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ORIGINAL PAPER

# Feeding problems, eating disorders, and nutritional status of Polish children and adolescents with neurodevelopmental disorders – a cross-sectional pilot study

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## ABSTRACT

**Introduction:** The pathomechanism of neurodevelopmental disorders includes disruption of sensory channels leading to cognitive-behavioural disorders. Feeding disorders (FED) are defined as unconscious or intentional periods of refusal and/or low food intake. Food intake is selective or accompanied by physiological/psychological inability in the process of food intake. The aim of this study was to assess feeding difficulties, nutritional status, and eating disorders in children diagnosed with neurodevelopmental disorders.

**Material and methods:** One hundred and forty-one patients of specialist neuropaediatric institutions with diagnosed neurodevelopmental disorders were enrolled in the study. Inclusion and exclusion criteria were as follows: consent of the patients' parents to conduct the study, age of the child, and diagnosis of neurodevelopmental disorders. The research tool was a self-administered survey questionnaire including the patients' metric data, type of disorder and its course, nutritional status using Cole's parameter, and feeding behaviour.

**Results:** Eating disorders were present in 26.24%, while FED were present in 74.47% of children with neurodevelopmental disorders – autism spectrum. The nutritional status of the paediatric population was "at risk of malnutrition" (68.09%).

**Conclusions:** Nutritional status according to the considered guidelines represented normal weight and the risk of malnutrition. Feeding disorders together with eating disorders occurred with diagnoses of neurodevelopmental spectrum disorders. The neuropaediatric group was characterised by feeding and eating disorders (sensory feeding neophobia and pervasive craving disorder) but showed no association with the type of food texture accepted. The range of measured and accepted temperatures and the consumption of foods with specific visual-organoleptic characteristics targeted feeding disorders. Children with neurodevelopmental disorders will require feeding therapy with a sensory diet.

KEY WORDS:

**nutritional status, eating disorders, autism spectrum, feeding disorders, spectrum of neurodevelopmental disorders.**

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## INDRODUCTION

Classification according to International Classification of Diseases 11th Revision (ICD-11) guidelines has identifies 7 types of neurodevelopmental disorder. Diagnosis based on the insightful system of the ICD-11 and its compatibility with the DSM-5 subdivision includes features of the patient's clinical picture and specific symptoms. In contrast, the most recent diagnostic guidelines (ICD-11) unify these into autism spectrum disorders. The strategy of the diagnostic model is based on the use of 2 therapeutic tools: an autism diagnostic observation schedule and an autism diagnostic interview revised, taking into account the family history and the mechanism of the child's behavioural symptoms [1, 2]. Based on the Polish Society of Child Neurologists recommendations, the therapeutic process focuses on multidisciplinary medical care in the form of an interdisciplinary team [3, 4].

Nutritional status is crucial for the ordinary course of the neurotransmitter pathway during neural-psychomotor development. Complications during chronic neurological disorders include malnutrition and the risk of malnutrition, reaching up to 80% of clinical cases.

The importance of clinical relevance within the assessment of nutritional status is directed towards the period of diagnosis of malnutrition and the implementation of subsequent diet therapeutic intervention in the paediatric patient. Screening should be performed at a frequency of 3–6 months [3].

The feeding behaviours of patients diagnosed with neurodevelopmental disorders on the autism spectrum, among others, contribute to further disorders, including feeding disorders (FED) such as avoidant/restrictive food disorder (ARFID) and pervasive craving (PICA). Cognitive-behavioural impairment leads to sensory-organoleptic preferences towards inedible products, i.e. hair, crayons, plasticine, sand, and iron. Consequently, they are a complication of lead poisoning, macrocytic anaemia, and gastrointestinal obstruction [5, 6]. The disorder manifested by ARFID among the lower borderline represents a range of approximately 13–21% to as high as 49% of cases in the age range of 4–9 years, with a particular focus on the male population. Also to be taken into account is the high proportion of cases undiagnosed for ARFID, which is also a medical concern.

The clinical picture of the paediatric patient includes the following:

- lack of appetite and/or interest in food products,
- avoidance due to sensory characteristics of food and meals,
- or new foods (pickiness and food neophobia),
- anxiety or fear of food intake due to fear of choking, coughing, or vomiting after meal consumption [5, 6].

