

Assessment of the Health of the Younger Generation of the Population of the Aral Sea Region

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Abstract – Data were obtained on the somatic health of schoolchildren in Kyzylorda (100 people) and rural schools - Syrdariya district (71 people) and Zhalagash district (114 people) located in the central part of the Aral Sea region. The weight, height, lung capacity, blood pressure, and heart rate were determined according to the health scale method. It is shown that only a third of high school students (18% of urban school students and 29% of rural schoolchildren) in the Aral Sea region have a high and above average level of health. More than 46% of urban schoolchildren and 36% of rural students showed an average level of health, the indicators of the remaining 35-36% of high school students corresponded to a low level of health. This state of health shows a high likelihood of developing chronic health disorders associated with functional insufficiency of the cardiovascular system (low levels of Robinson and Rufe indexes), lack of lung capacity (Quality of Life Index), underdevelopment of the muscular system and an increasing tendency to increase body fat components.

Keywords – the younger generation, Aral, Aral Sea region, health level, ecology.

I. INTRODUCTION

Active soil salinization processes due to increased salinity and a drop in the groundwater level, frequent salt-dust removal from the bare bottom of the Aral Sea, sandstorms and a harsh climate led to the development of aridization and desertification processes in the Aral Sea region [1, 2]. In this regard, at the legislative level in Kazakhstan, the Aral Sea region was referred to as zones of an "environmental crisis" [3].

According to a number of authors and official statistics, in the Aral Sea region, over the past 20 years, demographic processes have significantly deteriorated due to an increase in total and infant mortality. The main causes of mortality of the population are diseases of the circulatory system, respiratory and digestive organs [4,5]. Considering the current state and diversity of environmental factors influencing the formation of public health of the adult population, the problem of the health

of the younger generation in Aral Sea region attracts particular attention. This paper presents data from a survey of the somatic health of the younger generation, studying in both urban and rural areas of the Aral Sea region.

II. METHODS AND MATERIALS

Pupils of 10-11 grades, aged 16 to 18 years, urban (100 people) and rural schools took part in surveys from Syrdariya district (71 people) and Zhalagash district (114 people) related to the "environmental crisis."

Health scale [6, 7]. According to the Apanasenko methodology, there are five levels of health in the health scale: low, below average, medium, above average, high. Levels are calculated based on body mass, lung capacity, hand dynamometer, heart rate and blood pressure before and after the metered load. Schoolchildren who showed "high" and "above average" levels of health were included in a safe health zone. Students who have an "average" and "below average" level of health enter a risk zone when the likelihood of developing chronic diseases is very high, the third is a "low" level, at which schoolchildren may already have chronic health disorders.

In accordance with this scale of health, the assessment of the health of schoolchildren was carried out according to a point system. The Quetelet index was calculated by the ratio of weight-height indicators (body weight, kg / height, m²). When the index values were higher than 26 kg / m², an overweight was noted in the pupil, less than 17 kg / m² showed a body mass deficit and was evaluated in both cases as a "-2" point. When the index values from 17 to 25 kg / m² were defined as the average and below the average level of development or normal physical development with a rating from 0 to -1 points.

The vital index was calculated by the ratio of the vital capacity of the lungs to the body mass and the high and above

average levels were evaluated with values from 61 to 76 ml / kg and more (3 points), the average and below average from 45 to 60 ml / kg (from 1 to 2 points), values less than 45 ml / kg corresponded to a low index level (0 points).

The power index was calculated by the ratio of the indicators of hand dynamometry to body mass. At values above 51 units the power index corresponded to a high and above average level with a rating of 3-4 points, the average and below average level of development of muscle strength was determined at values from 41 to 51 units with a rating from 1 to 2 points. A low level of power index was noted with values below 40 units with a score of 0 points.

The Robinson index was calculated by the formula: heart rate (HR) x systolic blood pressure (SBP)/100. When the index values are less than 70 units defined as a high index level (4 points), with values from 71 to 75 units are above the average (3 points), the average and below the average level of the functional activity of the cardiovascular system were evaluated at index values from 76 to 95 units (from 1 to 2 points) and a low level was considered at values of more than 96 units with a score of 0 points.

According to the Apanasenko health scale, a high level of health was considered with a score of ≥ 13 points, above average – from 11 to 12 points, average – 6-10 points, below average – 3-5 points, low – less than 2 points.

