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ASSESSMENT OF THE THICKNESS OF THE SKIN-FAT LAYER IN SCHOOLCHILDREN OF DIFFERENT AGE GROUPS

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ABSTRACT

The rise in overweight and obesity among school-age children is currently one of the most serious

public health problems. With the progress of science and medicine, obesity and the development of various problems caused by it are widespread among schoolchildren and adults in general. In this sense, as a serious problem of medical science, it is alarming and relevant (Calonje Eduardo et. al, 2020). Obesity, as one of the diseases of civilization, is the result of hypodynamia, a disturbance of fat metabolism in the body, which leads to excess weight gain. ("Obesity and overweight Fact sheet N°311".WHO. January 2015. Retrieved 2 February 2016). In this sense, it is important to take into account the age period, and the deviations observed during normal development because each age period has its characteristics of fat metabolism. It has been shown that female schoolchildren of middle school age have a higher rate of obesity, which is not only determined by gender but also by age and body composition or somatotype. Middle and high-school-aged female schoolchildren have a peripheral type of obesity, that is, fat is predominantly stored in the subcutaneous tissue of the thighs, abdomen, and buttocks. It has been shown that there is a clear correlation between fat metabolism and somatotype in middle and high school children.

The results of the study suggest that physical activity should be part of a comprehensive weight loss therapy program and weight control strategy since it promotes excess weight loss and its sustainable maintenance, for which it is important to regularly monitor indicators of subcutaneous fat thickness and the relative content of adipose tissue throughout the body

Keywords: *physical activity, relative fat content, skin-fat layer assessment, schoolchildren, obesity, overweight, fat metabolism, age groups, somatotype, subcutaneous fat, weight control strategy.*

INTRODUCTION

As a result of a violation of the process of fat exchange in the body, obesity begins, which is considered a disease state and damages health (WHO. January 2015. Retrieved 2 February 2016). The World Health Organization defines obesity as the excess accumulation of adipose tissue, which can be assessed by determining the body mass index (Body Mass Index, BMI) (Anisimova A.V., 2020), the latter is based on body weight and height data. It has been shown that the body mass index in the norm is 18.5-24.9 kg/m² and the increase of the latter up to 25-29 kg/m² almost doubles the probability of developing coronary heart disease.

It has been confirmed that both boys and girls correlate with a sedentary lifestyle and changes in qualitative indicators of adipose tissue. A decrease in physical activity (PA) or lack of it in general creates various problems developing in the body (Calonje Eduardo, et al., 2020): In the case of regular PA, it is possible to ensure a moderate thickness of the fat layer (Ługowska et al., 2022).

Adipose tissue also plays a role in metabolic health and aging, affecting various bodily systems

(Yu, Yuan, Yang, & Qi, 2019). It is known that the white and gray types of adipose tissue act as an endocrine gland, the latter synthesize adipokines that influence metabolic, inflammatory and immune processes (Khudaverdyan D.N., 2020). The obesity gene, which is responsible for the synthesis of the hormone leptin and ensures energy balance by suppressing the feeling of hunger, is also important in the disturbance of fat metabolism in the body (Timasheva et al., 2021). Obesity is also caused by low physical activity, abuse of food, its qualitative composition, heredity, as well as disorders of the endocrine system. Urbanization of the population may also be a cause of obesity (Melnik, 2021). Genetic factors also significantly impact susceptibility to obesity, as well as other metabolic disorders (Timasheva, Balkhiyarova, & Kochetova, 2021).

Each age period has its characteristics of fat metabolism, the latter is caused by changes in the functional significance of fats during ontogenesis. In early childhood, compared to adulthood, the intensity of fat metabolism is 50% higher (Ayzman et al., 2021). From infancy to 20 years, the intensity of fat metabolism decreases by 3% per year. Between 20 and 60 years this figure levels off, and after 60 years it gradually decreases by 0.7%. It has been shown that with age, and also depending on gender, there are highly pronounced changes in the abdominal fat wall thickness (FWT) (Jourdan et al., 2020). Studies have shown that the accumulation of body fat varies with age and activity levels, influencing overall health and body composition (Melnik, 2021; Ługowska & Kolanowski, 2022).

