Scientific Review
UDC 616-056.52-092.12-084
DOI: 10.17816/pmj41398-108

# RISK FACTORS FOR EXOGENOUS-CONSTITUTIONAL OBESITY AND POSSIBILITIES OF ITS PREVENTION IN CHILDREN AND ADOLESCENTS

***A.D. Chernyadyev*, L.V. Sofronova, N.V. Minaeva, R.M. Akhmedova***
*E.A. Vagner Perm State Medical University, Russian Federation*

# ФАКТОРЫ РИСКА ФОРМИРОВАНИЯ ЭКЗОГЕННО-КОНСТИТУЦИОНАЛЬНОГО ОЖИРЕНИЯ И ВОЗМОЖНОСТИ ЕГО ПРОФИЛАКТИКИ У ДЕТЕЙ И ПОДРОСТКОВ

***А.Д. Чернядьев*, Л.В. Софронова, Н.В. Минаева, Р.М. Ахмедова***
*Пермский государственный медицинский университет имени академика Е.А. Вагнера, Российская Федерация*

The problem of obesity becomes more and more urgent due to its rising incidence and unfavourable effects on health of both children and adults. Various factors leading to an increased energy consumption while its output is reduced at different periods of life (from conception to adulthood) are considered in the article. Different ways of exogenous-constitutional obesity prevention in children and adolescents are described. Influence of phones/television/computers on the formation of hypodynamia and inadequate nutrition which can result in an excess body weight and obesity is characterized. The significance of behavioral response in the pathogenesis of obesity which should be considered while developing preventive methods is stressed. Thus, the problem of obesity requires further studies and discussion.
**Keywords.** Obesity, children, adolescents, risk factors, prevention.


tel. +7 902 645 31 08
e-mail: mne_c@mail.ru
[Chernyadyev A.D. (*contact person) – 2nd- year Postgraduate Student in the Specialty of Childhood Endocrinology, ORCID: 0009 0004 9460 1671; Sofronova L.V. – DSc (Medicine), Professor of the Department of Pediatrics with the Course of Polyclinic Pediatrics, ORCID: 0000 0001 5524 8191; Minaeva N.V. – DSc (Medicine), Professor, Head of the Department of Pediatrics with the Course of Polyclinic Pediatrics, ORCID: 0000 0002 2573 9173; Akhmedova R.M. – PhD (Medicine), Associate Professor of the Department of Pediatrics with the Course of Polyclinic Pediatrics ORCID: 0009 0005 6165 0466].


тел. +7 902 645 31 08
e-mail: mne_c@mail.ru
[Чернядьев А.Д. (*контактное лицо) – ординатор 2-го года по специальности детская эндокринология, ORCID: 0009-0004-9460-1671; Софронова Л.В. – доктор медицинских наук, профессор кафедры педиатрии с курсом поликлинической педиатрии, ORCID: 0000-0001-5524-8191; Минаева Н.В. – доктор медицинских наук, профессор, заведующий кафедрой педиатрии с курсом поликлинической педиатрии, ORCID: 0000-0002-2573-9173; Ахмедова Р.М. – кандидат медицинских наук, доцент кафедры педиатрии с курсом поликлинической педиатрии, ORCID: 0009-0005-6165-0466].

Проблема ожирения становится всё более актуальной в связи с его возрастающей распространённостью и неблагоприятными последствиями для здоровья детей и взрослых. Рассматриваются многообразные факторы, приводящие к повышенному потреблению энергии на фоне снижения её расходования в разные периоды жизни, от момента зачатия ребёнка до его перехода во взрослую жизнь. Описаны различные способы предупреждения экзогенно-конституционального ожирения у детей и подростков. Охарактеризовано влияние телефонов/телевидения/компьютеров на формирование гиподинамии и нерационального питания, следствием чего может быть избыток массы тела и ожирение. Подчёркнуто значение поведенческих реакций в патогенезе ожирения, которые необходимо учитывать при разработке методов профилактики. Таким образом, проблема ожирения, безусловно, требует дальнейшего углублённого изучения и обсуждения.
**Ключевые слова.** Ожирение, дети, подростки, факторы риска, профилактика.

