The prevalence of anemia among schoolchildren in Šiauliai region of Lithuania

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Background. The aim of this study is to investigate the prevalence of anemia, the frequency of the most common anemia-related symptoms and to assess anemia risk factors among school-age children.

Materials and methods. The study was performed from August 2002 to January 2003, with 318 children having taken part in the study. They were divided into three groups: Group I – 6–8-y-old children, Group II – teenage girls, and Group III – teenage boys. All parents of 6–8-year-old children, teenage girls and boys were asked to fill in the questionnaires about the presence of anemia-related symptoms, and the answers were examined by the pediatrician. Capillary blood including complete blood count with red blood cell indices was analysed using automated hematology analysers. Statistical data analysis was performed using SPSS 10.1 for Windows software statistical package.

Results. The overall percentage of 10.1% of anemic children was found in Šiauliai region among 6–16-year-old children. Anemia was diagnosed to 10.8% of 6–8-year-old children, 17.8% of teenage girls and 3.4% of teenage boys. The prevalence of anemia-related symptoms in all study group was 52.2%. Anemia-related symptoms predominated among teenage girls, giving an overall frequency of 78.8%.

Conclusions. Complete anamnesis and appearance of anemia symptoms is not enough to detect anemia; consequently, there is a need of blood test to perform. The presence of anemia-related symptoms is also very frequent among children without anemia. Prelatent or latent iron deficiency might be the reason, but capillary blood test is not enough to prove this. Further and more detailed tests are needed.

Analysing the prevalence of anemia and anemia-related symptoms among schoolchildren, the highest prevalence was defined among teenage girls. Teenage girls belong to the iron deficiency anemia risk group, so we would strongly reccommend prophylactic measures to be applied: at least one anemia screening test during adolescence and an oral iron preparation for prophylaxis.

Key words: anemia, iron deficiency, children, teenagers

INTRODUCTION

According to WHO, anemia is estimated to affect more than 2 billion people worldwide. Half of all reasons for anemia are iron deficiency (1, 2). Iron deficiency is a systemic condition with many consequences including anemia, impaired exercise capacity, and functional alterations of the small bowel. One of the most serious consequences of iron deficiency in children is the alteration of behavior and cognitive performance. The association of iron deficiency anemia with lower mental and motor developmental test scores in early childhood is well- described and has recently been reviewed (3, 7). The study on cognitive achievement in iron-deficient school-age children was performed by Halterman et al. in the United States (2000). They demonstrated lower standardized math scores among iron-deficient school-aged children and adolescents, including those with iron deficiency without anemia (3).

Iron deficiency is the most prevalent hematologic disorder in childhood. Infants from 9 to 24 months of age may develop dietary iron deficiency as bone marrow stores of iron are depleted during a period of accelerated growth. Adolescent girls are also susceptible to dietary iron deficiency because of a poor dietary intake in conjunction with high iron requirements related to rapid growth and menstrual blood loss (3). Adoles-

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cence is characterized by a large growth spurt and the acquisition of adult phenotypes and biologic rhythms. During this period, iron requirements increase dramatically in both boys and girls as a result of the expansion of the total blood volume, the increase in lean body mass and the onset of menses in young females (4).

Significant progress has been made over the last century in reducing and even eliminating iron deficiency in many industrialized countries. Current estimates are that the prevalence of iron deficiency has declined to <20% in many of these countries, even among women and young children, compared with 30% to 70% in many developing countries (5, 6). Some positive factors may have contributed to reducing the prevalence of iron-deficiency anaemia in some groups of population: the use of iron-fortified formulas and iron-fortified cereals; the use of oral contraceptives and increased enrichment of iron in several countries; and the use of iron supplements during pregnancy in some European countries (5, 6).

Anemia screening during infancy and pregnancy is recommended by a number of worldwide organizations. Some organizations recommend selective screening for specific high-risk population: teenagers with heavy menses, chronic weight loss, nutritional deficit or athletic activity (1–3).