A caliper is used to determine the volume of subcutaneous fat. Since the FWT is distributed differently in different parts of the body, when evaluating the FWT with the help of calipers, they rely on FWT measurements under the skin from 4-10 points of the body, after which the obtained results are calculated in millimeters and compared with the height and weight of the subject. And with the help of special formulas, the relative content of body fat (RBF) is derived. Calipers provide a standardized method for body fat measurement, essential in assessing body composition accurately (How to Determine Body Fat Content Using a Caliper, n.d.).

The localization of subcutaneous fat tissue and the degree of FWT depends not only on age, and gender but also on individual anthropometric indicators. It has been shown that with age, and also due to gender, the FWT of the abdominal wall undergoes highly pronounced changes (Jourdan et al., 2020; Akazawa, et al., 2021):

In the region, the statistical data on the FWT index among school-aged students are solid, so in the presented work, an attempt was made to investigate the 4 age groups of about 16 schools of the Vayots Dzor marz of the RA, particularly elementary, middle and senior school-aged students, in both sexes, body 4 different parts (including - muscle pelvic girdle suprailiacus (MPGS), muscle obliquus externus abdominis (MOEA), muscle subscapularis (MS), muscle triceps brachii (MTB)), and also to identify the

trend of obesity in the latter as a process detrimental to public health. In this regard, a problem has been posed.

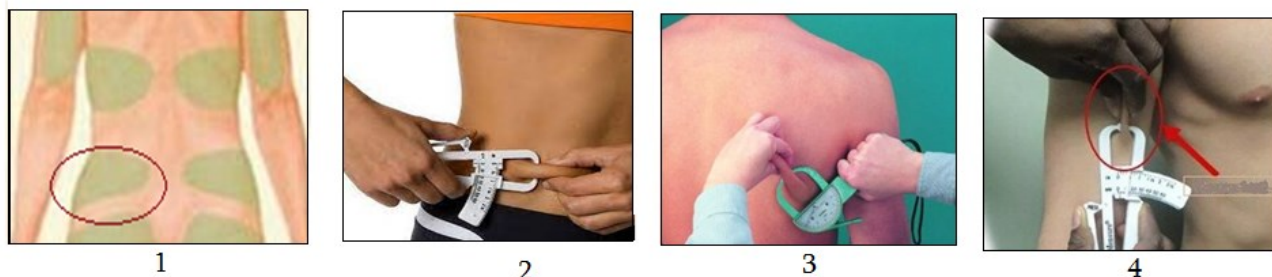
- To assess body height, mass, pelvic girdle, and chest circumferences with the help of anthropometric measurements in schoolchildren of both sexes of different age groups.
- To assess the FWT of the skin of 4 different body sites in schoolchildren of both sexes of different age groups with the help of calipers.
- Based on the anthropometric indicators and calipers estimated from 4 different points, calculate the skin mass index of all schoolchildren who participated in the research.
- To find out in which age group the risk of obesity is most pronounced, intergroup comparisons of FWT and RBF rates were made between different age groups.

METHODOLOGY

The research was carried out in about 16 schools of the Vayots Dzor region of the Republic of Armenia (RA). About 1320 schoolchildren of different age groups were examined. It should be noted that the entire course of research was carried out in accordance with the Declaration of Helsinki on the ethical norms of medical research involving human subjects (Ethical Committee of the Heratsu Yerevan State Medival University (N12-1/22)). The participation of schoolchildren was voluntary. Before carrying out the research, the purpose of the research and the actual technical process of the measurements were explained to all schoolchildren. After anthropometric measurements in schoolchildren of different age groups and estimation of the average thickness of skin folds from 4 different points of the body with the help of calipers (Picture 1), the average thickness of skin folds and also the absolute amount of fat in the body were determined using the formulas proposed by Mateika and known in the public literature. (Anisimova, 2021): In the whole organism, the indicator (expressed as a percentage) of the RBF was evaluated in the sum of the results of all 4 observed sites.

Picture 1.

