Associations between parent and child latent eating profiles and the role of parental feeding practices

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ABSTRACT

Previous research employing the person-centred approach of Latent Profile Analysis (LPA) with parent-reported data of their child's eating behaviour identified four distinct eating profiles in 3-6-year-old children: typical, avid, happy, and avoidant eating (Pickard et al., 2023). In this follow-up study, the same parents were asked to self-report their own eating behaviour (N = 785) and LPA was conducted to determine the latent eating profiles of the parents/caregivers. The LPA showed that a four-profile solution best represented the sample of parents, termed: typical eating (n = 325, 41.4%), avid eating (n = 293, 37.3%), emotional eating (n = 123, 15.7%) and avoidant eating (n = 44, 5.6%). Multiple mediation analysis was then conducted to examine both the direct associations between parents' eating profiles and the child's probability of eating profile membership, as well as the indirect associations through the mediatory role of specific parental feeding practices. The results suggested direct links between parent and child eating profiles, with the 'avid eating' and 'avoidant eating' profiles in parents predicting similar profiles in their children. Feeding practices, such as using food for emotional regulation, providing balanced and varied food, and promoting a healthy home food environment, mediated associations between parent and child eating profiles. This research provides novel evidence to reinforce the need for interventions to be specifically tailored to both the parent's and child's eating profiles. The work also provides an interesting avenue for future longitudinal examination of whether the parents' provision of a healthy home food environment could protect against intergenerational transmission of less favourable eating behaviours.

1. Introduction

Variation in appetite and eating behaviour renders individuals susceptible to their food environments (Llewellyn & Fildes, 2017). To date, the literature in this field has been dominated by a 'variable-centred approach', focusing on the dietary or obesity risk conferred by individual traits, rather than patterns of commonly co-occurring eating behaviours. However, a person-centred approach, which identifies behavioural profiles or phenotypes (Russell et al., 2018), can yield greater insight into differences *between people* rather than *between variables* in the prediction of risk. The person-centred approach of Latent Profile Analysis (LPA) acknowledges and accommodates the natural heterogeneity present in real-world data by partitioning individuals into

meaningful groups based on shared characteristics. We have previously applied LPA to children's eating behaviour as measured by the Children's Eating Behaviour Questionnaire (CEBQ; Wardle et al., 2001) and demonstrated that there are distinct and multidimensional eating behaviour profiles in children between 3 and 6 years old (Pickard et al., 2023). A four-profile solution best fits the sample of 995 children, termed (a) typical (44%), (b) avid (21.9%), (c) happy (17.7%), and (d) avoidant (16%) eating behaviour (a detailed description is provided in the methods section). LPA approaches for eating behaviour are becoming more popular as they allow for identifying sub-populations that may be more at risk of subsequent health risks or who may need tailored intervention. For example, children assigned to an avid eating profile may be more susceptible to overeating in obesogenic

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environments and as such should be the focus of future investigation and intervention (Tharner et al., 2014; Mattsson et al., 2021; Pickard et al., 2023).

A small number of studies have taken an LPA approach to investigating eating behaviours in adult populations. LPA of the eight subscales of the Adult Eating Behaviour Questionnaire (AEBQ; Hunot et al., 2016), which is the adult equivalent of the CEBQ, was conducted on university students in the US with an average age of 26 years old (Coakley et al., 2022). A four-profile solution was best representative of the sample: 'moderate eaters' (37.7%) had lower than mean scores for food approach and avoidance traits, 'food seekers and avoiders' (20.7%) had higher than mean scores for food approach *and* avoidance traits, 'food seekers' (21.6%) had higher than mean scores for food approach traits, and 'food avoiders' (20%) had higher than mean scores for food avoidance traits. Another study using only the Food Responsiveness, Enjoyment of Food, Satiety Responsiveness, Food Fussiness, and Slowness in Eating subscales of the AEBQ also favoured a four-profile solution using the AEBQ in a sample of Chinese adults aged between 17 and 24 years old (He et al., 2020). The 'picky eating' profile (19.4% of the sample) had low food responsiveness and enjoyment of food but high food fussiness. The 'moderate eating' (47.6%) profile demonstrated mean levels on all five eating behaviours. The 'severe picky eating' profile (3.3%) had very low scores for the enjoyment of food and very elevated scores for food fussiness. The final group labelled 'approaching eating' (28.9%) showed the highest levels of food responsiveness and food enjoyment, but the lowest scores for food fussiness. Similarly to the patterns observed in childhood, these studies demonstrate that adult eating behaviour profiles are more nuanced than a binary division into food approach vs. avoidance.

Parental feeding practices are key levers of change for mitigating the risk associated with certain eating phenotypes in children (Steinsbekk et al., 2016; Rodgers et al., 2013). The previous LPA of children's eating behaviour also showed that parental feeding practices varied across the four eating profiles of the children (Pickard et al., 2023). For example, less responsive and more indulgent feeding practices, such as using food as a reward and using food for emotional regulation were reported more frequently by parents of children in the avid eating profile. Variable-centred approaches using subscales of the CEBQ have also evidenced longitudinal and reciprocal relationships between a child's eating behaviour and the feeding practices used by parents (Kininmonth et al., 2023a; Kininmonth et al., 2023; 2023c). For example, covert restriction and pressure to eat differentially affected the development of food responsiveness and emotional overeating depending on the children's appetite avidity in toddlerhood (Kininmonth et al., 2023a). Using food to control a child's emotions or behaviour during toddlerhood is a feeding practice associated with increases in appetite avidity from toddlerhood to early childhood, irrespective of children's appetite in toddlerhood (Kininmonth et al., 2023a). Furthermore, parents adopt pressuring feeding practices partly in response to the appetite traits expressed by their children (Kininmonth et al., 2023b). In a discordant twin analysis, researchers determined that, compared to the other twin, parents exerted greater pressure on the twin who expressed a poorer appetite and a lower interest in food and eating in both toddlerhood and early childhood (Kininmonth et al., 2023b). Additionally, using food as a reward or as a contingency appears to nurture increases in emotional overeating in early childhood, but at the same time, it is used in response to a child expressing greater emotional overeating tendencies (Kininmonth et al., 2023c). Together these findings suggest that different feeding practices may be useful targets for tailored intervention and/or prevention programmes depending on children's eating behaviour profiles.

Several cross-sectional investigations have demonstrated a notable and strong connection between a parent's eating behaviour and a child's eating behaviour (Hansson et al., 2016; Larsen et al., 2015; Miller et al., 2011). In the early years of life, children rely heavily on parents and caregivers to act as role models and inform them of social norms and

behaviours, including eating behaviour. Children are learning what, when, and how much to eat based on the transmission of cultural and familial beliefs, attitudes, and practices surrounding food and eating (Savage et al., 2007). Eating behaviours show strong associations with genetic heritability as well as the foetal environment (Birch et al., 2007). For example, a twin cohort study observed that genetic heritability was high for satiety responsiveness (63%) and food responsiveness (75%) at 10 years old (Carnell et al., 2008). In contrast, emotional undereating and emotional overeating had very low genetic heritability (7% and 7%, respectively) but moderate explanations from shared environmental influences such as parental feeding practices (45%; Herle et al., 2017).

