

# Prospective associations between early childhood parental feeding practices and eating disorder symptoms and disordered eating behaviors in adolescence

Holly A. Harris PhD<sup>1,2</sup>  | Alice R. Kininmonth PhD<sup>3,4</sup>  | Zeynep Nas PhD<sup>4</sup>  |  
Ivonne P. M. Derks PhD<sup>1,2</sup>  | Fiona Quigley PhD<sup>5</sup>  | Pauline W. Jansen PhD<sup>1,2</sup>  |  
Clare Llewellyn PhD<sup>4</sup> 

<sup>1</sup>Department of Child & Adolescent Psychiatry/Psychology, Erasmus MC, University Medical Center, Rotterdam, The Netherlands

<sup>2</sup>Department of Psychology, Education and Child Studies, Erasmus University Rotterdam, Rotterdam, The Netherlands

<sup>3</sup>School of Psychology, University of Leeds, Leeds, UK

<sup>4</sup>Research Department of Behavioural Science and Health, Institute of Epidemiology and Health Care, University College London, London, UK

<sup>5</sup>Institute for Nursing and Health Research, Ulster University, Belfast, Northern Ireland

## Correspondence

Clare Llewellyn, Department of Behavioural Science and Health, University College London, Gower Street, London WC1E 6BT, UK.

Email: [c.llewellyn@ucl.ac.uk](mailto:c.llewellyn@ucl.ac.uk)

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## Abstract

**Objective:** Nonresponsive parental feeding practices are associated with poorer appetite self-regulation in children. It is unknown whether this relationship extends beyond childhood to be prospectively associated with the onset of eating disorder (ED) symptoms in adolescence. This exploratory study therefore investigated prospective associations between early childhood parental feeding practices and adolescent ED symptoms and disordered eating behaviors.

**Methods:** Data were from two population-based cohorts with harmonized measures: Generation R (Netherlands;  $n = 4900$ ) and Gemini (UK;  $n = 2094$ ). Parents self-reported their pressure to eat, restriction and instrumental feeding (i.e., using food as a reward) at child age 4–5 years. Adolescents self-reported their compensatory behaviors (e.g., fasting, purging), binge-eating symptoms, restrained eating, uncontrolled eating, and emotional eating at 12–14 years. Associations between feeding practices and ED symptoms were examined separately in each cohort using generalized linear models.

**Results:** In Gemini, pressure to eat in early childhood was associated with adolescents engaging in compensatory behaviors. In Generation R, parental restriction was associated with adolescents engaging in compensatory behaviors, restrained eating, uncontrolled eating, and emotional eating. Instrumental feeding was associated with uncontrolled eating and emotional eating in Generation R.

Holly A. Harris and Alice R. Kininmonth are shared first authors.

Pauline W. Jansen and Clare Llewellyn are shared senior authors.

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**Discussion:** Nonresponsive parental feeding practices were associated with a greater frequency of specific ED symptoms and disordered eating in adolescence, although effect sizes were small and findings were inconsistent between cohorts. Potentially, the cultural and developmental context in which child–parent feeding interactions occur is important for ED symptoms. Further replication studies are required to better understand parents' role in the development and maintenance of ED-related symptoms.

**Public Significance:** Prospective research examining how early childhood parental feeding practices might contribute to adolescent ED symptoms is limited. In two population-based cohorts, nonresponsive feeding practices (restriction, instrumental feeding, pressure to eat) predicted increased frequency of some ED symptoms and disordered eating behaviors in adolescence, although associations were small and further replication is required. Findings support the promotion of responsive feeding practices, which may benefit young children's developing relationship with food.