There are no data on the prevalence of anemia in Lithuania. Only clinically based observations show an increase in the prevalence of anemia over the last 10 years. Seeking to capture society's attention to that problem as well as at least approximately evaluate the prevalence of anemia among school-age children, a capillary blood test was performed to healthy children and examined using automated blood analyzers in 5 polyclinics of the Šiauliai region of Lithuania: Šiauliai, Joniškis, Pakruojis, Radviliškis and Kuršėnai. Peripheral blood test is the only eligible test for anemia in ambulatory practice in Lithuania. More accurate tests for iron deficiency are still not available in that setting.

The aim of the study was to define the prevalence of anemia and the frequency of common anemia-related symptoms among schoolchildren and to assess the relationship between the clinical signs of anemia, hemoglobin level and indices of hemograms.

MATHERIALS AND METHODS

The study cohort comprised 318 children. They were divided into three groups: Group I – 6–8-year-old children (n = 111), Group II – 13–16-year-old teenager girls (n = 117), Group III – 13–16-year-old teenager boys (n = 90). The questionnaire included the information on presence of weakness, changes of appetite, digestion problems, learning process and memory or disturbances, history of infection over the previous month and menarcheal status of teenage girls, reported by children or their parents. Skin the, colour status of hair and nails, height and weight were estimated by a pe-

diatrician. Capillary blood was examined using automated blood analysers.

Relying on the data provided in the questionnaires, the findings of doctor examination and results of hematology analysers, the incidence of anemia and anemia-related symptoms in the three groups was defined. Paleness, weekness, headaches, changes of appetite, nail fragility, shedding of hair and changes in taste and smell were defined as anemia-related symptoms. The frequency of anemia-related symptoms among girls and boys as well as among anemic and healthy children was compared. A relationship among digestion problems, the history of recent illnesses and anemia was analysed.

All the children were selected randomly, oral consent was obtained from their parents. The study was approved by the local Ethis Commitee. Seeking to get more reliable data, only healthy children were asked to give a blood sample; children with current infection were not examined.

The data of this article are based on statistical analysis using SPSS 10.1 for Windows statistical program. In the frequency and correlation analysis, statistical significance was determined using the p value at the probability of 0.05.

RESULTS

The overall prevalence of anemia was found to be 10.1%. Anemia was diagnosed to 10.8% of 6–8-year-old children, 17.8% teenage girls and 3.4% teenage boys (c^2 =11.694, df = 2, p = 0.003). Figure 1 demonstrates the incidence of anemia among three different groups. Comparing the prevalence of anemia among boys and girls of different age, in the group of 6–8-year-old children girls also more often than boys were found to be anemic (12.5% vs 9.1%), but didn't show a statistically reliable difference (p > 0.05).

Figure 2 shows a mean hemoglobin concentration in different groups. The lowest mean Hb concentration was found in the blood of 6–8-year-old children (12.9 g/dl, SD 0.89) and the highest in the blood of teenage boys (14.4 g/dl, SD 1.23).

Analysing erythrocyte indices of different groups, statistically reliable results were obtained for Hct and MCV. The WHO cut-off norms of red blood cells set as follows: Hct > 35, MCV > 80 fl. Summarizing the results of automated blood analysers, a low Hct was the most common finding among teenage girls (19.18 %, c^2 = 29.688, df = 2, p = 0.001) and a low MCV among 6–8-year-old children (43.2%, χ^2 = 39.402, df = 4, p = 0.001).

Hemoglobin and MCV correlation was measured in all groups. The strongest positive HB / MCV correlation was defined among teenage girls (r = 0.523, p < 0.05), and teenage boys (r = 0.287, p < 0.05).

The prevalence of anemia-related symptoms in all the groups was found to be 52.2%. As is shown in Fig. 3, anemia-related symptoms are the most frequent
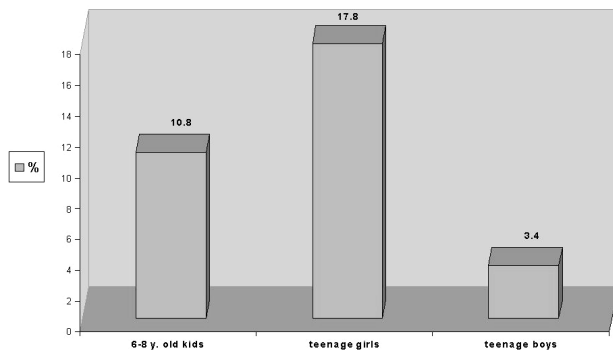
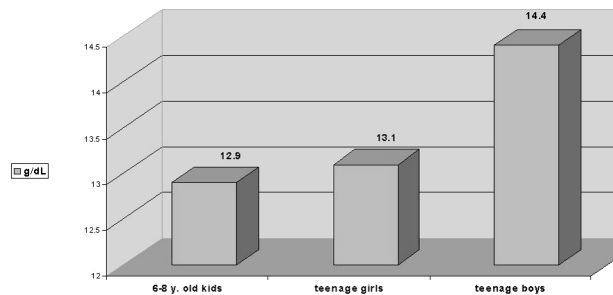**Fig. 1.** Incidence of anemia in different groups

