

ASSESSMENT OF SENIOR PUPILS' PHYSICAL FITNESS CONSIDERING PHYSICAL CONDITION INDICATORS

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Abstract. Consideration of physical condition indicators in assessment pupils' physical fitness permits to differentiate training and health restoration processes at physical culture lessons. *Purpose:* to substantiate criteria for pupils' physical fitness assessment, considering their physical condition indicators. *Material:* in the research 10-11 form pupils (n=406; 211 boys and 195 girls) participated. After physical fitness testing by requirement of acting programs we carried out diagnostic of pupils' psycho-emotional state. *Results:* by results of physical; fitness we observed substantial deviation from universal law of normal distribution. It was found that physical condition indicators of most pupils are beyond normal. It was also determined that the most informative indicators are body length, chest circumference and body relative mass. We substantiated that it is necessary to consider physical condition indicators, when determining physical fitness level. We also substantiated and worked out differentiated normative for assessment pupils' physical fitness. *Conclusions:* testing without consideration physical condition indicators does not facilitate pupils' motivation for further physical self-perfection. Such testing results in high situational anxiety and unfavorable psycho-emotional state of pupils.

Key words: pupils, tests, physical fitness, physical condition, motives.

Introduction

Organization of educational work with pupils on the base of differentiated approach ensures the best educational and health related effects. That is why such organization is very promising for physical culture (PC) optimization in modern schools. Physical condition (PCn) indicators are considered to be the most significant criteria for differentiated assessment of one sex-age group pupils' physical fitness (PF) differentiated assessment. It is substantiated by high significance of physical condition in realization motor potentials; simplicity and accessibility of registration; by close interconnection with bio-mechanical structure of physical exercises and intensity of organism's growth [1].

Specialists [2-5, 20, 21] regard the acting requirements to PF as imperfect. These requirements are not sufficiently substantiated. They do not meet age, motor and functional characteristics of children and youth. Acting PC program [6] does not envisage differentiation in assessment of pupils PF, depending on their morphological indicators. That is why Ministry of science and education of Ukraine stressed on importance of PC academic programs' adjustment to age, individual characteristics of child's growth and formation. Besides, it is necessary to consider positive international experience (resolution of Board of MSE of Ukraine, dt. November 2008, minutes № 13/ 1-2; 10 11/1, it. 4).

As on to day there have been a large number of tests for assessment of pupils PF. Besides, it has been worked out the following:

- Authors' methodic of assessment of pupils' motor fitness, which combine commonly known control exercises in different variants [7, 8];
- Diagnostic system for children's psycho-motor readiness for studying at school [19];
- Individual requirements to junior pupils' PF [9];
- Normative system for PF and health express control of secondary school age pupils [20].
- Objective criteria for determination of secondary school age pupils' functional reserves [21].

However, differentiation of requirements according to indicators of organism's natural condition is offered rather rarely. No attention is paid to the fact [10-12] that consideration of somatic metrical indicators positively influences on youth's attitude to PCn, PF, and their somatic and psychic health. There is a little of substantiated scientific data on determination of how PCn indicators influence on results of PC tests received by senior pupils of modern schools. In studies of specialists [10-16] searching of criteria, which it is necessary to consider, was initiated. But special literature data are often contradictory.

It is necessary to determine optimal set of morphological characteristics, which would characterize senior pupils' motor abilities to the largest extent. It will permit to substantiate and work out differentiated criteria of pupils' progress assessment. Building of PC programs, considering differentiated norms and PCn indicators of senior pupils will permit to individualize physical education process. It will also facilitate pupils' effective training and health improvement.

The purpose of the research was to substantiate criteria for physical fitness assessment of 10-11 form pupils, considering their physical condition indicators.

Material and methods

Participants: in the research 10 and 11 form pupils (n=406, 211 boys and 195 girls) participated. We also involved experts (n=19) – PC teachers with work experience of more than 20 years, in the research. The questioning of experts was required for analysis of the worked out approach to testing pupils' PF: feasibility of testing programs for teachers; feasibility of requirements for pupils; readiness for determination of sport reserves and for formation of pupils' skills in self-control.