The Rufe index reflects the adaptive capacity of the heart and is calculated by the formula: $(4 \times (P_1 + P_2 + P_3) - 200) / 10$, where P_1, P_2, P_3 is the pulse in the sitting position, after 30 squats in 45 seconds, one minute after the last measurements. When the values of the index Rufe from 15 units and a higher level of activity of the cardiovascular system was considered low and was rated at 0 points, from 11 to 15 units poorly developed or below average and scored 1 point, from 6 to 10 units considered satisfactory or average with a rating of 2 points, from 0.5 to 5.0 – good or above average with a rating of 3 points and less than 0.5 – excellent heart health or a high level of development with a rating of 4 points. At the same time, a high level of health, according to indicators of the Rufe index, was considered with values less than 3 points, above average – from 5 to 4 points, average – 6-9 points, below average – 10-14 points; low – more than 15 points.

On the survey of schoolchildren there was a decision of the local ethical commission of the Kazakh National Medical University n.a. S.D. Asfendiiarov.

III. LITERATURE REVIEW

The health of the population is one of the most important resources of the state; it is an integral indicator and an objective criterion of the success of political, social, and economic reforms of any state [8, 9].

Over the past 20 years, due to the environmental disadvantage of the Aral Sea region, there has been a significant increase in the overall morbidity of the population, exceeding in many respects the average republican data. According to statistical data 2015-2016 in the Aral Sea region, there was a high incidence of diseases of the respiratory,

digestive and nervous systems, 2 times higher than in the country (1955.2) the number of persons with iron deficiency anemia (4091.8) [10-15].

As shown in the statistical materials of the Ministry of Health of the Republic of Kazakhstan and in the scientific literature, in recent years the level of health of children and adolescents in the Kyzylorda region has drastically decreased, and the overall incidence of the adolescent population has significantly increased [13-15]. Over the past 10 years, adolescents have been diagnosed with an increase in blood and hematopoietic diseases, immunity disorders, iron deficiency anemia, exceeding the national average by 2 times. So, if in Kazakhstan the number of such diseases is 3,792.2 cases, respectively, per 100,000 adolescents, in children aged 15 to 17 years living in the Kyzylorda region, suffering from anemia, diseases of the blood and the immune system amounted to 7,976.8 cases, which 2 times more than the average Republican indicators [15-19]. At the same time, there was an increase in the number of children with blood diseases and immune reactivity living in rural areas by 46%, with signs of iron deficiency anemia by 24.1% more than among urban adolescents [16].

Given the difficult environmental situation in the region and the need for continuous monitoring of the health of the adolescent population in the region, this paper presents data on the somatic health survey of the urban and rural contingent of high school students in the Kyzylorda region according to the health scale [6,7].

IV. RESULTS

The assessment of the health of 10th grade urban schoolchildren, both boys and girls, aged 16 to 17 years, showed that the ratio of weight-height indicators or the Quetelet index for the overwhelming majority (87.5%) ranged from 17 to 25 kg / m², which corresponded to the normal physiological development of this group of students. In pupils of the 11th grade, only 73% showed this level of the Quetelet index. At the same time, the number of overweight individuals with a body mass index of more than 25 kg / m² increased by 20%. At the same time, the number of persons with body mass deficiency remained at the same level, making up 7-8% of the total number (Table 1).

When calculating indices of vital index (VI), an increase in the number of schoolchildren with a good development of the respiratory system as they grow up is revealed. Indicators of 11% of pupils aged 17 to 18 years corresponded to the “above average” level, 46% showed an average level of development of the respiratory system, while pupils in 10th grade, aged 16 to 17 years, had 25% of those. At the same time, the fourth part of students in both the 10th and 11th grades (25-27%) had “low” vital index, which shows the insufficiency of the development of the respiratory system in the younger generation (Table 1).

With increasing age, power indices changed. In the group of students from 16 to 17 years, about 30% of schoolchildren have a high and above-average level of strength capabilities, about 45% of students showed an average and below average level of development of the muscular system, and 25% of 10th

grade students had poorly developed muscle tone. Pupils of the 11th grade demonstrated a significant increase in strength indicators associated with the development of the muscular system. 55% of students from 17 to 18 years showed a high and above average level of dynamometric indicators, 30% of graduates had an average and below average level of development, the remaining 15% of schoolchildren showed weak muscle tone (Table 1).

Analysis of data on the state of the cardiovascular system and blood circulation, according to the Robinson index, in high school students showed an increase in the index depending on age. Thus, 60% of schoolchildren of 10th grades corresponded to the average and below average level of health (from 76 to 95 units), more than 15% showed high results (from 71 to 75 units), and the remaining 25% of students had Robinson's indexes significantly higher and corresponded to a low level of cardiovascular functionality (Table 1).

