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Prevalence and recurrence of pica behaviors in early childhood within the ALSPAC birth cohort

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Abstract

Objective: The present study examined prevalence and correlates of pica behaviors during childhood using data from the Avon Longitudinal Study of Parents and Children (ALSPAC) study.

Method: Data on 10,109 caregivers from the ALSPAC study who reported pica behavior at 36, 54, 65, 77, and 115 months on their child were included. Autism was obtained through clinical and education records, while DD was derived from the Denver Developmental Screening Test.

Results: A total of 312 parents (3.08%) reported pica behaviors in their child. Of these, 19.55% reported pica at least at two waves ($n = 61$). Pica was most common at 36 months ($N = 226$; 2.29%) and decreased as children aged. A significant association was found between pica and autism at all five waves ($p < .001$). There was a significant relationship between pica and DD, with individuals with DD more likely to experience pica than those without DD at 36 ($p = .01$), and 54 ($p < .001$), 65 ($p = .04$), 77 ($p < .001$), and 115 months ($p = .006$). Exploratory analyses examined pica behaviors with broader eating difficulties and child body mass index.

Discussion: This study enhances understanding of childhood pica behaviors, addressing a significant gap in knowledge. Pica occurrence in the general population is poorly understood due to few epidemiological studies. Findings from the present study indicate pica is an uncommon behavior in childhood; however, children with

DD or autism may benefit from pica screening and diagnosis between ages 36 and 115 months. Children who exhibit undereating, overeating, and food fussiness may also engage in pica behaviors.

KEYWORDS
ALSPAC, autism, developmental delay, eating disorder, pica

1 | INTRODUCTION

Pica is a feeding and eating disorder in DSM-5, and is defined as recurrent intake of non-nutritive, non-food substances (e.g., paper, soap) for at least 1 month, is inappropriate to the developmental stage of the individual, occurs outside of cultural norms, and occurs in the absence of another mental or physical condition (American Psychiatric Association, 2013). Pica is relatively understudied; however, individuals who experience pica frequently have adverse health and psychosocial outcomes (APA, 2013). Individuals with pica are at increased risk of significant medical consequences linked to dental enamel erosion, infection, intoxication (e.g., lead intoxication due to eating paint), anemia, and gastrointestinal obstruction from ingested non-food substances (APA, 2013; Ruddock, 1924). In addition to significant medical risks, pica is associated with diminished psychosocial well-being, specifically a lack of strong and supportive relationships with family, and less social contact (Ashworth et al., 2009).

Pica can occur at any point in life, with onset most commonly during childhood (APA, 2013). Common co-occurrences with pica include autism and developmental delays (DD), including intellectual disabilities (ID) (APA, 2013; Fields et al., 2021). Pica behavior, which involves the consumption of non-nutritive foods, differs from a formal pica diagnosis, which is based on the diagnostic criteria outlined in the DSM-V. Fields et al. (2021) assessed pica in children 30–68 months of age and found 3.5% of population-based controls reported pica behavior. Roughly 0.3%–25% of children with IDs demonstrated pica behavior, while 14%–36% of children with autism have shown pica behavior (Ali, 2001; Fields et al., 2021; LoVullo & Matson, 2009). Pica behaviors have been reported in 28% of children with autism and ID (Fields et al., 2021).

Furthermore, environmental factors have been demonstrated to influence pica behaviors. For instance, children from lower socioeconomic backgrounds are more likely to develop pica (Leung & Hon, 2019; Rose et al., 2000). Additionally, stressful events, parental neglect, low parent involvement, and child abuse have been positively associated with pica occurrence in children (Singhi et al., 1981). These findings highlight the importance of environmental variables that may contribute to or be associated with pica occurrence.

There is not one single, central theory that elucidates pica behavior in children, rather several theories have been proposed to explain the initiation and occurrence of pica behaviors (Rose et al., 2000). Of these, nutritional theories attribute pica behavior to specific deficiencies in certain minerals such as iron (Sayetta, 1986). This theory proposes that people with deficiencies in specific minerals might develop cravings for non-food items that could address their nutrient deficiencies (Sayetta, 1986). The sensory and physiologic theories of pica indicate that individuals prefer non-food items because they enjoy the taste, texture, or smell of the item (Sayetta, 1986). Finally, psychosocial theories posit that pica emerges because of family stress, lowered social support, and high stress (Sayetta, 1986). According to this theory, pica behavior serves to alleviate stress. Each of these theories may play a role in understanding the complex etiology of pica behaviors (Rose et al., 2000). Intellectual disability and developmental delays have been associated with motor and sensory differences, and some children with DD may not understand the difference between edible and inedible items (Autism Speaks Canada, 2020; Provost et al., 2010). Mayes and Zickgraf (2019) observed that pica was one aspect of a pattern of divergent eating behaviors, including picky eating and hypersensitivity to textures of food in children with autism.

Pica, as a feeding disorder, remains an understudied phenomenon in childhood. Our primary interest in exploring the associations between pica and other feeding behaviors such as food fussiness, overeating, and undereating is rooted in the need to shed light on the broader landscape of atypical feeding behaviors during child development. While sensory preferences have been linked to the emergence of food fussiness in young children (Mudholkar et al., 2022; Steinsbekk et al., 2017), the relationship between these factors and pica in children is still relatively uncharted. The primary reason we investigated food fussiness, overeating, undereating, and BMI in relation to pica is that these domains have been implicated as correlates for other feeding and eating disorders, such as previous findings that point to food fussiness as a precursor for anorexia nervosa in ALSPAC children (Herle et al., 2020). As such, it is important to understand whether pica behaviors in children are correlated with other eating behaviors such as food fussiness, overeating, and undereating. These exploratory aims provide a more comprehensive understanding of pica within the context of childhood feeding disorders.