## INTRODUCTION

The negative impact of excess body weight on human health is felt not so much in childhood as in the patient's later life. Obesity prevention helps to reduce severe, difficult-to-treat diseases in the population and increases the value of a person as a member of society [1].

It is now well known that the likelihood of developing obesity, in addition to genetic factors, significantly depends on lifestyle, diet, energy expenditure, and the duration of use of modern devices (television, computers, tablets, smartphones). Timely and rational prevention of excess body weight accumulation prevents the development of obesity, preserving the health of the nation and the country's financial resources [2; 3].

Up to 99 % of all types of obesity are exogenous-constitutional or simple obesity. Other forms of obesity – hypothalamic, iatrogenic, syndromic – are much less common, and some types of monogenic obesity account for only 10–20 clinical cases [4].

Childhood obesity can lead to both short-term and long-term complications for somatic and psychosocial health. Obesity disrupts all types of metabolism, primarily fat and carbohydrate metabolism, and, accordingly, increases the risk of developing cardiovascular diseases, diabetes, fatty hepatosis, musculoskeletal pathology, mental disorders and oncology; quality of life and its duration decrease [5; 6].

## EPIDEMIOLOGY OF OBESITY

In recent decades, overweight and obesity have become a major problem in many countries. According to the World Health Organization (WHO), more than a billion people on the planet are overweight and about 300 million are obese.

30 million children and adolescents are overweight, 15 million are obese [7].

Over 40 years (1975–2016), the number of children suffering from obesity has increased more than 8-fold (from 5 to 74 million). Another 213 million children and adolescents were overweight in 2016 [8], while, according to Lobstein et al. (2016), at least 42 million children were overweight or obese by the age of 5 [9; 10].

Similar trends are also evident in Russia. According to I.I. Dedov et al., in 2007, in the regions of Russia, obesity was present in 5.5 % of examined children in rural areas,

8.5 % in urban areas, and another 5.5–11.8 % of children were overweight. [11].

Currently, obesity is diagnosed by the body mass index (BMI) and the standard deviation (*SD*) from the median, i.e. from its average value.

In children, the standard deviation coefficient (*SDS*) of BMI from -2.0 to +1.0 is accepted as the norm. With BMI *SDS* +1.0 ... +2.0, excess body weight is diagnosed, and with BMI *SDS* over 2.0 – obesity.

## RISK FACTORS

The main cause of childhood obesity is considered to be a hereditary predisposition and an imbalance between energy intake and expenditure [12–14]. Modern conditions of civilization and favorable socio-economic factors relieve both adults and children from labor-intensive household duties, which inevitably leads to a decrease in energy expenditure and, accordingly, to the accumulation of fat mass. Gadgets (TV, computer, telephone) make a certain contribution to the decrease in sufficient physical activity. A clear link has been established between time spent in front of the TV and obesity [15].

During the period of intrauterine development and in the first months of postnatal life, metabolic processes are highly plastic and have the ability to quickly respond to changes in environmental conditions. Insufficient nutrition of a pregnant woman, impaired utero-placental circulation, anemia, stress and other unfavorable factors during the gestational period lead to a delay in physical development, the birth of a low-weight child, and the formation of an "economical" phenotype with a tendency to accumulate. In older age, this is short stature, early puberty, obesity. In addition, nutrient deficiency in the fetus and low birth weight lead to a decrease in the number of β-cells in the pancreas and their damage [16–20].

Excessive consumption of trans fats and sweets by a woman leads to the birth of a large child, who subsequently often develops obesity and metabolic syndrome (MS), while individual components of the metabolic syndrome are detected in some children already at an early or preschool age [21].

Adipocytes are laid down mainly in the last trimester of pregnancy and in the first two years of life, so overfeeding during this period leads not only to an increase in their volume, but also to an increase in the number of fat cells [14].

## OPERATIVE DELIVERY (CAESAREAN SECTION)

Operative delivery increases the risk of developing obesity in later life [22].

