 years (n=7)		14-15 years (n=7)	
		<i>M</i>	<i>m</i>	<i>M</i>	<i>m</i>	<i>M</i>	<i>m</i>
HR, b/min	before	93,7	1,7	90	1,9	90	2,2
	after	86,3*	1,2	83,1*	1,3	82*	1,9
SBP, mmHg	before	117,1	2,9	107,1	1	115,7	2,3
	after	112,9	1	111,4*	0,9	117,1	1,5
DBP, mmHg	before	70,7	1,7	62,9	2,9	68,6	3
	after	67,9*	1	64,3	2	70	2,2
The Stange test, s	before	22,9	2,5	21,7	2,1	24	3,7
	after	29,6*	1,7	30*	1,1	32,1*	2
The Hench test, s	before	14,6	1,4	15,6	2	17,1	2,6
	after	19,7*	1,3	21,7*	1,1	22,4*	1,6
Index of Ruffier, units	before	13,7	0,5	12,7	0,7	13	0,4
	after	10,1*	0,3	9,7*	0,3	9,8*	0,3
Index of Rorer, units	before	11	0,3	11,1	0,2	11,5	0,4
	after	11,4*	0,2	11,4	0,2	11,6	0,4
Index of Robinson, units	before	110	4,2	96,5	2,4	104	2,6
	after	97,4*	1,8	92,7*	1,9	95,9*	1,6
Index of Kerdo, units	before	24,5	1,5	29,8	4,2	23,6	3,7
	after	21,3	0,9	22,5*	3,1	14,2*	3,9

Note: * – p < 0.05 – accurate differences compare to beginning of the research

After implementation of the author's program during an academic year, significant decrease of heart rate in main group and in all age subgroups (p < 0.05) (Table 1) as comparing to the results of control group (p < 0.01 for subgroups of 10-11 years and 12-13 years, and p < 0.05 for subgroup of 14-15 years) was found (Table 1, 2).

Table 2. Changes in the indicators of the functional state of control group of the SMG pupils with AMCTD of 5-9 classes of rural schools

Indicator of the functional state		Average meanings of indicators in age subgroups					
		10-11 years (n=6)		12-13 years (n=7)		14-15 years (n=8)	
		<i>M</i>	<i>m</i>	<i>M</i>	<i>m</i>	<i>M</i>	<i>m</i>
HR, b/min	before	89	0,7	92,3	1,6	87,3	2,5
	after	91	0,9	91,1	1,4	87,5	1,7
SBP, mmHg	before	109,2	4,4	115,7	3,8	111,4	2,6
	after	110,8	4	116,4	4,3	113,1	2,1
DBP, mmHg	before	65,8	2	67,9	3,4	66,9	2,1
	after	66,7	1,7	68,6	2,6	68,1	2,1
The Stange test, s	before	23,5	1,8	23,4	2,2	25,1	2,4
	after	23,2	1,4	22,1	1,9	23,9	1,6
The Hench test, s	before	14	2,1	17,1	1,7	17,3	1,8
	after	14,8	1,4	16,4	1,6	17,6	1,3
Index of Ruffier, units	before	13,4	0,3	13,6	0,6	12	0,4
	after	13,2	0,3	13,4	0,5	12	0,3
Index of Rorer, units	before	11,4	1,2	12,8	0,9	12,3	0,8
	after	11,4	1,1	13*	0,9	12,3	0,8
Index of Robinson, units	before	97,2	4,2	107,1	5	96,9	2,2
	after	100,9	3,8	106,4	5,5	98,8	1,8
Index of Kerdo, units	before	26	2,4	26,4	3,6	22,5	4,6
	after	26,7	1,6	24,8	2,4	21,7	3,7

Note: * – p < 0.05 – accurate differences compare to beginning of the research

We also found truthful changes in blood pressure - systolic blood pressure (SBP) in the main group of 12-13 years (p < 0.05) and diastolic blood pressure (DBP) in the main group of 10-11 years (p < 0.05) (Table 1). We could observe the positive changes in indicators of breath tests: increasing of duration the Stange test, Hench test in all age subgroups of main group (p < 0.05) (Table 1) and comparing to the final indicators of control group (p < 0.05 for age subgroup of 10-11 years, p < 0.01 – 14-15 years, p < 0.001 – 12-13 years of the Stange test and p < 0.05 for all subgroups of the Hench test) (Table 1, 2). After classes of SMG rural pupils with AMCTD of 5-9 classes of main group by the author's program, there were marked significant decreasing in the index of Ruffier comparing to initial data in all age subgroups (p < 0.05) (Table 1) and comparing to the results of control group (p < 0.01 for subgroup of 10-11 years, 14-15 years, p < 0.001 – 12-13 years) (Table 1, 2). According to the research results we have noticed growth of indicators of Index of Rorer in main group for pupils of 10-11 years (Table 1) and control group of 12-13 years (Table 2) comparing to the initial data (p < 0.05) although we don't plan to influence body weight and growth of pupils. A statistically significant was final decreasing of Index of Robinson in all age subgroups of main group (p < 0.05) (Table 1) and comparing to control group data of 12-13-years

($p < 0.05$) (Table 1, 2). We registered a significant decreasing of vegetative index of Kerdo in main group pupils of 12-15 years old regarding to the initial data ($p < 0.05$) (Table 1) and 10-11 years old – comparing to the final indicators of control group ($p < 0.05$) (Table 1, 2).

Therefore, after the implementation of the author's program of physical education in the academic year of SMG pupils with AMCTD of 5 – 9 classes of rural secondary schools, we observed a number of positive changes in their functional state. Changes in all age subgroups of main group were statistically proved by heart rate (decrease by 8.2% in average) by the Stange test, Hench test (average increase by 33.8% and 35% respectively), by index of Ruffier (decrease by 24.8% in average) by index of Robinson (decrease by 7.7% in average). This may indicate increasing of tolerance to exercise, improvement of functional state of the respiratory and cardiovascular systems (systolic heart work and aerobic capacity in children). It should be mentioned that after classes by the author's program we have noticed a truthful decreasing of vegetative index of Kerdo (in average of 32.2%) for the pupils of 12-15 years old. Final average value of vegetative index of Kerdo we assess as an indicator of sympathicotonical type but its decreasing (closer to the normotonical type) shows the improvement of the autonomic nervous system as one of the main coordinators of organs and systems during adaptation process.

Conclusions

The initial results show generally low level of adaptation and spare capacity (poor adaptation, considerable stress of regulatory mechanisms) and a significant decreasing of functional state of special medical groups pupils with articular manifestations connective tissue dysplasia of 5 – 9 classes of rural schools.

After the implementation of the author's program of physical education in the the academic year of special medical groups pupils with articular manifestations connective tissue dysplasia of 5 – 9 classes of Ukrainian rural schools improvement of their functional state as well as cardiovascular and respiratory systems were found. Thus, the developed program can be used in Ukrainian rural schools to teach pupils exhibiting connective tissue dysplasia in order to compensate their lack of physical activity and improve their functional state thus preventing morbidity and development of complications.

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