The 5th European Conference on Health Promoting Schools

**Health, Wellbeing and Education:
Building a sustainable future**

20–22 November, 2019, Moscow, Russia

Wednesday, 20th November 15:00-16:00
Gallery

1.11

N.B. Pankova[1], S.V. Romanov[2], M.Yu. Karganov[1]

Negative trends in the dynamics of physical development of primary school students (by body mass index)

[1]Research Institute of General Pathology and Pathophysiology;
Laboratory of Physical, Chemical and Ecological Pathophysiology
Baltijskaya Str. 8 125315 Moscow Russian Federation
[2]School No. 5 of Reutov City (Moscow Region)

Introduction.

The living conditions that have changed in recent years lead to pronounced adaptive changes in the functional state of the human body. This mainly applies to schoolchildren, since the increasing time of studying with the workload, including using computer technology, and the reduction in time and volume of physical activity naturally lead to changes of the basic metabolic indicators, including indicators of physical development. In particular, there are more and more reasons to state the "obesity epidemic" among children and adolescents.

The **aim** of our work was a comparative analysis of the dynamics of physical development indicators in children during their primary school years in 2003–2006 and in 2016–2019.

Methods.

All measurements were carried out at the beginning of spring, in schools of Moscow (School 1) and the Moscow region (School 2).

The number of research participants in 2002-2006 was 31 boys and 34 girls, in 2015-2019 - 42 boys and 56 girls.

Enter the School
(7-8 years)

Measurements
(every April)

School 1 (2002-2006)

2002	Sen	Oct	No	Dec									class 1
2003					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	
	Sen	Oct	No	Dec									class 2
2004					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	
	Sen	Oct	No	Dec									class 3
2005					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	
	Sen	Oct	No	Dec									class 4
2006					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	

31 boys,
34 girls,
in dynamics

Enter the School
(7-8 years)

Measurements (every October and every April)

School 2 (2015-2019)

2015	Sen	Oct	No	Dec									class 1
2016					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	
	Sen	Oct	No	Dec									class 2
2017					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	
	Sen	Oct	No	Dec									class 3
2018					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	
	Sen	Oct	No	Dec									class 4
2019					Jan	Fev	Mar	Apr	May	Jun	Yul	Aug	

42 boys,
56 girls,
in dynamics

Standard methods were used to estimate body length and body mass, with subsequent calculation of body mass index (BMI). To assess the results in terms of "normal", "overweight" and "obesity", WHO tables were used as reference values (z-tables for boys and girls, with an accuracy of age characteristics up to 1 month). The boundary of the norm was considered the value of Me+1SD (percentile 84), the boundary of obesity - Me+2SD (percentile 97.5).

obesity
2,5%

overweight
13,5%

WHO recomendations

norm
84,0%
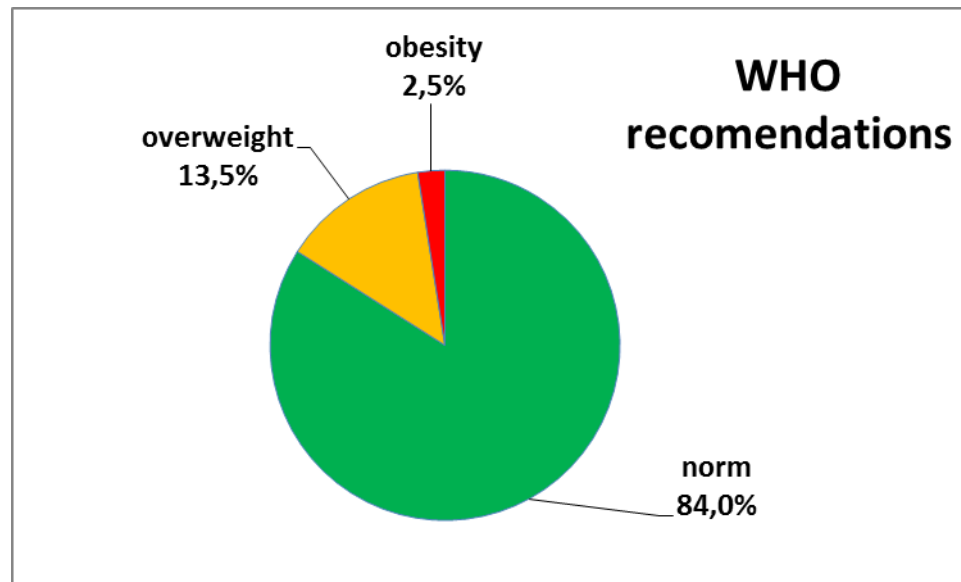
BMI-for-age (5-19 years) URL:
https://www.who.int/growthref/who2007_bmi_for_age/en/

BMI-for-age BOYS
5 to 19 years (z-scores)