Clinical studies show that progression of the feeding disorder decreases after the age of 6 years in the neuropediatric group but not in the group of children diagnosed with a neurodevelopmental disorder. An interdisciplinary diagnostic model should consider the ARFID and implement a feeding therapy strategy for children with autism spectrum disorders [7, 8]. This study aimed to assess the nutritional status and feeding difficulties of children diagnosed with a neurodevelopmental disorder.

## MATERIAL AND METHODS

### STUDY GROUP

The cross-sectional survey was conducted in late 2021–2022 (October 2021 – April 2022). Considering the inclusion and exclusion criteria, 141 children were eligible for the final analysis of the results. The age of the paediatric group ranged from 1 to 17 years of age. The age structure of the children was broken down into 5-year age groups using the following numerical ranges: $0 < x \leq 3$ ($n = 35$; 24.82%), $3 < x \leq 7$ ($n = 62$; 43.97%), $7 < x \leq 11$ ($n = 27$; 19.15%), $11 < x \leq 15$ ($n = 13$; 9.22%), and $15 < x \leq 19$ ($n = 4$; 2.84%). Children in the age range from the postnatal period to 17 years of age with a diagnosis of neurodevelopmental spectrum disorders were included in the study. The study is a pilot. Given the large age range from the first year to 17 years, it is worth noting that feeding problems may be more common in young children and children up to 10 years of age, while eating disorders may be more common in adolescents. Inclusion and exclusion criteria are shown in Figure 1.

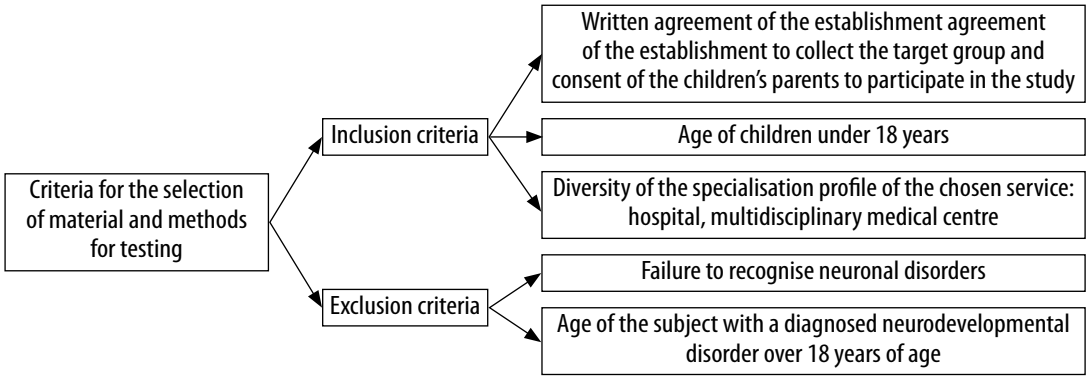


**FIGURE 1.** Inclusion and exclusion criteria in the surveyed group

The sample size was calculated according to the formula: N min = NP × (α2 × f(1-f)) ÷ NP × $e^2$ + $\alpha^2$ × f(1-f), where: N min = minimum sample size; NP = the size of the population from which the sample is drawn; α = the confidence level for the results; f = the size of the fraction; and e = the assumed maximum error. The population of Poland is ≈ 38 million people, and epidemiological data show that the incidence of neurodevelopmental disorders is 5 *per* 10,000 people. According to calculations, the population of people with neurodevelopmental disorders is ≈ 19,000. The minimum sample size of respondents was calculated, which was 138 (α = 0.95; f = 0.9; e = 0.05).

Based on these calculations, the collected group was considered representative. Normality was assessed by the absence of differences between subgroups ($p > 0.05$).

The location of the study was randomly selected. A cluster sampling method was used to determine the sample, guided by the speciality of the medical facility within the paediatric group. Three institutions were drawn from 55 institutions with a profile of behavioural-cognitive disorders from the neuropaediatric speciality in the Silesian Agglomeration in Poland, comprising the Upper Silesian Children's Health Centre in Katowice, the Municipal Hospital Complex in Chorzów, and the Statera Physiotherapy Centre in Katowice. The sampling method was based on the ethical principles of research with human subjects – in line with the Declaration of Helsinki. The study was carried out using a questionnaire and included retrospective data; it was not a medical experiment, but permission was sought from the Bioethics Committee Medical University of Silesian in Katowice for the publication of the results obtained. The Bioethics Committee issued a positive opinion to conduct the research on the topic 'Feeding disorders and oral hypersensitivity in the context of sensory feeding in patients with neurodevelopmental disorders' (resolution no. PCN/CBN/0052/KB1/142/22/23.

