

ORIGINAL PAPER

Analysis of the consumption of nutrients and minerals in the diets of children and adolescents

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ABSTRACT

Introduction: A consequence of nutrient and microelement deficiency in the diet is the inhibition of growth and development of the young body, as well as the lowering of immunity.

The aim of the research was to assess the level of consumption of nutrients and selected minerals in the everyday diet of children and adolescents living in rural areas.

Material and methods: The diets of 1180 pupils aged 7–18 years were analysed. The questionnaire contained questions about products consumed on a daily basis, including fast food products, sweetened drinks, snacks, and sweets, as well as information on any chronic illnesses the study participants suffered from. The questionnaire was completed over a 7-day period. The daily intake of energy (kcal) and the amount of selected nutrients and minerals consumed were determined using the DIETA FAO 5.0 computer program.

Results: In the group of 7–9- and 10–12-year-olds, the daily requirement for micronutrients was exceeded for sodium, potassium, magnesium, and iron, while there was a very low intake of calcium. In the group of 13–15-year-olds boys exceeded the daily intake of sodium, potassium, and iron, while there was a deficiency of magnesium and calcium. Among high school pupils, the intake of sodium and iron exceeded the recommended dietary allowance (RDA). The median intake of calcium corresponded to half the RDA.

Conclusions: Children and adolescents consume meals inconsistent with the rational nutrition guidelines, regardless of their age. The high carbohydrate and fat intake but low calcium intake suggest that the amount of meat and sweets consumed by children and adolescents needs to be reduced while the amount of milk and dairy products should be increased.

KEYWORDS:

adolescents, children, diet, minerals.

INTRODUCTION

Nutrition is a modifiable element of a healthy lifestyle. For children and adolescents, proper nutrition equals proper physical and psychological development. An incorrect diet, with either a deficiency or an excess of nutrients, can have a detrimental effect on the body as it develops. A consequence of long-term deficiency of microelements in the diet is the inhibition of growth and development

of the young body, as well as the lowering of immunity [1, 2]. Excess consumption of fat and certain minerals promotes metabolic disorders, which lead to excess body weight. An excess of sodium is particularly dangerous for the body because it leads to hypertension and strokes [3, 4].

The diet of pupils is typified by excess consumption of sweet foods and sweet drinks, and a low amount of vegetables and fruits [5]. This results in a diet low in minerals and vitamins. Research has demonstrated a close

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relationship between incorrect dietary habits and health problems later in life [3]. If a deficiency in minerals and incorrect dietary habits are identified early enough, actions can be taken to improve this.

Incorrect development and the occurrence of non-infectious chronic diseases, in particular cardiovascular diseases, are major public health issues [3, 4].

The aim of the research was to assess the level of consumption of nutrients and selected minerals in the everyday diet of children and adolescents living in rural areas.

MATERIAL AND METHODS

The study was conducted among pupils attending one of the schools (primary or secondary) located in a village on the outskirts of Bielsko-Biała, ranked in 566th place in terms of affluence among all districts in Poland.

Our questionnaire contained questions about products consumed daily, including fast food products, sweetened drinks, snacks, and sweets, as well as information on any chronic illnesses the study participants suffered from. The parents and adolescents were trained in correctly assessing the size of portions of foodstuffs consumed. The questionnaire was completed over a 7-day period. The size of the portions consumed were additionally checked using the *Album of photographs of food products and dishes* [6].

RECRUITMENT PROCEDURE

Before the study had begun, meetings were held with the children's parents and the adolescents, to obtain their permission for the research to be conducted. The inclusion criteria were age 7–18 years and primary or secondary school attendance. Children with diagnosed chronic diseases were excluded from the study (e.g. a food allergy or thyroid disease).

GATHERING AND ASSESSMENT OF ANTHROPOMETRIC DATA

The researcher carried out anthropometric tests, including body mass and height, on the children and adolescents dressed in their underwear. To eliminate errors, each measurement was taken 3 times and the average of the results was calculated. The body mass index (BMI) value was calculated for each participant and was classified using World Health Organization (WHO) reference data, assuming that correct values were between the 5th and 85th percentile [7–10].