TABLE I. DISTRIBUTION OF SURVEYED URBAN SCHOOLCHILDREN (%) OF HIGH SCHOOL CLASSES ON HEALTH SCALE

| Age Group | Number of pupils, % | | | | |
|-----------|--|---------------|---------|---------------|------|
| | high | above average | average | below average | low |
| | Quetelet Index (kg / m ²) | | | | |
| 16-17 age | 0 | 4.2 | 54.2 | 33.3 | 8.3 |
| 17-18 age | 11.5 | 7.7 | 61.5 | 11.5 | 7.7 |
| | Life Index (VC. ml / kg) | | | | |
| 16-17 age | 0 | 0 | 25.0 | 50.0 | 25.0 |
| 17-18 age | 0 | 11.5 | 46.1 | 15.4 | 27.0 |
| | Dynamometry (body weight. kg / kg) | | | | |
| 16-17 age | 20.8 | 8.2 | 29.4 | 16.6 | 25.0 |
| 17-18 age | 38.4 | 15.4 | 23.1 | 7.7 | 15.4 |
| | Robinson Index (HR * SBP / 100) | | | | |
| 16-17 age | 8.3 | 8.3 | 29.2 | 29.2 | 25.0 |
| 17-18 age | 11.5 | 7.7 | 3.8 | 15.4 | 61.6 |
| | Rufe index $4 \times (P_1 + P_2 + P_3) - 200 / 10$ | | | | |
| 16-17 age | 4.2 | 8.3 | 41.7 | 33.3 | 12.5 |
| 17-18 age | 15.4 | 19.2 | 27.0 | 19.2 | 19.2 |
| | Total | | | | |
| 16-17 age | 4.2 | 8.3 | 16.7 | 33.3 | 37.5 |
| 17-18 age | 15.4 | 7.7 | 11.5 | 30.8 | 34.6 |
| Average | 10.0 | 8.0 | 14.0 | 32.0 | 36.0 |

Significantly indicators of the Robinson index among students aged 17 to 18 years (grade 11) changed. The low level of the cardiovascular system, that is, an increased pulse rate and high systemic blood pressure, showed already 60% of graduates, average and below average – about 20%, high and above average level, that is, good functionality of the cardiovascular system, showed about 20% of schoolchildren.

As can be seen from the presented data, with an increase in the age of urban schoolchildren in the Aral Sea region, the number of students with functional insufficiency of the cardiovascular system significantly increases.

Determination of the Rufe index among schoolchildren of 10th grade showed that more than 75% of students had an average and below average level of cardiac performance, more than 12.5% showed a high and above average level, the remaining 12.5% of students showed a low level of cardiac functional activity vascular system. Schoolchildren of the 11th grade, aged 17 to 18, showed a significant improvement in the Rufe index. High and above average levels were found in 35% of students, and 46% of students showed an average and below average level of cardiac performance. However, there is also an increase in persons with a low level of compensatory capabilities of the cardiovascular system, which amounted to almost 19%. A comparative analysis of the health of the heart and cardiovascular system using the Rufe index showed that with increasing age, the number of urban schoolchildren grows with an unsatisfactory functional state of these systems - the percentage of pupils from 17 to 18 years old grew by 7% compared with schoolchildren from 16 to 17 years, but there is also an increase in the number of students by almost 20% in groups with high and above average levels of health indicators (Table 1).

In general, the health level of one-third of the surveyed high school students in the Priaralye urban schools (36%) corresponded to the “low” level on the Apanasenko health scale, which already indicates the presence of chronic diseases of the cardiovascular and respiratory systems associated with a small volume of lung vital capacity and low level of cardiac compensatory abilities. Almost half of the students (46%) showed an average and below average level of health, the presence of which shows the possibility of developing chronic disorders of the cardiorespiratory system, for example, hypertension in the future. Only 18% of students showed a high and above average level of health, that is, they had good physical health and harmonious development of the body.

The assessment of the health of students in rural areas on the scale of health among schoolchildren of 10-11 grades aged 16 to 18 years studying in rural schools in the Aral Sea region revealed similar health problems for the younger generation.

The values of the Quetelet index in the overwhelming majority of surveyed schoolchildren (from 80 to 86%) studying in rural schools ranged from 17 to 25 kg / m², which corresponded to the average and below the average level of the Apanasenko health scale (Table 2). A few people were found to be underweight, accounting for 6% of the total number of those examined and from 8 to 10% of the students were overweight. 11% of rural schoolchildren showed high and above average vital index indicators associated with normal lung capacity and respiratory system development (Table 2). Almost 50% of high school students showed a low level of vital index with the volume of VC below 2000 ml, which reflects the lack of development of the respiratory function and circulatory system (Table 2).