World Health Organization

Year: Month	Month	L	M	S	Z-scores (BMI in kg/m²)						
					-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
7: 3	87	-1.3040	15.5407	0.09176	12.3	13.2	14.3	15.5	17.1	19.2	21.9
7: 4	88	-1.3228	15.5608	0.09213	12.3	13.2	14.3	15.6	17.2	19.2	22.0
7: 5	89	-1.3414	15.5814	0.09251	12.3	13.2	14.3	15.6	17.2	19.3	22.0
7: 6	90	-1.3596	15.6023	0.09289	12.3	13.2	14.3	15.6	17.2	19.3	22.1
7: 7	91	-1.3776	15.6237	0.09327	12.3	13.2	14.3	15.6	17.3	19.4	22.2
7: 8	92	-1.3953	15.6455	0.09366	12.3	13.2	14.3	15.6	17.3	19.4	22.4
7: 9	93	-1.4126	15.6677	0.09406	12.4	13.3	14.3	15.7	17.3	19.5	22.5
7:10	94	-1.4297	15.6903	0.09445	12.4	13.3	14.4	15.7	17.4	19.6	22.6
7:11	95	-1.4464	15.7133	0.09486	12.4	13.3	14.4	15.7	17.4	19.6	22.7
8: 0	96	-1.4629	15.7368	0.09526	12.4	13.3	14.4	15.7	17.4	19.7	22.8
8: 1	97	-1.4790	15.7606	0.09567	12.4	13.3	14.4	15.8	17.5	19.7	22.9
8: 2	98	-1.4947	15.7848	0.09609	12.4	13.3	14.4	15.8	17.5	19.8	23.0
8: 3	99	-1.5101	15.8094	0.09651	12.4	13.3	14.4	15.8	17.5	19.9	23.1
8: 4	100	-1.5252	15.8344	0.09693	12.4	13.4	14.5	15.8	17.6	19.9	23.3
8: 5	101	-1.5399	15.8597	0.09735	12.5	13.4	14.5	15.9	17.6	20.0	23.4
8: 6	102	-1.5542	15.8855	0.09778	12.5	13.4	14.5	15.9	17.7	20.1	23.5

Accuracy of age assessment: 1 month
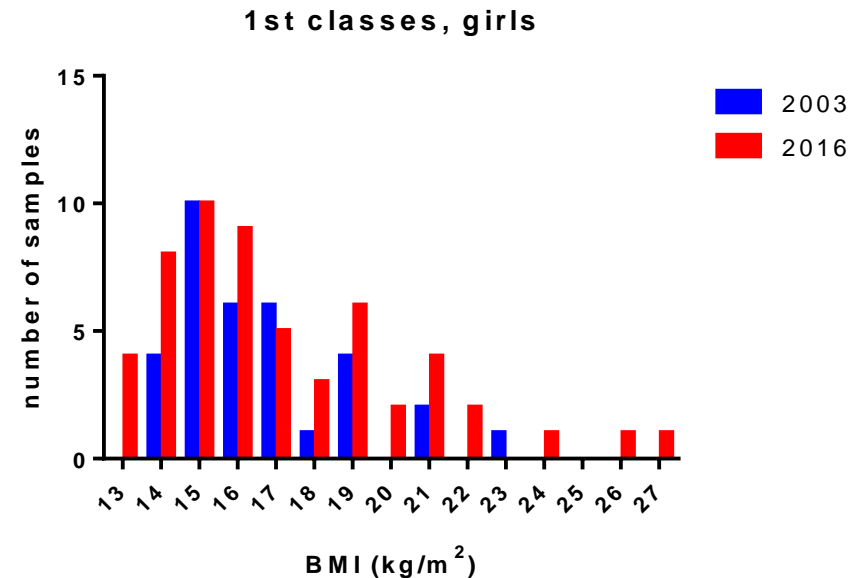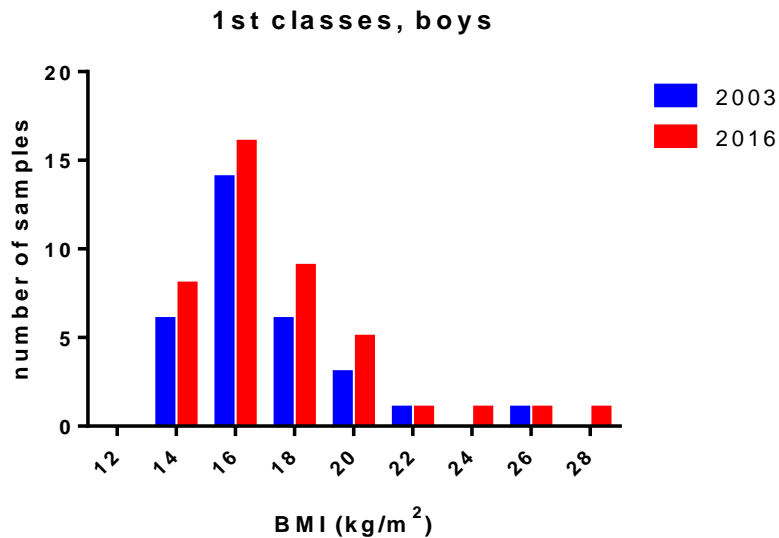Accuracy of body length measurement: 0,5 cm
Accuracy of body weight measurement: 0,1 kg

boundary of norm

boundary of obesity

Results.

