

Picture of the Nutritional Status of Adolescents, Living Under Different Environmental Conditions of the Western Region of the Republic of Kazakhstan

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The deficiencies in nutrition in early childhood and teenage age lead to the far-reaching consequences and negatively affect the health condition throughout the human life. The nutritional status is a hygienic criterion of human life quality, and its evaluation allows us to develop the individual programs for the integrated prevention. When studying and analyzing the nutritional status, and determining the nutritional status of adolescents, their physical development should be assessed to determine the adequacy of energy and flexible nutrition side. Such anthropometric indices as height and weight shall be studied, and the body mass index (BMI) is estimated. Purpose of the study was features studying of the Developmental Physiology of the baby's growing body among the urban and rural population of Aktobe and Mangistau regions in the Republic of Kazakhstan. In the study it was revealed, that the physical development of boys and girls under the evaluation of anthropometric data in all age groups is average, and corresponds to the age and sex. The body mass index of adolescents of both regions is on average within the normal range (BMI is equal to 18.5-24.9). In all age categories of examined children and in all schools the adolescents, who are overweight and obese, were revealed, at that the number of boys is almost 3 times more than girls. There are more children with the increased body mass index among the urban residents.

Key words: Physical growth, Body weight index, Nutritional status, Adolescents, Environmentally unfriendly region of residence, Height, Body weight.

According to WHO data 60% of all causes of mortality in people on the earth are directly related to the improper nutrition. The deficiencies in nutrition in early childhood and teenage age lead to the far-reaching consequences and negatively affect the health condition throughout the human life.

The nutritional status is the hygienic criterion of human life quality, and its evaluation allows us to develop the individual programs for the integrated prevention. Study and analysis of the nutritional status is carried out at the consistent assessment of actual nutrition, health and environmental status¹⁻⁵. Environmental situation is the most serious environmental problem that attracts the increasing attention, because the unfavorable environmental changes are accompanied by a noticeable deterioration in health of the population, expressed in the unfavorable demographic shifts, increasing the population

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morbidity, reducing the physical development indices, increasing the number of hereditary deformities, and etc⁶⁻⁸.

The intensive development of chrome extractive and chrome processing industry, and the oil and gas production in the Western region of the Republic of Kazakhstan in recent decades has an adverse effect on the environment of this region and, thus, acquires a special importance in the formation of population health, especially of children⁹⁻¹².

In the childhood and adolescence the intensive growth and weight gain, and the deep neurohumoral restructuring due to the puberty of adolescents are observed, the qualitative changes in the neuropsychic health occur. The high rate of growth and anabolic processes requires a constant supply of a sufficient number of macro- and micronutrient components of a healthy diet with the food, which first have the flexible and immunomodulatory properties¹³⁻¹⁴.

When studying and analyzing the nutritional status, and determining the nutritional status of adolescents, their physical development should be assessed to determine the adequacy of energy and flexible nutrition side¹⁵⁻¹⁷. Within a relatively short time the adolescent organism undergoes a complex restructuring that requires the great effort of many organs and systems. The intensive growth makes the organism particularly vulnerable. Therefore, you must treat the organization of regime and nutrition responsibly. After all, to ensure the rapid growth the full and qualitative building material is needed. It is proved that during the active growth the adolescents, who receive the valid nutrition, have the best indices of physical development, than those, who have diet faults (non-compliance with dietary regime, quantitative and qualitative composition of meals). Thus, the protein malnutrition leads to reduction in height and weight, and resistance to the infectious diseases is reduced¹⁸⁻²⁰. Such anthropometric indices as height and weight are studied, and the body mass index (BMI) is estimated.

Purpose of the study is studying features of the Developmental Physiology of the baby's growing body among the urban and rural population of Aktobe and Mangistau regions in the Republic of Kazakhstan.

