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Evaluation of malnutrition and nutritional history in children with cerebral palsy

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Summary

Purpose of the study. To reveal the features of the nutritional status of patients with cerebral palsy in various forms of the disease, depending on the violations of the oral-motor function.

Materials and methods. We examined 214 children with various forms of cerebral palsy, subdivided according to ICD-10 into 6 topographic forms. The average age of children was 6.7±0.27 years. All patients underwent a comprehensive clinical and neurological monitoring, including clinical observation during hospitalization with an assessment of the influence of the neurological status of a patient with cerebral palsy on the severity of changes in nutritional status. The Eating and Drinking Ability Classification System (EDACS) is applied to assess the functional skills and abilities to take fluids and food in daily life; The Drooling Impact Scale (DIS) was used to assess the severity of sialorrhea.

Results. The study of oral function showed that 36.9% of children with cerebral palsy had a sensory type of impairment, and 29.9% had a motor type. An analysis of the nutritional history revealed significant differences in the frequency of malnutrition (chewing, swallowing, sucking, introducing complementary foods, etc.) between the examined children with cerebral palsy, depending on the form of the disease, with a predominance of severe disorders in the G 80.0 form in 65.1% of children. The highest percentage of occurrence of oral-motor dysfunction was noted at G 80.3 (80.1%), while the lowest — at G 80.2 (13.1%). A pronounced degree of salivation was significantly more often noted in the forms G 80.0 (38.4±3.8 points; P <0.01), G 80.3 (37.9±3.4 points; P<0.01) and with G 80.8 (28.7±3.2 points; P<0.01) in relation to other forms of cerebral palsy. In general, 72% of children with cerebral palsy over the age of 3 years had some degree of disturbance in the intake of food and liquids in accordance with the EDACS scale.

Keywords: cerebral palsy, malnutrition, nutritional history, oral motor dysfunction

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

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Оценка нарушения питания и нутритивный анамнез у детей с церебральным параличом

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Резюме

Цель исследования. Выявить особенности нутритивного статуса больных с ДЦП при различных формах заболевания в зависимости от нарушений орально-моторной функции.

Материалы и методы исследования. Обследовано 214 детей с различными формами детского церебрального паралича, подразделенных в соответствии с МКБ-10 на 6 топографических форм. Средний возраст детей составил 6,7±0,27 лет. Всем пациентам проводился комплексный клинико-неврологический мониторинг, включающий клиническое наблюдение за время госпитализации с оценкой влияния неврологического статуса пациента с ДЦП на тяжесть изменений в нутритивном статусе. Для оценки функциональных навыков и способностей приема в повседневной жизни жидкости и пищи применена Система классификации способности принятия пищи и жидкости (Eating and Drinking Ability Classification System, EDACS); для оценки тяжести сиалореи использована Шкала оценки степени слюнотечения (The Drooling Impact Scale, DIS).

Результаты. Изучение оральной функции показало, что у 36,9% детей с ДЦП имел место сенсорный тип нарушений, а у 29,9% — моторный тип. Анализ особенностей нутритивного анамнеза выявил значительные различия по частоте нарушений питания (жевание, глотание, сосание, введение прикорма и другие) между обследованными детьми с ДЦП в зависимости от формы заболевания, с преобладанием тяжелых нарушений при форме G 80.0 у 65,1% детей. Наиболее высокий процент встречаемости орально-моторной дисфункции отмечался при G 80.3 (80,1%), тогда как наименьший — при G 80.2 (13,1%). Выраженная степень слюнотечения достоверно чаще отмечалась при формах G 80.0 (38,4±3,8 балла; P<0,01), G 80.3 (37,9±3,4 балла; P<0,01) и при G 80.8 (28,7±3,2 балла; P<0,01) по отношению к другим формам ДЦП. В целом 72% детей с ДЦП в возрасте старше 3-х лет имели в той или иной степени выраженности нарушения в приеме пищи и жидкости в соответствии со шкалой EDACS.

