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When eating inedible things: Determining the prevalence of pica disorder in a group of Polish adolescents aged 15-19 years

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Summary

Aim. This study aimed to determine the prevalence of pica among Polish adolescents aged 15–19 years, to identify the most commonly consumed inedible substances, and independent factors that increase the risk of pica.

Material and methods. The study was conducted with the participation of 1,696 secondary school students from all over Poland. Multiple random sampling was used. A three-part self-designed questionnaire, which included recall questions, diagnostic questions for pica disorder and an assessment of mental state was used in the study. The study assessed the relationships between selected variables, characteristics for other eating disorders, and drinking

(e.g. place of residence, level of physical activity, having siblings or level of parental education). The questionnaire was validated before the study.

Results. 3.2% of respondents ate starch in the form of raw flour, paper or tissue, 5.7% ate nasal discharge and 0.2% ate glass particles. 1.5% of respondents needed to see a specialist because they had eaten a non-nutritive substance. 10% of respondents characterized the severity of family stress above the 90th percentile; similarly, 9.4% of respondents described the high severity of school stress. 37.1% of the respondents engaged in self-injurious behavior.

Conclusions. Diagnostic criteria for pica were met by 5.7% of respondents. The most common non-nutritive substances consumed by respondents were: nasal discharge, raw starch and hair. Independent factors that increased the risk of pica included living in a city, the presence of self-aggressive behavior, the presence of suicidal thoughts and high levels of stress at school.

Key words: pica, eating disorders, not-otherwise specified eating disorders

Introduction

Eating disorders are one of the most common groups of psychiatric disorders affecting adolescents worldwide. They represent a diverse group of diseases and disorders with heterogeneous characteristics and prognoses [1]. These disorders are divided into two groups: specific eating disorders and non-specific eating disorders. The group of specific disorders includes anorexia nervosa and bulimia nervosa. The non-specific group includes diabulimia, pica, bigorexia and night eating syndrome. The epidemiology of eating disorders is difficult to determine due to the concealment of symptoms, delayed help-seeking and lack of awareness [2].

Pica is an eating disorder with slightly different characteristics from the other conditions in this group. In this case, the disorder relates more to the qualitative aspect of food than to the quantitative one, which is the predominant feature of other eating disorders [3].

Pica is characterised by the regular ingestion of non-nutritive substances and items not culturally recognised as food, such as non-food objects and materials (e.g. clay, paper, earth, glass, wood, nasal secretions, hair, faeces) or raw food ingredients (e.g. flour, large amounts of ice, etc.) [4, 5]. The ingestion of non-nutritive substances is persistent, intense and repeated over time. The need for specialist diagnosis and intervention arises in individuals who have reached the developmental age to distinguish between edible and inedible substances (around two years of age) [4-6]. The presence of such eating behaviour poses a health risk, impairs functioning and leads to gastrointestinal disorders [6]. According to the diagnostic criterion, pica can be diagnosed when such symptoms persist for at least one month [4-8].

Pica is usually diagnosed in children, but in a subset of individuals, it is not diagnosed until adolescence or adulthood [6]. Despite the identification of pica as a distinct entity in the International Classification of Diseases 11th Revision (ICD-11) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), there is still a lack of comprehensive tools to assess this disorder. Although some structured assessments, diagnostic and screening tools have been published, none of these scales assess the severity of psychopathology, associated impairment, or health risks, which is essential in clinical practice [3, 6]. The available rating scales have some drawbacks, e.g. the

Eating Disorder Assessment for DSM-5 (EDA-5) scale can only be used in adults and older adolescents, although research shows that pica is most common in children, and the Diagnostic Interview Schedule for Children (DISC-IV) can only be used in a limited group of children [3, 6].

The ingestion of non-edible substances is commonly reported in children and decreases with age [9]. It is most common in children younger than one year (about 75% of infants), and occurs in only about 15% of two- and three-year-olds [10]. Studies to date have not clarified the pathogenesis of this disorder. In children, the prevalence of the disorder seems to increase in the presence of nutritional deficiencies, high levels of psychosocial stress and an impoverished and disorganised family situation [10]. A hypothesis linking pica to iron deficiency has also been proposed [11]. This hypothesis has been largely supported, as iron treatment inhibited the symptoms characteristic of the disorder [11]. In adults, pica is most commonly associated with severe intellectual disability, pregnancy and psychotic disorders, especially schizophrenia [4, 12]. Some studies have shown an association between pica and obsessive-compulsive disorder, while other researchers have not found any relationship between these disorders [12].