Notable gaps in pica research exist. First, the extent of pica occurrence within community settings is poorly understood because there are few epidemiological studies (Sturmey & Williams, 2016). Of the few studies examining pica prevalence using population-level data, none have examined longitudinal data to investigate how prevalence changes across different developmental stages and persists across development. Our goal was to address this research gap by utilizing prospective data gathered from a population-based cohort to study pica behaviors over time.

Research from the Avon Longitudinal Study of Parents and Children (ALSPAC) has yielded significant findings related to child and

adolescent eating behaviors and eating disorders and, therefore, can provide essential insights into pica. Previous work using data from ALSPAC examined feeding, diet, and growth of children with autism and found differences in feeding symptoms at infancy and a less varied diet (with fewer vegetables, salad, fruit, sweets, and carbonated beverages) at 15 months compared with controls (Emond et al., 2010). This work also reported that children with autism were more likely than controls to report pica behaviors at 38 and 54 months. To date, no studies have examined the stability of pica behaviors throughout childhood using longitudinal prospectively reported data. Other ALSPAC research has assessed eating disorder diagnosis across three time points throughout adolescence but did not include pica (Micali et al., 2017). Furthermore, associations between childhood eating behaviors during the first 10 years of life and eating disorder diagnoses and behaviors at age 16 were observed using ALSPAC self-report and parent-reported data (Herle et al., 2020). However, this work primarily focused on the development of binge-eating behaviors, binge-eating disorder, and anorexia nervosa (Herle et al., 2020), and did not include pica.

The present study reports the prevalence, longitudinal patterns using descriptive data, and correlates of pica behaviors in children in the ALSPAC cohort. We evaluated pica behaviors across five waves, including questionnaires completed by mothers at 36, 54, 65, 77, and 115 months. Additionally, we compared the prevalence of pica between individuals with and without autism and DD. An exploratory aim of the present study was to determine the co-occurrence of pica and child eating behaviors, including food fussiness (the tendency to only consume specific foods with refusal to try new foods; Dovey et al., 2008), overeating, and undereating. Furthermore, we examined if pica behavior is related to child body mass index (BMI).

2 | METHOD

2.1 | Ethical approval

This study involves secondary analysis of data initially collected in the Avon Longitudinal Study of Parents and Children (ALSPAC) study. Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC Ethics and Law Committee at the time. Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees.

2.2 | Participants

All pregnant women living in Avon, UK who were expected to deliver between April 1, 1991, and December 31, 1992, were eligible to participate in the Avon Longitudinal Study of Parents and Children (ALSPAC) study (Boyd et al., 2013; Fraser et al., 2013). ALSPAC is a longitudinal, population-based prospective study of pregnant women and their children. All women provided informed and written consent.

TABLE 1 Participant demographics (n = 14,015).

	n(%)
Child sex at birth	
Male	7241 (51.7)
Female	6774 (48.3)
Ethnicity	
White	11,410 (81.4)
Non-White	605 (4.3)
Socioeconomic status quintiles	
Least deprived	2055 (14.7)
2	1313 (9.4)
3	1313 (9.4)
4	1425 (10.2)
Most deprived	1917 (13.7)

The study website contains details of all the available data through a fully searchable data dictionary and variable search tool. There is no information on reasons for missingness in the data ALSPAC provided. To access, reference the following webpage: http://www.bristol.ac.uk/alspac/researchers/our-data/.

Analysis of the ALSPAC sample was limited to participants in which child sex at birth was reported and where pica data was available in at least two of five waves (n = 14,015) to examine the persistence of pica behaviors over time (defined as pica-reported behaviors at two or more waves; see Table 1).

2.3 | Measures

Pica. At 36, 54, 65, 77, and 115 months, mothers were asked, "How often does the child eat coal, dirt, or other non-nutritious substances?" Response options included "every day," "at least once a week," "less than once a week," and "not at all." Pica behavior in the current study was defined as any respondent option that indicated pica occurred "every day," "at least once a week," and "less than once a week." When examining differences in pica between subgroups, a binary "yes/no" pica variable was created. When mothers answered "yes," to the pica item, they were required to include what the child consumed so that the provider could confirm the parent interpreted the question correctly. This strengthens the validity of the single-item measure.

Early childhood developmental skills. Child development was measured at 30 months using an adapted version of the Denver Developmental Screening Test (DDST-II) (Frankenburg & Dodds, 1967). The DDST-II has been used in ALSPAC to examine early child development (Hameed et al., 2018). The DDST-II examines four categories of development: social skills, fine motor skills, communication, and gross motor skills. As previously stated, children in the 10th percentile were identified as having DD. This definition is not limited to children with intellectual disability but includes those who exhibit a wide range of

developmental concerns, such as motor, language, and social developmental delays. The DDST-II has proven to be a valid indicator of developmental delay using ALSPAC data. This conclusion is drawn from its correlation with maternal reports of development, as demonstrated in the study by Iles-Caven et al. (2016). Questions were adapted to be appropriate to the child's age and were completed by the mother. The 30-month assessment was selected because it preceded the first pica assessment. For analyses in the current study, the total development score at 30 months was recoded into a new variable: those in the 10th percentile (indicating DD) and those outside of the 10th percentile (indicating no DD). Other researchers have used ALSPAC developmental measures to create a binary developmental problems measure using the 10th percentile as a marker for DD (Riglin et al., 2017).

2.4 | Autism

Autism diagnosis derived from a previous ALSPAC study was accessed (Williams et al., 2008). This previous study derived autism diagnosis from clinical and educational records (Williams et al., 2008), and ethical approval for this was obtained from the ALSPAC Law and Ethics committee and local research ethics committees (NHS Haydock REC: 10/H1010/70). At age 18, study children were sent "fair processing" materials describing ALSPAC's intended use of their health and administrative records. They were given clear means to consent or object via a written form. Data were not extracted for participants who objected or were not sent fair processing materials.

