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Comparison of Primary Disease Incidence Among Students of Pre-University Educational Schools of the Russian Ministry of Defence and Russian Adolescents

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ABSTRACT

BACKGROUND: In 33 educational schools of the Russian Ministry of Defense, approximately 18,000 students are enrolled in programs preparing them for military or other public service functions. These programs are focused on the development of an active personality, innovative thinking, physical training, and the improvement of the body's functional reserves.

AIM: of this study was to compare the primary incidence trends and patterns categorized by the International Classification of Diseases, 10th revision, among students of pre-university educational schools of the Russian Ministry of Defense and general population of Russian adolescents over a 12-year period (2010–2022).

METHODS: The analysis included primary disease incidence data submitted with 13K/MED reports. Primary disease codes were matched with classes of the 10th revision of the International Statistical Classification of Diseases and Related Health Problems. The incidence rates were calculated per 1000 students (%). The primary disease incidence rates were compared between students and general population of adolescents aged 15–17 years. The long-term average annual rate was determined based on total absolute values over the 12-year period. The annual average rates alongside with arithmetic means and their standard errors ($M \pm m$) were calculated for the analysis of similarities (differences). The trends were assessed by analyzing time series and calculating a second-order polynomial trendline.

RESULTS: Among students, the long-term average annual and average annual rates were 2694.3% and 2709.0 ± 77.1%, respectively, in 2010–2022. For Russian adolescents, lower values were observed, i.e. 1361.2% and 1380.0 ± 19.9%, respectively ($p < 0.001$). We assume that higher rates of primary disease incidence among students were attributed to higher rates of disease detection, more accessible qualified and high-tech medical care, and personalized accountability of all cases, including those of mild or moderate severity, which are associated with home treatment and are not reported by regional healthcare facilities of the Russian Ministry of Health. Primary incidence rates were calculated for main classes of diseases reported in students and Russian adolescents.

CONCLUSION: The early detection, prevention, timely treatment and rehabilitation of main classes of diseases can significantly reduce the primary disease incidence among students of pre-university educational schools of the Russian Ministry of Defense and Russian adolescents aged 15–17 years.

Keywords: student; cadet; Russian Ministry of Defense; nosological forms; primary disease incidence; adolescents; state of health; student of Suvorov Military College.

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Сравнение первичной заболеваемости воспитанников довузовских общеобразовательных организаций Минобороны России и подростков России

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АННОТАЦИЯ

Актуальность. В 33 общеобразовательных организациях Минобороны России 18 тыс. воспитанников проходят подготовку к военной или иной государственной службе. Особое внимание в них уделяется развитию активной личности и инновационности мышления, физической подготовке и оптимизации функциональных резервов организма.

Цель — сравнить динамику и структуру первичной заболеваемости по классам Международной классификации болезней и расстройств, связанных с болезнью, 10-го пересмотра у воспитанников довузовских общеобразовательных организаций Минобороны и подростков России за 12 лет (2010–2022 гг.).

Материалы и методы. Проанализированы показатели первичной заболеваемости в отчетах по форме 13К/МЕД. Нозологии первичной заболеваемости соотнесены с классами по Международной классификации болезней и расстройств, связанных с болезнью, 10-го пересмотра. Показатели заболеваемости рассчитаны на 1000 воспитанников (‰). Проведено сравнение уровней первичной заболеваемости воспитанников и подростков России в возрасте 15–17 лет. По сумме абсолютных показателей за 12 лет выявлен среднемноголетний уровень, а для анализа сходства (различий) — среднегодовой уровень со средними арифметическими величинами и их ошибками ($M \pm m$). Развитие показателей оценивали с помощью анализа динамических рядов и расчета полиномиального тренда 2-го порядка.