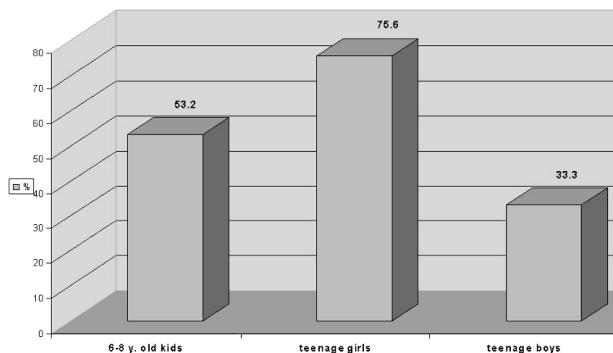**Fig. 2.** Mean hemoglobin concentration in different groups

Fig. 3. Incidence of anemia-related symptoms in different groups

finding among teenage girls (75.6%, $\chi^2 = 36.407$, df = 2, $p < 0.005$). Teenage girls are more likely to have anemia-related symptoms compared to teenage boys (63.6% vs 36.4%, $p < 0.05$).

Symptoms of anemia predominated among anemic and healthy teenage girls (87.5% vs 73%), but these results didn't show a statistically reliable difference ($p > 0.05$).

Paleness predominated among 6–8-year-old children (35.1%, $p < 0.005$), shedding of hair among teenage girls (41.1%, $p < 0.005$), headache among teenage boys (17.1%, $p < 0.05$).

Analysing the relationship between anemia-related symptoms and a low hemoglobin level (<12 g/dl), it was found to be more frequent among teenage girls (20.6%) vs 6–8-year-old kids (6.8%) or teenage boys (5.1%, $p < 0.05$). Anemia without any symptoms was diagnosed to 15.4% of 6–8-year-old children, to 9.1% of adolescent girls and 2.6% of adolescent boys ($p < 0.05$).

We have defined that anemia-related symptoms are more frequent among children with a recent history of infection. Almost 76.2% of children with the history of recent infection were found to have anemia-related symptoms ($p < 0.005$); 53.1% of these kids had more than one symptom of anemia ($p < 0.05$). We suppose that these symptoms reflect a negative effect of infection on immunity.

Digestion problems were detected more often among children with anemia-related symptoms than in those without these symptoms (35.5% vs 20.4%, $p < 0.005$). Among those with digestion problems, low Hct was defined for 43.6% of children ($p < 0.05$).

DISCUSSION

This report is the first to describe the prevalence of anemia among schoolchildren in Lithuania. The overall percentage of 10.1% of anemias among schoolchildren was not so high as reported from studies conducted in Kazakhstan (27%) and Malayzia (20%) (7, 8).

Our study revealed the highest incidence of anemia among teenage girls. Anemia in female adolescents appears to be a significant health problem in the world. The prevalence of anemia among teenage girls (17.8%) found in this study is much higher than in developed countries such as the United States and Norway where the prevalence of iron deficiency and anemia among adolescent girls was estimated to be 8.7% and 4%, respectively (3, 9). In the recent studies from developing countries like Kenya, India, Indonesia, Bangladesh, the prevalence of anemia among adolescent girls has been found to be 21.1–27% (10–13). However, anaemia in this region cannot be explained by iron deficiency alone, and other causes of anemia may also exist in this population, such as malaria, vitamin A deficiency, parasitic infections, etc. (7, 8, 10–13). Differently, inadequate dietary iron, intensive workload and exercise, gastrointestinal problems and ovarian dysfunction are the main reasons for iron deficiency in Lithuania

Another goal of this study was to find if the anamnesis or clinical symptoms of anemia might predict anemia. These data showed that there was not a very close relationship between anemia symptoms and low hemoglobin level, but these symptoms are a more common among anemic children than among healthy children.