2.5 | Eating behaviors

Emmett and Taylor (2022) have acknowledged the importance of utilizing ALSPAC data to further understanding and correlates of food fussiness and picky eating in children. Mothers answered items regarding child eating behaviors: food fussiness, overeating, and undereating. Food fussiness was measured at each of the five waves (36, 54, 65, 77, and 115 months) included in this study. Three items measured food fussiness: (1) "How worried are you because your child is choosy," (2) "How worried are you because your child has feeding difficulties," and (3) "How worried are you because your child is refusing food." Respondents were instructed to answer these items with the following options: "no/did not happen," "not worried," "a bit worried," and "greatly worried." Overeating was measured using a single item: "How worried are you that your child is overeating?" Similarly, undereating was captured with a single item: "How worried are you because your child is undereating?" Both items contained the same answer options: "yes, very worried," "yes, a bit worried," "yes, not worried," and "no, didn't happen." Dichotomous variables were created for food fussiness, overeating, and undereating at all five waves. Individuals who selected any of the following answer options: "yes, very worried," "yes, bit worried,"

"yes, not worried," were coded as 1. Those who selected "no, didn't happen" were coded as 0. A total food fussiness variable was derived from selecting any confirmed food fussiness (i.e., any response of "yes, very worried," "yes, a bit worried," "yes, not worried") on any of the three food fussiness variables. The variables used to obtain data on eating behaviors is akin to a behavior checklist (not a clinical questionnaire). Therefore, validity and reliability have not been ascertained.

2.6 | Child body mass index (BMI) Z-Scores

Child BMI data were collected at 37, 49, 61, 102, and 120 months. Height measurements were taken without shoes and recorded to the nearest millimeter. Weight measurements were measured and rounded to the nearest 0.1 kg. Both of these measurements were taken in clinic for all timepoints, except the 115 month timepoint, which was derived from parent report. BMI was calculated using kilograms per square meter (kg/m^2). BMI z-scores were used to examine the relationship between BMI and pica. To determine if pica behaviors predict child BMI, a linear regression was conducted for months 36, 54, and 66. Because of fewer pica cases in months 77 and 115, comparisons were made using independent samples t-tests to examine if there were significant differences in BMI z-scores between children who reported pica behaviors and those who had not reported pica behaviors.

2.7 | Data analysis

First, to understand the stability of pica behaviors from age 36–120 months, we analyzed the prevalence of pica across the five waves where pica was available to better understand pica prevalence over time. We conceptualized stability following previous work (Baca-Garcia et al., 2007), and examined the proportion of individuals who had pica prevalence at multiple time points. Next, we compared differences in the presence of pica behaviors between participants based on sex (male/female), those with and without autism, and those with and without a DD (defined as below the 10th percentile of the total development score at 30 months). Chi-square or Fisher's exact tests were conducted for categorical data; Fisher's exact test was used when any expected cell count was less than 5. Alpha values were set at .05. Because these analyses were exploratory, no adjustment was made for multiple comparison testing (Althouse, 2016; Bender & Lange, 2001; Cipriani et al., 2015). This should be considered when interpreting findings.

3 | RESULTS

In presenting the following study findings, it is important to note that the statistical analyses were not adjusted for the potential inflation of p-values due to multiple tests conducted.

TABLE 2 Pica prevalence across five data collection waves.

	Pica waves				
	36 months n/N (%; 95 CI)	54 months n/N (%; 95 CI)	65 months n/N (%; 95 CI)	77 months n/N (%; 95 CI)	115 months n/N (%; 95 CI)
Overall prevalence	226/9881 (2.29; 2.0–2.6%)	74/9497 (0.78%; 0.6–1.0%)	54/8758 (0.62%; 0.5–0.8%)	46/8361 (0.55%; 0.4–0.7%)	25/7650 (0.33%; 0.2–0.5%)
Male sex at birth	119/5097 (2.33%)	38/4909 (0.77%)	29/4515 (0.64%)	25/4296 (0.58%)	19/3875 (0.49%)
Female sex at birth	107/4784 (2.24%)	37/4588 (0.81%)	25/4243 (0.59%)	21/4065 (0.52%)	6/3775 (0.16%)
Autism present	8/64 (12.5%)	7/63 (11.11%)	6/59 (10.17%)	8/59 (13.6%)	6/56 (10.71%)
Autism not present	218/9802 (2.22%)	66/9418 (0.70%)	48/8684 (0.55%)	38/8290 (0.46%)	19/7584 (0.25%)
DD present	28/794 (3.53%)	14/775 (1.81%)	9/773 (1.16%)	11/695 (1.60%)	6/615 (0.98%)
DD not present	150/7198 (2.08%)	39/6980 (0.55%)	27/6510 (0.41%)	24/6254 (0.38%)	12/5662 (0.21%)

Note: n is cases, N is total sample.
Abbreviations: CI, confidence interval; DD is developmental delay.

3.1 | Pica prevalence across five waves

Pica prevalence was the highest at 36 months ($N = 226$; 2.29%) and decreased in prevalence across childhood, including 54 (0.78%), 65 (0.62%), 77 (0.55%), and 115 months (0.33%; see Table 2). To see the breakdown of how parents answered the pica item at each time point, see Table SA.

3.2 | Pica associations with sex at birth

Chi-square goodness of fit analyses were used to determine the relationship between pica and sex at birth (female/male). There was a significant relationship between pica and child sex at birth at 115 months; the prevalence of pica was greater in males than females (0.49% vs. 0.18%), X^2 (1, $N = 6330$) $= 6.01$, $p = .01$). No associations in pica behaviors were observed between male or female sex at 36, 54, 65, or 77 months (see Table SB). Odds ratios (OR) were calculated to assess the association between pica and sex at birth. At 115 months, the odds ratio was 3.11 (95% CI 2.45, 4.89), indicating a statistically significant association between pica and sex at birth in the ALSPAC sample. Specifically, males were about 3.11 times more likely to exhibit pica compared to females at 115 months.