Результаты. Среднемноголетний уровень первичной заболеваемости воспитанников в 2010–2022 гг. был 2694,3‰, среднегодовой — 2709,0±77,1‰. У подростков России он оказался меньше — 1361,2 и 1380,0±19,9‰ соответственно (p <0,001). Полагаем, что уровень первичной заболеваемости воспитанников определялся высокой выявляемостью, более выраженной доступностью при оказании квалифицированной и высокотехнологичной медицинской помощи и персонифицированным учетом всех случаев болезней, в том числе нозологий легкой или умеренной интенсивности, которые при домашнем лечении не регистрируются в территориальных организациях Минздрава России по месту жительства подростков. Были рассчитаны уровни первичной заболеваемости ведущих классов болезней для воспитанников и подростков России.

Заключение. Раннее выявление ведущих классов болезней, их профилактика, своевременное лечение и реабилитация могут существенно уменьшить уровень первичной заболеваемости воспитанников довузовских общеобразовательных организаций Минобороны и юношей России в возрасте 15–17 лет.

Ключевые слова: воспитанник; кадет; Минобороны России; нозологические формы; первичная заболеваемость; подростки; состояние здоровья; суворовец.

Как цитировать

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BACKGROUND

In 33 general education institutions under the Ministry of Defense of the Russian Federation, 18,000 cadets undergo training for military or other government services. Particular emphasis is placed on the development of active personality traits and innovative thinking, physical training, and optimization of the body's functional reserves.

Studies on morbidity among students of Suvorov Military College and cadet schools are few. Most studies focused on ocular pathology, digestive and musculoskeletal diseases, functional reserves of the cardiorespiratory system, and somatoform and stress-related neurotic disorders [1–6].

In 2016–2018, the overall morbidity by classes of the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), among students of the Suvorov Military College increased from 2196‰ to 2398‰, whereas the incidence of disease increased from 1522‰ to 1662‰, exceeding the corresponding rates among adolescents in Russia. The incidence of influenza and acute respiratory viral infections (class X) remained high, reaching 1640‰ in 2018. The incidence of diseases of the skin and subcutaneous tissue (class XII) decreased from 220‰ to 182‰, and injuries, poisonings, and certain other consequences of external causes (class XIX) from 375‰ to 225‰ [7].

In 2006, the overall morbidity among students of Omsk Cadet was 3348‰, which was almost threefold higher than that of the same age group nationwide. This may be explained by the 100% registration of healthcare visits [8].

Considering the higher level of disease incidence among students of educational institutions of the Ministry of Defense of the Russian Federation than among students of regular general education schools, some opponents, when discussing the results, indicated that the educational process in the former had a negative impact on students' health. The high morbidity rates were assumed to be associated with high population density (crowding) of students, emphasis on physical training, and strict documentation of health disorders.

This study aimed to compare the trends and structure of disease incidence by ICD-10 classes between students of pre-university educational institutions of the Ministry of Defense of the Russian Federation and adolescents in Russia over a 12-year period (2010–2022).

METHODS

This study was conducted as part of a dissertation project. Approval of the study involving human participants and the use of medical documents was obtained from the Independent Ethics Committee of the S.M. Kirov Military Medical Academy (protocol no. 260, dated February 22, 2022).

Medical monitoring and morbidity indicators from reports submitted in Form 13K/MED for 2010–2022 by heads of medical units of pre-university educational institutions of the Ministry of Defense of the Russian Federation were analyzed. The level, trend, and structure of disease incidence of 112,000 students were calculated. Cases of newly diagnosed conditions during a lifetime were considered primary, as well as all cases of acute diseases and injuries [9].

Disease incidence was categorized according to ICD-10 classes. The classes that ranked first to fifth in the incidence structure were considered leading, as their prevention could significantly decrease overall morbidity.

Morbidity rates were calculated per 1000 students (‰). As students aged 15–17 years represented the largest cohort (43.9%), incidence indicators were compared with data from adolescents of the same age group from statistical compilations of the Central Research Institute for Organization and Informatics of Healthcare*. The morbidity indicators for adolescents in Russia, originally calculated per 100,000 population, were normalized and converted to per mille (per 1,000 population) for subsequent comparison.