Superficial muscle of the pelvic girdle- MPGS (1), external oblique muscle of the abdominal wall- MOEA (2), subscapular muscle – MS (3), triceps brachii muscle –MTB (4).



The latter also made it possible to find out in which age group, and particularly in which gender, there is a trend of obesity. With the help of the GraphPad Prism computer program (version 5.0), the reliability of the skin FWT results of 4 different sites of the body was evaluated for all age groups and two different sexes. The obtained results were considered statistically significant in the ranges of $*P < 0.05$, $**P < 0.001$ and $***P < 0.0001$:

RESULTS AND DISCUSSION

From the analysis of anthropometric indicators, it was found that, although there is an increase in anthropometric indicators among ES schoolchildren, there are differences between the sexes. In particular, the indicators observed among female schoolchildren of ES are higher compared to male ones. In addition, the fact that the FWT of ES schoolchildren in terms of the indicator is common for some sites is observed, in particular, the FWT of the skin of MS and MTB in the indicator. There is also a commonality in the anthropometric index of height in SS schoolchildren, but compared to males, females have a prominent increase in chest and pelvic girths, as well as proportional skin FWT of MPGS, MOEA, MS, and MTB change, and MPGS and MOEA skin FWT growth is lower in females. This proves that heterochronism, expressed in the processes of growth and development of the body, is weakly expressed, but it is obvious that in both boys and girls of SS age, anthropometric indicators change in connection with puberty, and this proves that girls have almost all fat accumulations concentrated in the pelvic girdle and abdominal wall (Fedotova et al., 2021). A proportional change in the anthropometric index of height is observed among HSA schoolchildren, and commonality is observed in anthropometric indices among 17-year-old schoolchildren of both sexes. Compared to males, females showed an increase in chest and pelvic girths, FWT scores were higher than MPGS, MOEA, MS, and MTB skin FWT scores. This proves that both males and females of HSA have an

increase in anthropometric indicators due to age and puberty (Lysova N.Ph., 2018), and fat accumulation, especially in females, is again concentrated in the pelvic girdle and abdominal wall.

Analysis of FWT and RBF in percentages of the main sites observed in both sexes of schoolchildren of different age groups revealed that ES females had a 0.25% higher than FWT of males' MPGS. FWT of MOEA was 0.21% higher in females compared to males, FWT of MS was 0.38% in males and 0.45% in females, respectively. As for MTB FWT, there is almost no difference between the two sexes (0.53% for males and 0.55% for females).

It turned out that the results of the inter-gender comparison of FWT of the sites presented in ES schoolchildren are reliable, and as for the RBF in ES schoolchildren, it is 0.54% higher in females. (Fig. 3, 4). MPGS FWT was 0.75% higher in females compared to males in SSA, MOEA FWT was 0.71% higher in females compared to males, MS FWT was 0.68% for males and 0.77% for females. As for MTB FWT, the latter is again 1.4% higher in females than in males. Results of cross-gender comparisons of FWT at the sites presented in SSA schoolchildren are reliable. RBF in SSA school children is 2.71% higher in females compared to males (Fig. 2,3): In HSA females, FWT of MPGS is 0.84% higher than in males, FWT of MOEA is again 0.59% higher in females than in males, FWT of MS is again 0.43% higher in females. In HSA schoolchildren, the results of the inter-gender comparison of FWT of the presented sites are reliable. In HSA schoolchildren, RBF was 2.2% higher in females than in males (Figure 2,3).

Figure 2.

In male (A) and female (B) schoolchildren of different age groups, ES, SSA, and HSA, from 4 different sites, including the pelvic girdle superior muscle (MPGS), external oblique abdominis (MOEA), subscapularis muscle (MS), triceps brachii (MTB) fat layer thickness expressed as a percentage. There is reliability between sexes of different age groups (p < 0.001-0.007; **p < 0.001-0.006).**