3.3 | Pica associations with autism

Fisher's exact test was applied to determine if pica presence was associated with autism diagnosis. A significant association was found between pica and autism at all five waves with pica being more prevalent in autistic children ($p < .001$) (see Table 2). Odds ratios (OR) were calculated to assess the association between pica and autism across the five timepoints. The odds ratios were found to be 6.31 (95% CI 4.07, 11.16) at 36 months; 20.63 (95% CI 19.69, 31.77) at 54 months; 20.33 (95% CI 18.70, 32.87) at 65 months; 34.05 (95% CI 26.62, 44.79) at 77 months; and 47.78 CI 24.24, 76, 15) at 115 months.

These results indicate a statistically significant positive association between pica behaviors and autism diagnosis at all time points (see Table SB).

3.4 | Pica associations with DD

Both chi-square goodness of fit and Fisher's exact test were used to examine the relationship between pica and DD at each of the five waves. Fisher's exact test was used at months 65, 77, and 115 when the expected cell count violated the assumption of 5 or greater needed for chi-square. There was a significant relationship between pica and DD, with individuals who had DD more likely to experience pica than those without DD at 36 months, X^2 (1, $N = 7992$) $= 6.83$, $p = .01$, and 54 months, X^2 (1, $N = 7755$) $= 16.00$, $p < .001$. Fisher's exact test indicated significant relationships between pica and DD at 65 ($p = .04$), 77 ($p < .001$), and 115 months ($p = .006$). Chi-square goodness of fit was run to examine differences between children with autism and those with co-occurring autism and DD on pica behaviors across all five time points. No significant differences were observed between the two groups (see Table SB).

Odds ratios were calculated to determine the strength and direction of the association between pica and DD across all five timepoints. At 36 months, the odds ratio for the association of DD and pica was 49.29 (95% CI 46.55, 52.15), indicating a strong and statistically significant association. Children at 36 months with no DD were 49.29 times more likely to exhibit pica compared to those with DD in ALSPAC. The odds ratio between pica and DD was calculated to be 25.40 (95% CI 24.58, 26.29), indicating a strong association at 54 months. This indicates that children with no DD were 25.40 times more likely to exhibit pica compared to those with DD in ALSPAC. At 65 months, the odds ratio for the association between pica and DD was 37.11 (95% CI 33.28, 40.03). Individuals with DD were 37.11 times less likely to exhibit pica compared to those without DD. Finally, the odds ratio for the relationship between DD and pica was calculated at 115 months, with an odds ratio of 18.54 (95% CI

TABLE 3 Longitudinal stability of pica.

	Number of assessment waves pica persisted			
	1 wave	2 waves	3 waves	4 or more waves[a]
Frequencies	251	41	12	8

Note: This table presents the number of assessment waves an individual reported pica behavior.
[a]In accordance with ALSPAC's requirements not to allow cell counts <5, "4 waves" and "5 waves" categories were combined into "4 or more waves".

TABLE 4 Associations between sex, child eating behaviors, and pica at 36, 54, 65, 77, and 115 months.

Odds ratio (95% CI)				X^2	
	36 months	54 months	65 months	77 months	115 months
Sex (female)	0.93 (0.71–1.22) $p = .74$	1.02 (0.64–1.63) $p = .95$	0.96 (0.56–1.65) $p = .75$	0.16 $p = .70$	6.45[b] $p = .01$
Child eating behaviors					
Food fussiness	1.14 (0.76–1.70) $p = .53$	0.45 (0.25–0.83)[b] $p = .01$	1.62 (0.72–3.64) $p = .25$	2.47 $p = .12$	0.50 $p = .5$
Undereating	2.04 (1.50–2.78)[b] $p < .001$	2.07 (1.24–3.47)[b] $p = .01$	1.21 (0.63–2.34) $p = .57$	0.00 $p = .99$	12.74[b] $p < .001$
Overeating	1.48 (1.08–2.04)[b] $p = .01$	1.74 (1.02–2.96)[a] $p = .04$	1.65 (0.86–3.15) $p = .13$	1.60 $p = .21$	4.24[a] $p = .04$

Abbreviation: CI, confidence interval.
[a]Significant at the ≤.05 level.
[b]Significant at the ≤.01 level.

15.82, 21.60). Children with DD were 18.54 times less likely to exhibit pica compared to those without DD in our study sample.

3.5 | Longitudinal stability of pica

A total of 312 (3.08%) parents reported pica behaviors in their child. Of these, 19.55% reported pica at least at two waves ($n = 61$) (Table 3). Pica onset was most common at 36 months ($N = 226$; 2.29%) and decreased in prevalence across childhood (See Table 2). A total of 24 participants (0.24%) reported pica at 115 months (Time 5). Nine individuals reported pica at 36 months and again at 115 months but did not report pica behaviors at 54, 65, or 77 months. This indicates that pica behaviors persisted over 6.5 years (from 36 months to 115 months) and fluctuated (did not report pica at all 5 waves) for 9 out of 61 individuals (14.75%). Of children who reported pica at 3 or more time points ($n = 20$), 9 had DD, 5 had autism, and <5 had both autism and DD.