According to the study by Singh et al., during operative delivery, the child is not in contact with the mother's vaginal and intestinal microflora. As a result, the intestines are populated with microflora from the environment, the number of bifidobacteria decreases, and dysbiosis develops. Subsequently, impaired colonization persists for several months and even years [23]. According to the studies by Carl Vael et al., excessive concentrations of *B. fragilis* in infants are associated with the possibility of subsequent development of obesity [24].

### INFANCY

Excessive weight gain in infants can be associated with feeding with any anxiety, and in the case of artificial feeding – with excessive protein content in the formula and the child's inability to independently regulate the amount of feeding, since parents strive to fully consume the available formula [25].

The growth rate in infancy correlates with the protein content in the diet. With its excess consumption, the level of hormones that have an adipogenic effect (insulin, IGF-1) increases. Excessive growth in the first months of life programs obesity and metabolic syndrome (MS) in the future, and a decrease in protein intake reduces the likelihood of developing MS in older age [25].

The likelihood of developing obesity also increases with the early introduction of supplemental feeding, as well as the appointment of juices and fruit purees in the first six months of life. Sweet foods at this age disrupt eating behavior, since children subsequently refuse vegetable dishes [26; 27].

Tight swaddling, prolonged stay in fixing devices, lack of therapeutic exercises and conditions for crawling are risk factors for the development of obesity in the future [28].

A decrease in the duration of sleep has an adverse effect on metabolism and is one of the factors that increases the likelihood of developing obesity [28; 29].

### EARLY AGE

Nutritional characteristics of children over one year of age are largely determined by family traditions and taste preferences. In most cases, children receive more protein than recommended by WHO, which may be due to excessive consumption of milk used to quench their thirst. After 12 months, children often eat from the common table. During this period, pediatricians less strictly control the nature of nutrition. Parents are poorly oriented in matters of rational nutrition; they feed their children with confectionery, fast food, chips, and other products containing a lot of trans fats. Some mothers give their children milk instead of water to quench their thirst. While, children do not receive enough vegetables and fruits [30].

Parents often turn on entertainment content for their children on TV or phone in order to do their own things, thus creating another factor in childhood obesity [31–33].

### PRESCHOOL AND JUNIOR SCHOOL AGE

Typical food preferences during this period are pasta, chips, various baked goods, combined with a negative attitude towards fish and vegetables. Weight gain can be facilitated by the abuse of industrially produced juices, which contain a large amount of sugar and are high in calories [34].

The easiest way to please a child is to offer him something tasty, so parents often abuse candies, cakes and other sweets, thus forming deviant (emotionogenic) eating behavior. The formation of emotional eating behavior is also facilitated by the use of food as a reward or consolation. The stimulus for eating in the future is not hunger, but a low mood [35].

The demand of parents to eat all the food on the plate, regardless of its volume and the child's desire, leads to overeating and can provoke external eating behavior – the child gets used to eating all the food he sees. As a result, increased sensitivity to external signs that stimulate appetite develops: a bright shop window, a beautifully set table, spectacular advertising of food products, and the person eats without being hungry [35].

Excessive use of devices and television contributes to weight gain, since it not only reduces physical activity and duration of sleep, but is also often accompanied by food intake, while the child does not monitor the quality and quantity of food consumed, since his attention is occupied with something else [31–33].

### ADOLESCENCE

Against the background of the pubertal growth spurt, with the observance of the basic principles of a healthy lifestyle, it is possible to lose weight. Some teenagers become motivated to lose weight. Against the background of a normal-calorie diet and increased physical activity, obesity recedes. However, a significant portion of teenagers who are overweight continue to lead a sedentary lifestyle, eat when fell stressed, and obesity progresses [36]. The consequence of prolonged starvation with restrictive eating behavior (diets) are episodes of overeating and the development of "dietary depression" [37]. Studies of the quality of life of adolescents suffering from obesity have established a significant decrease in it in comparison with healthy peers and even with patients suffering from diabetes, especially on the scales of "social" and "physical" function. Quality of life suffers to a greater extent in girls [38; 39].

The literature has studied the influence of various modern technologies on the formation of obesity [40].