Ключевые слова: детский церебральный паралич, нарушения питания, нутритивный анамнез, орально-моторная дисфункция

Конфликт интересов. Авторы заявляют об отсутствии конфликта интересов.

Neurological disorders in the consensus of nutritional deficiencies are considered as a heterogeneous group of disorders that primarily refer to damage to the central nervous system that affects individual speech, motor skills, vision, memory and cognitive abilities [1,11,16]. Cerebral palsy (CP) refers to a group of conditions characterized by a range of non-progressive symptoms that occur due to involuntary muscle movements. This spasticity can lead to nutritional problems such as dysphagia and eating disorders [5,11,14].

Children with neurological impairments are at increased risk of malnutrition due to several nutritional and non-nutritive factors. Among nutritional factors, one of the main problems is insufficient food intake due to feeding difficulties, insufficient food intake due to gastrointestinal disorders, including oral motor dysfunction, gastroesophageal reflux and constipation [2,4,15]. Nutritional problems are often secondary to oropharyngeal dysphagia, which usually correlates with the severity of movement disorders and occurs in approximately 90% of preschool children with cerebral palsy during the first year of life [3,6,14].

The outcome of cerebral palsy is often affected by comorbid diseases [5,9]. Erkin G. et al. (2020) assessed

the relationship between the severity of cerebral palsy and problems with nutrition and the gastrointestinal system in 120 children aged 2–12 years and found anorexia in 38.3% of patients, sialorrhea – 30.8%, constipation – 25%, swallowing difficulties – 19.2% and eating disorders – 21.7% [12,15,16]. In a study by Lopes et al. (2018), difficulties in chewing were detected in 26% of cases, when swallowing solid food – in 9%, most pronounced in quadriplegia, accounting for 41% and 12.8%, respectively [5,13].

An analysis of the literature data showed that, in addition to the main neurological damage in cerebral palsy, especially in children with severe motor disorders, malnutrition is often noted, depending on the level of general motor dysfunction [7,8,15]. That is why regular nutritional assessment is important to identify signs and symptoms associated with malnutrition [10].

Since in patients with cerebral palsy one of the negative causes that have a negative impact on the nutritional status, not only in children with severe motor disorders, but also in cases of minor motor dysfunction, is oral-motor dysfunction, all this determined the purpose of this study.

Purpose of the study. To reveal the features of the nutritional status of patients with cerebral palsy in various forms of the disease, depending on the violations of the oral-motor function.

Materials and research methods

A comprehensive study of malnutrition and nutritional history was carried out in 214 children with various forms of cerebral palsy, divided in accordance with ICD-10 into 6 topographic groups: quadriplegia, G 80.0 (group I) – 43 people (20.1%); spastic diplegia, G 80.1 (group II) – 39 people (18.2%); children's hemiplegia, G 80.2 (group III) – 40 people (18.7%); dyskinetic form, G 80.3 (group IV) – 31 people (14.5%); atactic form, G 80.4 (V-th group) – 26 people (12.1%); another type of cerebral palsy, G 80.8 (group VI) – 35 people (16.4%) (Table 1). The average age of children with cerebral palsy was 6.7±0.27 years (from 2 to 16 years).

All patients with cerebral palsy underwent a comprehensive clinical and neurological monitoring, including clinical observation during hospitalization with an assessment of the influence of the neurological status of a patient with cerebral palsy on the severity of changes in nutritional status.

To assess the functional skills and abilities to take fluids and food in everyday life in children with cerebral palsy, the Classification System for the ability to take food and fluids (Eating and Drinking Ability classification System, EDACS), displaying elements of the motor and sensory systems of the lips, jaws, teeth, cheeks, tongue, pharynx and palate. EDACS is an ordinal scale with 5 levels of difficulty in eating solids and liquids from I to V, depending on the consistency, methods and degree of assistance: the child feeds independently; he needs help with feeding or is completely dependent.