We revealed that at both test points, the indicators of body mass and body mass index have not normal distribution due to a pronounced shift towards higher values (unlike body length, whose values have a normal distribution).

In the first grades the average age in 2003 for boys was 7.8±0.1 year, for girls - 7.7±0.1, in 2016 - the same values. We found a statistically significant increase up to 2016 the body length, both in boys and girls whereas the averaged body mass and BMI were not statistically altered.

	Boys			Girls		
	1st class					
	2003	2016	p	2003	2016	p
Age	7,8±0,1	7,8±0,1	NS	7,7±0,1	7,8±0,1	NS
Body length, cm	126,9±0,9	130,7±0,9	0,004*	126,3±0,9	129,6±0,9	0,018*
Body weight, kg	27,3±0,8	29,8±1,1	NS	26,4±0,8	28,9±1,1	NS
IMT, kg/m²	16,9±0,4	17,3±0,5	NS	16,5±0,4	17,0±0,4	NS

1st classes, boys

0,734

BMI, kg/m^2

2003 2016

years

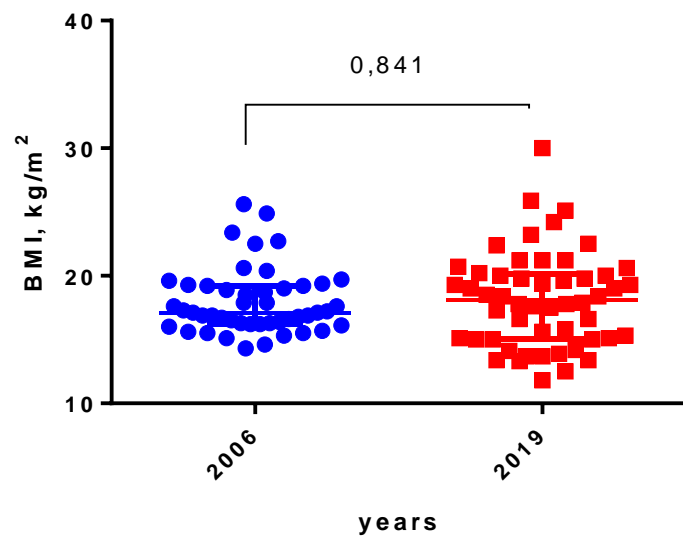**1st classes, girls**

0,764

BMI, kg/m^2

2003 2016
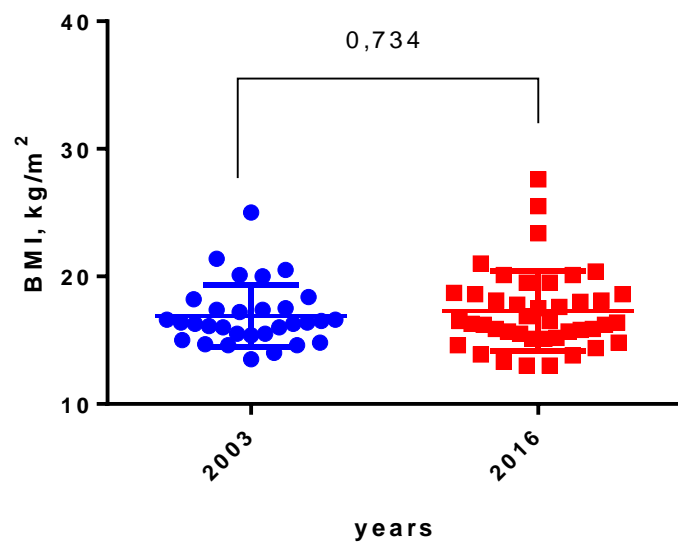
years
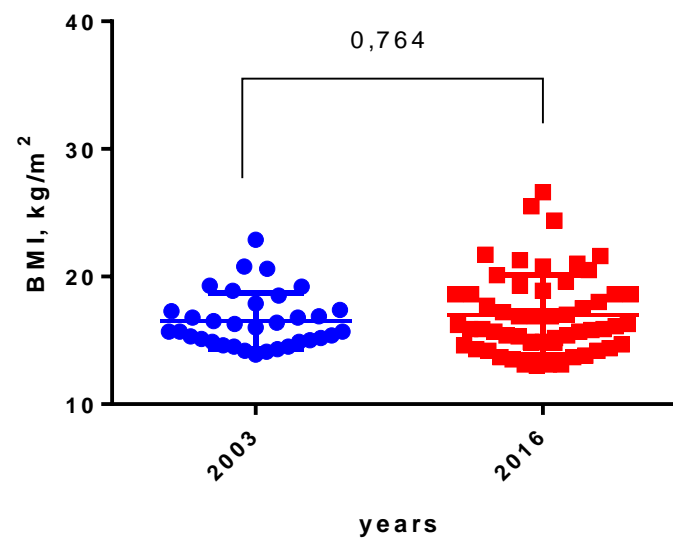
However, the BMI's assessment of the "norm" did not correspond to 84% of children, as the WHO tables suggest, but 68% of boys and 77% of girls in 2003, 57% of boys and 68% of girls in 2016. The estimated "overweight" (expected 13.5%) corresponded to 16% of boys an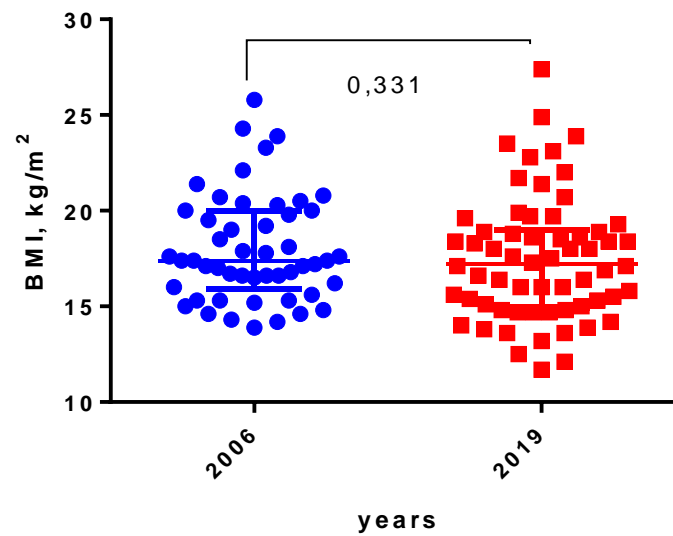d 15% of girls in 2003 and 21% of boys and 18% of girls in 2016. The estimated "obesity" (expected 2.5%) corresponded to 16% of boys and 9% of girls in 2003 and 16% of boys and 14% of girls in 2016.