During adolescence, the time spent in front of TV screens increases from 2.7 ± 0.17 h at 11 years of age to 3.4 ± 0.25 h at 15 years of age. At 11 years of age, 18.3 % of children spend four hours or more daily in front of TV screens, and by 15 years of age, this number increases to 38.5 %. With age, the number of schoolchildren eating in front of a screen increases: 33.4 % at 11 years of age and 47.4 % at 15 years of age [15].

Often, the use of computers/ phones/ gadgets leads to a reduction in night sleep, affects cognitive functions, mood, quality of life and somatic health of the patient [41].

When using gadgets, there is often background content that advertises various food products that are not always healthy [42].

Previously, when digital technologies were not used so widely, schoolchildren's entertainment included a wide range of active games and various competitions, which is currently significantly reduced due to unlimited access to gadgets [15].

A teenager should do physical exercises of varying degrees of difficulty at least an hour daily [28].

The risk of developing excess body weight in a child depends not only on the long-term use of phones, television, tablets, but also on the expansion of school programs that leave a minimum amount of time for

physical activity. As a result, children spend significantly less energy than they receive [43].

## Treatment

Obesity treatment requires a lot of time and efforts, it costs many times more than obesity prevention. In addition to a normal-calorie diet and mandatory physical exercise, children over 12 years of age may use medications. In Russia, orlistat and liraglutide are used to treat obesity [44–46].

## Prevention

Prevention of obesity is significantly more effective than subsequent treatment [47].

At the stage of pregnancy planning, women who are overweight (in Russia, 1/4 of women over 20 years of age are overweight) should try to normalize their body weight. It is necessary to review the nature of nutrition and monitor weight [48].

The first thousand days of life from the moment of conception is a "critical window" for subsequent human development. During this period, metabolic processes are highly plastic. Obesity can be prevented through coordinated actions of specialists who prepare a woman for childbirth, monitor her during pregnancy, and carry out dispensary observation of the child [49].

During pregnancy, special attention should be paid to women with diabetes and obesity. In some countries (Australia, Finland), these women are visited by specially trained mid-level health workers, who teach them the rules of rational nutrition, monitor their weight and eating behavior [50].

Timely diagnosis and treatment of gestational diabetes can reduce the risk of obesity in a child. Of particular importance for preventing insufficient fetal weight gain is the prevention of pregnancy complications [50].

The child's eating habits are formed during the period of intrauterine development, so a woman should limit sweets, confectionery, monitor the calorie content of food, and limit the consumption of saturated fats [51–56].

In order to prevent disruption of the normal intestinal microbiota of the child, it is advisable to perform a cesarean section strictly according to indications [22–24].

To avoid overfeeding, do not feed the child at any anxiety and completely exclude force-feeding. When signs of hunger relief appear, the child may tightly squeeze his mouth and even spit out food; in this situation, continuing feeding is inappropriate. At the same time, persistence should be shown when introducing new supplemental foods: return to them again, give them in small portions, combine with favorite foods, etc. [26; 27].

Juices and fruit purees should not be introduced into the diet in the first six months of life, so that children do not refuse vegetable dishes later [26; 27].

At an early age, instead of cow's milk, it is possible to use special baby food with a reduced amount of fat and a complex of vitamins and microelements in the composition.

It is necessary to limit the consumption of juices, especially industrially produced ones, containing a large amount of sugar, and give preference to fresh fruits.

For a smooth transition of children to the "common" table, you can use industrially produced cereals with the addition of pieces of fruit and flakes, which help develop chewing skills, as well as meat with vegetable and fish with vegetable purees [30].

You cannot limit the child's motor activity. Clothes, including those of the baby, should not restrict movement [28].

Tight swaddling is unacceptable. Parents should do gymnastics with the child, give him a massage, put the child in the playpen, stimulate crawling.

The child should be involved in active games, and conditions for active movement should be created for him. Children successfully master bicycles without pedals already in the 2nd year of life. Walking on rough terrain, climbing, swimming, scootering, cycling, etc. should become habitual for a child in the first years of life. A horizontal bar, a skipping rope, an expander and other “mini-stadium” items are necessary in every family [28].