GATHERING AND ASSESSMENT OF FOOD INTAKE DATA

The amount of individual food products consumed was calculated for each study participant on the basis

of 7-day food diaries completed by parents and the study participants. The results obtained were compared to the estimated average requirement (EAR) for the group, the recommended dietary allowances (RDA), and the adequate intake (AI), according to Polish nutritional norms [11].

STATISTICAL ANALYSIS

The statistical analysis included descriptive variable statistics, i.e. the average, the median (that is the 50th percentile), the 25th and 75th percentile, as well as the minimum and maximum for all values analysed, divided according to gender and age. The calendar ages of the study participants were determined on the basis of the difference between the date of the study and their date of birth, and they were subsequently allocated to appropriate age bands according to calendar year [12].

The daily intake of kilocalories and the amount of particular minerals and nutrients consumed were determined using the DIETA FAO 5.0 computer program, which contains data on 1067 typical food products.

STUDY GROUP SIZE

The study was conducted on 1243 pupils. The analysis excluded 63 participants with insufficiently completed questionnaires, as well as children with food allergies. The analysis included 621 girls and 559 boys. The group of girls consisted of 432 primary-school pupils, 106 middle-school pupils, and 83 secondary-school pupils. The group of boys was made up of 340 primary-school pupils, 163 middle-school pupils, and 56 secondary-school pupils. For statistical purposes, the participants were divided into 4 groups: pre-pubescent children (7–9 years old), children in the first stage of puberty (10–12 years old), middle-school-age children (13–15 years old), and secondary-school children (16–18 years old). This division also corresponded to the daily norms for energy requirement and nutrients.

BIOETHICS COMMITTEE PERMISSION AND FUNDING SOURCES

The research was financed by the National Centre for Science – Miniatura program No. DEC-2017/01/X/NZ7/00223.

The study was approved by the Bioethics Committee and was granted written approval number 2017/06/1/4, in accordance with the Helsinki declaration.

RESULTS

CHARACTERISTICS OF THE STUDY GROUP

In the analysed group of boys, 4.5% had low BMI, while 19.5% had high BMI, of whom 7.7% were obese

TABLE 1. Body mass index of boys according to age

| BMI percentile | 7–9 years (n) | 10–12 years (n) | 13–15 years (n) | 16–18 years (n) | Total (n/%) |
|----------------|---------------|-----------------|-----------------|-----------------|-------------|
| < 5 | 18 | 0 | 6 | 1 | 25/4.5 |
| 5–85 | 118 | 135 | 122 | 50 | 425/76 |
| 85–95 | 14 | 20 | 27 | 5 | 66/11.8 |
| < 95 | 14 | 21 | 8 | 0 | 43/7.7 |
| Total | 164 | 176 | 163 | 56 | 559/100 |

BMI – body mass index

TABLE 2. Body mass index of girls according to age

| BMI percentile | 7–9 years (n) | 10–12 years (n) | 13–15 years (n) | 16–18 years (n) | Total (n/%) |
|----------------|---------------|-----------------|-----------------|-----------------|-------------|
| < 5 | 6 | 7 | 11 | 4 | 28/4.5 |
| 5–85 | 109 | 144 | 128 | 73 | 454/73.1 |
| 85–95 | 13 | 24 | 25 | 2 | 64/10.3 |
| < 95 | 40 | 25 | 6 | 4 | 75/12.1 |
| Total | 168 | 200 | 170 | 83 | 621/100 |

BMI – body mass index

(Table 1). In the group of girls, similarly to the boys, 4.5% had low BMI. High BMI was noted in 22.4% of the girls, of whom 12.1% were obese (Table 2).

DAILY INTAKE OF ENERGY AND MACRONUTRIENTS

In the group of children aged 7–9 years, the daily intake of energy was exceeded – the maximum daily intake of kilocalories in this age group exceeded the reference values by more than 1000 kilocalories. In the group of 7–9-year-olds, the average consumption of proteins, fat, and carbohydrates was within the limits of the RDA. However, the maximum intake of fat (111–119 g) and carbohydrates (460–461 g) far exceeded the recommended daily intake (Table 3).