By the end of the fourth grade differences in average BMI did not reach the level of statistical significance.

	Boys			Girls		
	4th class					
	2006	2019	p	2006	2019	p
Age	10,7±0,1	10,8±0,1	NS	10,7±0,1	10,7±0,1	NS
Body length, cm	144,2±1,0	147,8±1,0	**0,011***	145,2±1,0	146,8±1,0	0,244
Body weight, kg	37,5±1,0	40,0±1,4	NS	38,1±1,0	37,9±1,1	NS
IMT, kg/m²	18,0±0,4	18,2±0,5	NS	18,1±0,4	19,7±0,7	NS

4th classes, boys

BMI, kg/m^2

0,841

40

30

20

10

2006   2019

years

4th classes, girls

BMI, kg/m^2

0,331

30

25

20

15

10

2006   2019

years
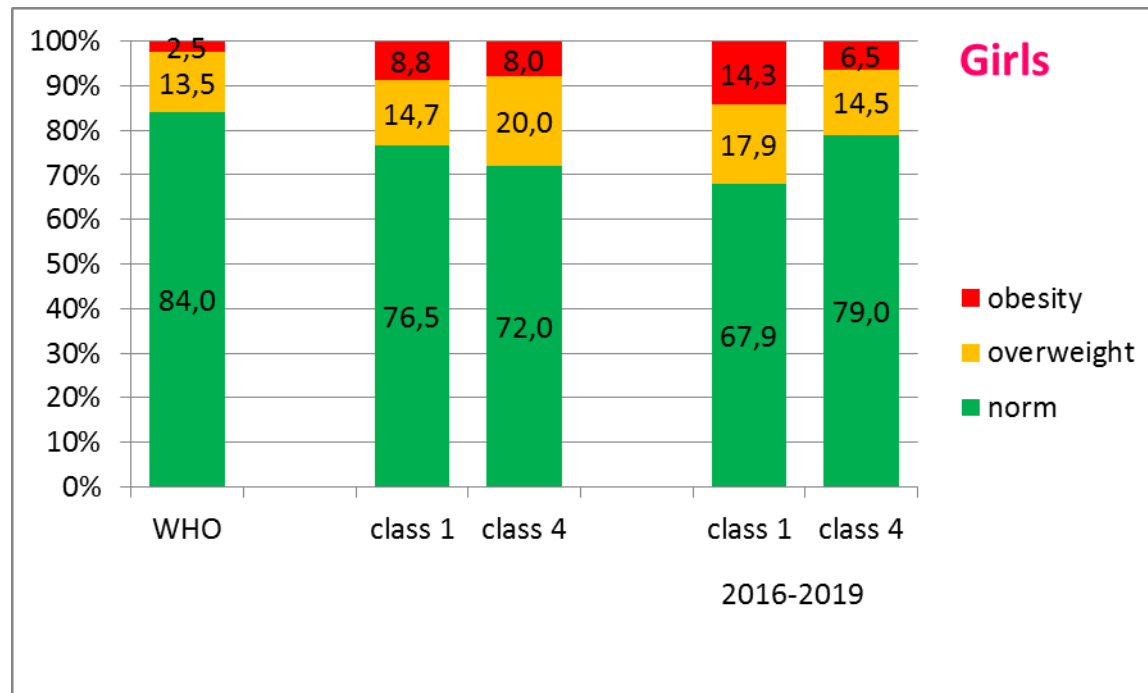