Uncontrolled use of modern electronic devices (television, computers, smartphones) affects behavioral habits. It is necessary to learn to live in harmony with new technologies, to form a behavior program in such a way as to allow digitalization into our lives and at the same time not to lose our health [31–33].

Developing an effective obesity prevention program is a global problem at the international level. It is necessary to identify a risk group of children with excess body weight and develop a system of preventive measures for them. The strategy for controlling excess body weight in children should include planned preventive measures with patients of all ages [57].

A promising strategy for obesity prevention should be multicomponent and begin at the pre-pregnancy preparation stage. Compliance with the rules of rational nutrition and optimal physical activity at different periods of life can prevent the development of obesity even in cases of a burdened heredity [30].

## Conclusions

Endocrinologists and pediatricians know the risk factors for the development of obesity, but there is currently no generally accepted system for its prevention. Identifying a risk group and planned work with it could significantly change the situation.

At the moment, there is a need to develop a comprehensive program for preventing obesity at different periods of life. Preventing obesity requires the friendly work of the family, school, health workers, the media and government agencies.

## References

1. *August G.P., Caprio S., Fennoy I., Freemark M., Kaufman F.R., Lustig R.H., Silverstein J.H., Speiser P.W., Styne D.M., Montori V.M.* Accelerating Progress in Obesity Prevention institute of medicine 2012.

2. *Wang Y., Lim H.* The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. Int. Rev. Psychiatry 2012; 24: 176–188.

3. *Borodich T.S.* The modifiable risk factors for obesity and overweight in early childhood period. *Obesity and metabolism*

2015; 12 (2): 51. DOI: 10.14341/OMET2015251 (in Russian).

4. *Peterkova V.A., Vasyukova O.V.* About the new classification of obesity in the children and adolescents. *Problems of Endocrinology* 2015; 61 (2): 39–44. DOI: 10.14341/probl201561239-44 (in Russian).

5. Primary Prevention of Cardiovascular Disease and Type 2 Diabetes in Patients at Metabolic Risk: An Endocrine Society Clinical Practice Guideline JCEM 2008; 93 (10): 3671–3689.

6. *Afshin A., Forouzanfar M.H., Reitsma M.B. et al.* Global health effects of overweight and obesity. N Engl J Med. 2017; 377 (1): 80–81. DOI: 10.1056/NEJMoa1614362

7. *Mladovsky P., Allin S., Masseria C. Hernadez-Auevedo C., McDaid D., Mossialios E.* Health in the European Union. Trends and analysis. Copenhagen: WHO Regional office for Europe 2009.

8. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet 2017; 390 (10113): 2627–2642 DOI: 10.1016/ S0140-6736 (17) 32129-3

9. *Lobstein T., Jackson-Leach R., Moodie M.L., Hall K.D., Gortmaker S.L., Swinburn B.A., James W. P.T., Wang Y., McPherson K.* Child and adolescent obesity: part of a bigger picture. Lancet 2015; 385 (9986): 2510–2520. DOI: 10.1016/ S0140-6736(14)61746-3

10. *Baranov A.A., Kuchma V.R., Namazova-Baranova L.S., Sukhareva L.M., Ilyin A.G., Rapoport I.K., Shirokova V.I., Levitskaya A.A., Chumakova O.V., Antonova E.V., Albitsky V.Yu., Zvezdina I.V., Chubarovsky V.V., Sokolova N.V., Sergeeva A.A.* Strategy "Health and development of adolescents in Russia" (harmonization of European and Russian approaches to the theory and practice of protecting and promoting the health of adolescents. Moscow 2010 (in Russian).

11. *Dedov I.I., Melnichenko G.A., Butrova S.A., Savelyeva L.V.* Obesity in adolescence. Results of a Russian epidemiological study. *Ter. archive*. 2007; 10: 28–32 (in Russian).