Organization of the research: the research was carried out on the base of 12 comprehensive educational establishments of Lvov. We fulfilled PF testing of senior pupils and determined indicators of their PCn. After PF testing by traditional, not differentiated requirements of PC program, we diagnosed pupils' psycho-emotional state.

Medical-biological methods of the research stipulated determination of the following PCn indicators: body length, body mass and chest circumference. Assessment of body length and mass was fulfilled in compliance with regional PCn standards [17]. Relative body mass (*BMI – body mass index*) was assessed by traditional methodic. *Psycho-diagnostic* implied application of V.A. Rosanova's methodic [27] for determination of pupils' motivation for success; SAM methodic (express assessment of self-feeling, activity and mood) was used for assessment of personal psychic state; psycho-emotional reaction to loads; for determination of individual features and biological rhythms of psycho-physiological functions. Besides, we used methodic of Ch.D. Spilberger, adapted by Yu.L. Khanin [26] for pupils' anxiety registration. *Testing* of pupils' PF was fulfilled by requirements of PC academic programs [6]. Questioning of experts envisaged their assessment and analysis of components' effectiveness of authors' system of differentiated PC requirements components effectiveness.

Statistical analysis (correlation, partial correlation, factorial and cluster) was used for substantiation of PF assessment criteria.

Results of the research

We found that PC lessons with PF testing without consideration physical condition indicators negatively impact on their psycho-emotional state: they do not facilitate motivation of 53–59% pupils for further physical self-perfection; result in high situational anxiety of 67–83% pupils (see fig.1). After testing unfavorable psycho-emotional state is felt by 11–35% of pupils. After such PC lessons in pupils we observed insufficient motivation for success and high situational anxiety. Besides, we registered lower than normal mean values of self feeling, activity and mood. It can be assumed that elimination of testing negative influence will facilitate strengthening of pupils' social and psychic health.

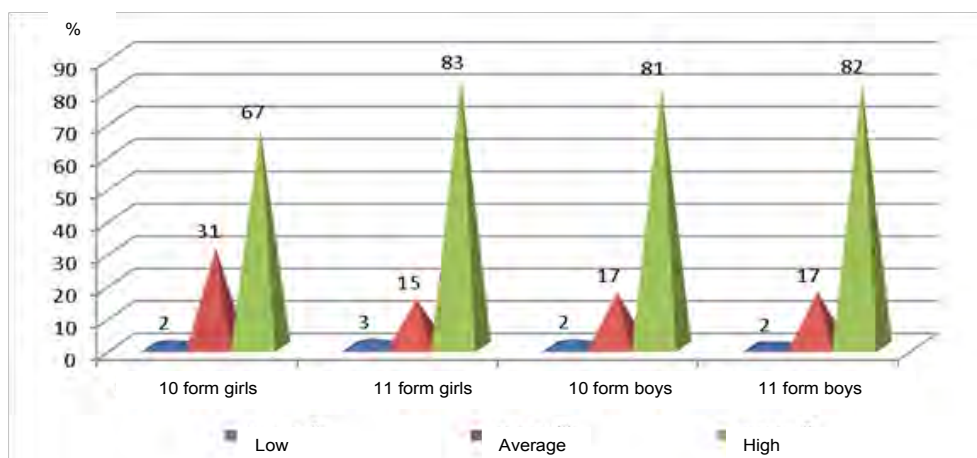


Fig.1. Level of senior pupils' situational anxiety after physical fitness testing at physical culture lessons:

We found that only some exercises in separate gender groups (torso bending in 11 form girls and in 10 form boys); long jump from the spot in 10 form girls and in 10-11 form boys; shuttle run and chin ups in 11 form boys) have normal distribution of initial levels. In most cases distribution of marks is asymmetric, i.e. asymmetry in respect to mean value is much higher than bordering values (in torso bending and 30 meters' run in 10 form girls and boys to the side of high marks; shuttle run in 10 form girls and boys and in 11 form girls – to the side of low marks) with insignificant quantity of average marks.