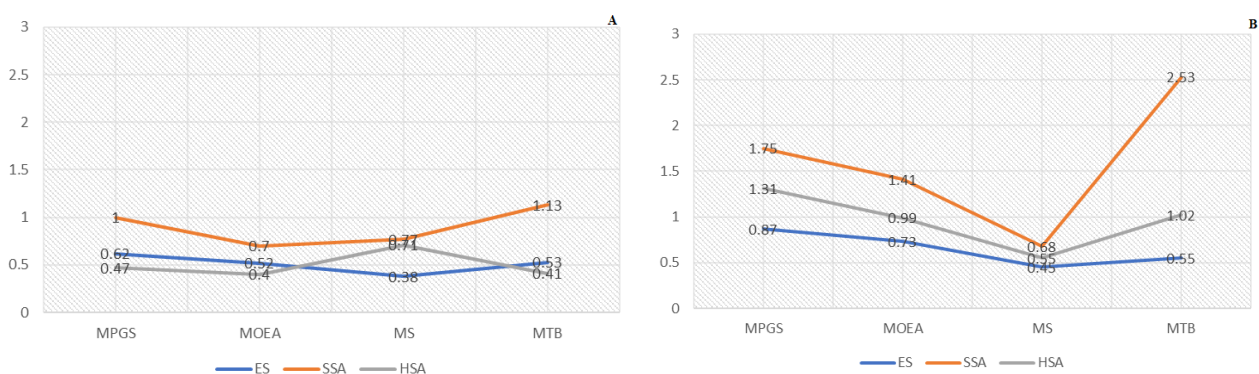
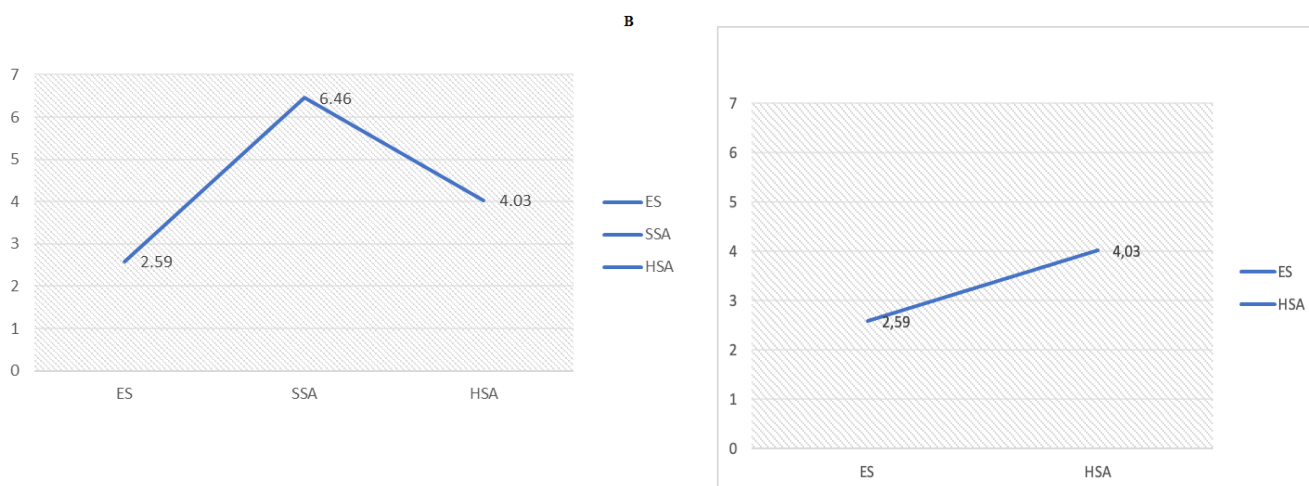


Figure 3.

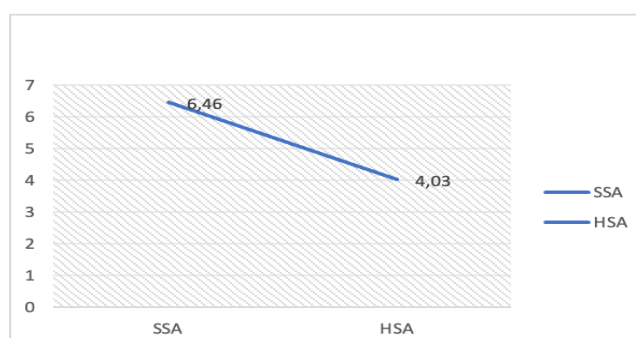
Relative fat content expressed in percentages in male (A) and female (B) schoolchildren of different age groups: ES, SSA, and HAS.