Obtained data were statistically analyzed using the Statistica 10.0 software package (Dell Inc, USA). The Kolmogorov–Smirnov test showed that the study results approximated a normal distribution. Based on the sum of absolute indicators over 12 years, the average long-term level of disease incidence was obtained. To analyze similarities and differences, the average annual level with arithmetic means and their standard errors ($M \pm m$) were determined. Trends were assessed using time series analysis and by calculating a second-order polynomial trend [10]. The coefficient of determination (R^2) demonstrated the accuracy of the polynomial curve: the closer the R^2 value to 1.0, the more accurately the curve was fitted. Congruence (consistency) of trends was evaluated using Pearson correlation coefficient.

RESULTS

The average long-term level of disease incidence among students in 2010–2022 was 2694.3‰, and the average annual level was 2709.0 ± 77.1‰. These indicators were 1361.2‰ and 1380.0 ± 19.9‰, respectively ($p < 0.001$), among adolescents in Russia aged 15–17 years.

*Official periodic publications: Morbidity of the child population of Russia/Statistical materials. Part IX. Ministry of Health of the Russian Federation, Department of Monitoring, Analysis, and Strategic Development of Health Care, Central Research Institute for Organization and Informatics of Health Care of the Ministry of Health of Russia. Moscow, 2009–2022. Available at: http://minzdrav.gov.ru/documents. Accessed on December 1, 2024.

Table 1. ICD-10 classes of diseases and disorders

Class	Name of class	Code
I	Certain infectious and parasitic diseases	A00–B99
II	Neoplasms	C00–D48
III	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	D50–D89
IV	Endocrine, nutritional, and metabolic diseases	E00–E90
V	Mental and behavioral disorders	F00–F99
VI	Diseases of the nervous system	G00–G99
VII	Diseases of the eye and adnexa	H00–H59
VIII	Diseases of the ear and mastoid process	H60–H95
IX	Diseases of the circulatory system	I00–I99
X	Diseases of the respiratory system	J00–J99
XI	Diseases of the digestive system	K00–K93
XII	Diseases of the skin and subcutaneous tissue	L00–L99
XIII	Diseases of the musculoskeletal system and connective tissue	M00–M99
XIV	Diseases of the genitourinary system	N00–N99
XVIII	Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	R00–R99
XIX	Injury, poisoning, and other consequences of external causes	S00–T98

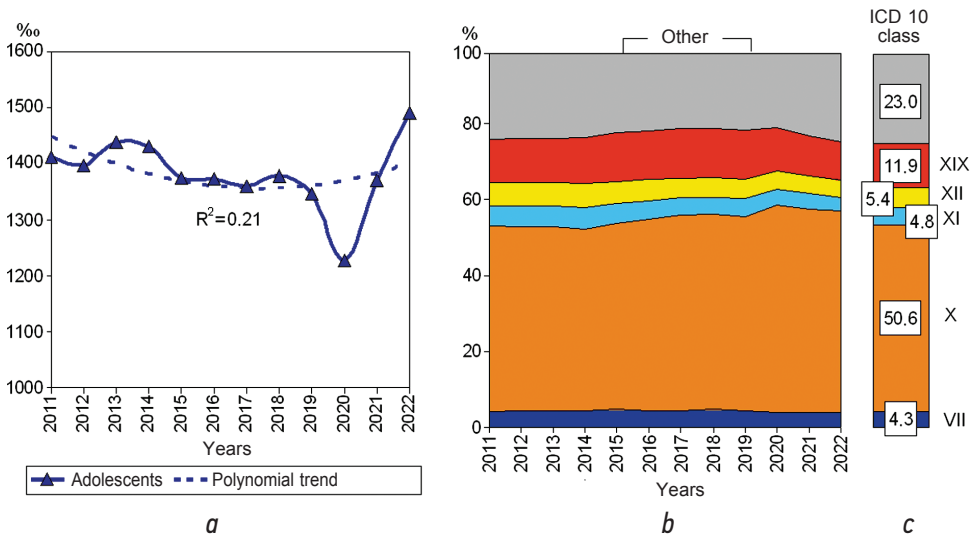
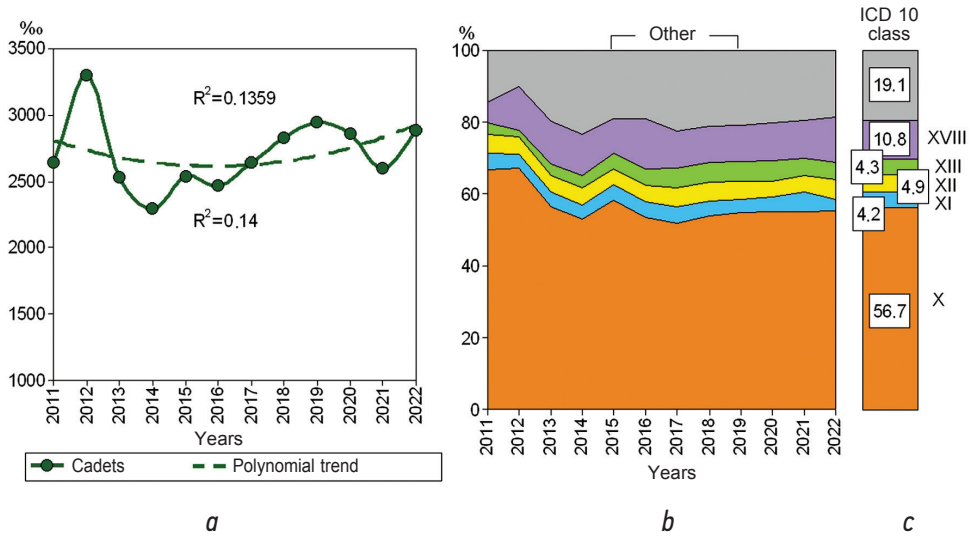