It was found (see fig.2) that PCn indicators are beyond normal in the following pupils: in 35.6% – by body length; in 65% – by body mass; in 45.6% – by chest circumference and in 20% – by relative body mass.

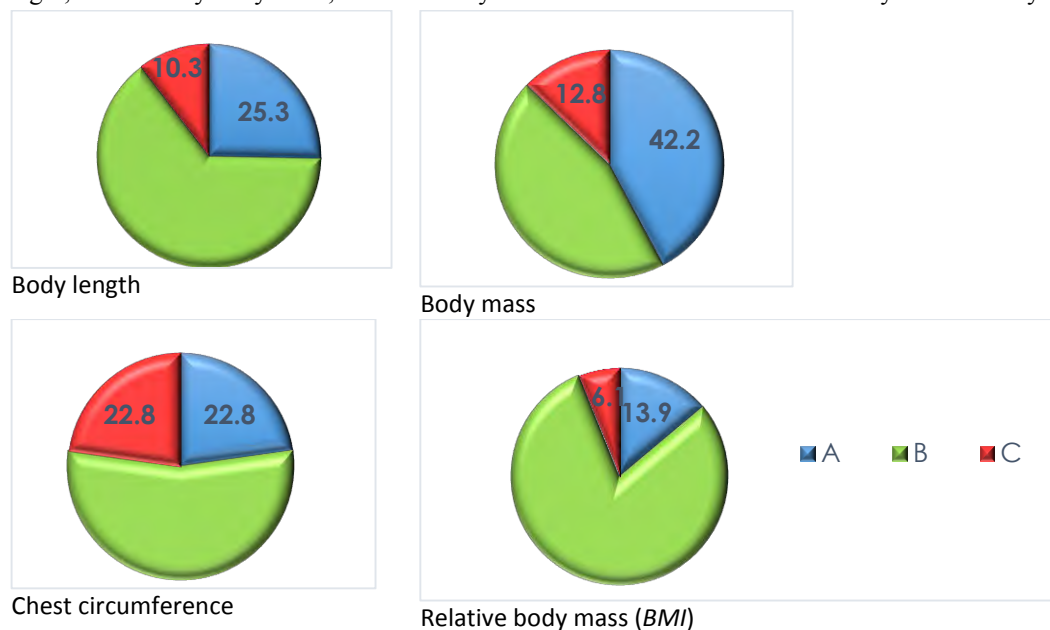


Fig.2. Percentage of pupils with different physical condition indicators: A – beyond normal; B – normal; C - lower than normal.

Analysis of correlations (see table 1) showed that in most cases between results of PF tests and PCn indicators of pupils there were registered weak and average by strength (though confident) correlations. Generalization of these data witnessed that chest circumference (CC) substantially illustrates PF natural level of senior pupils in test exercises. In most scientific works this indicators is underestimated. Values of relative body mass (*BMI*) create relatively more confident correlations with test results than indicators of absolute body mass. Thus, we proved information potential of criteria PCn, CC and *BMI* in differentiation PF requirements.

Table 1. Closeness of physical condition indicators' correlation to results of test exercises, fulfilled by senior pupils ($n=360$)

Tests Indicator	Contingent	30 meters' run	Long jump	Forward bending	1500 meters' run	Shuttle run 4x9m	Chin ups
	total	-0.194**	0.411** *	0.070	-0.218***	-0.269***	-0.079
Body length	boys	-0.131	0.310*	0.126	0.149	-0.078	0.061
	girls	-0.350**	0.130	0.358**	-0.073	-0.046	-0.055
	total	-0.164**	0.245** *	-0.059	-0.237***	-0.253***	-0.056
Body mass	boys	0.403**	-0.086	-0.213*	0.198*	0.069	0.072
	girls	0.141	0.028	-0.002	0.168	-0.054	-0.120