Research investigating parent-child correlations of appetitive traits has evidenced that maternal food approach traits are positively associated with corresponding child traits, demonstrating the intergenerational transmission of eating behaviours (Hunot-Alexander et al., 2022). This echoes the findings of previous work which found that maternal food responsiveness and emotional overeating were positively associated with the child's respective eating behaviours (Miller et al., 2020). However, this research also suggests a role for feeding practices in explaining the concordance between parental and child eating behaviours. Mediation analyses showed that both the relationships between maternal and child emotional overeating and food responsiveness were partially mediated by the use of food as a reward and overt restriction of food (Miller et al., 2020). Stone et al. (2022) further demonstrated the complexity of parent-child eating associations, showing that the mediatory effect of using food as a reward and food restriction on parent and child emotional eating associations varied as a function of the child's temperament. These findings demonstrate the complex inter-relationships between parental eating behaviour, parental feeding practices, and child eating behaviour. However, all mentioned studies have taken a variable-centred approach when examining parent-child eating behaviour associations.

Understanding the relationships between parent and child eating behaviours using a person-centred approach will illuminate the intergenerational transmission of behavioural profiles. LPA is particularly suited to looking at the intergenerational transmission of eating behaviour patterns because eating behaviours are heavily interrelated and LPA allows for the clustering of eating behaviours into meaningful groups, such as high food responsiveness combined with low satiety responsiveness. Therefore, an LPA approach is ideal to determine whether specific eating phenotypes are transmitted between generations more so than others. Furthermore, the examination of feeding practices as mediators of the relationships between parent and child profiles will help develop tailored feeding intervention and prevention programmes that account not only for parent and child eating behaviour profiles but also identify target feeding practices that link eating profiles associated with greater risk outcomes. To achieve these goals, the aims of this study were threefold. The first aim was to use LPA to identify distinct and holistic eating profiles in parents/caregivers of 3–6-year-old children. The second aim was to examine the associations between parent and child eating phenotypes, and the third aim was to examine the mediating role of feeding practices in those associations.

We hypothesised that at least three distinct eating profiles exist among parents/caregivers: food avoidant, food typical and food approach. Once the appropriate eating profile solution was determined for the parents/caregivers, we were then able to explore whether parents' eating profiles directly mapped onto children's eating behaviour profiles. Finally, we explored whether feeding practices mediated any relationships between parent and child eating behaviour profiles.

2. Method

2.1. Participants

Parents and primary caregivers who had provided survey data on their 3–6-year-old child's eating behaviour seven months before this

study (Pickard et al., 2023) were invited to take part in a second survey. To improve the quality of the data, a CAPTCHA was included at the beginning of the survey to screen out automated respondents and three attention checks were included asking participants to select a specific response. Of the 995 participants from the first wave of data collection, 838 parents initiated the survey, 22 participants failed to complete all the survey questions, 1 participant did not provide a known identifier for themselves and 30 failed the attention checks, leaving a total of 785 eligible respondents. The latent profile analysis of adults' eating behaviour was thus conducted on 785 adults living in England and Wales aged 22–60 years old (Mean = 36.1, SD = 5.5 years).

2.2. Procedure

We used the online research participant recruitment platform Prolific (https://www.prolific.co/) to contact the previous participants and invite them to complete the survey. Consenting participants completed an online survey taking approximately 20 min to complete via the survey platform Qualtrics (https://www.qualtrics.com/). As per the Prolific hourly rate, participants received £3.00 credit to their account upon completion.

2.3. Measures

The complete item list for all included measures and the respective reliability analyses can be found on the online repository.

2.3.1. Adult eating behaviour

The Adult Eating Behaviour Questionnaire (AEBQ) is a 35-item self-report scale that assesses appetitive traits among adults (Hunot et al., 2016). Higher scores on three scales indicate a higher food approach: *Emotional Overeating* (EOE; 5 items) = eating more in response to emotional stressors, *Food Responsiveness* (FR; 4 items) = eating in response to external food cues, and *Enjoyment of Food* (EF; 3 items) = subjective pleasure from eating. Higher scores on four scales indicate higher food avoidance: *Satiety Responsiveness* (SR; 4 items) = sensitivity to internal cues of 'fullness', *Slowness in Eating* (SE; 4 items) = speed of meal consumption, *Food Fussiness* (FF; 5 items) = selectivity of foods that are accepted, and *Emotional Undereating* (EUE; 5 items) = eating less in response to emotional stressors. The *Hunger* scale (H; 5 items) is a measure of general physical hunger.

Participants rated their behaviours and experiences on a 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree. The original development of the AEBQ showed good test-retest reliability for all subscales (ICCs: 0.73-0.91; Hunot et al., 2016). All AEBQ subscales showed very good reliability among our sample, with Cronbach's alphas for the eight scales ranging from 0.73 to 0.92 (see the online repository for the full reliability analyses).

2.3.2. Child eating profile

A Latent Profile Analysis (LPA) has previously been conducted on the participants' children to identify subpopulations of eating styles in young children (see Pickard et al., 2023 for the procedure and analysis). The four profiles identified by the authors are Avid eating, Happy eating, Typical eating, and Avoidant eating, with each child assigned a probability of assignment for all four profiles. "Avid eating" (n = 217, 22%) was characterised by significantly high levels of food responsiveness and emotional overeating. This profile demonstrated similarly high levels of enjoyment of food and equally low levels of satiety responsiveness to the happy eating profile. The avid eating and avoidant eating profiles both showed a significantly greater desire to drink than the typical and happy eating profiles. "Happy eating" (n = 170, 18%) was marked by similarly high levels of food enjoyment as the avid eating group, but significantly lower levels of slowness in eating, food fussiness, emotional overeating, and emotional undereating than the three other profiles. "Typical

eating" (n = 453, 44%) comprised children with standardised z-scores (standardised to the sample population) close to zero for all eight eating behaviours. This profile had similar levels of food responsiveness as the happy eating profile, similar levels of emotional overeating as the avoidant eating profile and similar levels of emotional undereating as the avid eating profile. The "Avoidant eating" (n = 155, 16%) profile was characterised by significantly high levels of food fussiness, satiety responsiveness, slowness in eating, and emotional undereating concomitant with significantly low levels of food enjoyment in comparison to the three other profiles. Children in this group displayed average levels of emotional overeating and desire to drink that did not differ significantly from the typical eating profile and avoidant eating profile, respectively.