However, the boys showed a significant decrease in the share of "norm" (from 70% to 52%, p = 0.034 by the exact Fisher method) due to an increase in the proportion of children with "overweight" (from 21% to 37%, p = 0.062).
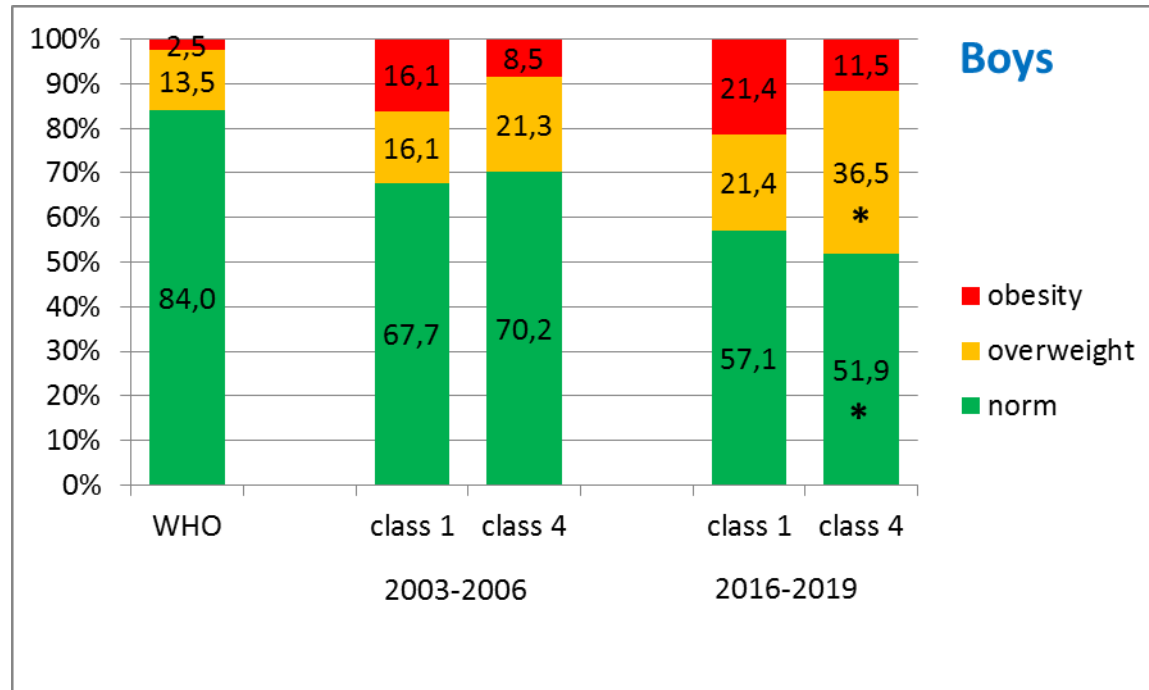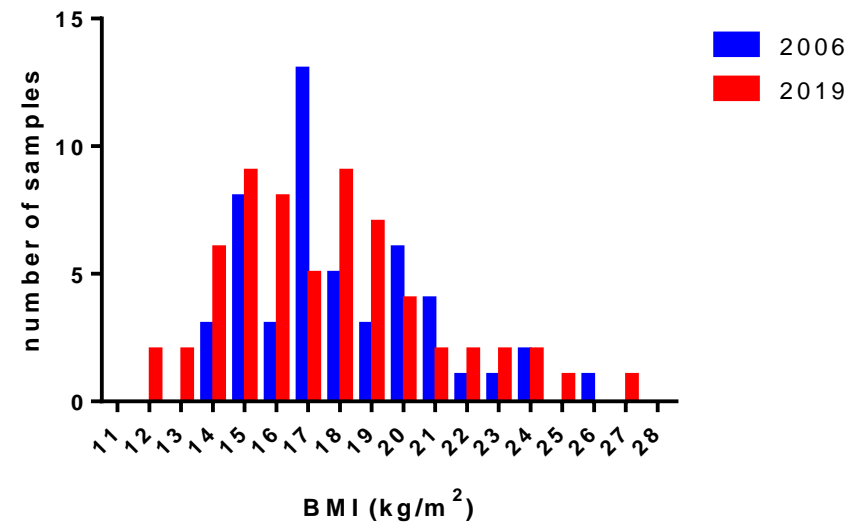
In girls, we note the hidden (latent) shifts in the form of the redistribution of children within the "norm" range towards higher values.

4th classes, boys

number of samples

BMI (kg/m²)

2006
2019

4th classes, girls
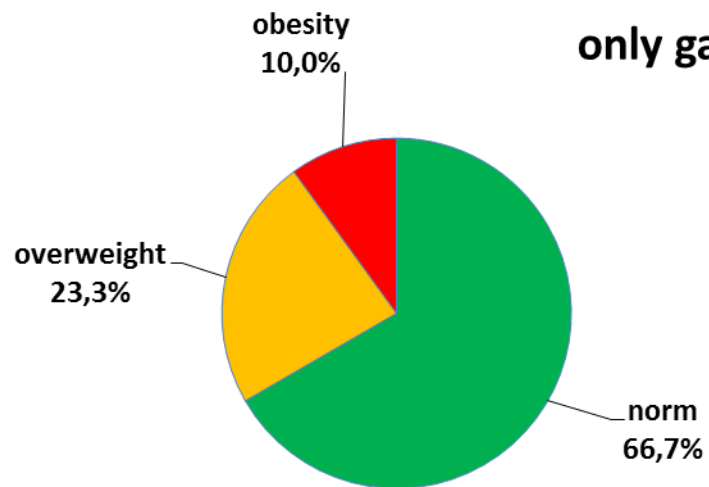
number of samples

BMI (kg/m²)