Tests Indicator	Contingent	30 meters' run	Long jump	Forward bending	1500 meters' run	Shuttle run 4x9m	Chin ups
	total	-0.318***	0.451** *	0.293***	-0.367***	-0.125*	0.439** *
CC	boys	-0.145	0.696**	0.442**	-0.632**	-0.339**	0.418**
	girls	-0.082	0.523**	0.358**	-0.386**	-0.079	0.416**
<i>BMI</i>	total	0.511***	-0.019	-0.135*	-0.127*	-0.111	-0.018
	boys	0.491**	-0.267**	-0.274**	0.068	0.090	0.006
	girls	0.422**	-0.090	-0.265**	0.227*	-0.054	-0.044

Notes: * – correlation coefficients are confident at $p < 0.05$; ** – at $p < 0.01$; *** – at $p < 0.001$

Analysis of partial correlations between PCh indicators (as well as results of factorial analysis) proved significance of body length, CC and *BMI* for differentiation of PF requirements for senior pupils. Average level ($r_{xy-z} = 0.632$, $p < 0.001$ and $r_{xy-z} = 0.650$, $p < 0.001$ respectively) of long jump from the spot positive influence points at CC without consideration of body length and mass. It witnesses that in conditions of equal body length and body mass children with greater CC could jump at longer distance. If to eliminate CC influence, partial correlation coefficients ($r_{xy-z} = 0.578$, $p < 0.001$ and $r_{xy-z} = 0.515$, $p < 0.001$) between distance of jump and body length (as well as between jump distance and body mass) remains to be rather high. I.e. in other equal conditions children with great chest circumference have advantage in this exercise. CC values, without consideration of body length and mass ($r_{xy-z} = 0.499$, $p < 0.001$ and $r_{xy-z} = 0.485$, $p < 0.001$ respectively) positively weakly (though approaching to average closeness) are reflected in results of chin ups. It proves that children with trained chest will have advantage in chin ups.

In other tests exercises CC big values (in other conditions equal) negatively impact on results. Pupils with great CC (in case of equal body length and mass) would run 4x9 meters' distance a little slower. It is witnessed by negative correlation coefficients ($r_{xy-z} = -0.405$, $p < 0.001$ and $r_{xy-z} = -0.426$, $p < 0.001$ respectively). In case of equal body length and mass children with little CC values will have advantage ($r_{xy-z} = -0.382$, $p < 0.001$ and $r_{xy-z} = 0.388$, $p < 0.001$ respectively) in 30 meters' run. Less than normal chest circumference values will provide advantage also in 1500 meters' run ($r_{xy-z} = -0.318$, $p < 0.001$ and $r_{xy-z} = 0.323$, $p < 0.001$ respectively).

CC values (without consideration of body length and mass) showed higher partial correlation coefficients ($r_{xy-z} = 0.499$ and $r_{xy-z} = 0.485$ against $r_{xy-z} = 0.439$) with results of chin ups that before elimination of influence. In the same way partial correlation coefficients ($r_{xy-z} = 0.632$ and $r_{xy-z} = 0.650$ against $r_{xy-z} = 0.451$) between CC and long jump results substantially increased. It also proves significance and demand in corrections of requirements to pupils, considering natural values of somatic metric indicators.

Correlation of body length (if mass does not change) insignificantly influences on results of long jump ($r_{xy-z} = 0.396$, $p < 0.001$): tall children jump longer. Even to less extent ($r_{xy-z} = -0.186$, $p < 0.05$) body length influences on shuttle run results. It witnesses that in run for dexterity short by body length pupils have advantage. Results of other exercises (if to eliminate body mass) are not influenced by body length indicators ($r \leq |0.065|$). Body length, with CC being unchanged, positively influences ($r_{xy-z} = 0.578$, $p < 0.001$) on long jump. I.e. tall children have advantages in long jumps. A little to less extent ($r_{xy-z} = -0.341$, $p < 0.001$) body length negatively influences on quantity of chin ups. I.e. in chin ups (if CC values are equal) children of smaller body length have advantage. Such children also will have advantage (without consideration of CC) in run for dexterity ($r_{xy-z} = 0.234$, $p < 0.01$). Between these indicators there is weak but confidently negative partial correlation. Body length without CC does not influence on results of 30 meters' and 1500 meters' run ($r_{xy-z} \leq -0.127$). The received by us results proved information of special literature that anthropometrical indicators do not influence on results of forward bending ($r_{xy-z} \leq |0.110|$).