3.6 | Co-occurring features

3.6.1 | Association of Pica with other eating behaviors and BMI

Logistic regression models were conducted to examine the relationship between food fussiness, overeating, and undereating with pica behaviors at 36, 54, and 65 months. These models controlled for child sex at birth. Of these behaviors, undereating and overeating were significantly associated with pica at 36 months. All three behaviors (food fussiness, overeating, and undereating) were significantly associated with pica at 54 months. None of the three eating behaviors were significantly associated with pica at 65 months. Because pica cases decreased over time, we were not sufficiently powered to run logistic regression at later waves (77 and 115 months). As such, chi-square goodness of fit or Fisher's tests were used at 77 and 115 months to examine the relationship between these eating behaviors and pica. Chi-square goodness of fit tests indicated overeating, undereating, and food fussiness were not significantly related to pica at 77 months. Both overeating X^2 (1, $N = 5824$) $= 4.24$, $p = .04$, and undereating $p < .001$ were significantly associated with pica at 115 months (see Table 4).

3.6.2 | Child BMI and pica behavior

Results from linear regression models at 36, 54, and 65 months indicated no statistically significant association between pica behavior and child BMI. Similarly, independent samples t-tests indicated no significant difference in BMI between children with and without pica behavior at 77 (pica BMI z-score $= .1389$ ($n = 35$), no pica behavior BMI z-score $= .1242$ ($n = 6378$), $p = .47$) and 115 months (pica BMI z-score $= -.1659$ ($n = 11$), no pica behavior BMI z-score $= -.0015$ ($n = 3827$), $p = .22$).

4 | DISCUSSION

In the ALSPAC cohort pica behavior was reported by mothers in 2.3% of their children at 36 months and the behavior became less common as children aged. Sex differences in pica behavior prevalence were not present early in development but a significant difference emerged at 115 months when pica behaviors were reported to be more common in males. We observed significant associations of pica behavior with autism and with DD at all waves of data collection. Of children who experienced pica behavior at any time point, 20% had recurrent pica behavior (i.e., pica behavior was reported in at least one other time point). Lastly, we examined the relationship between pica prevalence and child BMI and child eating behaviors (food fussiness and undereating/overeating). Pica behavior was found to be associated with increased likelihood of broader eating difficulties such as undereating, overeating, and food fussiness. No associations were observed between the presence of pica behavior and child BMI.

The prevalence of pica behavior within the ALSPAC cohort is lower than that reported in adults (5.5% of adults; Hartmann et al., 2022), but broadly similar to that reported in other samples of children (3.5%; in the population-based control group; Fields et al., 2021). The higher percentage of adults endorsing pica behaviors reported by Hartmann et al. (2022) may be explained by differences in pica measurement. In the present study, pica frequencies are reported by the child's caregiver, who observed pica behavior over the five time points assessed. In contrast, Hartmann et al. used a 7-point Likert scale where 0 indicated "never true," and six indicated "always true." Pica behavior was defined as any respondent who endorsed 1–6 on this Likert scale. Pica measurement used in Hartmann et al. (2022) may have led to higher pica reports since scores of 1–3 reflected subthreshold pica behaviors (where 0 is no pica and scores of 4–7 indicate pica).

The present study observed no evidence for a consistent significant association between sex at birth and pica behaviors at the majority of waves. Only at 115 months (age 9) were males more likely than females to exhibit pica behaviors, and it should be noted that the prevalence difference was small (age 9, 0.49% in males vs. 0.16% in females). These findings do not align with those reported by Fields et al. (2021), who examined children in children aged 7–14 years old with autism, other developmental disabilities, and general population-based controls and found significant differences in pica between males and females ages 48–68 months.

Further, significantly more caregivers of male children than female children ages 7–14 years old reported pica prevalence, and caregivers of male children reported higher frequencies of pica (selection of "often or greater" in response to "I like to eat things that are not meant for eating" item on the Eating Disorders in Youth Questionnaire (EDY-Q; Hilbert & van Dyck, 2016). The present study also observed significantly more males than females engaging in pica behaviors at age 9. Longitudinal research is needed to understand when sex differences emerge among children ages 3–14 years old using population-level data. Additional research that covers a wider range of ages could facilitate a better understanding of who is most at-risk and the optimal time to intervene.

Autism was associated with pica behaviors across all waves in this study. This association is aligned with other ALSPAC findings, which showed children with autism were more likely than controls to demonstrate pica behavior at 38 and 54 months (Emond et al., 2010). Emond et al. (2010) focused on children with autism and examined ALSPAC time points at 6, 15, 24, 38, and 54 months. The current study expands upon those reported in Emond in that we include all children with pica-reported behaviors in ALSPAC waves through 115 months. This extension improves understanding of which children experience pica behaviors and if those behaviors persist later into childhood. Our study highlights that most pica behaviors occur in children without autism, as evidenced by the ratio of cases at 36 months: 97% of cases occurred in children without an autism diagnosis (175 cases) compared to 6 cases within autistic children. This demonstrates the clinical significance of our findings, as it suggests that although pica is associated with autism diagnosis, most individuals with pica do not receive an autism diagnosis, indicating the presence of pica across different contexts. Our findings highlight that although pica behavior and autism may be associated, pica behaviors can occur outside of autism and developmental disabilities, and that pica is not solely a sub-feature of autism.

In alignment with findings that preschool-aged children with DD did not report elevated pica, current study findings yielded significant associations between DD and pica behaviors across all five waves, such that children with DD were less likely to exhibit pica behaviors (Fields et al., 2021). That said, there are notably different operational definitions of DD in the present study compared to the work of Fields and colleagues, who used a score of <11 on the Social Communication Questionnaire (SCQ), a measure that is a screening tool for autism. We carefully considered the definition of DD to avoid being overly restrictive and to be consistent with how others defined DD using ALSPAC data (Hameed et al., 2018; Riglin et al., 2017). The prevalence of pica in children with DD reported by Fields et al. is similar to that reported in this study (3.2% vs. 3.6%). The 3.6% prevalence of pica at 36 months observed in our study in children with DD is slightly lower than previous estimates of 4%–26% for people with DD (Matson et al., 2013). Again, this is likely explained by the heterogeneity of operational definitions of DD across studies.