#### KEYWORDS

adolescent, binge eating, child, cohort, compensatory behaviors, emotional eating, feeding practices, parents, restricted eating, uncontrolled eating

## 1 | INTRODUCTION

Parents play a critical role in structuring their children's early food environment and supporting their child's mastery of eating and appetite self-regulation through their feeding practices. Feeding practices may be “responsive” or “nonresponsive” to a child's hunger and satiety (Black & Aboud, 2011), with the latter representing a (likely unintentional) coercive or controlling feeding style (Birch et al., 2001). Feeding practices are nested within the socioeconomic and environmental context (Arlinghaus & Laska, 2021), and are a product of complex, bidirectional parent–child transactions. Parents develop their feeding practices partly in response to their child's eating styles and weight (e.g., parents of children with fussy eating (Mallan et al., 2018) or who have a low weight (Jansen et al., 2014) are more likely to pressure them to eat). Concurrently, feeding practices may also shape children's developing weight-related eating behavior. Pressuring a child to eat may be counterproductive (Galloway et al., 2006) or override their responses to hunger and satiety (Harris et al., 2014). Parents' restriction may increase children's preference for restricted foods and promote overeating when available (the so-called “forbidden fruit” effect) (Fisher & Birch, 1999). Parents offering well-liked foods to incentivize good behavior or eating disliked food may enhance a child's desire for the liked food (Newman & Taylor, 1992). Feeding practices therefore represent a potential target for interventions that foster children's positive relationship with food. Yet, surprisingly little is known about the long-term consequences of early feeding practices.

Parental feeding practices may play a behavioral role in the development of eating disorder (ED) symptoms, which are common in adolescence (Swanson et al., 2011). This relationship is theorized to stem from nonresponsive feeding practices contributing to a disruption of

children's autonomy of food intake and appetite self-regulation (Birch et al., 2001), thus increasing reliance on external cues (or cues unrelated to appetite) to regulate their eating. This may interact with latent predispositions toward EDs to manifest in overeating- and/or undereating-ED symptoms. However, empirical evidence supporting this theory is limited as research has primarily been conducted in cross-sectional samples (Haycraft et al., 2014; Loth et al., 2014; Schmidt et al., 2019). First, a cross-sectional US study ( $n = 2231$ ) showed that parents' restriction and pressure to eat was associated with adolescent boys' dieting, and unhealthy or extreme weight control behaviors; and only parental restriction was associated with adolescent girls' extreme weight control behaviors. Second, a UK study ( $n = 528$ , 13–15 years old) showed that adolescent boys' perceptions of their parents' restriction was positively associated with ED psychopathology (e.g., drive for thinness), while girls' perceptions of their parents' pressure to eat was positively associated with ED psychopathology (Haycraft et al., 2014). Lastly, a German study showed that mothers' restriction was associated with young adolescents' ( $n = 505$ , 11–13 years old) loss of control eating, although this was dependent on adolescent weight (Schmidt et al., 2019). These studies present initial cross-sectional evidence suggesting that, in adolescents, nonresponsive feeding practices are linked to overeating- and undereating-ED symptoms, both of which share common features (American Psychological Association, 2013; de Lauzon et al., 2004; Fairburn & Harrison, 2003). However, they are unable to shed light on whether the feeding practices preceded the onset of ED symptoms or are developed in response to ED symptoms.

Parental feeding practices may be particularly salient in early childhood, a period marked by the development of eating behaviors (Daniels et al., 2014). Yet research has not examined prospective

associations between feeding practices and later onset of ED symptoms in large, population-based cohorts. Large-scale epidemiological studies that consider the full ED symptom spectrum can facilitate the detection of differences across continua to identify early life risk factors for EDs, before the onset of symptoms. This is an important first step for preventive interventions. The context in which feeding occurs and ED symptoms develop must be understood within the societal norms, cultural practices and developmental characteristics of the populations studied (Musher-Eizenman et al., 2009). Expanding this knowledge across a range of cultures, contexts, and developmental periods can clarify the role of early feeding practices in the onset of ED symptoms as they develop in adolescence.

The objective of this exploratory study was to examine prospective associations between nonresponsive parental feeding practices at child age 4–5 years and ED symptoms and disordered eating at 12–14 years using data from two large cohort studies based in the Netherlands and the UK. In line with the theory that nonresponsive feeding practices may override children's self-regulation of food intake (Birch et al., 2001), we hypothesized that early nonresponsive feeding practices would be associated with an increased risk of ED symptoms and disordered eating in adolescence. As parental feeding practices are hypothesized to influence children's developing eating behaviors, the current study focusses on the behavioral elements of ED symptoms (e.g., compensatory behaviors) rather than the cognitive aspects (e.g., body image distortion).