Among pupils aged 10–12 years, the maximum daily intake of kilocalories exceeded the norm by 500–650 kilocalories. The maximum consumption of proteins both by the boys (108.26 g) and the girls (95.15 g) did not exceed the RDA (Table 4).

The average daily intake of kilocalories by pupils at middle-school age did not exceed the daily energy requirement. However, the maximum energy value of meals exceeded the reference values by 600 kilocalories. Analysis of the intake of protein showed that the 75th percentile did not exceed the RDA values. For the consumption of fat and carbohydrates the situation was somewhat different, with the maximum values exceeding the reference values (Table 5).

In the group of secondary-school pupils, the median of protein intake (boys 108 g, girls 85 g) and carbohydrates (boys 399 g, girls 299 g) was in line with the recommended values. Irrespective of gender, the maximum

intake of fat in the group of secondary-school pupils exceeded the recommended value (Table 6).

DAILY INTAKE OF MICRONUTRIENTS

In the group of 7–9-year-olds, the daily requirement for micronutrients was exceeded for sodium, potassium, magnesium, and iron, while there was a very low intake of calcium. The maximum calcium intake (boys 826 mg, girls 896 mg) did not reach the average daily requirement for this age group. The median intake of sodium in the group of girls (3496.6 mg) was higher than in the group of boys (3220.5 mg). In the same group of boys, the maximum intake of iron (23.8 mg) was more than double the RDA of this element, i.e. 10 mg (Table 3).

Among 10–12-year-olds, as with 7–9-year-olds, the daily intake of sodium, potassium, magnesium, and iron was higher than the RDA. The maximum intake of sodium exceeded 4-fold the AI of 1300 mg. The minimum intake of iron met the estimated average requirement (EAR, 7 mg) for the group. Both the average and the median intake of calcium in this group, irrespective of age, did not meet the EAR of this element for the group (Table 4).

In the group of middle-school pupils, the size of the average daily intake slightly differed between the group of boys and of girls. The boys exceeded the daily intake of sodium, potassium, and iron, while there was a deficiency of magnesium and calcium. The girls exceeded the daily intake of sodium. The average daily intake of iron and magnesium met the EAR for the group but did not meet the RDA. The average daily intake of potassium was at a level around the EAR norm. The maximum intake of calcium in the group of middle-school pupils was lower

TABLE 3. Daily intake of energy, macro-, and selected micro-nutrients in the group of children aged 7–9 years

| Gender | Studied variable and units | Mean | Median (IQR) | Min–max | Reference values |
|--------|----------------------------|--------|------------------------|---------------|-------------------------|
| Boys | Energy [kcal] | 2016.6 | 1971.9 (1850.5–2062.5) | 1787.3–2807.9 | 1800 |
| | Protein [g] | 64.9 | 65.1 (52.4–75.1) | 42.2–92.1 | 10–20% energy |
| | Fat [g] | 79.3 | 80.42 (67.1–100.0) | 53.3–119.9 | 40% energy |
| | Carbohydrates [g] | 272.7 | 266.0 (248.2–302.1) | 203.4–461.0 | 45–60% energy |
| | Sodium [mg] | 3423.5 | 3220.5 (2867.4–4303.4) | 1878.4–5483.9 | AI – 1200 |
| | Potassium [mg] | 2657.2 | 2544.4 (2238.5–4859.7) | 1679.6–4859.7 | EAR – 1800 |
| | Calcium [mg] | 494.1 | 483.6 (246.2–646.6) | 316.3–826.8 | EAR – 800 RDA – 1000 |
| | Magnesium [mg] | 247.4 | 255.9 (188.5–295.1) | 167.4–357.3 | EAR – 110 RDA – 130 |
| | Iron [mg] | 10.3 | 10.4 (8.6–14.3) | 6.3–23.8 | EAR – 4 RDA – 10 |
| Girls | Energy [kcal] | 1957.4 | 1976.0 (1732.6–2120.3) | 1340.1–2817.3 | 1800 |
| | Protein [g] | 68.2 | 65.4 (63.9–78.8) | 49.8–88.2 | 10–20% energy |
| | Fat [g] | 78.9 | 76.0 (60.1–94.3) | 48.8–111.1 | 40% energy |
| | Carbohydrates [g] | 258.2 | 263.4 (229.4–287.9) | 146.1–460.5 | 45–60% energy |
| | Sodium [mg] | 3612.2 | 3496.6 (3062.9–4460.2) | 2252.5–5483.9 | AI – 1200 |
| | Potassium [mg] | 2587.6 | 2477.1 (2178.0–3292.9) | 1900.1–4859.7 | EAR – 1800 |
| | Calcium [mg] | 535.7 | 483.6 (441.2–759.1) | 225.2–896.0 | EAR – 800 RDA – 1000 |
| | Magnesium [mg] | 247.7 | 251.1 (205.1–293.3) | 178.1–362.1 | EAR – 110 RDA – 130 |
| | Iron [mg] | 10.4 | 9.9 (8.2–13.4) | 6.8–17.1 | EAR – 4 RDA – 10 |