The degree of help «needs to be accompanied» was interpreted as help from another person or the use of adapted equipment for getting food into the mouth – from placing it in a spoon, placing it with food in the hand and directing it to the mouth, to verbal directions and procedures. Dependence was considered complete when it was impossible to independently deliver food to the mouth by a child with cerebral palsy.

Sialorrhoea, or drooling, is a common comorbid problem with cerebral palsy, contributing to the aggravation of problems with swallowing. In this connection, all patients with cerebral palsy underwent a comprehensive assessment of the severity of sialorrhea according to the Scale assessment of the degree of salivation (The Drooling Impact Scale, DIS). The scale consists of 10 questions, each of which was evaluated by the parents / guardians of a child with cerebral palsy in points from 1 to 10. At the same time, the severity of each symptom was studied during the last week and a total score was displayed indicating the severity of sialorrhea in a patient with cerebral palsy.

Results of the study and their discussion

Oral motor dysfunction in children with cerebral palsy was confirmed in the presence of one or more of the following signs: dysarthria; sialorrhea; asymmetry of oral tissues during rest or during speech, feeding; having difficulty eating and swallowing dysfunction.

The study of oral function showed that 36.9% of children with cerebral palsy had a sensory type of impairment, and 29.9% had a motor type (Table 1). Sensory oral disturbances often involved holding food in the child's mouth before swallowing, depending on the consistency of the food; with motor oral disorders, it was noted the inability to hold food in the mouth with the lips, followed by its loss, independent of the consistency of the product and accompanied by abundant salivation.

Depending on the topographic form of cerebral palsy, it was found that with G 80.0 there was the largest percentage of motor type (60.5%; P <0.01) of oral function disorders, while with the form G 80.2 this type of impairment was recorded in the smallest percentage (10.0%; P<0.05). In 48.6% of children with G80.8, a sensory type of oral dysfunction was recorded, while the lowest percentage of these oral dysfunctions was observed at G 80.4–11.5%.

An analysis of the nutritional history showed significant differences in the frequency of malnutrition (chewing, swallowing, sucking, introducing complementary foods, etc.) between the examined children with cerebral palsy, depending on the form of the disease. As shown in Table. 2, infants with cerebral palsy have had a number of feeding problems since birth, often as a result of so-called oral motor dysfunction.

In the G 80.0 form, oral-motor dysfunction was characterized by a high percentage of occurrence of problems with the introduction of complementary foods (93.0%), problems with biting and chewing (93.0%

Table 1.
Distribution of children with various forms of cerebral palsy depending on the type of oral dysfunction
Таблица 1.
Распределение детей с различными формами ДЦП в зависимости от типа нарушений оральной функции

Forms of cerebral palsy	Motor type		Touch type		Total	
	n	%	n	%	n	%
G 80.0, n=43	26	60.5	13	30.2	39	18.2
G 80.1, n=39	15	38.5	18	46.2	33	15.4
G 80.2, n=40	4	10.0	14	35.0	18	8.4
G 80.3, n=31	4	12.9	14	45.2	18	8.4
G 80.4, n=26	8	30.8	3	11.5	11	5.1
G 80.8, n=35	7	20.0	17	48.6	24	11.2
Total:	64	29.9	79	36.9	143	66.8

Table 2.
Oral-motor dysfunction as a manifestation of malnutrition in children with cerebral palsy
Таблица 2.
Орально-моторная дисфункция как проявление нарушения питания у детей с церебральным параличом