Despite the lack of representative studies, preliminary scientific results indicate large differences in the prevalence of disturbed appetite across different geographical regions of the world. Interestingly, there are large discrepancies in the epidemiology of this phenomenon in Western European countries. There is preliminary evidence that the prevalence of disturbed appetite is very low in Denmark and France (e.g. 0.02% in Danish pregnant women [13] and 0% in France [14]), whereas a significantly greater prevalence of the disorder is noted in Switzerland (10%) and Germany (12.3%) [14].

Pica is an important clinical problem because it can lead to life-threatening complications, especially heavy metal poisoning, parasitic infections or disruption of the continuity of the gastrointestinal tract requiring surgical intervention [26, 32, 33].

The available literature in the field of eating disorders confirms the association between selected socioeconomic and psychological variables and an increase in incidence of some disorders [1, 16, 17]. Anorexia nervosa is observed to be more prevalent among singletons, people of high socioeconomic status and those living in large cities. Some authors also report a higher risk of anorexia nervosa in children of highly educated parents [1, 2]. It is also noted that bulimia nervosa often co-occurs with other psychiatric disorders, suicidal thoughts, and self-aggressive or self-destructive behaviour [1, 16]. However, the available literature does not clearly explain the relationship between the occurrence of pica and these factors.

Despite medical advances, pica seems to be an under-researched topic. Aspects related to the pathogenesis, epidemiology and management of pica are described in a vague and generalised manner in the available literature.

This article aimed to determine the prevalence of pica in Polish adolescents aged 15-19 years. A further aim was to identify the most common inedible substances consumed by adolescents and the factors that increase the likelihood of developing this disorder.

Material and methods

Study group

The sample consisted of 1,696 Polish secondary school students aged between 15 and 19. The respondents were selected using a multi-stage random sampling method. In the first stage, the schools where the survey was to be conducted were randomly selected. The headmasters of these schools were asked for permission to conduct the study. In the final stage, the class of students was also drawn.

Participation was voluntary. Before the survey, the respondents were informed about its purpose and that the results would be used for research purposes. Due to the fact that a large group of respondents were underage, a letter was sent to their parents describing the team conducting the survey (psychologists, child and adolescent psychiatrists, dieticians, epidemiologists, paediatricians), the subject of the survey, its characteristics and its purpose. After obtaining consent to participate in the study, the students began to complete the questionnaire. The questionnaires were completed in classrooms in the presence of the investigators so that, if in doubt, the respondent could ask a question and get a quick answer. Due to the nature of the survey and the type of data being collected, respondents were seated at individual desks in such a way that no one could see their answers.

The design of the survey was approved by the Heads of the Departments of Education and the Heads of the schools where the survey was conducted. According to Polish law, the study was not a medical experiment, so it did not require the consent of the Bioethics Committee (Act of 5 December 1996 on the Professions of Physicians and Dentists (Journal of Laws of 2019, item 537)). The study complied with all research standards, including the provisions of the Declaration of Helsinki.

Inclusion criteria were age (15-19 years), consent to participate in the study and the maintenance of basic cognitive skills to complete the questionnaire (reading, writing, comprehension).

Exclusion criteria were education in special schools and preparatory schools (students with a statement of need for special education participated in the study but required the assistance of a teacher or tutor to complete the questionnaire).

Since the study used the respondents' self-assessment without taking into account detailed observation, a follow-up interview with parents and an objective clinical examination, it was decided that the results of the study would be presented as a possible diagnosis of pica, respecting the principle of diagnosing the patient individually during the medical or psychological examination, using all aspects of the specialist examination.

Due to the nature of the study, the questionnaire was completed in the presence of the study authors and the teacher. Students were able to ask questions about different aspects of the survey at any time. After completing the survey, time was set aside to discuss eating disorders and mental health. Places where young people could get help during times of distress or mental health crisis were also identified.