## RESEARCH TOOL

The research tool was a survey questionnaire conducted individually in the form of an interview each time with a parent of a neuropediatric patient, conducted by the person undertaking the research analysis. Part III of the questionnaire contained questions about the child's nutritional status and eating behaviour partly modelled on the mini nutritional assessment (MNA) nutritional status scale. The modified MNA scale served as a screening test for assessing nutritional status. The author's scale includes the following scoring: 14–16 points – normal nutritional status, 7.5–13.5 points – risk of malnutrition, less than 7 – malnutrition [9]. The above scale served as the author's screening index for the nutritional assessment of children with neurodevelopmental disorders. The scale's concordance was assessed at Cronbach's α = 0.82. Based on the formula, the Cole index was calculated to evaluate the children's nutritional status. An indicator of a non-invasive nature was used to assess the nutritional status of children and adolescents. The classification of the nutritional status was done by categorising the values of the computed index into appropriate levels: severe malnutrition – values < 75%, malnutrition – 75–85%, moderate malnutrition – 85–90%, normal body weight – 90–110%, overweight – 111–120%, and obesity – values > 120 [10].

At the time of the survey, paediatric patients on the ward or scheduled for consultation in the outpatient clinic had their weight measured using a medical scale and their height measured using a Martin-type anthropometer (in children and adolescents aged over 3–17 years) or their body length measured using a liberometer (in children aged up to 36 months in the neuropaediatric group) by a healthcare professional – neurologist, nurse, clinical dietician employed at one of the 3 institutions. Based on the reported weight and height from the patient's medical history contained in the medical records, a body mass index (BMI) value was calculated among children and adolescents aged 3–17 years, with the result related to the OLA and OLAF centile grids [11]. On the other hand, in children between birth and 3 years of age, a reference of measurements on centile grids based on the World Health Organisation interpretation was used. To assess the nutritional status of preterm infants, the corrected centile grid system standards for patients born prematurely were used, considering the age below 3 years [11].

## STATISTICAL ANALYSIS

Statistical analysis was performed using STATISTICA 13.0, StatSoft Poland. Measurable data were characterised using the mean value (X), standard deviation (SD), median (M), quartile range (Rk), minimum value (X min), and maximum value (X max). Nonparametric tests were conducted using $\chi^2$ ^ 2 not statistically significant and $\chi^2$ ^ 2 Pearson to verify statistical relationships among the unmeasured data. The significance of statistically significant differences was assessed using *p*-values, while statistical significance was determined at $p < 0.05$.

## DATA AVAILABILITY

Institutional Review Board Statement: Conducting the study did not require the authors to obtain approval from a bioethics committee in light of the Act on Physician and Dentist Professions of 5 December 1996, which includes a definition of medical experimentation.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

The data presented in this study are available upon request from the corresponding author. The data are

**TABLE 1.** Data on age, weight, and body length of the study group

| Details | X | SD | M | Rk | X min | X max |
|---|---|---|---|---|---|---|
| Age (years) | 6.35 | 3.76 | 5.30* | 4.50* | 1.00 | 17.00 |
| Weight [kg] | 27.01 | 15.18 | 22.00* | 16.00* | 10.00 | 84.00 |
| Body length [cm] | 122.43* | 23.86* | 121.00 | 36.00 | 78.00 | 178.00 |

*M – median, Rk – quartile range, SD – standard deviation, X – arithmetic mean, X min – minimum value, X max – maximum value*
**The numerical values of the measurable characteristics to be taken into account due to the asymmetry coefficient are highlighted.*