2.3.3. Feeding practices

The Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007) measures parental feeding practices. The CFPQ is composed of 49 items factored into twelve subscales; *Child Control* (5 items): allowing the child control of his/her eating behaviours and parent–child feeding interactions, *Emotion Regulation* (3 items): using food to regulate the child's emotional states, *Encouraging balance and variety* (4 items): promoting well-balanced food intake, including the consumption of varied foods and healthy food choices, *Environment* (4 items): making healthy foods available in the home, *Food as a reward* (3 items): using food as a reward for the child's behaviour, *Involvement* (3 items): encouraging the child's involvement in meal planning and preparation, *Modelling* (4 items): demonstrating healthy eating for the child, *Monitoring* (4 items): keeping track of the child's intake of less healthy foods, *Pressure to eat* (4 items): pressuring the child to consume more food at meals, *Restriction for health* (4 items): controlling the child's food intake with the purpose of limiting less healthy foods and sweets, *Restriction for weight control* (8 items): controlling the child's food intake with the purpose of decreasing or maintaining the child's weight, and *Teaching about nutrition* (3 items): using explicit didactic techniques to encourage the consumption of healthy foods. The CFPQ is constructed from items with two response formats. The first 13 questions have the 5-point response scale "never, rarely, sometimes, mostly, and always". The remaining questions have a 5-point response scale, "disagree, slightly disagree, neutral, slightly agree, and agree". The CFPQ scales showed moderate to good reliability among our sample, with Cronbach's alphas for the twelve scales ranging from 0.55 to 0.87 (see the online repository for the full reliability analyses).

2.3.4. Demographic information

Participants provided demographic information such as their age, sex, ethnicity, marital status, education, and employment. Of the 785 respondents, 510 provided their postcode as a measure of the Index of Multiple Deprivation (IMD). The IMD deciles are calculated by ranking the residential areas in England from most deprived to least deprived and dividing them into 10 equal groups. Areas in Decile 1 fall within the most deprived 10% of areas nationally and areas in Decile 10 fall within the least deprived 10% of areas nationally (Office for National Statistics, 2022). Participants also provided information on children's age, sex, birth weight, and childcare arrangements.

2.3.5. Anthropometric measures

Parents were asked to report their weight in stones and pounds or kilograms, and their height in feet and inches or centimeters. Weight and height data were used to calculate Body Mass Index (BMI), as a measure of adiposity, expressed in kilograms per meter of height squared. Of the 785 participants, 181 parents declined to answer.

2.4. Data analysis

Descriptive statistics were conducted using IBM SPSS Statistics 25.0. After checking that all the relevant assumptions were met (see Spurk

et al., 2020), Latent Profile Analysis (LPA) was conducted in Mplus version 8.9 to identify adults' eating profiles using continuous scores on the AEBQ subscales. For a clear interpretation of which indicator values are above or below the sample means, the scores of the planned LPA indicators (Food Responsiveness, Enjoyment of Food, Satiety Responsiveness, Food Fussiness, Hunger, Emotional Overeating, Emotional Undereating and Slowness in Eating) were standardized. In the process of model estimation, we used 500 starting values to guarantee that the true highest log-likelihood value was found (Geiser, 2012). We then tested models by starting with a 1-profile model and continuing to add an additional profile until a 6-profile solution. For selecting the optimal number of latent profiles, several fit indicators were referred to, namely, the AIC, BIC, aBIC, BLRT, LMRT, and Entropy. Lower values of the AIC, BIC, and aBIC indicate that the model fits the data better. Entropy is a measure of classification accuracy with higher values indicating better quality of classification. The LMRT and BLRT are tests of significance between two models with k classes against k-1 classes; a significant p-value indicates that the k class is a better fit. Moreover, it should be noted that the determination of the final model is based not only on fit indicators but also on interpretability and practical implications for practitioners (Marsh et al., 2009). Once the optimal number of profiles is identified, Mplus assigns each participant a posterior probability of profile membership (Muthén & Muthén, 1998-2017), which indicates which profile each participant is most likely to be assigned to. The posterior probability is the average probability of the LPA model accurately predicting class membership for each individual, with values closer to 1.0 indicating a higher level of accuracy (Muthén & Muthén, 2000).

Follow-up statistical analyses were conducted using SPSS version 25 to identify the variables to include in the mediation analyses. Data was explored using the Kolmogorov-Smirnov method and all CFPQ scales and child probability of assignment to the four eating profiles were non-normally distributed. Spearman's rank correlations (two-tailed, with a significance level of p < 0.05) were computed to assess the relationships between adult age, child age and all CFPQ subscales. Kruskal-Wallis was used to compare scores for CFPQ subscales and the probability of the child's assignment to the four eating profiles across the eating profiles of the parents.

Once the associated variables of interest were identified, four multiple mediation models were computed using the PROCESS v4 macro (Hayes, 2017) to establish whether the relationship between parents' assigned eating profile (independent variable 'X') and the probability of children's assignment to each of the four eating profiles (outcome variable 'Y') could be explained by parental feeding practices (mediator variables 'M'). The outcome measure for the mediation models is the probability of the child being assigned to each eating profile rather than the nominal profile membership. Because the independent variable is categorical with four levels, the parents' eating profiles were dummy-coded and subsequently pairwise compared, with typical eating treated as the reference category, i.e., typical eating versus avid eating, typical eating versus avoidant eating, and typical eating versus emotional eating. This dummy coding scheme and pairwise comparison design were identical in all four separate multiple mediation models predicting the child's assignment to the four different eating profiles. The general multiple mediation analysis method, proposed by Yu et al. (2019), improves traditional methods (e.g., estimation of natural and controlled direct effects) to enable consideration of multiple mediators/confounders simultaneously. A total of four multiple mediation models were conducted.

3. Results

3.1. Adult eating profiles

Model fit indices for parent latent profile analyses are listed in the supplementary material on the OSF repository. A four-profile solution

appeared to be the most appropriate fit based on fit statistics and our conceptual considerations. Entropy was highest for the six-profile solution, but the LMR-LRT test was not significant, which indicates that the *k*-class model does not perform significantly better than the *k*-1-class model (Padgett & Tipton, 2020). We then compared the four- and five-profile solutions and although the five-profile solution had lower AIC, BIC, adjusted-BIC and LMR-LRT values, the entropy was higher for a four-profile solution. Furthermore, the four-profile solution provided larger group sizes allowing for sufficient size for the subsequent mediation analyses.

The four profiles were given the following descriptive labels (see Table 1 for mean scores and significant differences between the four profiles and Fig. 1 for data visualisation):

1. Typical Eating (n = 325, 41.4%): This profile showed standardised z-scores (standardised to the sample population) ranging between −1 and 1 on all eight eating behaviours with no extreme eating subscale scores.
2. Avid eating (n = 293, 37.3%): This profile was characterised as having the lowest scores for satiety responsiveness and slowness in eating, concomitant with the highest scores for food responsiveness, hunger, and enjoyment of food, compared to all other profiles.
3. Avoidant eating (n = 44, 5.6%): This subgroup was highest in food fussiness and satiety responsiveness and lowest in food responsiveness and enjoyment of food than all other subgroups.
4. Emotional over-eating (n = 123, 15.7%): The final subgroup showed the highest levels of emotional overeating compared to all other profiles, and a lower enjoyment of food than the typical and avid eating profiles.