A good development of the muscular system – the indicators of dynamometry corresponded to a high and above

average level of development on the Apanasenko health scale were noted in more than half of the students in rural schools. In the third part of students, the indicators were at the level of the average and below the average level of development. In 15% of students, strength did not exceed 40 units, which corresponded to a low level of development of the muscular system (Table 2).

The Robinson index as an indicator of the state of the cardiovascular system, among schoolchildren in rural schools was distributed unevenly from low to high level on the health scale. From 15 to 20% of students showed high and above average levels of compensatory function of the cardiovascular system, medium and below average – 40-45% of students and almost 35% of schoolchildren were distinguished by low Robinson index, which reflects the presence of functional failure of the cardiovascular system.

A similar trend was identified when calculating the Rufe index. It was shown that from 60 to 70% of rural schoolchildren from 16 to 18 years old had index values higher than 13, which indicates that the cardiovascular system is not functioning, the remaining 30-40% of students showed a satisfactory and good development of the heart.

TABLE II. DISTRIBUTION OF SURVEYED SCHOOLCHILDREN OF SENIOR CLASSES OF RURAL AREAS BY HEALTH SCALE (% TO THE TOTAL NUMBER OF THE GROUP)

| Age Group | Number of pupils,% | | | | |
|--|--------------------|---------------|---------|-------------------|------|
| | high | above average | average | below the average | low |
| Quetelet Index (kg / m ²) | | | | | |
| 10 grade | 2.5 | 5.1 | 63.3 | 22.8 | 6.3 |
| 11 grade | 5.3 | 5.3 | 59.6 | 23.7 | 6.1 |
| Life Index (VC. ml / kg) | | | | | |
| 10 grade | 3.8 | 7.6 | 21.5 | 16.5 | 50.6 |
| 11 grade | 0.9 | 10.4 | 27.4 | 24.5 | 36.8 |
| Dynamometry (body weight. kg / kg) | | | | | |
| 10 grade | 24.0 | 26.6 | 19.0 | 15.2 | 15.2 |
| 11 grade | 29.2 | 25.5 | 18.9 | 10.4 | 16.0 |
| Robinson Index (HR * SBP / 100) | | | | | |
| 10 grade | 8.8 | 15.2 | 26.6 | 16.5 | 32.9 |
| 11 grade | 12.2 | 3.8 | 21.7 | 23.6 | 38.7 |
| Rufe index $4 \times (P_1 + P_2 + P_3) - 200 / 10$ | | | | | |
| 10 grade | 19.0 | 10.1 | 29.1 | 17.7 | 24.1 |
| 11 grade | 26.4 | 14.2 | 30.2 | 19.8 | 9.4 |
| Total | | | | | |
| 10 grade | 15.2 | 11.4 | 22.8 | 16.5 | 34.1 |
| 11 grade | 16.9 | 14.2 | 18.9 | 15.1 | 34.9 |
| Total information | 16.2 | 13.0 | 20.5 | 15.7 | 34.6 |

A comparative analysis of the data showed that among pupils in the 10th grade, 27% of schoolchildren had a high and above average level of health, 39% showed an average and below average level of health, the remaining 34% showed a low level (Table 2).

Among pupils of 11th grades, the number of persons with high and higher average levels of health increased by 5% and amounted to 31% of the total number of the examined. The average and below average levels of health were shown by 34% of those surveyed and low levels of health were shown by 35% of students. In general, among pupils in the 10th and 11th grades of rural schools in the Aral Sea region, about 29% of students showed a high and above average level of health, 36% showed middle and below average, and the remaining 35% had a low level of health.

V. CONCLUSION

A comparative assessment of the health of urban and rural schoolchildren living in the Aral Sea region showed that 18% of urban schoolchildren and 29% of rural schoolchildren have high and above average levels, 46% of urban schoolchildren and 36% of rural students have average and below average. A low level of health was found in 35% of both urban and rural students in grades 10 and 11, that is, about a third of high school students in schools in the Aral region already have chronic health disorders associated with functional insufficiency of the cardiovascular system (Robinson index and Rufe) and lung capacity development deficiency (LI index). The main reasons for this state of health is the ecological distress of the region of residence [16–22]. The obtained data are consistent with the statistical materials of the official structures of Kazakhstan, indicating a catastrophic increase in the overall incidence of the adolescent population in the Aral region [10-15]. In general, the growing incidence of the younger generation of the Aral region can be viewed as a direct result of the environmental crisis of the Aral Sea and the increased mineralization of water supply.

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