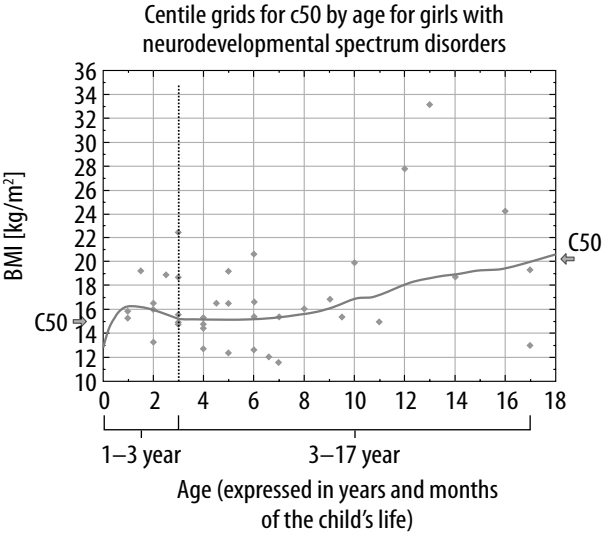


**FIGURE 2.** Scatter plot of centiles with body mass index and age among girls

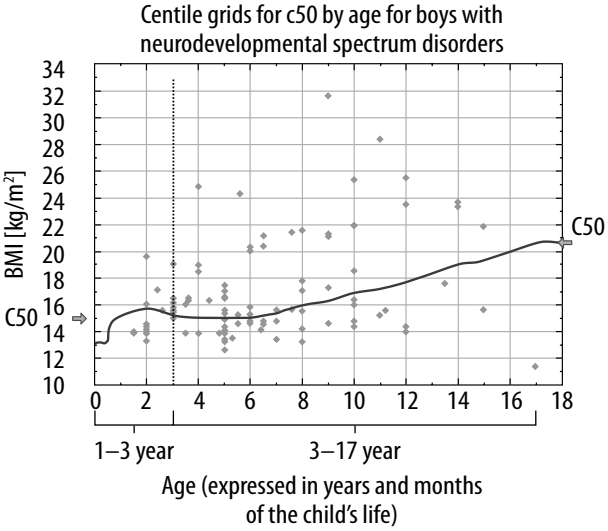


**FIGURE 3.** Scatter plot of percentiles with body mass index and age among boys

not publicly available due to restrictions that apply to the availability of these data.

## RESULTS

### CHARACTERISTICS OF THE NEUROPAEDIATRIC GROUP

The study included 141 patients from neuropediatric facilities, including 102 boys (72.34%) and 39 girls (27.66%). The age of the paediatric group ranged from 1 to 17 years. The age structure of the children was presented by 5 groups using the following numerical ranges: $0 < x \leq 3$ ($n$ = 35; 24.82%), $3 < x \leq 7$ ($n$ = 62; 43.97%), $7 < x \leq 11$ ($n$ = 27; 19.15%), $11 < x \leq 15$ ($n$ = 13; 9.22%), and $15 < x \leq 17$ ($n$ = 4; 2.84%). Detailed metrics of the neuropaediatric group are provided in Table 1. A scatter plot was made with a percentile channel layout in the form of centile grids by patient gender (Figure 2, 3).

The neuropaediatric female population was characterised by a BMI in the centile channel below c50 and above c50, narrowly falling into the 50–c50 centile for ages 1–3 and 3–18 years.

The neuropaediatric male population was characterised by a BMI in the centile channel below c50 and above c50, narrowly falling into the 50–c50 centile for ages 1–3 and 3–18 years.

Diagnoses of neurodevelopmental disorders targeting the autism spectrum ($n$ = 105; 74.47%) represented a significant majority among the paediatric group when compared with other neurodevelopmental disorders in the form of Asperger's syndrome ($n$ = 30; 21.28%), Rett syndrome ($n$ = 3; 2.13%), selective mutism ($n$ = 2; 1.42%), and attention deficit hyperactivity disorder ($n$ = 1; 0.71%). Among a higher proportion of patients, births were completed naturally ($n$ = 73; 51.77%) but at a higher level among children on the autism spectrum ($n$ = 47; 64.38%). On the other hand, when assessing the caesarean section method, it was observed that it was most prevalent among children diagnosed with autism spectrum disorder (ASD) ($n$ = 51; 85%) compared to other neurodevelopmental spectrum disorders ($n$ = 9; 15%).

### NUTRITIONAL STATUS OF CHILDREN WITH NEURODEVELOPMENTAL DISORDERS

Based on the Cole index, the nutritional status of the neuropaediatric group was assessed as normal, falling within the 90–110% range ($n$ = 69; 48.94%), but half as many children had obesity values above 120% ($n$ = 35; 24.82%).