The sample was representative of the UK government statistics for ethnicity; 85.6% White, 3.4% Asian, 2.7% Black, 7.8% Mixed ethnicity and 0.5% other. The sample was predominantly female (n = 639, 81.4%), 85.6% lived in a dual-parent household (e.g., two adults in a relationship living in the same house and looking after the children), and 47.4% worked at least 30 h per week. Table 2 displays the demographic details of the total sample as well as the demographic details and test statistics of differences between each eating profile. Chi-square tests of independence were conducted to test for differences in parents' sex, ethnicity, and level of education and a one-way analysis of variance was conducted to test for differences in age and BMI across profiles. Age, ethnicity, and level of education did not differ significantly across the four eating profiles. Self-reported Body Mass Index (BMI) differed significantly between the profiles; parents in the avid eating profile had

Table 1

Mean scores of the AEBQ subscales across all four eating profiles.

	Total Sample	Profile 1	Profile 2	Profile 3	Profile 4
		Typical	Avid	Avoidant	Emotional
	N = 785	n = 325	n = 293	n = 44	n = 123
AEBQ Subscales					
Hunger	3.1 (0.73)	2.83 (0.42)	3.49 (0.43)	2.69 (0.8)	3.04 (0.65)
Food responsiveness	3.38 (0.75)	2.98 (0.57)	4.03 (0.49)	2.45 (0.56)	3.21 (0.54)
Emotional overeating	2.97 (1.05)	2.15 (0.67)	3.63 (0.8)	2.08 (0.77)	3.87 (0.57)
Food enjoyment	4.4 (0.66)	4.4 (0.47)	4.85 (0.28)	2.69 (0.67)	3.94 (0.37)
Satiety responsiveness	2.49 (0.79)	2.65 (0.71)	2.09 (0.69)	3.18 (0.9)	2.76 (0.72)
Slowness in eating	2.5 (0.93)	2.67 (0.9)	2.13 (0.9)	3.063 (0.9)	2.74 (0.85)
Food fussiness	2.01 (0.84)	1.83 (0.62)	1.75 (0.73)	3.33 (0.92)	2.65 (0.83)
Emotional undereating	2.9 (1.0)	3.47 (0.92)	2.4 (0.76)	3.68 (0.92)	2.31 (0.69)
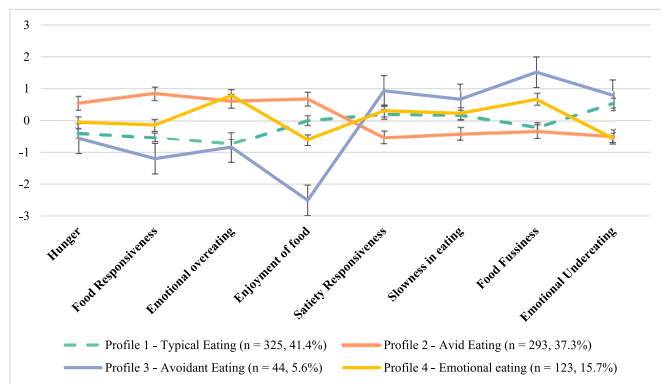
Fig. 1. Mean scores on eight eating behaviours for each of the four adult eating behaviour profiles identified by the latent profile analysis (N = 785).

a reported BMI that was significantly higher than the typical and avoidant eating profiles. Parents in the emotional eating profile also had a BMI that was higher than the typical eating profile but not the avoidant eating profile (see Fig. 2).

### 3.2. Associations with parent and child eating profiles

Correlational analyses were conducted to determine which variables met the criteria for inclusion in the multiple mediation models, the full correlational matrices can be found in the supplementary material. Spearman's rank correlations showed that child age was not significantly correlated with the children's probability of assignment to the eating profiles, but parent age was negatively correlated with the child's probability of assignment to the avid eating profile. Child control and food for emotional regulation were negatively correlated with the child's age, but involvement, restriction for weight, and teaching about nutrition were positively correlated with the child's age, bivariate correlations between CFPQ and child profiles are also presented in the supplemental material (Table 10). Partial correlations were run to determine the relationship between CFPQ subscales and the probability of child assignment to the avid, avoidant, typical and happy eating profiles while controlling for both parent and child age. Zero-order correlations showed parent and child age had very little influence on the relationship between CFPQ subscales and the probability of

assignment to the four-eating profiles. Thus, parent and child age were not deemed necessary to include as potential covariates in the subsequent mediation analyses.

Kruskal-Wallis statistical testing revealed that there were statistically significant differences in emotional regulation, balance and variety, environment, food as a reward, modelling, and monitoring feeding practices across the four adult eating profiles (see online repository for supplementary tables).

3.3. Investigating mediation between parent and child eating profiles

Mediation assumptions were examined (Hayes, 2017) and only the assumption of normality was violated. However, given the relatively large sample size (>200), the Central Limit Theorem deems that the distribution will be approximately normal despite statistical violation (Hayes, 2017). A multiple mediation analysis was performed only for the feeding practices (mediators) that were significantly associated with (i) the independent variable (parental eating profile) and (ii) the outcome variable (child's probability of Latent Profile Analysis assigning that child to the four child eating profiles). As such, the following feeding practices appear to have no significant mediatory role on adult eating
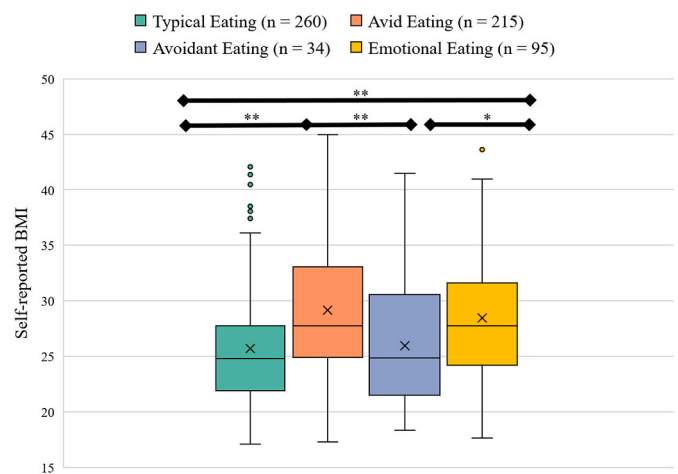
Fig. 2. Boxplot of reported BMI across the four eating profiles (** denotes significant difference between profiles at p < 0.001, *p < 0.05).

Table 2
Demographic information for parents across the four eating profiles and the test statistic and significance level for differences between profiles.