2006
2019
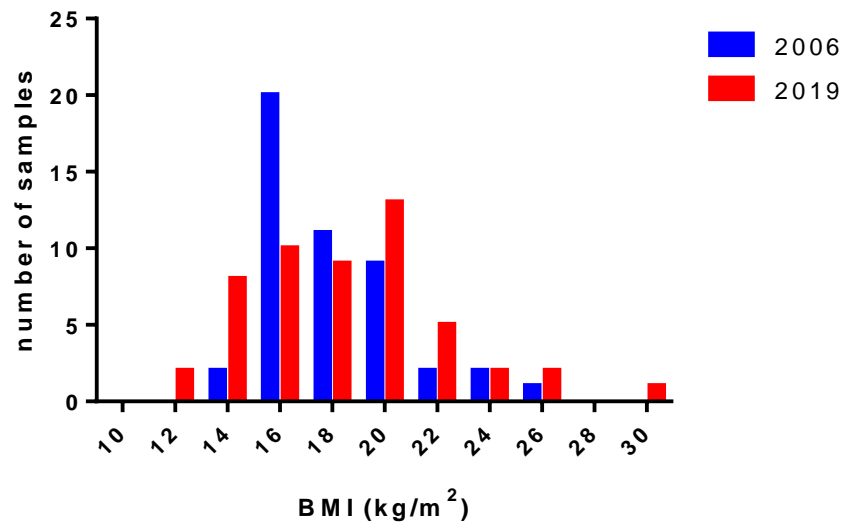
It is important that in girls the degree of change in the dynamics of BMI was related to the level of physical activity and the content of physical education lesson (only games, or the use of special exercises with heart rate of 160-170 beats/min [1]).