12. *Weihrauch-Blüher S., Wiegand S.* Risk Factors and Implications of Childhood Obesity. Curr Obes Rep. 2018; 7 (4): 254–259. DOI: 10.1007/s13679-018-0320-0

13. *Martínez-Villanueva J., González-Leal R., Argente J., Martos-Moreno G.Á.* La obesidad parental se asocia con la gravedad de la obesidad infantil y de sus comorbilidades [Parental obesity is associated with the severity of childhood obesity and its comorbidities]. An Pediatr (Barc). 2019; 90 (4): 224–231.DOI: 10.1016/j.anpedi.2018.06.013

14. *Netrebenko O.K., Ukraintsev S.E., Melnikova I.Yu.* Obesity in children: new concepts and directions for prevention. Literature review. *Issues of modern pediatrics* 2017; 16 (5): 399–405. DOI: 10.15690/vsp.v16i5.1804 (in Russian).

15. *Namazova-Baranova L.S., Kovtun O.P., Anufrieva E.V., Naboychenko E.S.* The value of behavioral determinants in the formation of overweight and obesity in adolescents. *Russian Journal of Preventive Medicine* 2019; 22 (4): 2043–2048. DOI: 10.17116/profmed20192204243 (in Russian).

16. *Wallby T., Lagerberg D., Magnusson M.* Relationship Between Breastfeeding and Early Childhood Obesity: Results of a Prospective Longitudinal Study from Birth to 4 Years. Breastfeed Med. 2017; 12: 48 53. DOI: 10.1089/bfm.2016.0124

17. *Baran J., Weres A., Czenczek-Lewandowska E. et al.* Excessive Gestational Weight Gain: Long-Term Consequences for the Child. J Clin Med. 2020; 9 (12): 3795. DOI: 10.3390/jcm9123795

18. *Jimenez-Chillaron J.C., Duaz R., Martinez D., Pentinat T., Ramon-Krauel M., Ribo S., Plosch T.* The role of nutrition on epigenetic modifications and their implications on health. Biochimie 2012; 94: 2242–2263.

19. *Ng S.F., Lin R.C., Laybutt D.R., Barres R., Owens J.A., Morris M.J.* Chronic high – fat diet in fathers programs betacell dysfunction in female rat offspring. Nature 2010; 467: 963–966.

20. *Carone B.R., Fauquier L., Habib N.* Paternally induced transgenerational environmental reprogramming of metabolic gene expression in mammals. Cell. 2010; 143: 1084–1096.

21. *Wallby T., Lagerberg D., Magnusson M.* Relationship Between Breastfeeding and Early Childhood Obesity: Results of a Prospective Longitudinal Study from Birth to 4 Years. Breastfeed Med. 2017; 12: 48–53. DOI: 10.1089/bfm.2016.0124

22. *Mueller N.T., Mao G., Bennet W.L. et al.* Does vaginal delivery mitigate or strengthen the intergenerational association of overweight and obesity? Findings from the Boston Birth Cohort. Int J Obes (Lond). 2017; 41 (4): 497–501. DOI: 10.1038/ijo.2016.219

23. *Singh S.B., Madan J., Coker M. et al.* Does birth mode modify associations of maternal pre-pregnancy BMI and gestational weight gain with the infant gut microbiome? Int J Obes (Lond). 2020; 44 (1): 23–32. DOI: 10.1038/s41366-018-0273-0

24. *Vael C., Verhulst S.L., Nelen V., H Goossens & Kristine N.* Desager Intestinal microflora and body mass index during the first three years of life: an observational study. Gut Pathog. 2011; 3 (1): 8. DOI: 10.1186/1757-4749-3-8

26. *Wang J., Wu Y., Xiong G. et al.* Introduction of complementary feeding before 4 months of age increases the risk of childhood overweight or obesity: A meta-analysis of prospective cohort studies. Nutr Res. 2016; 36: 759–770. DOI: 10.1016/j.nutres.2016.03.003

27. *Grote V., Theurich M., Luque V. et al.* Complementary Feeding, Infant Growth, and Obesity Risk: Timing, Composition, and Mode of Feeding. Nestle Nutr Inst Workshop Ser. 2018; 89: 93–103. DOI: 10.1159/000486495

28. *Peterkova V.A., Bezlepkina O.B., Bolotova N.V. et al.* Clinical guidelines «Obesity in children». *Problems of Endocrinology* 2021; 67 (5): 67–83. DOI: 10.14341/probl12802 (in Russian).