	Total Sample	Typical eating	Avid eating	Avoidant eating	Emotional eating	Test Statistic	P-value
		Profile 1	Profile 2	Profile 3	Profile 4		
	N = 785	n = 325 (41.4%)	n = 293 (37.3%)	n = 44 (5.6%)	n = 123 (15.7%)		
Parent Age, years, Y (SD)	36.1 (5.5)	36.5 (5.7)	35.8 (4.9)	36 (6.0)	35.6 (6.0)	F = 1.04	0.376
Parent BMI (SD)	27.55 (5.7)	25.7 (4.8)	29.4 (6.0) [a]	25.9 (5.9) [b]	28.6 (5.3) [a c]	F = 25.52	<0.001
Parent Sex, n (%)						$X^2 = 3.06$	0.801
Male	145 (18.5)	66 (20.3)	49 (16.7)	9 (20.5)	21 (17.1)		
Female	639 (81.4)	258 (79.4)	244 (83.3)	35 (79.5)	102 (82.9)		
Not reported	1 (0.1)	1 (0.3)	0	0	0		
Parent Education, n, (%)						$X^2 = 6.31$	0.097
Degree	424 (54.1)	186 (57.2)	161 (54.9)	18 (40.9)	59 (48.0)		
No degree	361 (45.9)	139 (42.8)	132 (45.1)	26 (59.1)	64 (52.0)		
Parent Ethnicity, n (%)						$X^2 = 11.03$	0.527
Asian or Asian British	27 (3.4)	14 (4.3)	5 (1.7)	2 (4.5)	6 (4.9)		
Black, Black British, Caribbean, or African	21 (2.7)	10 (3.1)	6 (2.0)	0	5 (4.1)		
Mixed or multiple ethnic groups	61 (7.8)	28 (8.6)	25 (8.5)	3 (6.8)	5 (4.1)		
White	672 (85.6)	271 (83.4)	255 (87)	39 (88.6)	107 (87)		
Other ethnic groups	4 (0.5)	2 (0.6)	2 (0.7)	0	0		

Bold values indicate that the eating profile is significantly different to the other three profiles.
[a] Denotes significantly different to profile 1.
[b] Denotes significantly different to profile 2.
[c] Denotes significantly different to profile 3.

profile and child eating profile associations: allowing a child control over feeding interactions, involvement with food preparation, pressuring the child to eat, restricting food for weight purposes, teaching about nutrition, and restricting food for health purposes.

Therefore, mediation was tested using PROCESS model 4 (multiple mediation) with four models. Multiple mediation models simultaneously include several mediator variables, which reduces the likelihood of parameter bias, identifies to what extent specific variables mediate the effect conditional on the presence of other mediators in the model and determines the relative magnitudes of the specific indirect effects associated with all mediators (Preacher & Hayes, 2008). Mediation model 1 predicting child assignment to the avid eating profile included the mediator variables input simultaneously: food for emotion regulation, providing balance and variety, food as a reward, and monitoring of food. Mediation model 2 predicting child assignment to the avoidant eating profile included: providing balance and variety, food environment, and monitoring of food. Model 3 predicting assignment to the happy eating profile included the mediator variables: food for emotion regulation, providing balance and variety, food environment, food as a reward, modelling and monitoring. Model 4 predicting child assignment to the typical eating profile included only encouraging balance and variety as a mediator variable.

In the subsequent results section, individual pathways are only presented for the significant indexes indicating that mediation occurred (see Fig. 3 for an overview of significant direct and indirect associations between child and parent eating profiles). The indexes for all pathways are reported on the project's online repository.

Fig. 4 presents the mediation pathways for child assignment to the avid eating profile via the use of food for emotion regulation for parents with avid versus typical eating. Parents with avid eating use more emotional regulation feeding practices than parents with typical eating. The use of food for emotional regulation in turn is linked to a greater probability of the child being assigned to the avid eating profile. There is also a significant direct association between parent profile and child profile, in that a parent with avid eating has a greater probability of having a child with avid eating. Therefore, the higher likelihood of a parent with avid, rather than typical, eating having a child with avid eating is partially mediated by using food to regulate emotions.

Fig. 5 presents the mediation pathways for parents with an emotional eating versus typical eating. Parents with emotional eating show more use of food for emotional regulation than parents with typical eating. Once again, more use of food to regulate emotions is significantly associated with a higher probability of child assignment to the avid eating profile. The direct effect for parents with emotional versus typical eating predicting child assignment to the avid eating profile is not
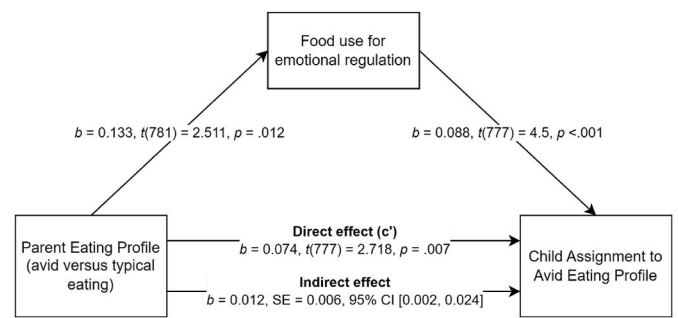

Fig. 4. Parents' avid eating predicting child avid eating via emotional regulation.

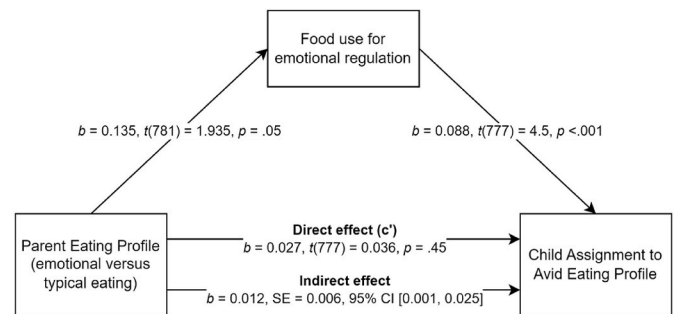**Fig. 5.** Parents' emotional eating predicting child avid eating via emotional regulation.

significant but the indirect effect is. Therefore, the higher probability of a parent with emotional, rather than typical, eating having a child with avid eating is fully mediated by parents' use of food for emotional regulation.

3.3.1. Predicting child assignment to the avoidant eating profile

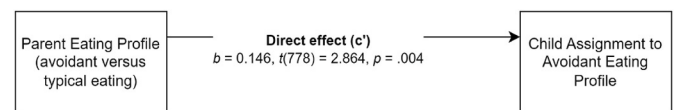Fig. 6 presents the direct association between parents assigned to the

Fig. 6. Parents' avoidant eating predicting child avoidant eating.

Outcome: Child's eating profile probability	Predictor: Parent's eating profile		
	Avid Eating	Avoidant Eating	Emotional Eating
Avid Eating	▲ ▲ §		▲ §
Avoidant Eating	▲ †	▲	▲ †
Happy Eating	▼ §†		▼ §†
Typical Eating	▼		▲ ‖

N.B. Arrows in an upward direction indicate that there is a positive association between child and parent eating profiles (i.e., parents in the avid eating profile have an increased likelihood of children in the avid eating profile) compared with parents with typical eating behaviours. A blue arrow indicates that the parent's eating profile is associated with the probability of the child's assignment to the eating profile independent of the included parental feeding practices. Orange arrows indicate that the association is mediated through parental feeding practices.