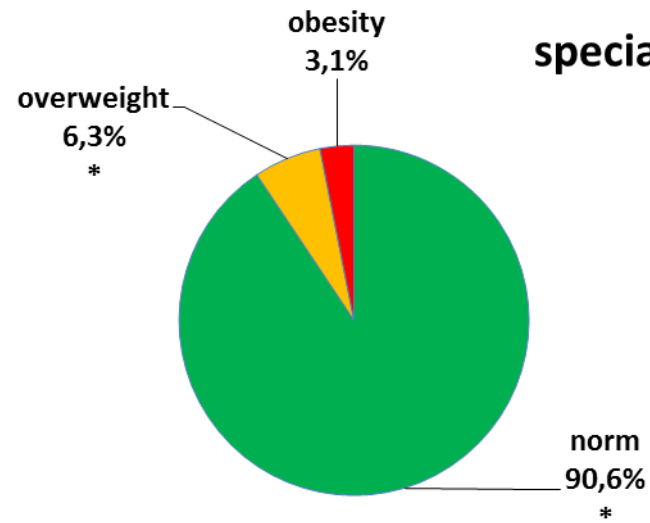4th classes, girls from classes with different program of physical education
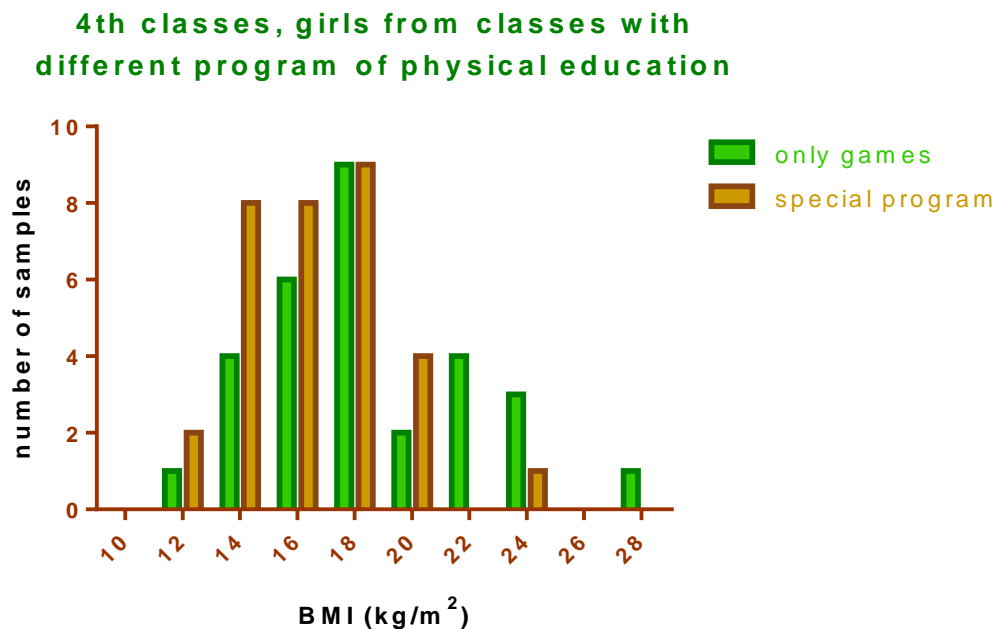
[1] Pankova NB, Romanov S.V. Health-saving potential of running warm-up in the gym (method for elementary school) // Health-saving education. - 2013. - № 8 (36). - pp. 89-93. (in Russian) URL: https://elibrary.ru/item.asp?id=21846972
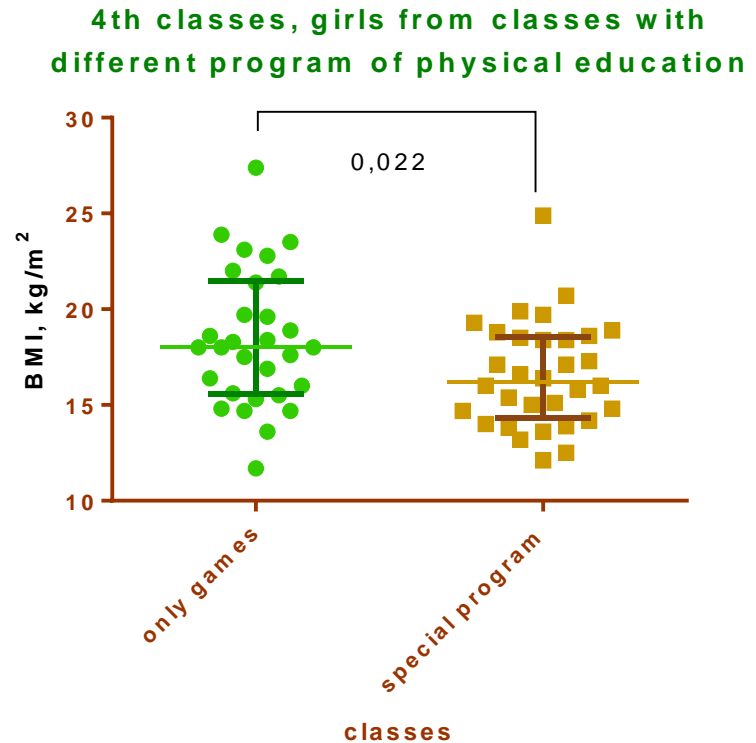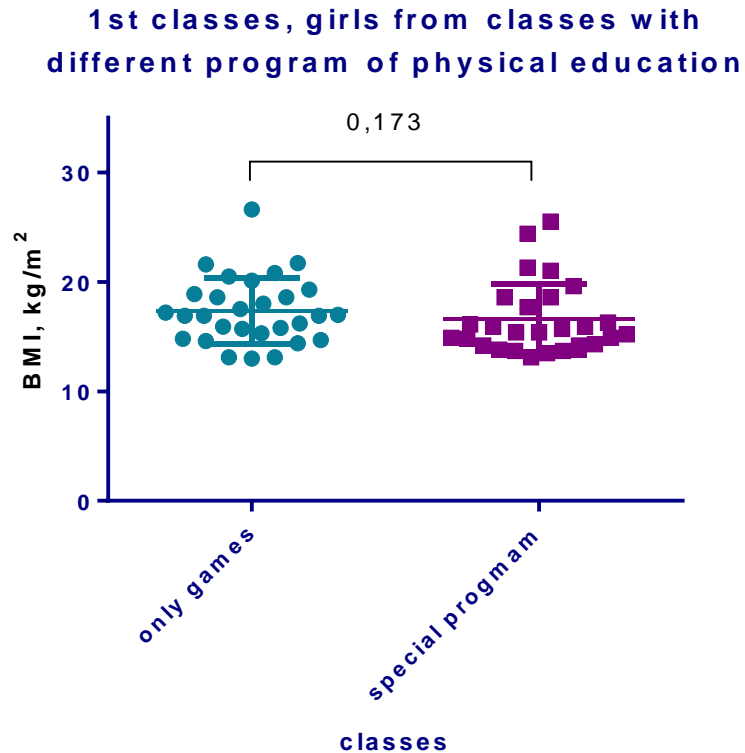
only games

obesity
10,0%

overweight
23,3%

norm
66,7%

special program

obesity
3,1%

overweight
6,3%
*

norm
90,6%
*

Differences between girls from classes with different levels of physical activity in terms of BMI reached a level of statistical significance ($p = 0.023$ by ANOVA). In boys, such differences have not been identified, which may be due to gender differences in the time of the onset of puberty, which we have already described for 5th grade students [2]

1st classes, girls from classes with different program of physical education

0,173

BMI, kg/m^2

30

20

10

0

only games
special progmam

classes

4th classes, girls from classes with different program of physical education

0,022

BMI, kg/m^2

30

25

20

15

10

only games
special program

classes

[2] Pankova NB, Romanov S.V., Petrenko N.V., Karganov M.Yu. Evaluation of physical development, physical qualities and functional state of the cardiovascular system in pupils in the fifth grades of the Moscow region // Problems of school and university medicine and health. - 2017. - № 3. - p. 30-35. (in Russian) URL: https://elibrary.ru/item.asp?id=30575313

Conclusion.