Research tool

The study used a questionnaire consisting of three parts:

(a) The first part consisted of questions on metric data: age, gender, weight and height, place of residence, type of secondary school attended by the respondent, family financial status, parents' education, level of physical activity, number of siblings, previous diagnosis of eating disorders and presence of a chronic disease.
(b) The second part was a self-administered questionnaire based on the diagnostic criteria for pica. The questions limited possible answers to a nominal scale (yes/no) – respondents referred to the presence of a specific symptom or behaviour in themselves.
(c) The third part consisted of questions about the mental state – the occurrence of suicidal thoughts in real time during the study and in the past, the occurrence of self-aggressive and self-destructive behaviour, as well as the intensity of school and family stress. The parameters of school and family stress were measured based on the occurrence of a specific stressor (e.g. oral answer, test, violence, etc.) and its specific intensity (according to the Likert scale, where 0 – no stressor, 1 – minimal stress, 5 – maximum stress).

Validation of the survey

Before the survey, the questionnaire was validated. Validation was carried out on 120 people. They were asked to complete the questionnaire twice, with a 14-day test interval (the test-retest interval was shortened due to the psychological nature of the study, taking into account, according to other authors [18-20], that the psychological state is a condition that changes over time and that extending the test-retest interval would carry a high risk of not obtaining similar answers due to changes in the psychological state). The results obtained were statistically analysed to assess the reliability of the developed questionnaires. The internal consistency of the scales was tested using Cronbach's alpha coefficient [21, 22]. The reproducibility of the scales (test-retest) was determined by comparing the results of the same questionnaire completed twice by the same person, 14 days apart, and by calculating the intraclass correlation coefficient (ICC) and Cohen's kappa coefficient [23]. The calculated Cronbach's alpha coefficient was 0.91, indicating a very good internal consistency of the questionnaire.

A reliability analysis of the questionnaire was performed based on two correctly completed questionnaires. The degree of reproducibility was determined using the ICC coefficient (0.82; $p < 0.001$) and Cohen's kappa coefficient (0.81; $p < 0.001$). Correlation coefficients were calculated between responses to individual questions obtained at the first and second administration of the questionnaire. A significantly high correlation was found between the results obtained for each question when the questionnaire was completed twice ($p < 0.05$ and $r > 0.46$ in each case).

Statistical analysis

Statistical analysis was performed using STATISTICA 13.3 PL (StatSoft Poland, Krakow, Poland) and SAS 9.4 (SAS Institute INC., Cary, NC, USA). Quantitative data were presented as mean (*X*) with standard deviation (*SD*) or median (*Me*) with lower and upper quartiles (Q1-Q3). The frequency of individual responses reported by respondents was described by the number (*n*) and as a percentage of group responses. The normality of distributions was assessed using the Shapiro-Wilk test. The homogeneity of variance was assessed using Levene's test. The chi-square test or Fisher's exact test was used to determine statistical significance for qualitative variables, and the Mann-Whitney U test for quantitative variables.

Univariate logistic regression analyses were performed to identify the variables that were significant risk factors, and these were used to determine multivariate models. In the multivariate analyses, variables with a p-value < 0.3 from the univariate analyses were selected for the initial model. Subsequently, an automatic stepwise elimination procedure was performed on the variables in the multivariate model, with $p < 0.2$ as the entry criterion and $p < 0.3$ as the retention criterion for the variable in the model. Finally, only those variables with $p < 0.05$ values were considered significant risk factors. In the analysis of associations between the study variables, the test of correlations was used – Spearman's non-parametric correlation test.

Results for which $p < 0.05$ were considered statistically significant.

Results

Baseline metrics characterising the study group are presented in Tables 1 and 2. The mean age of all study participants was 16.9 ± 2.44 years. The mean body weight of the respondents was 62.7 ± 13.31 kg, with the lowest recorded weight being 34 kg and the highest 142 kg. The mean BMI for the whole group was 21.5 ± 3.53 kg/m^2.