§ Denotes food use for emotional regulation mediates the parent-child eating association

† Denotes promoting a healthy food environment mediates the parent-child eating association

‖ Denotes providing balance and variety mediates the parent-child eating association

Fig. 3. – Overview of significant associations between parent eating behaviour profiles and child eating behaviour profiles and their mediation through the included parental feeding practices (N = 785).

avoidant eating profile and the child's probability of assignment to the avoidant eating profile ($b = 0.146$, $t(778) = 2.864$, $p = .004$). Parents with avoidant eating are more likely to have a child assigned to the avoidant eating profile than parents with typical eating. No feeding practices were mediators of this relationship.

Figs. 7 and 8 demonstrate that parents with avid eating and emotional eating behaviours are less likely to create a healthy food environment than parents with typical eating. In turn, a less healthy food environment increased the probability of children being assigned to the avoidant eating profile. The direct effects for parents with avid and emotional eating versus typical eating in predicting child assignment to the avoidant eating profile are not significant but the indirect effects are. Therefore, the higher probability of a parent with avid or emotional eating, rather than typical eating, having a child with avoidant eating is fully mediated by the food environment.

Figs. 9 and 10 demonstrate that parents with either avid eating or emotional eating, respectively, report more food use for emotional regulation and are less likely to create a healthy food environment than parents with typical eating parents. In turn, more food use for emotional regulation is associated with a lower probability of a child with happy eating, while a less healthy food environment is associated with a reduced probability of a child with happy eating. Using food to regulate emotions and providing a healthy food environment both fully mediate the associations between parents with avid and emotional eating and the probability of a child with happy eating behaviour.

Fig. 11 presents the direct association between parents assigned to the avid eating profile and the child's probability of assignment to the typical eating profile ($b = -0.107$, $t(780) = -3.275$, $p = .001$). Parents with avid, compared to typical, eating are less likely to have a child with typical eating behaviour.

Fig. 12 demonstrates that parents with emotional eating are less encouraging of balance and variety of food than parents with typical eating. Less encouragement of balance and variety is subsequently associated with a higher probability of a child with typical eating. The direct effect between parents with emotional versus typical eating predicting a child with a typical eating profile is not significant, but the indirect effect is. Therefore, the lower probability of a parent with emotional eating, rather than typical eating, having a child with typical eating is fully mediated by encouraging balance and variety of food.

4. Discussion

This research applied the person-centred approach of Latent Profile Analysis (LPA) to determine holistic eating behaviour profiles in a sample of UK-based parents/caregivers of children aged 3–6 years old. Based on a previously conducted LPA of children's eating behaviour (Pickard et al., 2023), mediation analysis was then conducted to examine how parents' eating profiles are associated with children's eating profiles and whether that association is mediated by feeding practices. Much previous research has evidenced that young children's eating behaviour is believed to be both directly and indirectly linked to
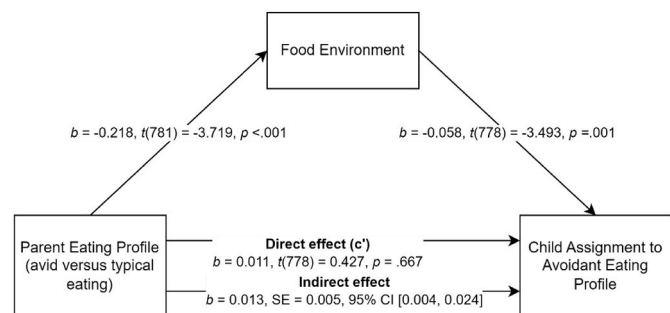
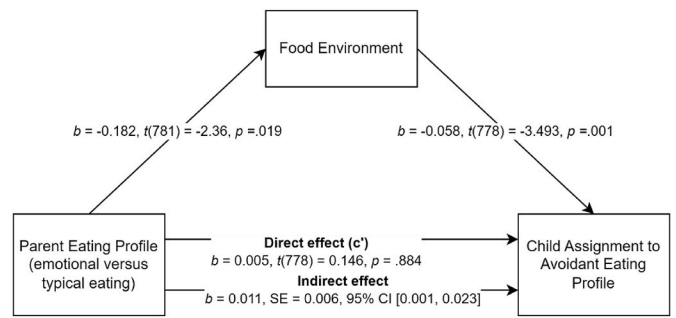**Fig. 7.** Parents' avid eating predicting child avoidant eating via food environment.

Fig. 8. Parents' emotional eating predicting child avoidant eating via food environment.
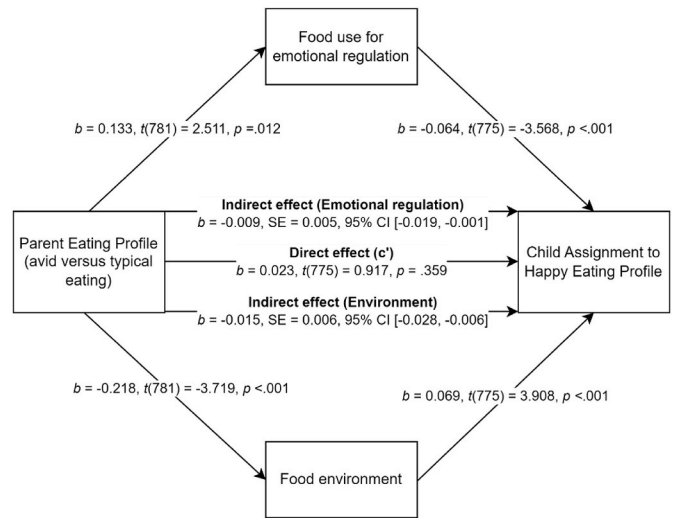
Fig. 9. Parents' avid eating predicting child happy eating via emotional regulation and food environment.
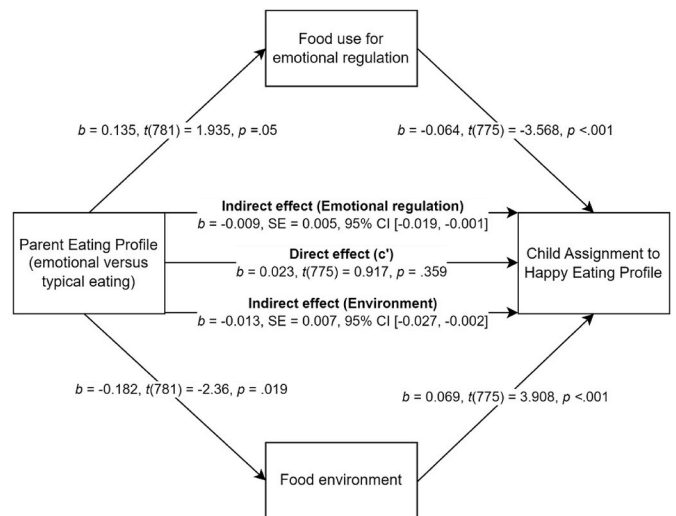
Fig. 10. – Parents' emotional eating predicting child happy eating via emotional regulation and food environment.