Materials and Techniques

990 adolescents in grades 6-11, living at the different distances from the industrial enterprises in the city of Aktobe, were examined (Secondary school #16 that is located near the industrial enterprises, Secondary school #35 – some distance away, and Secondary school #29 – in the environmentally “friendly” area of the city of Aktau, adolescents also the adolescents of the country school were examined – v. Martuk) and 366 adolescents in grades 6-11, living in the environmentally “friendly” areas of the city of Aktau (Secondary school #10, Grammar school #4) and in the village Munaily of Mangistau region that is located in the oil production areas (Munaily Secondary school #5).

Methods

The data obtained were processed in the West Kazakhstan State Medical University named after Marat Ospanov with the statistical method by using the SAS software, Version 9.2.

Study results

148 children aged 12, who live in Aktobe and v. Martuk were examined. The higher rates of height were observed among girls rather than in boys in this age group - so-called “puberty leap”, which is explained by the earlier onset of sexual maturation of girls. Average height of boys was 147.4 cm, girls – 150.7 cm. Children, who live in environmentally friendly area of residence of Aktobe, were the higher – (150.55±8.97) cm – in boys and (153.8±7.17) cm – in girls. Among inhabitants of the village – the rates are slightly lower (147.9±7.26) cm in boys and (151.78±6.82) cm in girls. Average body weight was: 41.9 kg in boys, and 42.9 kg in girls. Among boys the greatest rates of body weight were observed in the environmentally unfavorable region of residence – (44±12.44) kg, among girls – in the group living in a relatively «clear» zone – (43.62±8.69) kg. Correlation coefficient is positive – 0.5 to 0.8, at $p \leq 0.0001-0.1$. The BMI on the average was within the normal range – 19.1 – in boys and 18.8 – in girls. However, the increased body weight was observed in the group of boys from the «clear» zone – BMI = 27.55 and the third-degree obesity in boys of relatively «clear» area of residence – BMI = 45.9.

68 children the same aged, who live in Mangistau region (the city of Aktau and the village

of Munaily), were examined. Average height of boys was 151.3 cm, girls – 151.1 cm, weight – 43.7 kg in boys and 41.4 kg – in girls. The greatest rates of height and body weight were observed in residents of the city: in boys – (154.7±9.5) cm and (49.4±11.4) kg, in girls (154.6±8.4) cm and (42.4±7.2) kg, respectively. Correlation between the height and weight rates of children is positive, strong, except for the female residents of the city ($k = 0.2$, at $p > 0.05$). The average body mass index of children is 18.4, which corresponds to the normal range. The cases of excessive body weight in boys of the city were observed (BMI = 27.46).

197 adolescents aged 13 from Aktobe region and 51 adolescents aged 13 from Mangistau region were examined. In this age group of Aktobe region the higher rates of height were observed in girls – 153.7 cm against 152.8 cm – in boys. The highest rates of height were observed in the residents of environmentally friendly area (School No.29): (156.4±6.98) cm – in boys and (156.77±6.18) cm – in girls, in children of the village the rates are lower – (152.4±8.4) cm – in boys and (152.1±10.8) cm – in girls. Average body weight was 45.5 kg in boys and 44.8 kg – in girls, at high values at the School No.29 in boys – (49.38±10.31) kg, in girls at the School No.16 (“pollution” zone) – (47.03±5.91) kg. Correlation coefficient is positive – 0.5–0.7 for all values of height and weight, however, in girls from the School No.16 the connection is poor – $k = 0.1$. The certainty is $p \leq 0.0001$ –0.3. Average values of BMI is within the age norm – 19.3 – in boys, 18.9 – in girls. However, an increased BMI is observed at almost all schools, both in boys and in girls: the excessive body weight in boys is observed at Schools # 16, 35, v. Martuk (BMI is 25.7 to 26.3), first degree obesity – School # 29 (BMI = 33.3); the excessive body weight in girls (BMI is 25.06–27.9) – at Schools # 35, 29, first degree obesity (BMI = 33.2) – in girls from the School # 16.