Fig. 1. Trends in the incidence of disease among adolescents (*a*), trends in the structure of disease incidence (*b*), and structure of disease incidence (*c*).

Figures 1 and 2 presents the trends of disease incidence. With very low coefficients of determination, the polynomial trend of incidence among adolescents exhibited a tendency toward minimal change (Fig. 1*a*), whereas among students, it resembled a shallow *U*-shaped curve with a tendency toward increasing values in the last observation period (Fig. 2*a*). Trend congruence was weak, negative, and statistically nonsignificant ($r = -0.161$; $p > 0.05$), indicating the potential influence of different (oppositely directed) factors, such as educational and training processes.

Table 2 summarizes the results of disease incidence among adolescents in Russia aged 15–17 years. The highest rank was attributed to respiratory diseases (class X), with an average long-term level of 689.7‰ and a share of 50.6% in the structure; rank 2, injuries, poisoning, and certain other consequences of external causes (class XIX), 162.5‰ and 11.9%; rank 3, diseases of the skin and subcutaneous tissue (class XII), 73.5‰ and 5.4%; rank 4, diseases of the digestive system (class XI), 65.6‰ and 4.8%; and rank 5, diseases of the eye and adnexa (class VII), 58.8‰ and 4.3%, respectively (Table 2).



a *b* *c*

Fig. 2. Trends in the incidence of disease among cadets (*a*), trends in the structure of disease incidence (*b*), and structure of disease incidence (*c*).

Table 2. Indicators of disease incidence in adolescents in Russia, 2010–2022

ICD 10 class	Average long-term level, ‰	Structure, %	Rank	R^2	Trend	Average annual level, ($M \pm m$) ‰
I	43.3	3.5	8th	0.82	∪↑	49.0 ± 8.3
II	4.8	0.4	17th	0.73	↑	4.8 ± 0.1
III	8.5	0.6	15–16th	0.37	↓	8.7 ± 0.2
IV	24.2	1.8	11th	0.23	↑	24.5 ± 2.1
V	9.1	0.7	13–14th	0.89	↓	9.3 ± 0.6
VI	37.8	2.8	9th	0.53	↓	38.5 ± 0.8
VII	58.8	4.3	5th	0.51	∩↓	59.9 ± 1.4
VIII	34.0	2.5	10th	0.60	∩↓	34.6 ± 0.7
IX	15.9	1.2	12th	0.76	↓	16.1 ± 0.5
X	689.7	50.6	1st	0.63	∪↑	699.8 ± 9.8
XI	65.6	4.8	4th	0.83	↓	66.9 ± 2.9
XII	73.5	5.4	3rd	0.85	↓	74.9 ± 3.1
XIII	55.3	4.1	6–7th	0.70	↓	56.3 ± 1.6
XIV	56.2	4.1	6–7th	0.80	↓	57.2 ± 1.9
XVIII	7.6	0.6	15–16th	0.92	↓	7.8 ± 2.4
XIX	162.5	11.9	2nd	0.60	∩↓	165.5 ± 3.6
Other	38.7	0.7	13–14th	0.81	∪↑	37.6 ± 16.1
Total	1361.2	100.0		0.21	∪	1380.0 ± 19.9