their parent's eating behaviour (Hansson et al., 2016; Mahmood et al., 2021; Miller et al., 2011). This study provides the first examination of this association using a person-centred approach and demonstrates that parent and child eating behaviour profiles are both directly and indirectly linked, with three feeding practices serving as key mediators
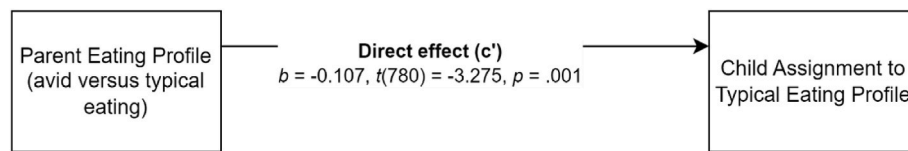
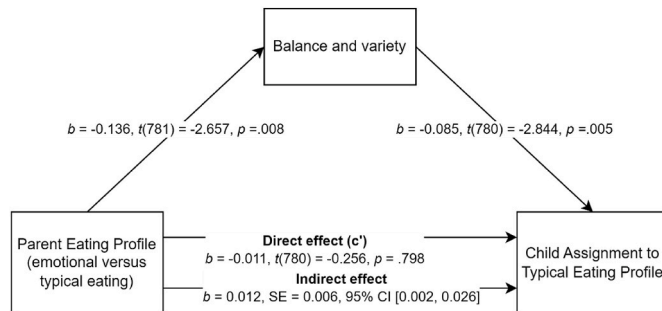**Fig. 11.** – Parents' avid eating predicting child typical eating.

Fig. 12. Parents' emotional eating predicting child typical eating via encouragement of balance and variety.

between parent and child eating behaviour profiles.

4.1. The four profiles of parent eating behaviour

A four-profile solution appeared to be the most appropriate model to represent the eating behaviours of the parents in our sample, which aligns with previous research conducted on adult samples using the Adult Eating Behaviour Questionnaire (AEBQ) (Coakley et al., 2022; He et al., 2020). The largest profile in our sample was termed 'typical eating' and comprised 41.4% of the parents, which is similar to 47.6% classified as 'moderate' in He and colleagues' LPA study on young adults. This group does not show high levels of emotional or 'external' eating behaviours, but neither are they selective in their eating behaviour. Our second largest group (37.3% of the sample) was high in food approach traits and low in food avoidance traits and was termed 'avid eating'. This profile shows traits that have been previously associated with an increased risk of overweight and obesity, such as reduced satiety responsiveness (Barkeling et al., 2007; Drapeau et al., 2011), high food responsiveness and high emotional overeating (Llewellyn & Fildes, 2017), and increased speed of eating (Kolay et al., 2021). The combination of these traits in the 'avid eating' profile is likely to leave individuals with this profile more susceptible to weight gain in obesogenic environments. This is reflected in the higher self-reported BMI in this group of parents as compared to the 'typical' and 'avoidant' eating profiles. Understanding that this phenotype of eating behaviour may be associated with increased food intake and risk of adiposity is useful when targeting and tailoring interventions to the eating styles of individuals.

The 'emotional eating' profile comprised 15.7% of the sample and was so-termed because participants belonging to this profile scored higher on emotional over-eating than the three other profiles, despite showing low levels of food enjoyment and high food fussiness. This behavioural grouping suggests that, in contrast to those in the avid eating group, food consumption is not driven by higher-than-usual hunger, a love of food or the presence of food cues in the environment, but largely is the result of the use of food for emotion regulation. As with the avid eating profile, this sub-group may be at greater risk of eating in the absence of hunger in response to emotional arousal and potentially more susceptible to weight gain. Again, the parents with emotional eating reported higher BMI than parents with typical eating behaviour. Therefore, parents with an emotional eating style could benefit from intervention methods to reduce their risk of overeating and

subsequent weight gain. Equally, this profile could benefit from intervention efforts to improve the adults' relationship with food, including the promotion of eating in response to hunger and satiety cues rather than to soothe emotions.

Another important population to target is the small group of parents classified as avoidant eaters (5.6%). Parents assigned to the avoidant eating profile showed high levels of food fussiness and satiety responsiveness and the lowest levels of food responsiveness and enjoyment of food than all other subgroups. This is a small sample of the population, but an important group to improve their relationship with food and eating because these individuals may be most at risk of reduced dietary variety (Zickraf & Schepps, 2016). Interventions to boost food enjoyment and food acceptance would not only help the parent develop a better experience with eating but would also increase the likelihood of modelling positive eating behaviours for their children.

4.2. Direct relationships between parent eating profile and child eating profile

Our mediation analysis demonstrated some key direct associations between parent-child eating profiles. Parents assigned to the avid eating profile as opposed to the typical eating profile were more likely to have a child assigned to an avid eating profile and less likely to have a child assigned to the typical eating profile. This direct effect was not erased by the addition of feeding practices to the model which aligns with substantial evidence of the powerful heritability of avid appetite (Llewellyn et al., 2023). Furthermore, parents assigned to the avoidant eating profile, as opposed to the typical eating profile, were more likely to have a child assigned to an avoidant eating profile and this association was not to be mediated by any parental feeding practices. This finding supports recent studies showing that 74–79% of individual differences in food fussiness in children, an important index variable for classifying parents and children with avoidant eating, is explained by genetic factors rather than shared environmental factors (Nas, Herle, et al., 2023).

4.3. Indirect relationships between parent eating profile and child eating profile

Aside from the relationship between parent and child avoidant eating profiles and between the avid eating profile in parents and the typical eating profile in children, all other parent-child eating profile associations were partially or fully mediated by the use of specific parental feeding practices. Therefore, interventions targeting parents' use of these feeding practices could be leveraged to interrupt direct associations between parent and child eating behaviours.

Parents with either an emotional or avid eating behaviour profile reported greater use of food for emotional regulation than parents with typical eating. This greater use of food for emotional regulation was subsequently associated with an increased probability of the child being assigned to the avid eating profile and a decreased probability of being assigned to the typical eating profile. This finding demonstrates the impact of using food to regulate a child's emotions, particularly when a parent is already modelling eating in response to emotions. Children with avid eating behaviour display increased emotional overeating which could be a result of a parent's strategy to use food to soothe or calm a child (Kininmonth et al., 2023c). Previous research which determined that using food as a reward or to soothe was used in response

to a child expressing greater emotional overeating tendencies supports this interpretation (Kininmonth et al., 2023c). Strategies to reduce a parent's use of food for emotional regulation could be effective at improving a child's relationship with food and may reduce risks of developing emotional overeating. For example, parents could receive support regarding how to soothe or comfort children with non-food-based activities, such as attention and affection. Importantly, parents with emotional or avid eating may also benefit from explicit support in regulating their own emotions without the use of food before they can manage their children's emotions in healthy ways. These findings speak to the complexity of food parenting and emphasise the need to understand not only the effects of feeding practices on children's eating behaviour but also why parents are more likely to use such feeding practices with their children. Without this understanding, interventions and support programmes are at risk of being ineffective by giving directive instructions about what to do/not to do without providing alternative strategies and skills that parents feel capable and motivated to use.