Among 51 adolescents of Mangistau region the following was revealed: average height of boys was 159.17 cm, girls – 158.4 cm. Children, who live in the environmentally friendly area of residence – Aktau, were more tall – (164.3±9.3) cm – in boys and (159.0±4.9) cm – in girls. In children of the village the rates are lower (154.0±8.7) cm in boys and (157.8±5.4) cm – in girls. Average height weight was: 52.4 kg in boys, in girls – 50.5 kg. Among boys the greatest rates were observed in

the environmentally friendly region of residence – (57.7±13.6) kg, among girls in the group living also in the «clear» zone – (54.0±10.9) kg. Correlation coefficient is positive: a strong correlation between the values was observed in boys – 0.5–0.6, in girls it was poor – 0.1–0.3, at $p > 0.05$. The BMI on the average was within the normal range – 20.3. However, the increased body weight was observed in the group of boys and girls from the «clear» zone – BMI is 28.9 and 29.98.

208 adolescents aged 14 of Aktobe were examined. Average height of boys in this age group is outstripping the height of girls: 162.5 cm and 158.5 cm. Height of boys from v. Martuk was (166.3±22.2) cm, which is higher than the height of their peers living in the city – (165.11±9.27) cm (School #29), (160.42±6.48) cm (School #16) and (158.43±9.9) cm (School #35). Among girls the greatest rates of height are observed in the girls of School #16 – (161.96±6.48) cm, in the rural females – 157.28±5.9) cm. Average body weight of boys was 54.3 kg, girls – 48.55 kg. The high values of body weight are observed in boys of School #29 – (58.2±17.5) kg and girls of School #16 – (53.125±11) kg. Correlation coefficient is positive – 0.2–0.3 (in girls of School #16 and boys from v. Martuk), at $p = 0.3616$ to 0.7 – 0.8 , $p \leq 0.0001$ – 0.07 . Average body mass index – 20.4 in boys and 19.3 in girls, however, the second degree obesity is observed in the girl living in the polluted zone (BMI is 39.05) and boys of School No.29 and v. Martuk (BMI is 39.17 and 37.97), first degree obesity in the boy of School #35 (BMI is 31.05).

Among 75 examined 14- years old adolescents from Mangistau region we have found that the average height of boys in this age group is outstripping the height of girls: 163.5 cm and 159.6 cm. The highest rates of height were observed among residents of the environmentally friendly region: (165,4±7,59) cm – in boys and (162,3±6,5) cm – in girls, children of the village have the lower rates – (161.5±7.2) cm – in boys and (157.0±5.4) cm – in girls. Average weight is 51.9 kg in boys and 50.5 kg in girls, at the high values among boys from the city – (53.2±10.2) kg and girls (53.08±9.3) kg. Correlation coefficient is positive – 0.6 almost for all values of height and weight, at $p < 0.05$, however, in girls from the village the connection is poor – $k = 0.3$. Certainty is $p > 0.05$. Average values of BMI are within the age norm – 19.5. However, an

increased BMI is observed in girls of both village and city (BMI=25.6 and 27.6).

193 adolescents aged 15 of Aktobe and village Martuk. Average height rate is – 167.6 cm in boys and 161 cm – in girls. The highest rates of height were observed in boys from the environmentally “clear” zone – (171.35±8.26) cm and in girls from the School #16 – (163.75±7.13) cm. The height rates among residents of v. Martuk are much lower – (166.4±9.05) cm in boys and (160.73±6.82) cm - in girls, respectively. Average values of body weight – 58.1 kg in boys and 53.3 kg in girls, at that the high values are in boys at the School # 29 – (62.5±14.9) kg, in girls at the School #16 – (54.6±10.2) kg. The correlation connection of height and weight is positive and strong in this age group – $k = 0.4-0.7$, at $p \leq 0.0001-0.7$. Average BMI is 20.2 and 20.5 in boys and in girls, respectively. Excessive body weight was also observed in boys (BMI is 25.6 – 28.02) and in girls (28.08 – 26.84) from the city schools and boys from the village (BMI=27.3). First degree obesity is in a boy from the School # 29 – BMI = 32.47, and in a girl from the School #35 – BMI = 33.66.