Eating problems	G 80.0		G 80.1		G 80.2		G 80.3		G 80.4		G 80.8	
	n	%	n	%	n	%	n	%	n	%	n	%
Sucking problems	33	76.7	22	56.4	17	42.5	27	87.1	10	38.5	23	65.7
The problem with the introduction of complementary foods	40	93.0	26	66.7	13	32.5	28	90.3	13	50.0	22	62.9
drinking problem	18	41.9	26	66.7	3	7.5	19	61.3	4	15.4	10	28.6
Biting problem	40	93.0	22	56.4	6	15.0	26	83.9	13	50.0	16	45.7
chewing problem	40	93.0	31	79.5	7	17.5	27	87.1	12	46.2	25	71.4
Difficulty swallowing	18	41.9	4	10.3	2	5.0	24	77.4	9	34.6	12	34.3
Poor hand/mouth coordination	18	41.9	6	15.4	8	20.0	24	77.4	10	38.5	8	22.9
Violation of the natural regulation of nutrition	37	86.0	6	15.4	2	5.0	20	64.5	6	23.1	18	51.4
Delayed development of oral reflexes	33	76.7	8	20.5	0	0.0	24	77.4	7	26.9	13	37.1
Delayed swallowing reflex	22	51.2	8	20.5	1	2.5	22	71.0	6	23.1	12	34.3
Difficulty closing the mouth	15	34.9	7	17.9	1	2.5	27	87.1	2	7.7	10	28.6
Permanent tongue protrusion	10	23.3	5	12.8	3	7.5	28	90.3	2	7.7	12	34.3
Difficulty in food bolus formation	40	93.0	21	53.8	5	12.5	27	87.1	6	23.1	22	62.9
Group average		65.1		37.9		13.1		80.1		29.6		44.6

for each sign), as well as difficulty in the formation of a food bolus (93.0%). Problems with sucking (76.7%), delayed development of oral reflexes (76.7%), delayed swallowing reflex (51.2%) and problems with drinking (41.9%) were recorded somewhat less frequently.

In form G 80.1, oral-motor dysfunction was characterized by a high percentage of occurrence of problems with chewing (79.5%), problems with the introduction of complementary foods (66.7%) and problems with drinking (66.7%), also in 56.4% patients reported problems with sucking and problems with biting (56.4%). In contrast to other forms, in this form of cerebral palsy, children in the smallest percentage encountered difficulties with swallowing (10.3%).

In form G 80.2, the least pronounced oral-motor dysfunction was noted, which was mainly characterized by problems with sucking (42.5%) from the first days of the child's life, later parents paid attention to problems with the introduction of complementary foods (32.5%). Other signs of oral-motor dysfunction were noted significantly less frequently in relation to other forms of cerebral palsy ($P < 0.01$).

The severity of oral-motor dysfunction in children with G 80.3 reached 80.1%. This is primarily due to the involvement of the muscles of the face and mouth in involuntary twitches, which is accompanied by the appearance of inadequate facial expressions, choking on food (liquids), sialorrhea. At the same time, the most common symptoms of dysfunction were problems with sucking, noted from the first days of life (87.1%).

In the future, parents paid attention to problems with the introduction of complementary foods (90.3%), accompanied by problems with biting and chewing (83.9% and 87.1%, respectively), swallowing difficulties (77.4%), delayed development of oral reflexes (77.4%), delayed swallowing reflex (71.0%), difficulty closing the mouth (87.1%), constant protrusion of the tongue (90.3%), as well as difficulties in the formation of a food bolus (87.1%).

Also, one of the severe forms in terms of the severity of oral-motor dysfunction is the form of cerebral palsy G 80.8. In this group, the most common symptoms were problems with sucking (in 65.7% of the examined patients were observed from the first days of life), later parents paid attention to problems with the introduction of complementary foods, including solid food (62.9%) and chewing (71.4%), as well as difficult formation of the food bolus (up to 62.9%). Also in this category of patients, there is a high percentage of violations of the natural regulation of nutrition (51.4%), a delay in the development of oral reflexes (37.1%) and a delay in the swallowing reflex (34.3%).

A milder form in terms of severity of oral-motor dysfunction is the form of cerebral palsy G 80.4. Parents of these children most often complained of problems with the introduction of complementary foods (50.0%) and problems with biting (50.0%) and chewing (46.2%). The least pronounced signs were manifested by difficult closing of the mouth and constant protrusion of the tongue (7.7% for each of the signs, respectively).