Pica behaviors were found to be associated with undereating, overeating, and food fussiness at 36 and 54 months. Identifying these eating behaviors could potentially be a marker of early disordered eating. Previous findings from ALSPAC show that childhood overeating is associated with adolescent binge eating, while undereating and food fussiness in childhood is linked to adolescent anorexia nervosa (Herle et al., 2020). Our results support improved pica screening practices in early childhood (36–54 months) to improve early intervention efforts and potentially mitigate longer-term disordered eating behaviors. One option for screening pica in clinical settings would be the Pica, ARFID, and Rumination Disorder Interview (PARDI; Bryant-Waugh et al., 2019), which is designed for individuals ages 2+ and has demonstrated robust psychometric properties. We did not find evidence that pica behaviors and BMI were associated, similar to findings reported by Hartmann et al. (2022),

who reported no BMI differences in adults who exhibit long-term pica behaviors relative to those who do not. These findings show that children of all sizes, shapes, and weights may exhibit pica behaviors alongside broader eating difficulties, and this is a salient point for primary care providers who are essential to eating disorder screening and detection (Voss, 2022).

Finally, pica behavior persistence (defined as pica occurrence at two or more waves) was observed in 19.55% of cases. Our findings highlight heterogeneity in pica trajectories. For the majority of children, it is a transient behavior; nonetheless, for a significant subset (19.5%), it persists across development. This is the first study to examine pica behavior recurrence from early childhood (36 months; 3 years) through age 115 months (9 years). It is important to note that individuals must be at least 2 years old to be diagnosed with pica (Al Nasser et al., 2022). We examined reports of pica behavior beginning at age 36 months, ensuring that early pica behaviors were captured shortly after the required age of diagnosis. More comprehensive longitudinal studies are needed to understand pica behaviors from early childhood into adulthood. A priority of future research is to investigate if those individuals who are reported by their caregivers to exhibit pica behaviors in childhood also report pica behaviors into adolescence and adulthood and whether there are a developmental points where pica is likely to cease and to recur.

Our study has several noteworthy strengths. The data used in this study were obtained from ALSPAC, considered one of the most detailed population-based cohort studies covering childhood to young adulthood (http://www.bristol.ac.uk/alspac/about/). To our knowledge, the present study is the most extensive prospective investigation of pica behaviors spanning a broad timeframe in childhood using ALSPAC data. This provides greater insight into the longitudinal stability of pica behavior and its association with other co-occurring conditions thereby improving generalizability of findings.

Limitations should also be considered. One limitation is that although we report on pica behaviors, DSM 5 Pica diagnosis could not be derived. Respondent options for indicating pica behavior consisted of "every day," "at least once a week," "less than once a week," and "not at all." Although this provides insight into the presence of pica behaviors, it limits precision of how frequently these behaviors occur within children. For example, a mother who selected "at least once a week" may observe their child eating non-nutritive foods once per week or six times per week. We could not account for the severity of pica behaviors, given the lack of true frequency assessment for pica behaviors within ALSPAC. Furthermore, we could not identify how many children in this sample met diagnostic criteria for pica. Diagnostic considerations for pica that we could not capture with ALSPAC measurement include expectations regarding appropriate eating behavior based on cultural and normative practices, and duration of one or more month.

Future studies using population-level data should consider collecting continuous-level data on pica behaviors to better quantify prevalence. Dinkler and Bryant-Waugh (2021) noted that pica measurements typically include a single screening item and do not examine specific features of pica. Existing single-item screeners typically inquire into the consumption of non-nutritive foods and contain a Likert-scale, such as that found in the Eating Disorders in Youth-Questionnaire (EDY-Q) and Screening Tool of Feeding Problems (STEP) (Hilbert & van Dyck, 2016; Matson & Kuhn, 2001). No screening questionnaires exist that capture all the diagnostic criteria for pica outlined in the DSM-5. In addition to capturing a more specific frequency of pica behaviors, future work could develop a pica measurement that incorporates multiple items, some of which would permit a better understanding of how pica presents and pica phenotypes. What is observed in this study examining pica in childhood may not translate well into pica observed in later developmental periods and adulthood. There are various causes in adulthood, ranging from co-occurrences with anorexia nervosa, pica triggered by pregnancy, or pica because of factitious disorder (APA, 2013). We observed a decrease in pica behaviors as the child aged. It is unclear if this is because pica prevalence naturally decreased with age or if the caregivers spent less time observing children's eating behaviors as the children grew older and became more independent. Finally, as this was an exploratory study, we did not correct for multiple comparisons, and some of the observed differences might have arisen by chance. There are known factors that have been associated with missingness in this dataset (Boyd et al., Cornish et al., 2021; Micali et al., 2017). Namely, lower educational attainment, lower consultation and prescription rates, higher BMI, special education needs, not having asthma, depression, and smoking were associated with lower participation in ALSPAC (Cornish et al., 2021).

Despite the longitudinal design and large sample size of the ALSPAC data, this sample comes from the 8th largest urban area in the United Kingdom which limits generalizability to other populations. Furthermore, there were relatively small cell sizes when examining pica that limited options for statistical analyses. Because of small cell sizes, we were unable to adjust for multiple testing and control for racial or ethnic differences. The sample recruited for ALSPAC was different from the general population of the UK at the time of study launch in two key ways: 1) this sample does not represent less affluent families and those living in rented households, and 2) there are fewer ethnic minority mothers in ALSPAC than in the general population Boyd et al., 2013. Both limitations of the sample reduce the generalizability of study findings. It's important to recognize that the population composition of the UK has changed considerably since the study's launch. However, it is impossible for a cohort study to capture sociodemographic changes that occur after the birth of the cohort.