Factorial matrix of 10-11 form girls includes 4 leading factors, which explain 75.20% of general dispersion. According to the obtained matrix first factor covers 21.78%. It was called "flexibility". It includes results of two exercises – 30 meters' run (0.924) and torso bending (0.734). Other factor explains 18.54% of general dispersion and was called "anthropometry". It consists of body mass (0.903) and body length (0.777) values. The third factor

(18.35%) was called “endurance”. It includes results of two exercises, connected with aerobic and power endurance: 1500 meters’ run (0.833) and chin ups on low horizontal bar (0.762). The fourth factor determines 16.53% of dispersion. It combined results of shuttle run (0.889) and long jump from the spot (0.566). Both these exercises require quickness that is why this factor was called “quickness”.

Boys’ factorial matrix of PCn and PF included 8 leading factors, from which the first three cover 67.39% of general dispersion. The first factor was 31.45% of dispersion. To the largest extent results of 1500 meters’ run (0.805), torso bending (0.786), 30 meters’ run (0.743) and long jumps from the spot (0.606) are connected with this factor. This factor was called “general physical fitness”. It should be noted that at second by significance place (explains 18.94% of dispersion) anthropometric factor is. The most significant for it were body length (0.866) and body mass (0.869). In the third factor (17.94% of dispersion) the highest were results of shuttle run (0.783) and chin ups (0.732).

So, generalization of factorial analysis data proved that PCn indicators (first of all body length and mass) take important (second) by significance place in structure of factors, determining boys’ and girls’ physical fitness level.

Cluster analysis (see tables 2 and 3) permitted to find that among tested by us senior pupils not all groups have all possible variants of PCn highest, lowest, lower than average and average indicators. We registered only 3 (girls) and 6 (boys) group[s] with sufficient quantity of persons, whose bordering (high or low) PCn indicators are accompanied by high or low results of physical fitness testing. Requirements to these groups were differentiated, depending on PCn indicators. Some more cluster groups were represented only by 1(2) persons that did not permit to differentiate PF requirements.

Table 2. Results of cluster analysis (girls)

Indicators	Body length	Body mass	Chest circumference	BMI	Pinette’s index	Long jump	Torso bending	60 meters’ run	Shuttle run 4x9m	Chin ups in lying position
1	X 162.353 N 82 σ .74321	C 52.670 82 .61719	C 83.329 82 .52863	C 19.996 82 .21615	C 26.353 82 .68436	H 169.719 82 2.12166	C 9.5976 82 .45079	H 5.875 82 .05672	B 10.601 82 .07796	B 9.8902 82 .57421
2	X 166.000 N 2 σ .00000	C 74.000 2 .00000	B 81.000 2 1.0000	H 26.900 2 .00000	B 11.000 2 1.0000	C 200.000 2 .00000	B 18.000 2 .00000	B 4.800 2 .0000	B 10.300 2 .00000	B 20.0000 2 .00000
3	X 170.500 N 4 σ 1.55456	B 70.000 4 2.5495	C 94.500 4 2.0615	B 24.025 4 .47500	C 6.0000 4 2.0412	B 198.250 4 15.0685	B 13.000 4 1.2909	C 6.200 4 .2000	C 10.425 4 .38161	B 12.0000 4 1.87083
4	X 160.6154 N 13 σ 1.4655	H 51.3077 13 1.1344	H 98.0769 13 .38333	B 19.9308 13 .4631	C 11.2308 13 1.4682	C 176.1538 13 1.7753	B 9.6154 13 .5375	H 6.3615 13 .0804	C 10.6385 13 .05609	B 22.9231 13 .6646

Results of cluster analysis were used for working out approximate academic requirements of PF, considering sex and PCn indicators of senior pupils: body length, relative body mass and CC. Their information potential was substantiated by us at previous stages of the research [19-21]. Limits of average level of pupils’ competence were $X \pm \sigma$, sufficient and low – from $X \pm \sigma$ to $X \pm 2\sigma$, high - above $X \pm 2\sigma$.