29. *Taveras E.M., Rifas-Shiman S.L., Oken E. et al.* Short sleep duration in infancy and risk of childhood overweight. Arch Pediatr Adolesc Med. 2008; 162 (4): 305–311. DOI: 10.1001/archpedi.162.4.305

30. *Aleksandrov A.A., Peterkova V.A., Vasyukova O.V.* Rekomendatsii po diagnostike, lecheniyu i profilaktike ozhireniya u detei i podrostkov. Moscow: Praktika 2015; 136 (in Russian).

31. *Robinson T.N., Banda J.A., Hale L. et al.* Screen Media Exposure and Obesity in Children and Adolescents. Pediatrics. 2017; 140 (S2): 97–101. DOI: 10.1542/peds.2016-1758K

32. *Bickham D.S., Blood E.A., Walls C.E. et al.* Characteristics of screen media use associated with higher BMI in young adolescents. Pediatrics. 2013; 131 (5): 935–941. DOI: 10.1542/peds.2012-1197

33. *Li C., Cheng G., Sha T. et al.* The Relationships between Screen Use and Health Indicators among Infants, Toddlers, and Preschoolers: A Meta-Analysis and Systematic Review. Int J Environ Res Public Health 2020; 17 (19): 7324. DOI: 10.3390/ijerph17197324

34. *He B., Long W., Li X. et al.* Sugar-Sweetened Beverages Consumption Positively Associated with the Risks of Obesity and Hypertriglyceridemia Among Children Aged 7–18 Years in South China. J Atheroscler Thromb. 2018; 25 (1): 81–89. DOI: 10.5551/jat.38570

35. *Dedov I.I., Melnichenko G.A.* Obesity. Moscow: MIA 2004; 456 (in Russian).

36. *Simmonds M., Burch J., Llewellyn A.* The use of measures of obesity in childhood for predicting obesity and the development of obesity-related diseases in adulthood: A systematic review and meta-analysis. Health Technol Assess. 2015; 19: 1–336. DOI: 10.3310/hta19430

37. *Van Strien T., Bazelier F.G.* Perceived parental control of food intake is related to external, restrained and emotional eating in 7–12-year old boys and girls. Appetite 2007; 49 (3): 618–625.

38. *Endokrinologiya: novosti, mneniya, obucheniye* 2018; 7 (2): 51–59. DOI: 10.24411/2304-9529-2018-12005 (in Russian).

39. *Akhmedova R.M., Sofronova L.V., Vladimirova K.N.* Assessment of the quality of life of adolescents suffering from endocrine diseases. *Pediatrician* 2016; 7 (1): 16–21. DOI: 10.17816/PED7116-21 (in Russian).

40. *Boswell N., Byrne R., Davies P.S.W.* Aetiology of eating behaviours: A possible mechanism to understand obesity development in early childhood. Neurosci Biobehav Rev. 2018; 95: 438–448. DOI: 10.1016/j.neubiorev.2018.10.020

41. *Berdin O.N.* The role of sleep and its disorders in the formation of cognitive functions in childhood. *Bulletin of the VSSC SB RAMS* 2014; 6 (100) (in Russian).

42. *Norman J., Kelly B., McMahon A.T. et al.* Sustained impact of energy-dense TV and online food advertising on children's dietary intake: a withinsubject, randomised, crossover, counter-balanced trial. Int J Behav Nutr Phys Act. 2018; 15 (1): 37. DOI: 10.1186/s12966-018-0672-6

43. *Drapkina O.M., Karamnova N.S., Kontsevaya A.V., Gorny B.E., Dadaeva V.A., Drozdova L.Yu., Yeganyan R.A., Eliashevich S.O., Izmailova O. V., Lavrenova E.A., Lischenko O.V., Skripnikova I.A., Shvabskaya O.B., Shishkova V.N.* Russian Society for the Prevention of Noncommunicable Diseases (ROPNIZ). Alimentary-dependent risk factors for chronic non-communicable diseases and eating habits: dietary correction within the framework of preventive counseling. Methodological Guidelines. *Cardiovascular Therapy and Prevention* 2021; 20 (5): 2952. DOI: 10.15829/1728-8800-2021-2952 (in Russian).