A screening test taking into account psychomotor abilities, the appearance of weight loss, lack of appetite for the last 3 months, and a qualitative assessment of diet concluded that a significant proportion of the neuro-

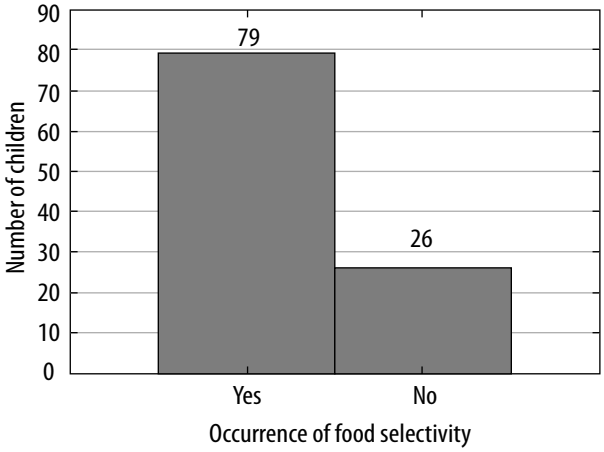


**FIGURE 4.** Food selectivity among children with autism spectrum disorders

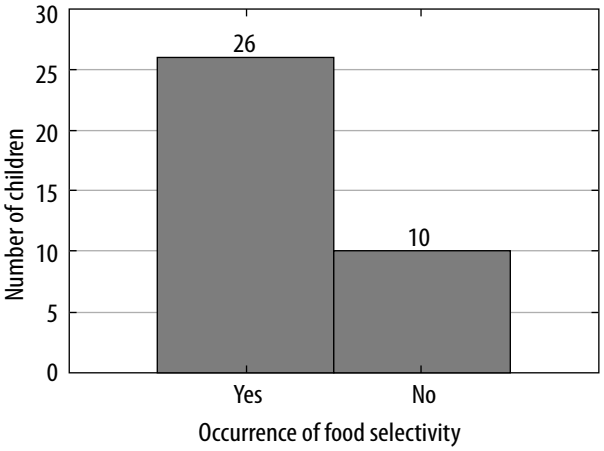


**FIGURE 5.** Food selectivity among children with other neurodevelopmental spectrum disorders

pediatric population is at risk of malnutrition ($n$ = 96; 68.09%), while a smaller proportion comprised children with normal nutritional status ($n$ = 38; 26.95%).

### ANALYSIS OF THE SUPPLEMENTATION PROCESS TAKING INTO ACCOUNT THE VALUES OF THE COLE INDEX

The juxtaposition of nutritional status assessment with the implementation of supplements showed no statistical significance with weak correlation strength ($p$ = 0.09; Vc = 0.22). Neuropaediatric patients with normal nutritional status were not taking ($n$ = 13; 50%) and were taking ($n$ = 56; 49%) supplements in the form of vitamins A, D, E, K, and C, niacin, riboflavin, pyridoxine, and minerals – iron, magnesium, zinc, taurine, lysine, nucleotides, and omega-3 acids at similar percentage levels.

### ANALYSIS OF THE SUPPLEMENTATION PROCESS INCLUDING ASSESSMENT OF THE SCREENING TEST – MINI NUTRITIONAL ASSESSMENT SCALE

The juxtaposition of nutritional status assessment with the implementation of supplements showed no statistical significance with weak correlation strength ($p$ = 0.38; Vc = 0.11). Neuropaediatric patients with normal nutritional status took supplements significantly at higher levels ($n$ = 33; 30%) in the form of vitamins A, D, E, K, and C, niacin, riboflavin, pyridoxine, and minerals – iron, magnesium, zinc, taurine, lysine, nucleotides, and omega-3 acids. Children with neuronal disorders at risk of malnutrition were most likely not to take supplements ($n$ = 20; 80%).

### FEEDING DISORDERS AMONG CHILDREN WITH NEURODEVELOPMENTAL SPECTRUM DISORDERS

Among neuropaediatric children, aversion to specific foods/products was found at increased levels among other neurodevelopmental spectrum disorders – Asperger's syndrome, Rett syndrome, attention deficit hyperactivity disorder, and selective mutism ($n$ = 26; 72.22%). In contrast, the incidence of food selectivity was much lower ($n$ = 10; 27.78%) (Figure 4).