Making healthy foods available in the home (food environment) was linked with reduced risk of a child's assignment to avoidant or avid eating profiles. This is a particularly important finding because it suggests that positive, protective feeding practices may improve the likelihood that children of parents with avid or emotional eating profiles develop typical or happy eating tendencies rather than avid or avoidant eating tendencies. Parents with either an avid or emotional eating profile reported a lower likelihood of creating a healthy home food environment, which was subsequently associated with a reduced likelihood of a child with a happy eating behaviour profile and a higher likelihood of a child with an avoidant eating profile. Additionally, parents with an emotional eating profile reported less encouragement of balance and variety of food which in turn was associated with a lower probability of a child having a typical eating profile. This finding may be a result of the feeding practices parents use in response to the child's eating behaviour, illustrating the complex bi-directional relationship between feeding practices and children's eating behaviour. Both encouraging balance and variety and making healthy foods available in the home are frequently suggested as structured feeding practices that can encourage children to develop a healthy relationship with food (Varela et al., 2023). Lower levels of such feeding practices in parents with avid and emotional eating profiles suggest that the role of parents' own eating behaviours may be an important barrier to the creation of healthier home food environments for their children.

4.4. Non-significant mediation pathways for feeding practices

Somewhat surprisingly, several feeding practices expected to mediate the associations between parent and child eating profiles were not significant in the models. Based on previous research, we would expect that the use of food as a reward, pressure to eat, modelling positive eating behaviours and restricting food would mediate associations between parent and child eating (Kininmonth et al., 2023a). Genetic predispositions, environmental influences, and individual differences in temperament could be substantial contributors to a child's eating habits, potentially overshadowing the direct impact of specific parental feeding practices in our dataset. As such, when including both parents' eating behaviour and feeding practices, the model is likely to disregard feeding practices which do not provide a significant contribution to predicting a child's eating profile. However, that is not to say that these feeding practices are insignificant in developing children's eating behaviour, it is merely that other feeding practices, such as encouragement of balance and variety of food and a healthy food environment may be of greater impact.

4.5. Implications for feasible intervention development

In interpreting these findings through the lens of identifying feeding

practices as intervention targets, it is important to consider the feasibility of adopting such strategies. Any advice provided to parents about their feeding practices needs to be mindful of the parents' own challenges with eating behaviour, but also the family's more general background including the accessibility and availability of food. For example, Pickard et al. (2023) demonstrated that food security differed between the children's eating profiles, with avoidant and avid eating children experiencing lower levels of food security. Although it would be ideal for parents and caregivers to provide a wide and varied food environment for all children, this advice needs to be tailored within the remit of their socio-economic environment. This is an important consideration for policymakers and future intervention strategies to ensure that all families are provided with equal access and availability to food (Holley & Mason, 2019). Additionally, strategies also need to consider other barriers that parents may report concerning adopting certain feeding practices, such as the child's temperament or time scarcity. The previous LPA analysis of children's eating profiles demonstrated that children with avid eating were also reported to be more surgent/impulsive and have high negative affect (Pickard et al., 2023). Therefore, parents are likely to have adopted certain feeding practices such as the use of food to soothe or comfort in response to their child's disposition.

4.6. Strengths & limitations

The LPA method employed in this research offers a distinct and holistic exploration of parents' eating behaviour and associations with such profiles (Bauer & Shanahan, 2007).

This study has several strengths, such as the relatively large sample size, robust statistical analysis of eating behaviour, and the application of reliable psychometric assessments for parental feeding practices, child eating behaviour, and adult eating behaviour. The use of psychometric measures may also introduce measurement error due to the self-report and subjective nature, evidenced by the lower Cronbach's alpha scores for certain measures: five of the twelve CFPQ subscales had reliability scores lower than the commonly accepted standard of 0.7. Moreover, because many of the associations between parent and child behavior involved similar behavior patterns (e.g., parent avid eating was related to child avid eating or parent avoidant eating was related to child avoidant eating) these associations may be a function of parent response styles (social desirability, use of endpoints versus middle of the scales, idiosyncratic views about what constitutes eating "too little" or "too much," etc.). Future studies should incorporate multiple methods and sources of data, such as direct observations and independent assessments, to provide a more comprehensive and accurate picture of parent and child eating behaviours. Additionally, although this paper reports on the eating profiles of 'parents', the sample was comprised largely of females (81.4%). As a result, the samples were potentially too small to detect any difference in profile assignment by parent gender. Future work should aim to recruit a larger male sample to determine whether the identified profiles and findings are replicated in this population.

Furthermore, although this work was regarded as cross-sectional it may also be considered a short-term longitudinal study, in which data collected at wave 2 was used to predict data collected at wave 1, seven months earlier. This was done intentionally to reduce common methods bias from parents when reporting on their eating habits and their child's. The timing does pose challenges for interpreting direct and indirect effects, as ideally, parent eating behaviour should be assessed before child eating behaviour to establish temporal precedence. Additionally, certain feeding practices are used in response to a child expressing a lesser or greater interest in food (Kininmonth et al., 2023c). For example, previous research has demonstrated that parents also use food for emotional regulation in response to a child demonstrating greater emotional eating tendencies (Kininmonth et al., 2023c). Consequently, it is difficult to disentangle the role of parents' eating behaviour on children's eating behaviour and to understand the potential mediatory role that feeding practices play in the parent-child association. We propose that future

research should employ stronger designs, such as collecting parent eating behaviour at an earlier time point relative to child eating behaviour or collecting data on both parent and child eating behaviours at multiple time points to better examine the directionality of effects.

5. Conclusion

In conclusion, this novel research applied Latent Profile Analysis to identify distinct eating behaviour profiles among UK-based parents of 3-6-year-old children and explored the mediatory role of parental feeding practices on parent-child eating profile associations. Four eating profiles were identified in the sample of parents, with the 'avid eating' and 'emotional eating' phenotypes showing traits associated with an increased risk of overweight and obesity. The analysis revealed direct links between parent and child eating profiles, with the 'avid eating' and 'avoidant eating' profiles in parents associated with similar profiles in their children. Feeding practices, such as using food for emotional regulation, providing balanced and varied food, and promoting a healthy home food environment, mediated associations between parent and child eating profiles. The study emphasises the need for nuanced, tailored interventions to address the intricate relationship between parent and child eating behaviours.

Ethical statement

All research was conducted in accordance with the Declaration of Helsinki and ethical approval was granted by the Aston University School of Health and Life Sciences Ethical board (Project ID Number: HLS21003). Written informed consent was provided by participants.

CRediT authorship contribution statement

Abigail Pickard: Writing – original draft, Visualization, Methodology, Formal analysis, Data curation. **Claire Farrow:** Writing – review & editing, Funding acquisition, Conceptualization. **Emma Haycraft:** Writing – review & editing, Funding acquisition, Conceptualization. **Moritz Herle:** Writing – review & editing, Funding acquisition, Conceptualization. **Katie Edwards:** Writing – review & editing. **Clare Llewellyn:** Funding acquisition, Conceptualization. **Helen Croker:** Funding acquisition, Conceptualization. **Jacqueline Blissett:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

No conflict of interest.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2024.107589.

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