Summarizing the obtained data, we can conclude that the highest average percentage of occurrence of oral-motor dysfunction was noted at G 80.3 (80.1%), while the lowest – at G 80.2 (13.1%). Somewhat less often, oral-motor dysfunction was noted in the forms G80.0 and G 80.8 (65.1% and 44.6%, respectively).

Figure 1. Indicators of the level of oral-motor dysfunction in children depending on the form of cerebral palsy

Рисунок 1. Показатели уровня орально-моторной дисфункции у детей в зависимости от формы ДЦП

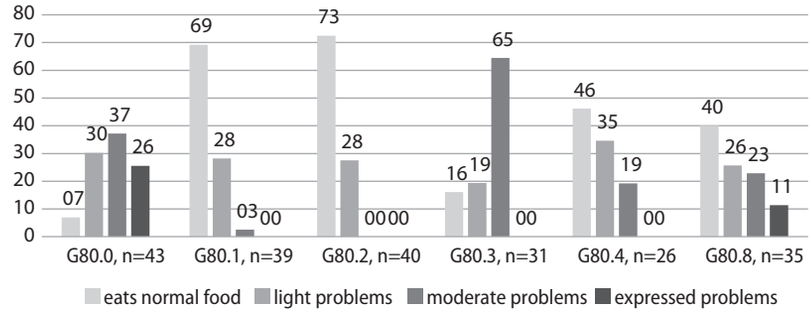
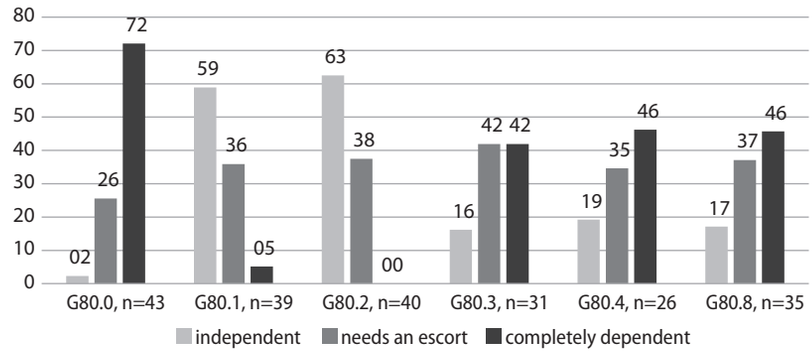


Figure 2. Distribution of children with various forms of cerebral palsy according to independence in feeding or fluid intake

Рисунок 2. Распределение детей с различными формами ДЦП в соответствии с независимостью при кормлении или употреблении жидкости



Based on the above, we determined the total level of oral-motor dysfunction, which was assessed in accordance with the problems that arise when eating and drinking. The results obtained are shown in Fig 1.

As can be seen from the presented data, the absence of problems with eating (the child eats normal food) is recorded in most patients with forms G 80.1, G 80.2 and G 80.4 (69.2%, 72.5% and 46.2%, respectively). In groups G 80.3 and G 80.8, the absence of problems with eating was noted in 16.1% and 40.0%, respectively, and in the form G 80.0 – only in 7.0% of cases.

Mild problems in the process of eating and swallowing, characterized by the need to feed the child with crushed food or puree, were recorded in 34.6% of cases – at G 80.4, in 30.2% – at G 80.0, in 28.2% – at G 80.1, in 27.5% – at G 80.2, in 25.7% – at G 80.8 and in 19.4% – at G 80.3. Moderate problems, when the child had to be fed with soft, chopped or liquid food, were significantly more often recorded at G 80.3 with almost a 2-fold predominance in relation to other forms of cerebral palsy, amounting to 64.5%, while at G 80.0–37.2% and G 80.8–22.9%. Severe problems in the oral-motor function in children with cerebral palsy were noted only in the forms G 80.0 and G 80.8 (25.6% and 11.4%, respectively), the patient ate food in the form of a thick liquid or puree.