Among neuropaediatric children aversion to specific foods/food products was found at increased levels among autism spectrum disorders ($n$ = 79; 75.24%). In contrast, the incidence of food selectivity was at a much lower level ($n$ = 26; 24.76%) (Figure 5).

Eating disorders in the form of a propensity for inedible products (PICA) were not present among a higher proportion of the neuropaediatric group studied ($n$ = 104; 73.76%). It was observed that the most preferred

**TABLE 2.** Pervasive craving eating disorder and preferred food texture among children with neurodevelopmental spectrum disorders

| Disorder nutrition PICA | Type of food texture accepted | | | | | | |
|---|---|---|---|---|---|---|---|
| | Consistency solid | Consistency mushy with lumps | Consistency mushy without lumps | Consistency liquid | Total *N* (%) | *p*-value ($x^2$ NS) | Correlation coefficient |
| Propensity for disorder, *n* (%) | 26 (70) | 2 (5) | 7 (19) | 2 (5) | 37 (100) | $p = 0.26$ ($p > 0.05$) – NW | Cramer's V = 0.18 |
| There is no tendency to disorder, *n* (%) | 89 (86) | 3 (3) | 9 (9) | 3 (3) | 104 (100) | | |

*NW – not statistically significant, PICA – eating inedible food*

**TABLE 3.** Level of acceptable temperature range considering consumption of shaped and coloured products

| Consumption of products of a certain shape, colour | Level of acceptable meal temperature | | | |
|---|---|---|---|---|
| | Temperature range not measured, not defined | Temperature range previously measured, specified | *p*-value ($x^2$ Pearson) | Correlation coefficient |
| Yes, *n* (%) | 41 (44) | 32 (68) | $p = 0.006$ ($p < 0.05$) | Φ-Yula = – 0.23 |
| Not, *n* (%) | 53 (56) | 15 (32) | | |
| Total, *N* (%) | 94 (100) | 47 (100) | | |

food texture was solid ($n = 115$; 81.56%), and the least accepted texture was mushy with lumps and liquid at equal levels of frequency ($n = 5$; 3.55%). The data are presented in Table 2.

There was no significant correlation between food texture acceptance and the occurrence of eating disorders according to the PICA scale.

Products with specific sensory/organoleptic qualities were included ($n = 73$; 51.77%) or not included ($n = 68$; 48.23%) at a similar level of frequency. The level of accepted temperature range at a much higher level was unmeasured and specified ($n = 94$; 66.67%). The data are presented in Table 3.

A significant correlation was observed between the level of temperature acceptance and the consumption of products of a certain shape and colour. Significantly more frequent consumption of products with a certain shape and colour was observed among products for which the temperature had previously been measured and determined compared to those for which the temperature had not been measured.

Consumption of products with a predetermined range of acceptable temperatures by the child was significantly more likely to translate into sensory preferences for products taking into account specific visual characteristics ($n = 32$; 68%). In contrast, consumption of products with a previously unspecified temperature range accepted by the study group translated into unspecified sensory preferences without taking into account a specific shape and colour. Statistical analysis of the characteristics summarised above showed a statistically significant relationship ($p = 0.006$), while the value of the correlation coefficient indicated the absence of a stochastic relationship between the variables (Φ-Yula = –0.23).

## DISCUSSION

The spectrum of neurodevelopmental disorders is characterised by disorders with multifactorial interactions, including sensorimotor (sensory channel disruptions) and behavioural-cognitive, along with neuroatypical feeding behaviours, including feeding and eating disorders. Epidemiological data indicate an increasing recognition rate of ASD and a varying incidence ranging from 1.76/1000 to 7.17/1000 globally. The diagnostic model is based on specific procedures leading to multiple abnormalities due to the subjective nature, heterogeneity of symptoms, and non-specific biomarkers in the process of diagnosing the disorders [12, 13].