The location of the respondents was also taken into account in the study. A total of 55.7% of the respondents lived in an urban area. When analysing the exact structure of the city as a place of residence, most respondents lived in a medium-sized city (n = 337; 19.9%), followed by a very large city (n = 256; 15.1%), a large city (n = 211; 12.4%) and a small city (n = 141; 8.3%). The largest number of respondents attended technical schools (n = 754; 44.5%) and general secondary schools (n = 636; 37.5%). The smallest number of respondents were students from vocational schools (n = 306; 18.0%).

The characteristics of the study participants also included their level of physical activity. The largest number of respondents (n = 589; 34.5%) reported doing about 1 hour of physical activity per day. Slightly fewer respondents (n = 459; 27.1%) spent about 30 minutes on physical activity. Only 7.8% of the students (n = 132) had a very high level of physical activity, i.e. they spent more than 2 hours per day on physical activity.

Another aspect included in the group characteristics was the diagnosis of eating disorders. Only 3.4% of the students surveyed admitted to having an eating disorder

(n = 58). The remaining respondents (n = 1,638; 96.6%) denied the presence of such conditions. Respondents were asked about the presence of other chronic diseases. A total of 87.2% (n = 1,479) of the students denied having a chronic disease, while the remaining respondents (n = 217, 12.8%) admitted to having one.

The study also looked at the financial status of the respondents' families, the presence of siblings and the level of education of the father and mother (Table 2).

Table 1. **Baseline metrics of the study group**

Variables	$X \pm SD$	Minimum	Maximum
Age [years]	16.9 ± 2.44	15	19
Body weight [kg]	62.7 ± 13.31	34	142
Body height [cm]	170.3 ± 9.28	135	202
BMI [kg/m^2]	21.5 ± 3.53	13.1	42.8

Table 2. **Characteristics of the study group by gender**

Variables	Total *n*;%	Gender		*p*-value
		Women *n*; % 1,064; 62.7%	Men *n*; % 632; 37.3%	
Age (years)				
15	349; 20.6%	211; 19.8%	138; 21.8%	0.44*
16	427; 25.2%	256; 24.1%	171; 27.1%	
17	352; 20.7%	210; 19.7%	142; 22.5%	
18	324; 19.1%	222; 20.9%	102; 16.1%	
19	244; 14.4%	165; 15.5%	79; 12.5%	
Place of residence				
Village	751; 44.3%	445; 41.8%	306; 48.4%	0.07*
Small town (up to 20,000 inhabitants)	141; 8.3%	98; 9.2%	43; 6.8%	
Medium town (20,000 to 60,000 inhabitants)	337; 19.9%	214; 20.1%	123; 19.5%	
Large city (60,000 to 100,000 inhabitants)	211;12.4%	140; 13.2%	71; 11.2%	
Very large city (100,000 inhabitants and more)	256; 15.1%	167; 15.7%	89; 14.1%	

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Variables	Total *n*;%	Gender		*p*-value
		Women *n*; % 1,064; 62.7%	Men *n*; % 632; 37.3%	
Type of school				
Vocational school	306; 18%	113; 10.6%	193; 30.5%	<0.0001*
Technical school	754; 44.5%	441; 41.4%	313; 49.5%	
Secondary high school	636; 37.5%	510; 47.9%	126; 19.9%	
Physical activity				
Very low (<15 min per day)	323; 19%	245; 23.0%	78; 12.3%	<0.0001*
Low (15-30 min per day)	459; 27.1%	328; 30.8%	131; 20.7%	
Good (31-60 min per day)	589; 34.7%	356; 33.5%	233; 36.9%	
High (61-120 min per day)	193; 11.4%	95; 8.9%	98; 15.5%	
Very high (>120 min per day)	132; 7.8%	40; 3.8%	92; 14.6%	
Diagnosed eating disorders				
No	1638; 96.6%	1014; 95.3%	624; 98.7%	0.0002**
Yes	58; 3.4%	50; 4.7%	3; 0.5%	
Presence of chronic illness				
No	1479; 87.2%	887; 83.4%	592; 93.8%	<0.0001*
Yes	217; 12.8%	177; 16.6%	39; 6.2%	
Economic status of the family				
Poor	20; 1.2%	12; 1.1%	8; 1.3%	0.31*
Fair	268; 15.8%	176; 16.5	92; 14.6%	
Good	1061; 62.6%	648; 60.9%	413; 65.3%	
Very good	347; 20.4%	228; 21.4%	119; 18.8%	
Having siblings				
No siblings	245; 14.4%	152; 14.3%	93; 14.7%	0.07*
1 sister or 1 brother	764; 45%	479; 45.0%	285; 45.1%	
2 siblings	394; 23.3%	265; 24.9%	129; 20.4%	
3 or more siblings	293; 17.3%	168; 15.8%	125; 19.8%	