Also there were 75 adolescents aged 15 from Aktau and village Munaily. Average height is 167.6 cm - in boys and 159.9 cm – in girls. Height rate of boys from both neighborhoods was approximately the same - (167.8±7.09) cm and (167.5±6.46) cm. Average body weight in boys was equal to 58.5 kg, in girls – 51.3 kg. Weight of the villagers was bigger than weight of children from the city - (60.1±14.05) kg. The girls from the city were significantly higher and bigger in this age group than the rural girls. Height of girls from the city was higher than the height of rural girls - (162.03±5.28) cm, body weight was also bigger - (55.5±11.9) kg. The correlation connection of height and weight is positive and strong in this age group, $k = 0.4-0.6$, at $p \leq 0.05$. Average BMI is 20.76 and 19.9 in boys and in girls, respectively. Excessive body weight was observed in boys from the city (BMI is 28.29), first degree obesity was in girls (32.9) from the city schools and in boys from the village (BMI=30.75).

In the age group of 16 year olds 117 boys and girls, who live in Aktobe region. Their average height is: 171.5 cm – in boys and 160.7 cm – in girls. The greatest rates of height were observed in pupils from the environmentally unfavorable areas

of the city: (175.15±7.2) cm – in boys, (164.54±7.2) cm in girls, among residents of the village - (172.7±7.04) cm and (159.7±3.45) cm in boys and girls, respectively. Average weight is 58.9 kg in boys and 50.9 kg – in girls. Weight of boys from the School # 29 and girls from the School # 16 was the greatest – (62.57±11.02) kg and (55.7±8.36) kg, respectively. Correlation coefficient is positive, connection is strong – 0.4–0.6, $p = 0.004-0.2$. Average BMI – 19.9 and 19.7, however, there are cases of excessive body weight (BMI is 26.53–28.73) in urban residents.

54 girls and boys in the same age group of 16-year-olds, who live in Mangistau region, were examined. Their average height is: 174.99 cm in boys and 163.4 cm in girls. The greatest height rate in boys from the city schools is (176.8±6.9) cm, in girls from the village schools – (164.0±4.2) cm. Average body weight was 60.03 kg in boys and 56.15 kg in girls. The highest values at the city school: (65.9±10.02) kg and (57.3±10.3) kg. The correlation connection is good in boys – 0.4–0.6, $p < 0.05$, in girls – positive and poor – 0.1–0.2, $p > 0.05$. Average BMI in boys is 19.5 and in girls is 21.07. There are cases of excessive body weight in boys, who live in the city (BMI= 28,1), in girls from the city - the first degree obesity (BMI is 31.05).

58 pupils of Aktobe aged 17 were examined. Average height is 175.8 in boys and 161.04 in girls. Height of boys from the School # 16 is (180.5±6.68) cm – the highest rate, girls from the School # 29 – (162.57±3.6) cm. Average body weight is – 62,4 :3 in boys and 53,2 :3 – in girls. The highest values are at the School # 29: (70±18.7) kg and (54.57±6.4) kg. Correlation connection is strong – 0.5–0.7, $p \leq 0.0001-0.3$. Average BMI in boys is 20.09 and in girls – 20.4. Excessive body weight was met in residents of the city (BMI is 25.56 – 26.8) and in a young man of School # 29 – the second degree obesity (BMI is 35.41).