### FEEDING DISORDERS WITH NEURODEVELOPMENT DISORDERS

Feeding disorders are defined as an unconscious period of refusal and/or low food intake. Food consumption is selective or accompanied by physio-psychological incapacity in the process of food intake, together with FED of various origins. Difficulties during the feeding process with the most frequent mixed type (behavioural and organic) are found in the age range of up to 3 years at a level of 80% with the course of neurological disorders, and about 90% of the paediatric population with a diagnosis of autism spectrum disorders, taking into account the diverse age range. The feeding phenomenon represents a complex process with synergism between the physiology of the central nervous system and the peripheral nervous system and the functionality of mechanisms such as the oropharyngeal, respiratory, and digestive systems, as well as the processes of coordination of the muscular tissue and the elements building the oral cavity and articulatory structure with the craniospinal nerves. The causes that have a destructive effect on food intake are biological, psychological, and related to the motor and sensory disturbances in the orofacial and oral area, motor processes, and acquired and innate motivation leading to impaired anthropometric parameters in the form of slow growth and/or loss of body weight and body length. Subsequently, increased predisposition to nutritional deficiencies results in abnormal development, intellectual-emotional impairment, viral infections, and cellular dehydration [14–16].

### FOOD SELECTIVITY AND NUTRITIONAL DEFICIENCIES

Selective food choice (picky eating) is a symptom of the course of FED characterised by a low proportion

of vegetables and dairy products in the feeding pattern of the neuropaediatric group. In addition, the clinical condition shows nutrient deficiencies, including vitamins A, C, D, E, K, $B_6$, $B_9$, and $B_{12}$, macronutrients – calcium, micronutrients – iron, zinc, and additionally fibre of insoluble fraction [15].

## PAEDIATRIC FEEDING DISORDERS

Risk factors affecting the abnormal feeding process of obstetric, environmental origin are the first pregnancy ending in childbirth (first-born children), the use of stimulants in the form of tobacco in the perinatal period, the clinical condition of the foetus defined as premature, foetal hypotrophy (less than 1500 g), as well as polyphasic within the congenital disabilities of the respiratory, circulatory, and digestive systems in the newborn. Scientific publications emphasise the importance of a correct feeding algorithm for the baby towards the formation of the sensory profile. This strategy should include the following components: regular exposure to small portions of meals at an interval of 2–4 hours, serving a solid meal first, followed by a liquid meal, duration of consumption no longer than 30 minutes, stimulation to eat independently, lack of interest and playing with the meal results in termination of feeding after 15 minutes, serving only water between meals, a neutral eating environment without parental coercion, the meal is not a form of reward, no attention to the issue of mess during meal consumption, and hygiene methods (wiping the mouth, face) should take place after the feeding process is completed [16, 17]. Atypical eating behaviours belong to the substrate of inorganic and organic (higher levels in neurodevelopmental disorders). Eating disorders represent 3 categories: consumption of small amounts of food, selective consumption with extreme sensory variety, and psychological concerns and fear of feeding [15–17].

## SENSORY HYPERSENSITIVITY AMONG CHILDREN WITH NEURODEVELOPMENTAL DISORDERS

The first taste exposure to specific food groups shows a correlation between the development of food neophobia and diversity in food preferences. Food selectivity is an intrinsic part of the developmental stage of children between the ages of 4 and 7 years, but a chronically persistent state of food selectivity leads to eating and feeding disorders. A group particularly vulnerable to its pathomechanism is the population of children with neurodevelopmental spectrum disorders, especially patients with ASD [17–19]. A study by Stanley *et al*. indicates the prevalence of FED and the burden of dysphagia, leading to the need for nutritional modifications among 57% of children with Down's syndrome along with the neural-behavioural burden [18]. On the other hand, the work by Thorsteinsdottir *et al*. divided the study into a group with and without a neural disorder diagnosis, presenting about 50% in the study group with high unacceptability and selectivity in food intake together with family conditioning in the form of restriction of food intake also by the parents of the children studied. The level of intake of green leafy vegetables in the form of kale, salads, spinach and berries, fresh fruit, and nuts, among others, represented a low level compared to the control group [19]. Subsequently, an analysis of atypical eating behaviours in a study by Dickerson *et al*. reported restricted food preferences in 88% of children on the autism spectrum, along with a 25% degree of having 3 or more non-specific relationships with food [20]. Regarding the above study, the self-analysis undertaken shows a parallel to the high levels of food selectivity found by parents of ASD patients ($n$ = 79; 75.24%), while other atypical disorders showed slightly lower levels of recognition of aversion to specific foods and fear of new foods ($n$ = 26; 72.22%).