Anemia-related symptoms are more common among children with a recent history of infection; they can be assessed as a latent iron deficiency and as an increased receptivity for infections due to postinfectious astenisation.

Symptoms of anemia are related to digestion problems. Meanwhile, we need an additional research to prove that digestion problems due to disorders of iron resorption or presence of *Helicobacter pylori* infection in the stomach may cause anemia.

CONCLUSIONS

Analysing the prevalence of anemia and anemia-related symptoms among schoolage children, the highest prevalence was defined among teenage girls.

Teenage girls belong to an iron-deficiency anemia risk group, so we would strongly reccommend prophylactic measures to be applied: at least one anemia screening test during adolescence and an oral iron preparation for prophylaxis.

A complete anamnesis and the appearance of anemia-related symptoms is not enough to detect anemia, so there is a need of a blood test to perform.

The presence of anemia-related symptoms is also very frequent among children without anemia. Pre-latent or latent iron deficiency might be the reason, but capillary blood test is not enough to prove this. Further and more detailed tests are needed.

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ANEMIJOS PAPLITIMAS TARP MOKYKLINIO AMŽIAUS VAIKŲ LIETUVOS ŠIAULIŲ KRAŠTE

Darbo tikslas – nustatyti anemijos paplitimą ir anemijos simptomų dažnumą tarp mokyklinio amžiaus vaikų, išsiaiškinti anemijos rizikos veiksnius.

Darbo metodai. Tyrimas buvo atliekamas 2002 m. rugpjūčio – 2003 m. sausio mėnesį. Tyrime dalyvavę vaikai (318) buvo suskirstyti į tris grupes: I grupė – 6–8 metų amžiaus vaikai, II grupė – 13–16 metų paauglės mergaitės, III grupė – 13–16 metų paaugliai berniukai. Visiems vaikams arba jų tėvams buvo išdalytos anketos, kuriose prašoma pažymėti anemijos simptomus, klausiama apie silpnumą, apetito pokyčius, dispepsijos reiškinius, mokymąsi ir atmintį, dėmesio koncentraciją, sergamumą per paskutinį mėnesį. Gydytojo pediatro apžiūros metu buvo įvertinama odos spalva, plaukų ir nagų būklė. Automatiniais analizatoriais buvo tiriamas kapiliarinis kraujas. Šiame straipsnyje pateikta duomenų analizė buvo atlikta naudojant SPSS 10.1 for Windows statistinę programą.

Rezultatai. Anemijos paplitimas tarp Šiaulių krašto 6–16 metų amžiaus vaikų siekia 10,1%. Anemija diagnozuota 10,8% ankstyvojo mokyklinio amžiaus vaikų, 17,8% paauglių mergaičių ir 6,4% paauglių berniukų. Anemijos simptomai pasireiškė 52,2% vaikų, dažniausiai – paauglėms mergaitėms (78,8%). Anemijos simptomai tik vos dažniau stebimi tarp sergančiųjų anemija nei tarp sveikų vaikų.

Išvados. Nustatėme, kad klinikinius anemijos simptomus ne visada patvirtina hemoglobino lygis kraujuje, todėl diagnozuojant anemiją ir skiriant gydymą visada reikia atlikti kraujo tyrimą. Anemijos simptomai be anemijos rodytų prelatentinę ar latentinę geležies stoką. Latentinė geležies stoka nustatoma tikslesniais tyrimais, kuriuos sudėtinga atlikti poliklinikos sąlygomis.

Anemija dažniausiai serga paauglės mergaitės, tarp jų dažnesni ir anemijos simptomai. Paauglės mergaitės priklauso anemijos rizikos grupei, todėl rekomenduojame profilaktiškai atlikti bent vieną kraujo tyrimą ir skirti geležies preparatus.

Raktažodžiai: anemija, geležies stoka, vaikai, paaugliai