AI – adequate intake, EAR – estimated average requirement, IQR – interquartile range, RDA – recommended dietary allowance

than the average requirement (1100 mg) for the group (Table 5).

Among high-school pupils, the intake of sodium (5254.5 mg) and iron (15.9 mg) exceeded the RDA norms; however, the intake of potassium (3532.8 mg) and magnesium (352.5 mg) corresponded to the EAR norm. Among the girls, only the intake of sodium (4740.9 mg) exceeded the 1500 mg. The average intake of magnesium (309.9 mg) and iron (13.8) corresponded to the EAR values; however, the average intake of potassium (3109.5 mg) did not meet the EAR norm of 3500 mg. The median intake of calcium in the group of boys (699.3 mg) and the group of girls (564.5 mg) of high-school age corresponded to half the RDA (Table 6).

DISCUSSION

A crucial element in nutrition is a correctly balanced diet. Both excessive and insufficient intake of nutrients have a negative effect on the body as it develops, causing an increase in diet-related illnesses including obesity and deficiency diseases. Research conducted to date analysing the amount of minerals in the diet of children

and adolescents has focused primarily on city dwellers or on inhabitants of both cities and villages. Our research is therefore pioneering in that it analyses the quality of the diet of inhabitants living in the countryside with a high income per capita. At the same time, due to the 'escape' of city dwellers to less populated locations, there are large differences in terms of education among those living in the countryside.

In our research, we found excessive body mass in 19.5% of boys and 22.4% of girls. Meanwhile, 4.5% of boys and 4.5% of girls had insufficient body mass. In all study groups, irrespective of age and gender, the maximum intake of carbohydrates exceeded the daily requirement. The minimum daily intake of fat in all groups was below the daily requirement norm. In girls of middle-school and high-school age, the minimum daily intake of protein was below the average requirement for these groups. The daily intake of sodium in all study groups exceeded the adequate daily intake. In addition, all groups showed an insufficient intake of calcium, which did not meet the RDA.

In the groups of children and adolescents studied, the amount of protein in the diet was between 12.0% and

TABLE 4. Daily intake of energy, macro-, and selected micro-nutrients in the group of children aged 10–12 years