The cumulative contribution of these disease classes accounted for 77% of the structure of disease incidence among adolescents (Fig. 1*c*).

With varying degrees of change, a decrease in disease incidence was observed over time among adolescents in 5 classes (63% of the structure), and an increase was noted in 12 classes (37%) (Table 2). In the trend of the structure of leading classes, an increase was found in the share of class X diseases and a decrease in the shares of other classes (Fig. 1*b*).

Table 3 summarizes the results of disease incidence among students. In the structure, the highest rank was attributed to respiratory diseases (class X), with an average long-term level of 1490.3‰ and a share of 56.7%; rank 2, symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (class XVIII), 295.5‰ and 10.8%; rank 3, diseases of the skin and subcutaneous tissue (class XII), 131.1‰ and 4.9%; rank 4, diseases of the musculoskeletal system and connective tissue (class XIII), 128.8‰ and 4.3%; and rank 5,

Table 3. Indicators of disease incidence in cadets, 2010–2022

ICD 10 class	Average long-term level, ‰	Structure, %	Rank	R^2	Trend	Average annual level, ($M\pm m$) ‰	$p<$
I	86.8	3.4	8th	0.63	↓	91.7 ± 4.1	*0.001
II	1.1	0.04	16th	0.31	∩↓	1.0 ± 0.2	↓0.001
III	1.8	0.1	15th	0.20	∩	1.9 ± 0.3	↓0.001
IV	38.1	1.2	11th	0.75	↑	32.2 ± 5.8	↑0.001
V	5.8	0.2	14th	0.15	∩↑	5.5 ± 1.0	↓0.001
VI	114.2	3.9	7th	0.55	↑	104.5 ± 10.0	↑0.001
VII	86.7	3.0	9th	0.40	↑	81.5 ± 8.2	↑0.01
VIII	51.8	2.0	10th	0.39	↓	53.1 ± 2.8	↑0.001
IX	24.5	0.9	12th	0.23	∩↑	23.3 ± 1.8	↑0.001
X	1490.3	56.7	1st	0.35	∪↓	1543.5 ± 74.5	↑0.001
XI	113.8	4.2	5th	0.05	↑	112.8 ± 4.3	↑0.001
XII	131.1	4.9	3rd	0.25	∪	131.8 ± 5.0	↑0.001
XIII	128.8	4.3	4th	0.75	↑	117.3 ± 9.7	↑0.001
XIV	9.6	0.4	13th	0.54	∩	9.7 ± 0.8	↓0.001
XVIII	295.5	10.8	2nd	0.10	↑	291.4 ± 18.2	↑0.001
XIX	114.4	4.0	6th	0.61	↑	107.7 ± 6.7	↓0.001
Total	2694.3	100.0		0.14	∪	2709.0 ± 77.1	↑0.001

Note. * Significant differences between indicators of cadets and adolescents. An upward arrow indicates a higher-level cadets; a downward arrow indicates the opposite.

diseases of the digestive system (class XI), 113.8‰ and 4.2%, respectively (Table 3). The cumulative contribution of these disease classes accounted for 80.9% of the structure of disease incidence among students (Fig. 2*c*).