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Variables	Total *n*;%	Gender		*p*-value
		Women *n*; % 1,064; 62.7%	Men *n*; % 632; 37.3%	
Mother's education				
Primary	52; 3.1%	31; 2.9%	21; 3.3%	0.0029*
Vocational	401; 23.6%	254; 23.9%	147; 23.3%	
Secondary	476; 28.1%	314; 29.5%	162; 25.6%	
Higher	543; 32%	352; 33.1%	191; 30.2%	
Do not know	186; 11%	95; 8.9%	91; 14.4%	
Not applicable	38; 2.2%	18; 1.7%	20; 3.2%	
Father's education				
Primary	55; 3.2%	29; 2.7%	26; 4.1%	0.06*
Vocational	586; 34.6%	373; 35.1%	213; 33.7%	
Secondary	434; 25.6%	287; 27.0%	147; 23.3%	
Higher	317; 18.7%	203; 19.1%	114; 18.0%	
Do not know	234; 13.8%	135; 12.7%	99; 15.7%	
Not applicable	70; 4.1%	37; 3.5%	33; 5.2%	

* χ^2 test

** Fisher's test

The frequency of consumption of specific inedible substances is shown in Table 3. A total of 3.2% of respondents admitted to consuming starch in the form of paper, tissue paper, raw flour, etc. A small percentage of respondents admitted to eating soil or glass particles (0.4% and 0.2% of respondents, respectively).

Among all the substances listed, the largest number of respondents admitted to eating nasal secretions, totalling 5.7%. This characteristic was not significantly related to gender. In turn, 1.4% of respondents (n = 24) reported eating hair. A total of 5.8% of respondents (n = 99) met the diagnostic time criterion, i.e. the consumption of specific non-nutritive and non-edible substances lasted for at least one month. This was reported by 6.8% of women and 4.3% of men. Detailed data on specific non-nutritive substances and the time criterion are presented in Table 3.

Table 3. **Diagnostic criteria for pica and selected aspects of the clinical presentation of the disorder according to gender**

Diagnostic criterion/disease pattern	Yes/No	Total *n*; %	Gender		*p*-value
			Women *n*; %	Men *n*; %	
Eating starch (paper, tissue paper, raw flour, etc.)	Yes	55; 3.2%	33; 3.1%	22; 3.5%	0.67*
	No	1641; 96.8%	1031; 96.9%	610; 96.5%	
Eating soil	Yes	7; 0.4%	2; 0.2%	5; 0.8%	0.11**
	No	1689; 99.6%	1062; 99.8%	627; 99.2%	
Eating glass particles	Yes	4; 0.2%	0; 0%	4; 0.6%	0.0192**
	No	1692; 99.8%	1064; 100%	628; 99.4%	
Eating stones and/or pebbles	Yes	5; 0.3%	3; 0.3%	2; 0.3%	0.99**
	No	1691; 99.7%	1061; 99.7%	630; 99.7%	
Eating nasal discharge	Yes	96; 5.7%	59; 5.6%	37; 5.9%	0.82*
	No	1579; 94.3%	989; 94.4%	590; 94.1%	
Eating hair	Yes	24; 1.4%	18; 1.7%	6; 0.9%	0.29**
	No	1672; 98.6%	1046; 98.3%	626; 99.1%	
Eating wood	Yes	15; 0.9%	9; 0.8%	6; 0.9%	0.79**
	No	1681; 99.1%	1055; 99.2%	626; 99.1%	
Eating specified non-nutritive substances for at least one month	Yes	99; 5.8%	72; 6.8%	27; 4.3%	0.034*
	No	1597; 94.2%	992; 93.2%	605; 95.7%	

*χ^2 test

** Fisher's test

The use of non-edible substances resulted in the need for specialist medical advice (e.g. surgery or gastroenterology) for 1.5% of all respondents who reported such use. Taking into account the gender of the respondents, 4.2% of men reporting disturbed appetite had such a consultation, while 100% of women denied having one (Figure 1).