Results of experts’ questioning proved that the offered system of assessment of pupils’ PF, considering PCn level, is rather fruitful for increasing teachers’ functioning effectiveness; on training pupils’ physical qualities, formation of their skills in control and self-control. Such system can be applied in physical culture teaching in comprehensive schools.

Discussion

Our data supplement information [22, 23] about indifferent and often negative senior pupils’ attitude to PC lessons. Alongside with it, it was found that PC lessons with PF testing by traditional program requirements worsen children’s psycho-emotional state. Besides we supplemented data [24, 18, 26], that after passing control tests in pupils insufficient motivation for activity is observed as well as high situational anxiety and lower than average self-feeling, activity and mood.

Table 3. Results of cluster analysis (boys)

Indicators	Body length	Body mass	Chest circumference	BMI	Pinette's index	Long jump	Torso bending	60 meters' run	Shuttle run 4x9m	Chin ups on horizontal bar
1	X 178.611 N 18 σ 1.07600	C 58.611 18 .84459	H 95.111 18 .82402	B 18.372 18 .24639	H 24.888 18 1.04127	C 217.333 18 2.49575	B 5.0389 18 .07927	B 10.500 18 .45194	B 9.6111 18 .05653	B 10.777 18 .46831
3	X 176.769 N 13 σ 1.42844	C 70.5385 13 1.45715	C 98.2308 13 .77752	B 22.615 13 .56020	C 8.0000 13 1.35401	B 224.230 13 3.37820	B 5.1154 13 .08309	B 13.384 13 .66543	B 9.4077 13 .13130	B 12.076 13 .61458
5	X 173.043 N 23 σ 1.01272	C 68.8261 23 .82129	C 88.6087 23 .71334	C 23.013 23 .30667	C 15.6087 23 1.26482	C 201.130 23 2.33067	C 5.6217 23 .07750	C 5.7391 23 .30293	C 9.8043 23 .14008	C 14.434 23 .76697
6	X 172.958 N 24 σ .98812	C 66.5417 24 1.02147	C 79.5833 24 .89870	H 22.237 24 .24736	C 26.8333 24 .87986	C 190.041 24 2.67468	H 5.3417 24 .07540	C 8.0833 24 .42099	B 10.641 24 .17723	H 7.8333 24 .28018
7	X 165.846 N 13 σ 1.35328	C 60.3846 13 .85138	H 91.5385 13 1.39420	C 21.961 13 .16034	C 13.9231 13 1.23237	C 198.076 13 3.93124	H 4.8846 13 .05867	B 9.6154 13 .26647	B 9.4846 13 .14180	B 7.6154 13 .82849
10	X 169.333 N 15 σ .79682	C 66.8667 15 .79801	C 95.0000 15 .83381	B 23.333 15 .24624	C 7.4667 15 .72287	B 211.000 15 2.71679	B 5.7733 15 .04522	H 8.2000 15 .69144	B 10.206 15 .20082	C 9.7333 15 .90746
11	X 171.750 N 4 σ 2.65754	C 71.0000 4 2.61406	B 79.0000 4 .00000	H 24.050 4 .73993	C 21.7500 4 2.25000	C 142.000 4 5.81664	H 6.0250 4 .02500	H 5.7500 4 .47871	B 9.2250 4 .30380	B 17.250 4 .85391

Strong deviation from law of normal distribution in assessment of PF tests by existing PC program witnesses that it is necessary to improve PF requirements for senior pupils.

Reasonability of PF improvement according to PCn indicators is substantiated by substantial quantity of senior pupils, who have higher or lower than normal PCn indicators (35.6% – body length indicators; 65% – body mass; 45.6% – chest circumference indicators and 20% – by value of relative body mass).