| Gender | Studied variable and units | Mean | Median (IQR) | Min–max | Reference values |
|--------|----------------------------|--------|-------------------------|---------------|--------------------------------|
| Boys | Energy [kcal] | 2161.8 | 2105.6 (1924.7–2292.6) | 1698.2–2869.7 | 2350 |
| | Protein [g] | 73.0 | 70.6 (61.7–79.1) | 58.4–108.2 | 10–20% energy |
| | Fat [g] | 94.3 | 91.2 (78.5–110.6) | 60.3–127.2 | 40% energy |
| | Carbohydrates [g] | 270.0 | 259.2 (222.5–291.5) | 217.6–397.1 | 45–60% energy |
| | Sodium [mg] | 3870.3 | 3983.3 (2985.7–4450.2) | 2671.4–5141.4 | AI – 1300 |
| | Potassium [mg] | 2836.3 | 2742.4 (2648.6–3268.5) | 1978.6–3668.6 | EAR – 2400 |
| | Calcium [mg] | 687.0 | 719.2 (521.7–840.9) | 264.2–1255.7 | EAR – 1100 RDA – 1300 |
| | Magnesium [mg] | 269.6 | 271.6 (252.5–299.5) | 164.1–335.1 | EAR – 200 RDA – 240 |
| | Iron [mg] | 10.4 | 10.2 (8.4–12.4) | 7.2–16.7 | EAR – 7 RDA – 10 |
| Girls | Energy [kcal] | 2147.3 | 2063.3 (2002.8–2337.2) | 1859.4–2752.7 | 2100 |
| | Protein [g] | 73.6 | 75.6 (64.7–84.8) | 48.2–95.1 | 10–20% energy |
| | Fat [g] | 88.1 | 83.6 (74.0–96.0) | 60.3–135.5 | 40% energy |
| | Carbohydrates [g] | 280.8 | 275.4 (236.2–316.1) | 221.6–368.1 | 45–60% energy |
| | Sodium [mg] | 3763.6 | 3390.9 (3184.5–4450.1) | 2103.1–5414.4 | AI – 1300 |
| | Potassium [mg] | 2819.8 | 2724.76 (2338.1–3487.1) | 1542.7–4284.9 | EAR – 2400 |
| | Calcium [mg] | 597.5 | 619.7 (334.7–916.6) | 186.3–1254.2 | EAR – 1100 RDA – 1300 |
| | Magnesium [mg] | 263.6 | 252.5 (229.1–321.41) | 164.1–437.5 | EAR – 200 RDA – 240 |
| | Iron [mg] | 11.3 | 10.7 (9.1–14.6) | 7.2–16.7 | EAR – 7 (8)* RDA – 10 (15)* |

AI – adequate intake, EAR – estimated average requirement, RDA – recommended dietary allowance

15.0% of the daily energy requirement, depending on age. The diet of the study participants contained a large amount of carbohydrates and fat. An excessive amount of these elements in the diet combined with low physical activity leads to excessive body mass. One example of this is Mexican children, whose diet is rich in carbohydrates and fat, causing excess weight and obesity in 33.2% of this population group [13].

A high amount of carbohydrates and fat and low amounts of vitamins and minerals is typical for fast-food products, which are an inseparable daily element of modern society [14, 15].

Excessive intake of sodium, similarly to fat and carbohydrates, is a dangerous and widespread phenomenon [16–18]. Research carried out on 205 residents aged 4–20 years from children's homes in Kraków showed that intake of sodium exceeded the AI by 285% [3]. Our research has shown that the AI of sodium of 1300 mg was exceeded in all groups studied, with the highest result being 450% among adolescents 13–15 years old.

Research conducted in New Zealand on a group of 8–11-year-olds showed that around 50% of the study participants had excessive intake of sodium [17]. In practice,

too much sodium in the diet means an excessive intake of salt, which, according to the WHO, should not exceed 5 g (1 teaspoon) per day [18].

Research on a group of American 12–14-year-olds showed that 14% of the study participants had a high intake of sodium (above 7500 mg/day), and a low intake of potassium (below 700 mg/day) [4]. Our research analysed the amount of macro- and micronutrients consumed over a 7-day period, which to some degree limited the element of chance in determining the amount of nutrients in the diet. Potassium is a counterbalance to sodium and has a positive effect on the functioning of the nervous and muscular systems. The diets of Polish children and adolescents contain too little of this element [19–21]. The results of our analysis do not confirm this and show that an average daily intake of potassium below the EAR was only recorded in girls aged 16–18 years, while in the other groups analysed it fulfilled the norm.

In addition to potassium, magnesium is one of the principal intracellular elements. It accelerates the breakdown of carbohydrates, protein, and fat [22]. In the human body, 60% of the magnesium is in the bones, 20% in the skeletal muscles, and 19% in soft tissues [23].