With varying degrees of change, a decrease in the level of primary morbidity among students was observed over time in 12 classes (43% of the structure) and an increase in 4 classes (57%) (Table 3). In the trend of the structure of leading classes, an increase was noted in the shares of classes XII, XIII, and XVIII and a decrease in the shares of classes X and XI (Fig. 2*b*).

When comparing the average annual levels between students and adolescents, adolescents demonstrated significantly higher rates of neoplasms (class II); diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (class III); mental and behavioral disorders (class V); diseases of the genitourinary system (class XIV); and injuries, poisoning, and certain other consequences of external causes (class XIX) (Table 3). For other classes of diseases, the rates were higher among students (Table 3); they accounted for a substantial proportion of the incidence. This phenomenon will be analyzed in more detail below.

DISCUSSION

The average long-term incidence of certain infectious and parasitic diseases (class I) and respiratory diseases (class X) was higher in cadets than in adolescents by 44‰ and 801‰, respectively. To prevent the spread of these diseases within relatively crowded accommodations of cadets, affected individuals were referred for inpatient treatment. Accordingly, these conditions were recorded among cadets, whereas at home, adolescents were often treated by relatives without contacting medical personnel; hence, such cases were not documented in territorial institutions of the Ministry of Health of Russia at the place of residence.

Among cadets, the incidence of class XVIII conditions identified through laboratory and clinical (instrumental) examinations was higher by 288‰, reflecting a higher level of detection and greater availability of qualified and high-technology medical care in pre-university educational institutions of the Ministry of Defense of the Russian Federation.

Moreover, the average long-term incidence of diseases of the nervous system was higher among cadets by 76‰ (class VI). These were mainly episodic headaches (G44.2) of mild and, less often, moderate intensity caused by overexertion or emotional stress. At home, adolescents were typically advised to rest or prescribed a pharmacological agent. When cadets presented with the same complaint to a medical station, this episode of seeking medical care was recorded.

Furthermore, among cadets, the incidence of diseases of the skin and subcutaneous tissue (class XII) was higher by 74‰, primarily due to localized infections of the skin and subcutaneous tissue (pyoderma, furuncle, infectious folliculitis, etc.; ICD-10 category L02), acne (L70), urticaria (L50), and others. It was assumed that during home treatment, these conditions were often not

included in the morbidity register of adolescents at their place of residence.

Compared with adolescents, cadets had 48‰ fewer injuries, but the incidence of diseases of the musculoskeletal system and connective tissue was higher by 74‰. In some cases, abrasions and excoriations in cadets may have not been classified as superficial injuries and therefore were not attributed to class XIX.

Further studies of specific conditions (groups) within ICD-10 classes among cadets are warranted. However, even the presented comparative analysis demonstrated that cadets had a personalized record of all disease cases, including conditions of mild or moderate severity, which under home treatment were not registered in the territorial institutions of the Ministry of Health of Russia at the place of residence of adolescents.

CONCLUSION

In 2010–2022, the average long-term level of disease incidence among cadets of pre-university general education institutions of the Ministry of Defense of the Russian Federation was 2694.3‰, and the average annual rate was 2709.0 ± 77.1‰; among adolescents in Russia, these rates were lower-1361.2‰ and 1380.0‰ ± 19.9‰, respectively ($p < 0.001$). The incidence of disease rate among cadets was determined by high detectability, greater accessibility to qualified and advanced medical care, and personalized recording of all disease cases.

Further research on specific conditions (groups) within ICD-10 classes is required to study excessive strain of the functional reserves of adolescents during educational activities in general education institutions of the Ministry of Defense of the Russian Federation.

ADDITIONAL INFO

Author contributions: All authors made substantial contributions to the conceptualization, investigation and manuscript preparation, and reviewed and approved the final version prior to publication. Personal contribution of each author: I.K. Soldatov: primary data collection and processing, data analysis, image preparation, editing of the final version; V.I. Evdokimov: statistical analysis, image preparation, writing—original draft; V.G. Arsentiev: conceptualization and methodology; R.G. Makiev: methodology, conceptualization; O.A. Fedorov: sources review, data interpretation.

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Финансирование. Поисково-аналитическая работа проведена на личные средства авторского коллектива.

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