Furthermore, there were relatively small cell sizes when examining pica that limited options for statistical analyses. Because of small cell sizes, we were unable to adjust for multiple testing and control for racial or ethnic differences. Lastly, it is critical to consider whether pica behavior remains consistent among children born in more recent decades, such as those in the 2020s. We recognize that the factors initiating and maintaining pica behavior in contemporary children may differ from those in earlier generations (children in the ALSPAC cohort we studied were born in the early 1990s). Given the limited body of research on pica and uncertainties surrounding stability of pica

behaviors in childhood, our study contributes to existing knowledge. We hope these findings will serve as a valuable reference for present and future investigations, especially those collecting data on pica in contemporary cohorts. Understanding how pica behavior manifests in today's children can illustrate evolving trends and inform interventions and prevention strategies.

5 | CONCLUSION

This study provides critical information for clinicians to recognize and screen for pica in early childhood regardless of child BMI. Furthermore, providers could screen for pica behaviors in children with autism as pica prevalence was higher (although clearly not limited to) this group. Ultimately, more tailored and effective diagnostic and treatment options can be developed or adapted through improved understanding of how pica behaviors present and persist throughout the lifespan and its co-occurring conditions.

AUTHOR CONTRIBUTIONS

Natalie M. Papini: Formal analysis; investigation; project administration; writing – original draft; writing – review and editing. **Cynthia M. Bulik:** Supervision; writing – review and editing. **Samuel J. R. A. Chawner:** Conceptualization; data curation; formal analysis; funding acquisition; investigation; project administration; resources; supervision; writing – review and editing. **Nadia Micali:** Conceptualization; supervision; writing – review and editing.

DATA AVAILABILITY STATEMENT

This study was a re-analysis of existing data, which is available at the location cited in the reference section. Full details of how the data were obtained are available in the documentation available at https://www.bristol.ac.uk/alspac/researchers/our-data/

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REFERENCES

Al Nasser, Y., Muco, E., & Alsaad, A. J. (2022). StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.

Ali, Z. (2001). Pica in people with intellectual disability: A literature review of aetiology, epidemiology, and complications. *Journal of Intellectual and Developmental Disability*, *26*(3), 205–215.

Althouse, A. D. (2016). Adjust for multiple comparisons? It's not that simple. *The Annals of Thoracic Surgery*, *101*(5), 1644–1645.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). American Psychiatric Association.

Ashworth, M., Hirdes, J. P., & Martin, L. (2009). The social and recreational characteristics of adults with intellectual disability and pica living in institutions. *Research in Developmental Disabilities*, *30*(3), 512–520.

Autism Speaks Canada. (2020). *Guides to pica for parents and professionals*. Retrieved from https://www.autismspeaks.ca/science-services-resources/resources/tool-kits/guides-to-pica-for-parents-and-professionals/

Baca-Garcia, E., Perez-Rodriguez, M. M., Basurte-Villamor, I., del Moral, A. L. F., Jimenez-Arriero, M. A., de Rivera, J. L. G., ... Oquendo, M. A. (2007). Diagnostic stability of psychiatric disorders in clinical practice. *The British Journal of Psychiatry*, *190*(3), 210–216.

Bender, R., & Lange, S. (2001). Adjusting for multiple testing—When and how? *Journal of Clinical Epidemiology*, *54*(4), 343–349.

Boyd, A., Golding, J., Macleod, J., Lawlor, D. A., Fraser, A., Henderson, J., Molloy, L., Ness, A., Ring, S., & Davey, S. G. (2013). Cohort profile: The 'children of the 90s'; the index offspring of the Avon longitudinal study of parents and children (ALSPAC). *International Journal of Epidemiology*, *42*, 111–127.

Bryant-Waugh, R., Micali, N., Cooke, L., Lawson, E. A., Eddy, K. T., & Thomas, J. J. (2019). Development of the Pica, ARFID, and Rumination Disorder Interview, a multi-informant, semi-structured interview of feeding disorders across the lifespan: A pilot study for ages 10–22. *International Journal of Eating Disorders*, *52*(4), 378–387.

Cipriani, V., Quartilho, A., Bunce, C., Freemantle, N., & Doré, C. J. (2015). Ophthalmic statistics note 7: Multiple hypothesis testing—To adjust or not to adjust. *British Journal of Ophthalmology*, *99*(9), 1155–1157.

Cornish, R. P., Macleod, J., Boyd, A., & Tilling, K. (2021). Factors associated with participation over time in the Avon longitudinal study of parents and children: A study using linked education and primary care data. *International Journal of Epidemiology*, *50*(1), 293–302.

Dinkler, L., & Bryant-Waugh, R. (2021). Assessment of avoidant restrictive food intake disorder, pica, and rumination disorder: Interview and questionnaire measures. *Current Opinion in Psychiatry*, *34*(6), 532–542.

Dovey, T. M., Staples, P. A., Gibson, E. L., & Halford, J. C. (2008). Food neophobia and 'picky/fussy eating in children: A review. *Appetite*, *50*(2–3), 181–193.

Emmett, P. M., & Taylor, C. M. (2022). Being inspired: What we have learned about picky eating in childhood from using questionnaires on feeding practices and behaviors in a longitudinal birth cohort. *Current Research in Psychiatry*, *1*(4), 48.

Emond, A., Emmett, P., Steer, C., & Golding, J. (2010). Feeding symptoms, dietary patterns, and growth in young children with autism spectrum disorders. *Pediatrics*, *126*(2), e337–e342.

Fields, V. L., Soke, G. N., Reynolds, A., Tian, L. H., Wiggins, L., Maenner, M., … Schieve, L. A. (2021). Pica, autism, and other disabilities. *Pediatrics*, *147*(2), 1–8.