The obtained data showed that the negative changes in medicine in terms of the physical development of children in the form of increasing BMI did not begin in the last 3 years. Their likely basis is a metabolic disorder, laid down in preschool age, before entering primary school. However, such changes, at least in part, can be compensated by adequate physical activity, even in the framework of school physical education lessons.

Used data beyond this communication:

Seasonal variability of anthropometric indicators gain in younger schoolchildren in the Moscow region

N. B. Pankova, M. Yu. Karganov

Introduction. *Monitoring biomedical studies indicate that there is a pronounced seasonal variability in body weight and body mass index (BMI) gain in children and adolescents. However, there is no ambiguity in the description of the dynamics of such changes: some researchers report a predominant increase in BMI in the winter, and some during the summer holidays. The aim of our study was to assess the presence and dynamics of seasonal changes in the gain of most common hygienic indicators of physical development (body length and weight, BMI, brush force dynamometry) in primary school students in the Moscow region.*
Materials and Methods. *214 children were monitored, from 1st to 5th grades, with two annual examinations in late September – early October and late March – early April. The work used data on length and body weight, BMI, as well as brush force dynamometry.*
Results. *It is shown that the body weight and BMI in primary school students have a pronounced seasonal variability, with an increase in the winter period. BMI variability is characteristic of both girls and boys, and does not depend on the age of admission to school (in the range of 7-8 years). At the same time, the prevalence of obesity among first-grade students corresponds to the WHO control values for the corresponding age and sex groups, and does not increase until the end of the 5th grade. However, during the period from 1st to 5th grades there is an increase in the proportion of overweight children with a decrease in the proportion of children with normal BMI values; this process can be prevented by adequate physical activity in the school program of physical education. Seasonal variability in indicators of hand force dynamometry, as well as control standards of physical culture tests was not found.*
Conclusions. *The data obtained allow us to assume that the surveyed sample of children in terms of anthropometry is close to normal, and the existing negative trends in the increasing proportion of students with excess body weight are reversible.*
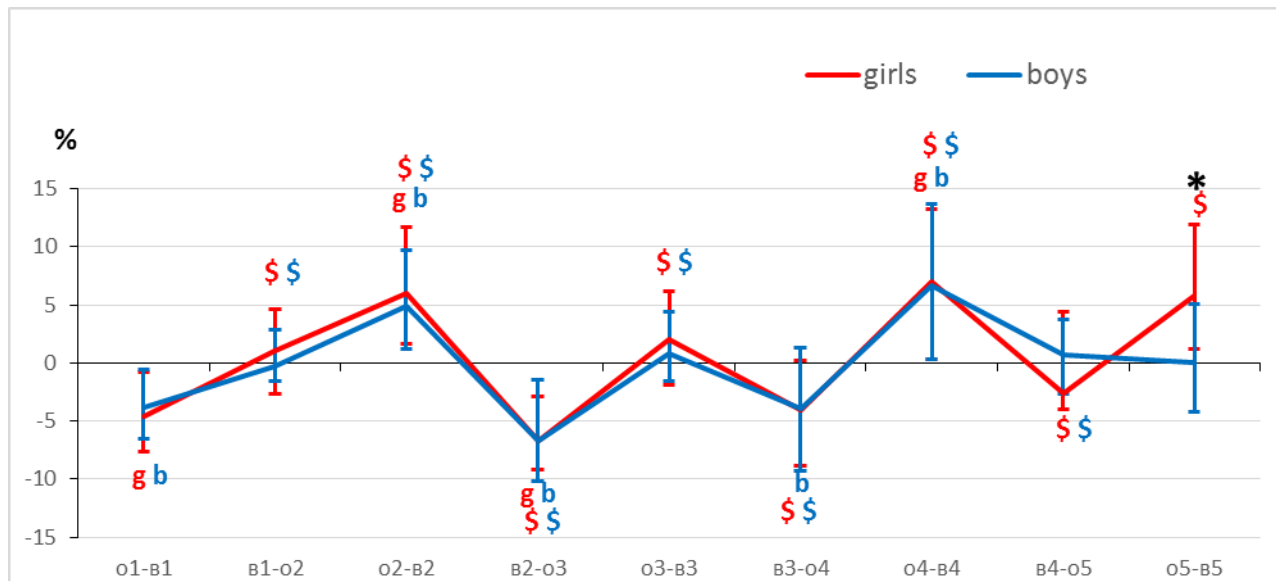
Dynamics of growth (in%) of BMI by seasons (data are presented as median and interquartile range). The designations of time periods: "o" - autumn, "в" - spring, numbers denote class.

Girls data are marked with a red line, boys data are marked with a blue line. All data are presented as a median and interquartile range. Statistically significant changes over the time interval (according to the Wilcoxon paired criterion) are indicated by the red letter "g" for girls, and the blue letter "b" for boys. Statistically significant differences between girls and boys (according to the Mann-Whitney test) are marked with black asterisk (*). The "$" signifies statistically significant differences from the previous interval in its group (according to the Mann-Whitney test).