Since the likelihood of malnutrition increases significantly with decreasing independence in feeding and with increasing duration of eating, all patients were divided into groups according to independence in feeding: completely independent; partially independent; completely dependent on parents/guardians.

As can be seen from the diagram, the complete independence of the child during food intake and fluid intake in most cases is noted in the forms G 80.1 and G 80.2 (58.9% and 62.5%, respectively), while in other forms this percentage was significantly lower (P <0.01). Partial dependence of the patient on an adult in the process of eating and drinking was noted in all forms of cerebral palsy, but most often diagnosed in the form of G 80.3 (41.9%), less often with G 80.2 and G 80.8 (37.% and 37.1%, respectively). The complete dependence of the child on the adult in the process of feeding was noted in all forms of cerebral palsy, with the exception of form G 80.2. The most pronounced dependence of children in the process of feeding and taking fluids was recorded with the following forms of cerebral palsy: G 80.0–72.1%, G 80.4–46.2%, G 80.8–45.7%, G 80.3–41.9% and only in 5.1% of cases with the form G 80.1 (Fig. 2).

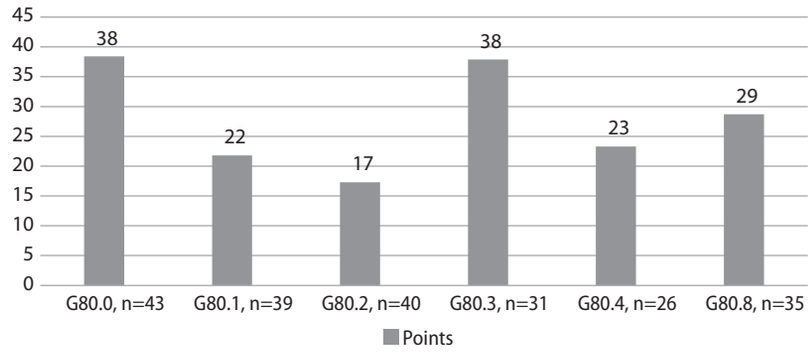
One of the symptoms of cerebral palsy and a factor in malnutrition is sialorrhea, which develops as a result of a violation of neuromuscular regulation and reflex swallowing in the mechanical and nutritional status. The severity of salivation in various topographic forms of cerebral palsy in children was assessed according to the Scale for assessing the degree of salivation (The Drooling Impact Scale, DIS) and is shown in Figure 3.

As can be seen from the presented data, a significantly more pronounced degree of salivation was noted in the forms G 80.0 (38.4±3.8 points; P<0.01), G80.3 (37.9±3.4 points; P<0.01) and with G 80.8 (28.7±3.2 points; P<0.01) in relation to the forms G 80.2 (17.3±1.3 points), G 80.1 (21.8±1.9 points) and G80.4 (23.3±3.1 points). There was no correlation between salivation according to DIS and severity of motor function according to GMFCS (r = 0.2; p > 0.05), both with mild (GMFCS I–II) and severe (GMFCS IV–V) levels of motor deficit (p = 0.52), that is, the severity of salivation does not depend on the severity of motor limitation.

For the subsequent interpretation of the ability to consume food and liquids, the data of 186 children with cerebral palsy over 3 years old were studied according to EDACS with an assessment of the skills of taking liquids and food, the need for outside help in the process of feeding.

I on the EDACS scale ate a wide range of foods of various textures, corresponding to age (Table 3). Half of the children at level I had difficulty eating some very

Figure 3.
Scoring of the severity of salivation in children depending on the form of cerebral palsy
Рисунок 3.
Балльная характеристика выраженности слюнотечения у детей в зависимости от формы ДЦП



hard foods. When analyzing the frequency of occurrence of level I on the EDACS scale in various forms of cerebral palsy, its predominance was established at G 80.2 (60.5%; P<0.01) and G 80.1 (48.6%; P<0.05). In almost every fifth child, this level was recorded in the forms G 80.4 (20.0%; P<0.01) and G 80.8 (18.8%; P<0.05). Only 7.1% of children with form G 80.3 did not experience difficulties in eating and drinking (P <0.01).