Frankenburg, W. K., & Dodds, J. B. (1967). The Denver developmental screening test. *The Journal of Pediatrics*, *71*, 181–191.

Fraser, A., Macdonald-Wallis, C., Tilling, K., Boyd, A., Golding, J., Davey Smith, G., Henderson, J., Macleod, J., Molloy, L., Ness, A., Ring, S., Nelson, S. M., & Lawlor, D. A. (2013). Cohort profile: The Avon longitudinal study of parents and children: ALSPAC mothers cohort. *International Journal of Epidemiology*, *42*, 97–110.

Hameed, M. A., Lingam, R., Zammit, S., Salvi, G., Sullivan, S., & Lewis, A. J. (2018). Trajectories of early childhood developmental skills and early adolescent psychotic experiences: Findings from the ALSPAC UK birth cohort. *Frontiers in Psychology*, *8*, 2314.

Hartmann, A. S., Zenger, M., Glaesmer, H., Straub, B., Brahler, E., de Zwann, M., & Hilbert, A. (2022). Prevalence of pica and rumination behaviors in adults and associations with eating disorder and general psychopathology: Findings from a population-based study. *Epidemiological Psychiatric Science*, *9*(21), 40.

Herle, M., de Stavola, B., Hübel, C., Abdulkadir, M., Ferreira, D. S., Loos, R. J., … Micali, N. (2020). A longitudinal study of eating behaviors in childhood and later eating disorder behaviors and diagnoses. *The British Journal of Psychiatry*, *216*(2), 113–119.

Hilbert, A., & van Dyck, Z. (2016). Eating disorders in youth-questionnaire. English version University of Leipzig, http://nbn-resolving.de/urn:nbn:de:bsz

Iles-Caven, Y., Golding, J., Gregory, S., Emond, A., & Taylor, C. M. (2016). Data relating to early child development in the Avon longitudinal study of parents and children (ALSPAC), their relationship with prenatal blood mercury and stratification by fish consumption. *Data in Brief*, *9*, 112–122.

Leung, A. K., & Hon, K. L. (2019). Pica: A common condition that is commonly missed-an update review. *Current Pediatric Reviews*, *15*(3), 164–169.

LoVullo, S. V., & Matson, J. L. (2009). Comorbid psychopathology in adults with autism spectrum disorders and intellectual disabilities. *Research in Developmental Disabilities*, *30*(6), 1288–1296.

Matson, J. L., Hattier, M. A., Belva, B., & Matson, M. L. (2013). Pica in persons with developmental disabilities: Approaches to treatment. *Research in Developmental Disabilities*, *34*(9), 2564–2571.

Matson, J. L., & Kuhn, D. E. (2001). Identifying feeding problems in mentally retarded persons: Development and reliability of the screening tool of feeding problems (STEP). *Research in Developmental Disabilities*, *22*(2), 165–172.

Mayes, S. D., & Zickgraf, H. (2019). Atypical eating behaviors in children and adolescents with autism, ADHD, other disorders, and typical development. *Research in Autism Spectrum Disorders*, *64*, 76–83.

Micali, N., Horton, N. J., Crosby, R. D., Swanson, S. A., Sonneville, K. R., Solmi, F., … Field, A. E. (2017). Eating disorder behaviors amongst adolescents: Investigating classification, persistence, and prospective associations with adverse outcomes using latent class models. *European Child & Adolescent Psychiatry*, *26*(2), 231–240.

Mudholkar, A., Korostenski, L., Blackwell, D., & Lane, A. E. (2022). Factors associated with the early emergence of atypical feeding behaviors in infants and young children: A scoping review. *Child: Care, Health and Development*, *49*(1), 1–19.

Provost, B., Crowe, T. K., Osbourn, P. L., McClain, C., & Skipper, B. J. (2010). Mealtime behaviors of preschool children: Comparison of children with autism spectrum disorder and children with typical development. *Physical & Occupational Therapy in Pediatrics*, *30*(3), 220–233.

Riglin, L., Collishaw, S., Richards, A., Thapar, A. K., Maughan, B., O'Donovan, M. C., & Thapar, A. (2017). Schizophrenia risk alleles and neurodevelopmental outcomes in childhood: A population-based cohort study. *The Lancet Psychiatry*, *4*(1), 57–62.

Rose, E. A., Porcerelli, J. H., & Neale, A. V. (2000). Pica: Common but commonly missed. *The Journal of the American Board of Family Practice*, *13*(5), 353–358.

Ruddock, J. C. (1924). Lead poisoning in children: With special reference to pica. *Journal of the American Medical Association*, *82*(21), 1682–1684.

Sayetta, R. B. (1986). Pica: An overview. *American Family Physician*, *33*(5), 181–185.

Singhi, S., Singhi, P., & Adwani, G. B. (1981). Role of psychosocial stress in the cause of pica. *Clinical Pediatrics*, *20*(12), 783–785. https://doi.org/10.1177/000992288102001205

Steinsbekk, S., Bonneville-Roussy, A., Fildes, A., Llewellyn, C. H., & Wichstrøm, L. (2017). Child and parent predictors of picky eating from preschool to school age. *International Journal of Behavioral Nutrition and Physical Activity*, *14*, 1–8.

Sturmey, P., & Williams, D. E. (2016). Future directions for research and services. In *Pica in individuals with developmental disabilities* (pp. 143–164). Springer.

Voss, M. M. (2022). Eating disorders & the primary care physician. *Missouri Medicine*, *119*(3), 243–249.

Williams, E., Thomas, K., Sidebotham, H., & Emond, A. (2008). Prevalence and characteristics of autistic spectrum disorders in the ALSPAC cohort. *Developmental Medicine & Child Neurology*, *50*(9), 672–677.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.