TABLE 5. Daily intake of energy, macro-, and selected micro-nutrients in the group of children aged 13–15 years

| Gender | Studied variable and units | Mean | Median (IQR) | Min–max | Reference values |
|--------|----------------------------|--------|------------------------|---------------|--------------------------|
| Boys | Energy [kcal] | 2556.6 | 2206.5 2042.3–2905.7 | 1859.6–3633.6 | 3000 |
| | Protein [g] | 89.9 | 87.2 (63.7–120.5) | 58.9–146.1 | 10–20% energy |
| | Fat [g] | 103.5 | 97.6 (79.4–128.7) | 63.1–190.1 | 40% energy |
| | Carbohydrates [g] | 333.9 | 356.4 (242.6–417.4) | 237.7–510.0 | 45–60% energy |
| | Sodium [mg] | 4768.8 | 4984.2 (3334.0–5722.8) | 2942.9–8310.2 | AI–1500 |
| | Potassium [mg] | 3204.4 | 3324.4 (2796.0–4128.4) | 2002.1–5593.4 | EAR – 3000 |
| | Calcium [mg] | 714.1 | 708.2 (334.7–1106.1) | 224.8–1687.1 | EAR – 1100 RDA – 1300 |
| | Magnesium [mg] | 306.7 | 298.2 (233.1–378.2) | 185.9–526.3 | EAR – 340 RDA – 410 |
| | Iron [mg] | 14.1 | 12.3 (10.7–18.8) | 9.5–26.2 | EAR – 8 RDA – 12 |
| Girls | Energy [kcal] | 2373.6 | 2273.1 2086.5–2600.1 | 1977.9–3001.7 | 2450 |
| | Protein [g] | 84.6 | 86.9 (76.3–91.4) | 36.1–117.1 | 10–20% energy |
| | Fat [g] | 94.8 | 88.1 (74.3–112.1) | 61.5–135.5 | 40% energy |
| | Carbohydrates [g] | 312.9 | 304.1 (276.9–365.3) | 218.8– 461.6 | 45–60% energy |
| | Sodium [mg] | 4668.6 | 4829.0 (3893.9–5670.3) | 2098.0–6954.1 | AI – 1500 |
| | Potassium [mg] | 3054.4 | 3024.1 (2681.2–3542.9) | 1587.4–4859.7 | EAR – 3000 |
| | Calcium [mg] | 597.8 | 572.1 (487.8–842.3) | 216.9–1036.4 | EAR – 1100 RDA – 1300 |
| | Magnesium [mg] | 301.4 | 286.1 (246.0–352.4) | 188.6–419.8 | EAR – 300 RDA – 360 |
| | Iron [mg] | 13.1 | 11.4 (10.7–15.2) | 9.1–22.7 | EAR – 8 RDA – 15 |

AI – adequate intake, EAR – estimated average requirement, RDA – recommended dietary allowance

A deficiency of magnesium can lead to depression, difficulties with concentration, cardiac and neuromuscular disorders, and the development of metabolic syndrome or diabetes [22, 24]. Research conducted in Poland showed that the magnesium in the diet covers only 65.5–70.5% of the daily requirement [25]. The body's requirement for magnesium increases during greater physical activity and stress. Additionally, at around 13 years of age the magnesium requirement increases suddenly, which is the cause of deficiencies at this time of life [11]. This is confirmed by our research, which showed that the average daily intake of magnesium from the age of 13 years met only the average requirement for a given age group.

Our research has found an alarmingly low intake of calcium in all study participants, which in most cases was only 50% of the recommended daily intake. Intake of protein among children and adolescents around the norm, accompanied by an intake of calcium below the average requirement for a given age group, may suggest that the main source of protein is meat and not dairy products [13]. Consumption of products rich in calcium along with products containing high levels of iron is not beneficial because, although calcium is vital for correct

development, it inhibits the absorption of iron by as much as 60% [23, 26].

Research into dietary behaviours has shown that there is too little iron in the diet compared to the required amount. Iron is vital for erythropoiesis, it is a component of myoglobin, and it affects immunity and the nervous system and the metabolism of cholesterol [27, 28]. Menstruating girls also lose iron in menstrual blood.