According to the responses, it is possible to diagnose a distorted appetite (pica) in 5.7% of respondents, including 6.6% of women and 4.3% of men ($p = 0.048$) (Table 4).

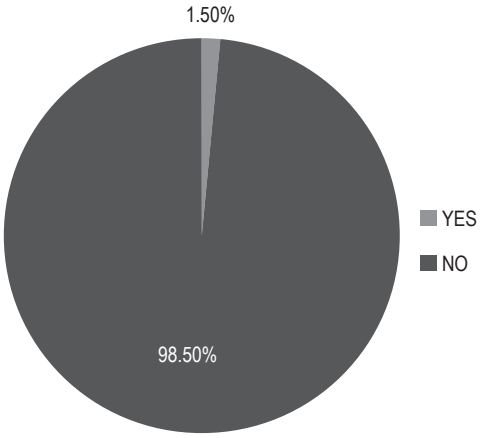

Figure 1. **Need for specialist consultation (surgery, gastroenterology, etc.) due to consumption of non-nutritive substances**

Table 4. **Possible diagnosis of pica based on diagnostic criteria**

Diagnosis	Yes/No	Total *n*; %	Gender		*p*-value
			Women *n*; %	Men *n*; %	
Fulfilment of diagnostic criteria for disturbed appetite (pica)	Yes	97; 5.7%	70; 6.6%	27; 4.3%	0.048*
	No	1,599; 94.3%	994; 93.4%	605; 95.7%	

*χ^2 test

Among those with a possible diagnosis of pica, 67% of respondents (n = 65) reported abusing psychoactive substances. School stress >90th percentile characterised 26.8% of respondents meeting diagnostic criteria for pica and 8.5% of respondents not meeting the criteria. As many as 71.1% of respondents with symptoms of distorted appetite were characterised by the occurrence of self-injurious behaviour. In this group, 39.2% admitted to having had suicidal thoughts in the past or at the time of the study, and 25.8% admitted to having a past suicide attempt. No statistical significance was found for family distress >90th percentile in the group of respondents meeting diagnostic criteria for pica and those not meeting these criteria (Table 5).

Table 5. **Possible diagnosis of pica with selected variables**

Variables	Category	Total *n*; %	Possible diagnosis of pica		*p*-value
			Yes *n*; %	No *n*; %	
Substance abuse	Yes	815; 48.1%	65; 67.0%	750; 46.9%	0.0001*
	No	881; 51.9%	32; 33.0%	849; 53.1%	

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Variables	Category	Total *n*; %	Possible diagnosis of pica		*p*-value
			Yes *n*; %	No *n*; %	
Stress at school >90th percentile	Yes	159; 9.4%	26; 26.8%	133; 8.5%	<0.0001*
	No	1537; 90.6%	71; 73.2%	1466; 91.5%	
Stress in the family > 90th percentile	Yes	170; 10.0%	12; 12.4%	158; 10.7%	0.61*
	No	1526; 90.0%	85; 87.6%	1441; 89.3%	
Auto-aggressive behaviour in the past or during the study period	Yes	629; 37.1%	69; 71.1%	560; 35.0%	<0.0001*
	No	1067; 62.9%	28; 28.9%	1039; 65.0%	
Suicidal thoughts in the past or during the study period	Yes	235; 13.9%	38; 39.2%	197; 12.3%	<0.0001*
	No	1461; 86.1%	59; 60.8%	1402; 87.7%	
Past suicide attempt	Yes	196; 11.6%	25; 25.8%	171; 10.7%	<0.0001*
	No	1500; 88.4%	72; 74.2%	1428; 89.3%	

* test χ^2

Multivariate logistic regression analysis identified factors that increased the likelihood of developing pica among the students studied. Independent factors that significantly increased the odds of developing pica included place of residence, reported self-harm, the presence of suicidal ideation and high levels of school stress. The odds of developing pica were highest – 3.9 times higher – for those who engaged in self-aggressive behaviour compared to those who did not (OR = 3.88). Respondents living in a very large city were 2.3 times more likely to develop pica than those living in a rural area (OR = 2.263). Detailed data are presented in Table 6.