## NUTRITIONAL DISORDERS WITH AN AUTISM DISORDER – AVOIDANT/RESTRICTIVE FOOD DISORDER, PERVASIVE CRAVING

The nutritional strategy in selecting dietary intervention should consider the propensity for eating disorders in the form of ARFID (5–22.5% of clinical cases) and PICA (3.5–29% of diagnoses) among the neuropaediatric group. Underlying avoidance and restricted eating are sensory aversions triggered by a particular taste, smell, texture, or shape, followed by a low sensation of hunger, lack of appetite stimulation, and psychological aversions with traumatic and anxiety-related causes [21, 22]. Pervasive craving disorder involves the consumption of inedible foods, most often by hiding/homing them in advance, leading to a life- and health-threatening condition for children on the autism spectrum. Validation of the prevalence of PICA disorder in a study by Fields *et al*. shows the diagnosis of eating inedible foods with a higher frequency among the group with ASD (23.2%) and a lower level in patients with other neural conditions (8.4%) with predisposing intellectual disabilities that influenced the level of non-physiological eating behaviour [23–25]. Subsequently, the analysis by Fields *et al*. also indicates a predisposition to PICA disorders with a rate of 12%, especially among the group with ASD, hypersensitivity towards the texture of the meal eaten (46%), and storing food in pockets without subsequently biting and swallowing (19%). In the above study, general atypical and non-specific relations with food accounted for 70.4% of the autism spectrum group [23]. In light of our results, the analysis presented here shows similarity with other authors' studies in the development of PICA disorder in children with neuroatypicality, including ASD and other neural conditions ($n$ = 37; 26.24%), along with the preferred texture of solid food ($n$ = 115; 81.56%) and the least acceptable texture of mushy with lumps and

liquid ($n$ = 5; 3.55%) – indicating sensorimotor-driven sensory hypersensitivity among the patients studied. Pervasive craving type eating disorder, together with a summary of preferred food texture, stated the choice of solid texture regardless of the susceptibility to PICA pathomechanism (86% – susceptibility to PICA and solid texture vs. 70% – no susceptibility to PICA and solid texture) with no significant differences between acceptable texture and susceptibility to the disorder ($p$ = 0.26). In addition, a significant correlation was observed between the level of temperature acceptability and the consumption of products with specific shapes and colours, because significantly more consumption of products with specific shapes and colours was observed among products with pre-measured and specific temperature levels compared to foods with unmeasured temperature levels ($p$ = 0.006). Consumption of products with a predetermined temperature range acceptable to the child was significantly more likely to translate into a sensory preference for products, taking into account the specific visual characteristics of the product among children with neural conditions ($n$ = 32; 68%) [26–28].

### LIMITATIONS AND STRENGTHS OF THE STUDY

In conclusion, among the study's strengths, the issue of collecting a diverse group of patients with neuronal disorders together with an individually conducted medical and nutritional interview in the form of a questionnaire should be emphasised. The model of the planned nutritional study brings originality and innovation to the scientific field by revealing multifactorial aspects of the holistic process of health determinants during the pathomechanism of conditions from the spectrum of neurodevelopmental disorders. The author's study has limitations in terms of the size of the collected group of patients with diagnosed neurodevelopmental disorders because, at this stage, it is a clinical study with a small sample of children without a comparative control group of healthy children. Furthermore, the fact that the study group was not analysed by age but categorised into age subgroups may be a limitation. However, given that nutritional problems differ in children and adolescents, this allows the identification of a nutritional problem in a group with a wide age range. Confirmation of the present self-reported results by an additional number of large-scale prospective studies is needed.

## CONCLUSIONS

Based on the Cole index, normal nutritional status was demonstrated in most of the studied children with neurodevelopmental disorders. On the other hand, the MNA screening scale showed a state of malnutrition risk in the study group. The neurodevelopmental group studied was characterised by feeding and eating disorders, sensory neophobia, and PICA disorder but showed no association with the type of food texture accepted. The range of measured and accepted temperatures and the consumption of foods with specific visual/organoleptic characteristics were targeted by feeding disorders. Therefore, children with autism spectrum disorders will require feeding therapy with sensory diets.

## DISCLOSURE

The authors declare no conflict of interest.

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