Our researches enriched scientific information about demand in consideration PCn indicators in determination of PF level. Our data prove information [15] about influence of body length on results of exercises, connected with bearing own weight. It should be noted that general tendency of body length's positive influence on results of most run exercises was not confirmed when dividing the tested sample by sex. Exclusion was only correlation of body length with 30 meters' run results ($r=-0.35$, $p<0.01$).

Our data attested results [12, 13] about dependence of PF tests' passing (30 meters' run, long jump from the spot, forward bending, 1500 meters' run and shuttle run 4x9 m) on body length: results of 100 meters' and 1000 meters' run ($r = 0.44$ and $r = 0.42$) [12] and results of filled ball throw, high jump from the spot, long jump and shuttle run [13]. Alongside with it, in our research we determined that body length does not influence on results of forward bending (except girls, whose torso forward bending results improve with body length increasing - $r=0.36$, $p<0.01$) and chin ups. But correlation between these indicators is practically absent. Thus we proved results of some researchers [14, 11], who insist on absence of PCn influence on PF indicators. Contradictory character of information about PCn and PF indicators correlations only underlines the complexity of the studied problem.

For the first time we proved that implementation of PF differentiated normative for senior pupils, considering natural PCn level, facilitated substantial weakening of situational anxiety. It is confirmed by increase of pupils' quantity: with low anxiety level (by 21%); with average level (by 7%). And vice versa: quantity of pupils with high anxiety level significantly reduced (by 28%). We also observed strengthening of motivation for PC lessons; quantity of pupils, attending sports circles, increased by 2%. By 5% more pupils became to fulfill physical exercises independently. By 12% quantity of missed without excuse PC lessons reduced.

We also confirmed information about importance of CC consideration [14] when working out differentiated normative for senior pupils as well as for the first time substantiated higher significance of relative body mass indicators, comparing with absolute body mass. For the first time we substantiated and worked out differentiated requirements for assessment PF level of 10-11 form comprehensive schools' pupils, considering three PCn indicators: body length, relative body mass and chest circumference.

Conclusions

PF testing without consideration PCn indicators does not facilitated motivation of 53–59% pupils for further physical self-perfection. They result in high situational anxiety of 67–83% pupils; unfavorable psycho-emotional state of 11–35% pupils. As a result we observed insufficient motivation of pupils for success in their activity (115.34 ± 33.19 – 124.00 ± 34.13 conv.un.), high situational anxiety (49.38 ± 10.07 – 50.94 ± 8.96 conv.un.) lower than normal mean values of self-feeling, activity and mood (47.59 ± 9.35 – 49.73 ± 7.89 conv.un.). It substantiates importance of PCn indicators' consideration in determination PF level in senior pupils.

In assessment of PF tests' passing by senior pupils we observed substantial deviation from law of normal distribution. Only separate exercises in some gender groups had normal distribution of educational progress levels. Quantity of senior pupils, whose indicators were above normal, is rather substantial: 35.6% – by body length indicators, 65% – by body mass, 45.6% – by CC and 20% – by BMI.

It was found that the most informative PCn indicators by level of influence on senior pupils' PF are body length, CC and BMI. CC shows average level of partial correlation influence ($r_{xy-z}=0.632$, $p<0.001$ and $r_{xy-z}=0.650$, $p<0.001$ respectively) on results of long jump from the spot (without consideration body length and mass). CC values (without consideration body length and mass) ($r_{xy-z}=0.499$, $p<0.001$ and $r_{xy-z}=0.485$, $p<0.001$ respectively) positively weakly but closely to average density, influence on chin ups results. Factorial analysis proved significant (second by significance) importance of PCn indicators of senior pupils. The second by significance factor of senior pupils' matrixes (18.54% of general dispersion in girls and 18.94% – in boys) combined indicators of body length and body mass.

We worked out differentiated requirements for assessment of 10-11 form pupils' physical fitness, considering sex and PCn indicators: body length, relative body mass and chest circumference. Experts proved that the offered system of pupils' PF assessment, considering their physical condition is efficient: in improvements of teacher actions' effectiveness; in development of pupils' physical qualities; in formation pupils' skills in control and self-control.

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