44 pupils of Mangistau region aged 17 were examined. Average height is 175.8 in boys and 164.8 in girls. By the anthropometric indices the inhabitants of «clear» area are taller than adolescents, who live in the oil production area. The greatest height rates were observed in pupils from the city: (177.7±10.09) cm – in boys, (166.28±7.8) cm in girls, in inhabitants of the village - (170.0±5.6) cm and (157.3±6.8) cm in boys and girls, respectively. Average weight is 67.85 kg – in boys

and 56.63kg – in girls. The weight of boys and girls from the city schools is the biggest – (74.2±14.7) kg and (62.2±15.3) kg, respectively. Correlation coefficient is positive, connection is strong – 0.6–0.8, $p \leq 0.05$. Average BMI – 22.2 and 21.6, However, there are cases of overweight (BMI – 28.2) in boys and obesity of the first degree in girls (BMI – 31.5) from the city.

Discussion of study results

1. The physical development of boys and girls under the evaluation of anthropometric data (measuring of height, body weight, BMI calculation) is average, and corresponds to the age and sex in all age groups in both areas.
2. In almost all age groups the growth rates is higher in adolescents, who live in Mangistau region, than in their peers from the Aktobe region. Considering the growth rates among regions we have revealed the following: in Aktobe region - the height of both, boys and girls, is higher in schoolchildren, who live in the city, than in the rural population, however, no significant differences were found in all age groups ($p > 0.05$). Among the urban schoolchildren, 12,13,14 aged boys and girls was significantly higher in the environmentally «clear» area – School No.29 ($p < 0.05$), boys aged 15 from the School #29 are taller than boys from the School #35 ($p < 0.05$) and #16 ($p > 0.05$), girls aged 15 from the School #16 are taller than girls from the School #35 ($p < 0.05$) and #29 ($p > 0.05$), pupils aged 16,17 are taller in the School #16, however, no significant differences were found between the area of residence and height in those age groups. Analyzing height rates among the residents of Mangistau region we can say, that the height of both, boys and girls, is taller in schoolchildren in the city than in the rural population, however, the significant differences between them were not found in all age categories.
3. In the age group of 12-13 years old the height of boys is lower than the height of girls, due the puberty of adolescents and norms.
4. Body weight of adolescents from Mangistau region is bigger in almost all age categories,

both in boys and girls. Comparing the weight indices among the residents of Aktobe region we have noted, that boys and girls, who live in the city, are bigger than the villagers, however, the significant differences between them were not found in all age groups ($p > 0.05$). The significant differences in body weight between pupils in Aktobe were found only at the age of 13 years old: the boys from the School #29 are bigger than their peers from the School #35 ($p < 0.05$), at age 14 the schoolgirls from the School #16 are significantly bigger, and at age 16 - the pupils from the School #16 are bigger than pupils from other schools (the significance is with the pupils from the School #35 ($p < 0.05$), and School #29 - ($p > 0.05$). Among the adolescents, who live in the city of Aktau and the village of Munaily in Mangistau region, the boys and girls are bigger for the body weight in the city than the villagers, however, the significant differences between them were not found in all age groups ($p > 0.05$).

5. The body mass index of adolescents of both regions is on average within the normal range (BMI = 18.5-24.9).

CONCLUSION

The results of our studies show the following: for the Aktobe region during puberty (12-14 years old) the adolescents, who live away from the industrial enterprises, are taller and bigger, whereas with the onset of sexual maturation (15 years old and older) the rate of growth and development is dominated among the schoolchildren, who live in the zone of ecological trouble. And in the Mangistau region the adolescents, who live in the environmentally «clear» area (Aktau), are taller and bigger in almost all age groups in comparison with their peers – residents of the environmentally unfriendly area of residence.

The adolescents, who are overweight and obese (12.4% of all examined in Aktobe region and 9.5% of the children examined in Mangistau region), were revealed in all age categories of children examined and in all schools, at that the number of boys is almost 3 times more than girls

(9.1% compared to 3.3%, respectively). Among the urban residents of both, Aktobe and Mangistau regions, there are more children with a high BMI.

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