44. *Kelly A.S., Auerbach P., Barrientos-Perez M. et al.* A Randomized, Controlled Trial of Liraglutide for Adolescents with Obesity. N Engl J Med. 2020; 382 (22): 2117–2128. DOI: 10.1056/NEJMoa1916038

45. *Mastrandrea L.D., Witten L., Carlsson Petri K.C. et al.* Liraglutide effects in a paediat-

ric (7-11 y) population with obesity: A randomized, double-blind, placebo-controlled, short-term trial to assess safety, tolerability, pharmacokinetics, and pharmacodynamics. Pediatr Obes. 2019; 14 (5): e12495. DOI: 10.1111/ijpo.12495

46. *Robert H. Lustig, Pamela S. Hinds, Karen Ringwald-Smith, Robbin K. Christensen, Sue C. Kaste, Randi E. Schreiber, Shesh N. Rai, Shelly Y. Lensing, Shengjie Wu, Xiaoping Xiong* Octreotide Therapy of Pediatric Hypothalamic Obesity: A Double-Blind, Placebo-Controlled Trial. The Journal of Clinical Endocrinology & Metabolism 2003; 88 (6): 2586–2592. DOI: 10.1210/jc.2002-030003

47. *Pandita A., Sharma D., Pandita D. et al.* Childhood obesity: prevention is better than cure. Diabetes Metab Syndr Obes. 2016; 9: 83–89. DOI: 10.2147/DMSO.S90783

48. *Razina A.O., Runenko S.D., Achkasov E.E.* Obesity: Current Global and Russian Trends. *Annals of the Russian Academy of Medical Sciences* 2016; 71 (2): 154–159. DOI: 10.15690/vramn655 (in Russian).

49. *Belyaeva I.A., Namazova-Baranova L.S., Turti T.V.* Introduction of complementary feeding as a measure to prevent overweight and obesity in children from the perspective of the "first 1000 days" concept. *Issues of modern pediatrics* 2020; 19 (3): 220–227. DOI: 10.15690/vsp.v19i3.2118 (in Russian).

50. Gestational diabetes mellitus in Europe: prevalence, current screening practice and barriers to screening. Diabetic Medicine 2011; 844–854.

51. *Shenderov B.A.* The role of nutrition and intestinal microflora in the programming and implementation of the epigenome of healthy and sick people. *Bulletin of restorative medicine* 2013; 1: 102–107 (in Russian).

52. *Tutelyan V.A., Kon I.Ya.* Baby food: A guide for doctors. Moscow: Medical Information Agency 2013; 744 (in Russian).

53. *Netrebenko O.K.* Infantile origins of obesity and cardiovascular disease in children. *Nestle News Bulletin* 2012; 34: 4–6 (in Russian).

54. *Baturin A.K., Kon I.Ya., Gmoshinskaya M.V., Ukraintsev S.E.* Rational nutrition for pregnant and lactating women. Information mail. Moscow 2009; 16 (in Russian).

55. *Kon I.Ya., Gmoshinskaya M.V.* Nutrition of women during pregnancy. *Consilium medicum. Application "Pediatrics"* 2006; 1: 57–62 (in Russian).

56. *Kamalova AA.* Current approaches to preventing childhood obesity. *Rossijskij vestnik perinatologii i pediatrii* 2016; 61 (6): 43–48. DOI: 10.21508/1027-4065-2016-61-6-43-48 (in Russian).

**Funding.** The study had no external funding.

**Conflict of interest.** The authors declare no conflict of interest.

**Author contributions** are equivalent.

Received: 05/06/2024
Revised version received: 05/30/2024
Accepted: 05/31/2024

Please cite this article in English as: Chernyadyev A.D., Sofronova L.V., Minaeva N.V., Akhmedova R.M. Risk factors for exogenous-constitutional obesity and possibilities of its prevention in children and adolescents. *Perm Medical Journal*, 2024, vol. 41, no. 3, pp. 98-108. DOI: 10.17816/pmj41398-108