Table 6. **Factors influencing the development of pica (based on a multivariate logistic regression model)**

Dependent variable – eating disorders	Factor – predictor	OR** (95% CI)	*p*-value
Development of pica disorder	Place of residence		
	(very large city/rural area*)	2.263 (1.30-3.94)	0.0039
	(large city/rural area*)	1.166 (0.57-2.37)	0.67
	(medium town/rural area*)	1.046 (0.55-1.98)	0.89
	(small town/rural area*)	1.658 (0.75-3.67)	0.21
	Self-aggression (yes / no*)	3.88 (2.36-6.38)	<0.0001
	Suicidal thoughts (yes / no*)	1.789 (1.06-3.03)	0.029
	School stress >90th percentile (yes / no*)	1.253 (1.04-1.51)	0.019

*reference group (OR = 1.0)

** OR standardised to variables included in the model

Discussion

No epidemiological data on pica in the Polish population are available in the literature. However, it has been suggested that pica is a significant health problem in countries with very low gross national income, especially in Africa and Asia [23-25]. Our study showed that pica occurred in 5.7% of all adolescents surveyed. It was found to be more common among girls than boys, but the differences were not statistically significant. The most commonly ingested non-nutritive substances were nasal secretions (5.7% overall), starch in the form of paper, tissue paper or raw flour (3.2%) and hair (1.4%). Nasal secretions and starch were eaten more often by boys, while hair was eaten more often by girls. Other inedible substances were consumed by less than 1% of respondents.

A particularly interesting aspect of pica appears to be the ingestion of nasal secretions, which may have both a compulsive aetiology and potential biological significance. While this behaviour is commonly regarded as a habit arising from boredom or a mechanism for emotional regulation, certain hypotheses suggest that it may contribute to immune system modulation. According to studies [5, 15, 24], exposure of the gastrointestinal tract to pathogens present in nasal mucus may facilitate immunological priming through mechanisms analogous to vaccination. This theory aligns with the hygiene hypothesis, which postulates that limited early-life exposure to microbial antigens increases susceptibility to autoimmune disorders and allergic conditions [25]. Furthermore, nasal mucus contains lysozyme and other antimicrobial enzymes, suggesting that its ingestion may not be inherently detrimental from a physiological standpoint. Research findings [14, 27, 28] indicate that this behaviour is prevalent among children, potentially implying an evolutionary adaptive function. However, there is currently insufficient empirical evidence to substantiate the purported immunological benefits of this practice. Further studies are warranted to elucidate whether this phenomenon constitutes merely a compulsive behaviour or serves a specific biological function.

The results of our study differ significantly from the study conducted by Ahmed et al. [15] among adolescents in Northern Sudan. They indicated that pica was very common among the adolescents studied (30.7%). In that study, the most common type of pica craving was the consumption of soil (86.4%) and raw flour (1.6%). Even higher prevalence rates of pica have been reported in Zambia (74.4%), Kenya (73.1%) and Uganda (57%). Ahmed et al. [15] showed that pica symptoms were significantly more common in girls than in boys, which was not demonstrated in our study. It seems that cultural context, competition for food and the position of girls and women in the family and society may be important factors in understanding this phenomenon. German and Iranian studies, analogous to our own, found a similar prevalence of distorted appetite in both sexes. However, significant differences were found between the epidemiology of pica among Polish adolescents and German and Iranian adolescents [23-25]. It should be noted that the study groups differed – our study was conducted among general school students, excluding special and preparatory school students and students with mild intellectual disability, whereas the studies by Hartmann et al. [26] and Sadeghzadeh et al. [27] did not apply similar exclusion criteria.

In our study, those who met the diagnostic criteria for distorted appetite were more likely to abuse psychoactive substances, experience greater stress at school, and display a higher incidence of self-aggressive and self-destructive behaviour. This may support the neuropsychiatric and psychosocial theory of the development of pica in humans [28]. The neuropsychiatric theory has been supported by animal studies (rats and cats). Pica has been observed in domestic cats and rats with changes in the amygdala of the brain [29]. In humans, pica has been linked to a deficiency of dopamine, a neurotransmitter involved in mental and emotional processes [28-32]. In addition, distorted appetite has been found in a significant number of patients with dementia, particularly in its more severe stages, supporting a neuropathological basis for the disorder [28, 33].