Our research found that the average daily intake of iron in girls up to 12 years of age was at the correct level. Among girls above 13 years of age it was below the RDA but above the EAR for this group. In the group of boys up to 12 years old, the average daily intake of iron was at the level of the RDA, while in the group of boys above 13 years of age it was above the recommended intake, which may indicate consumption of a large amount of meat. It may be that the deficiency of iron in the groups studied resulted from a low amount of vitamin C in their diet, which improves the absorption of iron. Studies conducted to date have dealt mainly with the problem of iron deficiency anaemia. The US Department of Health and Human Services and the WHO have set a target of reducing the incidence of iron deficiency anaemia [29]. Research is being conduc-

TABLE 6. Daily intake of energy, macro-, and selected micro-nutrients in the group of children aged 16–18 years

| Gender | Studied variable and units | Mean | Median (IQR) | Min–max | Reference values |
|--------|----------------------------|--------|------------------------|----------------|--------------------------|
| Boys | Energy [kcal] | 2998.7 | 2769.5 (2603.4–3421.7) | 2184.1–3633.6 | 3400 |
| | Protein [g] | 104.5 | 108.5 (98.6–130.0) | 66.2–146.1 | 10–20% energy |
| | Fat [g] | 119.9 | 114.6 (94.8–149.7) | 69.2–193.1 | 40% energy |
| | Carbohydrates [g] | 393.7 | 399.2 (345.1–445.8) | 306.2–587.9 | 45–60% energy |
| | Sodium [mg] | 5254.5 | 5203.8 (4555.4–5957.8) | 3659.7–7369.7 | AI – 1500 |
| | Potassium [mg] | 3532.8 | 3411.3 (3095.3–4215.7) | 2192.0– 5593.4 | EAR – 3500 |
| | Calcium [mg] | 589.9 | 699.3 (571.5–1182.3) | 447.3–1984.1 | EAR – 1100 RDA – 1300 |
| | Magnesium [mg] | 352.5 | 344.3 (299.1–393.4) | 240.8–526.3 | EAR – 340 RDA – 410 |
| | Iron [mg] | 15.9 | 15.8 (14.4–18.3) | 9.8–24.2 | EAR – 8 RDA – 12 |
| Girls | Energy [kcal] | 2484.8 | 2429.6 (2096.5–2743.5) | 1976.6–3225.4 | 2500 |
| | Protein [g] | 87.8 | 85.6 (72.2–98.5) | 35.8–118.7 | 10–20% energy |
| | Fat [g] | 100.0 | 98.9 (85.1–116.2) | 70.1–140.9 | 40% energy |
| | Carbohydrates [g] | 326.5 | 299.0 (284.9–386.4) | 222.0–461.6 | 45–60% energy |
| | Sodium [mg] | 4740.9 | 4984.2 (4209.4–5630.2) | 2942.9– 6058.6 | AI – 1500 |
| | Potassium [mg] | 3109.5 | 3102.0 (2838.1–3585.5) | 1587.4–4215.7 | EAR – 3500 |
| | Calcium [mg] | 679.8 | 564.5 (500.9–918.8) | 369.6–1787.1 | EAR – 1100 RDA – 1300 |
| | Magnesium [mg] | 309.9 | 328.5 (255.8–348.5) | 190.5–393.4 | EAR – 300 RDA – 360 |
| | Iron [mg] | 13.8 | 11.8 (11.1–19.3) | 9.5–22.6 | EAR – 8 RDA – 15 |

AI – adequate intake, EAR – estimated average requirement, RDA – recommended dietary allowance

ted into increasing the amount of iodine, folic acid, and iron in salt. Once this technology is made widely available, it will most certainly reduce the problem of deficiencies of these minerals in populations particularly at risk [30]. A simultaneous deficiency of 2 or more nutrients or minerals in the diet adversely affects the body as it develops.

This study represents only a limited scope of the problem of nutrition, due to the limited space and time available for this research. The authors acknowledge the dietary reference intakes (DRI); however, the DRI was consciously omitted, and the research was conducted on the basis of the RDA, EAR, and AI norms because their application is established in science in Poland.

CONCLUSIONS

Excessive body mass is a problem that affects 1 in 5 of the study participants.

Children and adolescents consume meals that are inconsistent with the rational nutrition guidelines, regardless of their age.

The high carbohydrate and fat intake and low calcium intake suggest that the amount of meat and sweets consu-

med by children and adolescents needs to be reduced while the amount of milk and dairy products should be increased.

An educational campaign aimed at improving the dietary habits of children and adolescents should be launched due to their lack of a balanced diet.

DISCLOSURE

The authors declare no conflict of interest.

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