Comparing ES with SSA, it turns out that especially in females, the thickness of the fat layer is 6.46%. Comparing the ES with the HSA, it was found that it was 4.03% higher at the HSA, comparing the SSA with the HSA, it was found that the HAS rate was recorded at the SSA, 6.46%. In terms of males, the comparison with the same approach also confirms that the HSA rate is present at the SSA (Figure 4). Regarding the reliability of intergroup comparisons, the results obtained are actually reliable.

Figure 4.

Intergroup comparison of relative fat content in male (A) and female (B) schoolchildren of different age groups: ES, SSA, and HSA.



Intergroup comparisons of FWT and RBF were also performed for all observed sites, to understand the trend of obesity in general, in which age group, and in which gender in particular. Comparisons revealed that MPGS FWT in SSA females was higher (1.75%) than in the other two age groups, and somewhat higher in HSA females (1.31%). The FWT of MOEA in SSA females is again high (1.41%) compared to other age groups. The FWT of MS and MTB is relatively high in SSA and HSA schoolchildren (Figure 2). The intergroup comparison of RBF also states that although the latter is high in females of all age groups, it is higher in SSA and HSA schoolchildren.

Undoubtedly, it should be assumed that in the group of SSA schoolchildren, due to puberty, the endomorphic type of somatotype prevails in the female sex, that is, high indicators of the pelvic girdle and chest circumference, pronounced abdomen, fat deposits in the pelvic area. In males, the mesomorphic somatotype, i.e., medium height, rectangular body shape, broad chest, and narrow pelvis. Among the latter, fat is mainly concentrated in the upper half of the body, in the neck, shoulders, and lower abdomen. It should be assumed that due to puberty, the male sex hormone testosterone, as an anabolic hormone, significantly contributes to the synthesis of muscle proteins in HSA schoolchildren, as a result of which, during puberty, the muscle mass is on average 1.5 times higher than the female muscle mass, and fat the process of increasing the layer is depressed (Saphonenko, 2018; Maltsev, 2023). In addition, the influence of testosterone stimulates the accumulation and preservation of calcium in the bones, as a result of which, although the bones expand and strengthen, the accumulation of fats is also suppressed (Khudaverdyan, 2020). As a result, a stronger male-specific support is formed: a funnel-shaped, narrow pelvic cavity, which was also confirmed by our research.

CONCLUSIONS

As a result of research, it was found that in about 16 schools of Vayots Dzor region of RA, especially in Vaik schools, the RBF of SSA schoolchildren is quite high. In the latter, the endomorphic somatotype prevails and there is a risk of obesity. There is a clear correlation between fat metabolism and somatotype in SSA and HSA schoolchildren. Physical activity should be accepted as a comprehensive weight loss therapy and part of a strategic weight control program, as it contributes to the loss of excess weight and its sustainable maintenance, under conditions of regular evaluation of the body mass index.

Thus, with age, visceral adipose tissue, as well as intermuscular fat, tends to increase, and the peripheral subcutaneous adipose tissue layer is significantly reduced. Gender differences observed during the research generally prove once again that the distribution of subcutaneous fat is relatively more balanced in male schoolchildren of SSA and HSA. In females, it is expressed by the accumulation of

subcutaneous tissue in the thighs, abdomen, buttocks and front of the chest, on the surface of the upper limbs, which is also documented by public literature data. (Akazawan., et all., 2021). Fat distribution in females also influences reproductive health, highlighting the complex interactions between adipose tissue and hormonal balance (Fat Tissue and the Female Reproductive System, n.d.). In addition, it was found that the index of 4 different points of the body is correlated with anthropometric individual indicators and somatotype of schoolchildren (Anisimova, 2023):

It should be assumed that perhaps the sedentary lifestyle or hypodynamia of schoolchildren, as well as an unhealthy diet, to some extent lead to the accumulation of excess fat mass.

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