Psychosocial theories suggest a higher incidence of distorted appetite in individuals with a smaller social support network [34]. It is thought that distorted appetite may serve as a way of relieving stress and coping with difficult emotions. It appears to be associated with self-injurious behaviours, underpinned by a lack of adaptive skills to manage difficulties and regulate emotional states. It should also be noted that suicidal behaviour is more common among those who meet diagnostic criteria for distorted appetite. Full psychiatric assessment of patients with pica disorder is essential, as it may protect this group from severe psychological distress and suicide [34, 35].

The available literature also suggests that addiction plays an important role in the diagnostic and treatment process [36]. Our study showed that individuals with distorted appetite were more likely to abuse psychoactive substances and exhibit a tendency towards addiction. Interestingly, it has been found that many patients continue to consume inedible substances even after the physiological causes of distorted appetite (e.g. nutritional deficiencies) have been addressed. Patients argue that this is due to the habitual consumption of certain substances and the original taste sensations associated with the inedible substances. This appears to suggest the emergence of mechanisms typical of addiction [36, 37]. However, further research is needed in this area, as there is no conclusive data on whether this type of behaviour represents addiction or a learned behavioural pattern.

Ahmed et al. [15] showed that factors such as age, BMI, father's educational level and mother's educational level did not correlate with the prevalence of distorted appetite. In contrast, our study showed that living in a very large city, self-harm, suicidal ideation and high school stress parameters increased the likelihood of pica. Ahmed et al. [15] and Hartmann et al. [26] considered female gender and low father education level as risk factors (which was not confirmed in our research).

Pica is an eating disorder characterised by the compulsive ingestion of products that are not classified as food or that usually require heat treatment. It can be difficult to diagnose and treat because it requires the patient to admit to certain unnatural dietary choices. Particularly at risk are pregnant women, young children, the elderly, individuals with lower economic status and those with intellectual disabilities. It is a condition that may resolve spontaneously, but treatment is essential to eliminate and prevent health consequences. Complications can vary depending on the substances consumed. Treatment must be tailored to the individual and the specific problem. Psychological and psychiatric support is needed in addition to interventions addressing somatic

symptoms. Pica can be associated with several psychiatric disorders, such as autism, schizophrenia or obsessive-compulsive disorder [34, 35]. The information presented so far on pica does not exhaust all the uncertainties; therefore, it is necessary to extend the research and take into account additional variables that affect the incidence of pica.

The results of our study, along with the available literature on pica, indicate the complexity of the issues surrounding this disorder and the frequent psychiatric comorbidity. In light of the above, the findings from our study can contribute not only to a better understanding of eating disorders but also to the development of effective treatments and support for individuals struggling with these problems. However, we acknowledge several limitations of this self-report study. Firstly, it was based on a structured questionnaire; secondly, the authors did not verify the respondents' medical histories against their medical records and therefore relied solely on self-reported data. The study used self-designeded questionnaires, which was due to the lack of standardised tools measuring symptoms of pica, as well as school and family stress, that are adapted to the Polish adolescent population.

The high risk of social desirability bias should also be considered as a significant limitation. We are aware that the subject under study may lead respondents to present themselves in a more positive light than is accurate (a tendency to answer in such a way that the person interpreting the survey does not negatively judge the respondent). Of course, the authors informed participants prior to the survey that the data collected was fully anonymous and that the responses should be given truthfully, without fear of potential judgment regarding certain behaviours. Another limitation is that participants' weight and height were self-reported – the authors did not conduct additional measurements.

In conclusion, 5.7% of respondents met the diagnostic criteria for pica. The most commonly consumed non-nutritive substances were nasal discharge, raw starch and hair. Independent factors associated with an increased risk of pica included living in a city, the presence of self-aggressive behaviour, suicidal ideation and high levels of stress at school. Future research should shed more light on the causes of this disorder and explore the implications of these findings across different age groups.

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