The predominant level of functional ability according to the EDACS scale was level II, which was determined in 32.8% of children with cerebral palsy. Children at this level consumed most food and liquid textures but required little change in texture. When eating more complex food textures, some restrictions were noted. The highest percentage of children with this functional level was noted at G 80.1 (48.6%; P<0.01) and at G 80.4 (45.0%; P<0.05), as well as in almost every third child with forms G 80.2 (34.2%; P<0.05) and G 80.8 (37.5%; P<0.05) and almost every fourth child with G 80.3 (21.4%; P<0.05).

25.3% of children with cerebral palsy with level III according to the EDACS scale consumed mostly puree or well-ground food, while the ability to bite and chew soft food was preserved. Most often, this level was noted in the form of G 80.0 (51.5%; P <0.01), that is, in almost every second child. With forms G 80.3 (39.3%; P <0.01), G 80.4 (35.0%; P<0.01) and G 80.8 (28.1%; P<0.01) III level of functional ability to the intake of food and liquid was observed in almost every third child. With forms G 80.1 and G 80.2, this form was recorded in 2.8% and 5.3% of patients, respectively (P <0.01).

Children with functional level IV were under close supervision when eating due to a high risk of aspiration and suffocation, which was noted in 13.4% of children with cerebral palsy. 33.3%, 32.1% and 15.6% of children experienced difficulties in the process of eating, requiring thorough chewing, with topographic forms G 80.0, G 80.3 and G80.8, respectively. Y level of ability to take food and liquids, when the patient could not drink and eat safely, was recorded in only 1 patient with form G 80.0 (3.0%).

Conclusions

Thus, the degree of violation of the nutritional status of children with cerebral palsy directly depends on the form of the disease. When analyzing the oral-motor function of children with cerebral palsy, dysfunction was established, which was noted in all forms of cerebral palsy with the highest representation in the forms G 80.0 (100%), G 80.3 (92.9%), G80.4 (80%) and G80.8 (81.3%).

In general, 72% of children (n=134) with cerebral palsy over the age of 3 years had some degree of disturbance in food and liquid intake according to the EDACS scale.

Clinical and neurological monitoring of a child with cerebral palsy should be systematic and include, along with standardized methods of medical examination, an assessment of the child's nutritional status, which will allow for the prevention of secondary complications. For a child with cerebral palsy, the normal functioning of the oral region is very important, and the sensory organization of the mouth is extremely important, as this leads to an improvement in the organization of the whole body and reduces the state of general tension.

Table 3.
The results of assessing the level of functional ability to eat and drink according to the EDACS scale in children with cerebral palsy
Таблица 3.
Результаты оценки уровня функциональной способности к принятию пищи и жидкости по шкале EDACS у детей с ДЦП

Forms of cerebral palsy	EDACS level										Oral motor dysfunction total for the group	
	I level		II level		III level		IY level		Y level			
	n	%	n	%	n	%	n	%	n	%	n	%
G 80.0, n=33	0	0.0	4	12.1	17	51.5*	11	33.3*	1	3.0	33	100.0
G 80.1, n=35	17	48.6*	17	48.6*	1	2.8	0	0.0	0	0.0	18	51.4
G 80.2, n=38	23	60.5*	13	34.2*	2	5.3	0	0.0	0	0.0	15	39.5
G 80.3, n=28	2	7.1	6	21.4	11	39.3*	9	32.1*	0	0.0	26	92.9
G 80.4, n=20	4	20.0*	9	45.0*	7	35.0*	0	0.0	0	0.0	16	80.0
G 80.8, n=32	6	18.8*	12	37.5*	9	28.1*	5	15.6	0	0.0	26	81.3
Total: n=186	52	28.0	61	32.8	47	25.3	25	13.4	1	0.5	134	72.0
Note: reliability of data to the lowest percentages in groups depending on the form of cerebral palsy (P<0.05–0.01)												

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