## 2 | METHODS

### 2.1 | Study design and population

This study is embedded in two established cohorts; the Generation R Study (Generation R), and the Gemini Study (Gemini). This study was prospectively planned prior to data collection in Gemini by the PIs of Generation R (PWJ) and Gemini (CL), to harmonize outcome measures across cohorts.

#### 2.1.1 | Generation R

Generation R is a Dutch population-based cohort that examines growth, development and health from fetal life onwards (Jaddoe et al., 2006). Details about the cohort are published elsewhere (Kooijman et al., 2016). The study has been approved by the Medical Ethical Committee of Erasmus Medical Center Rotterdam. Written informed consent was obtained from parents and their adolescents up to 14 years. The final study sample consisted of participants with full information available on parental feeding practices at 4 years ( $n = 4900$ ; participant acceptable threshold diagram shown in Additional File 1: Figure S1). Those who consented to participate but who were excluded due to

missing values on parental feeding practices ( $n = 2395$ ) were more likely to have a non-Dutch background and lower birthweight, and had mothers who were younger, had lower educational attainment and a higher BMI at baseline, and a lower household income (all  $p < .01$ ).

#### 2.1.2 | Gemini

Gemini is a longitudinal birth cohort of twins born in England and Wales. Details about the cohort are published elsewhere (van Jaarsveld et al., 2010). Ethical approval was originally granted for the study in 2007 by the University College London Committee for the Ethics of non-National Health Service Human Research, with continuing approval until 2023. Written informed consent was provided by all Gemini families. The final study sample consisted of participants with full information available on parental feeding practices at 5 years ( $n = 2094$ ; participant flow diagram shown in Additional File 1: Figure S2). Those who consented to participate but who were excluded due to missing values on parental feeding practices ( $n = 2710$ ) were mothers who were younger, had lower educational attainment, had a higher BMI at baseline and lower household income (all  $p < .01$ ).

## 2.2 | Measures

### 2.2.1 | Parental feeding practices

The items for each parental feeding practice assessed are shown in Additional File 1: Table S1. In Generation R, parents (87% mothers) completed the “pressure to eat” and “restriction” subscales of the Child Feeding Questionnaire (CFQ) at child age 4 years (Birch et al., 2001). Pressure to eat examined the frequency with which parents coerced their child to eat more (4 items,  $\alpha = .66$ ). The original 8-item restriction subscale was divided into two subscales which conceptually represented restricting a child's intake of food or “restriction” (6 items,  $\alpha = .75$ ) and using food as reward in exchange for good behavior or “instrumental feeding” (2 items,  $\alpha = .72$ ).

In Gemini, feeding practices were self-reported by the primary caregiver (96% mothers) at child age 5 years, with parents reporting on their two twin children separately. Pressure to eat was also measured using the CFQ (Birch et al., 2001) (4 items,  $\alpha = .61$ ). Instrumental feeding was assessed using the Parental Feeding Style Questionnaire (PFSQ) (Wardle et al., 2002) (4 items,  $\alpha = .68$ ). Restriction was assessed using a subscale from the Poppets study (4 items,  $\alpha = .90$ ); parents indicated how strict they were with their limitation of foods (Sweetman et al., 2011).

Response options were anchored on a 5-point Likert scale, except for instrumental feeding in Gemini (anchored on a 7-point Likert scale). Mean item scores were calculated. Z scores were calculated to facilitate comparisons in effect sizes between cohorts.

## 2.3 | ED symptoms

### 2.3.1 | Compensatory behaviors

Information on compensatory behaviors was derived from the Development and Wellbeing Assessment (DAWBA) (Moya et al., 2005). The DAWBA has demonstrated good psychometric properties and can accurately detect EDs (Moya et al., 2005). In both cohorts, adolescents were asked if they engaged in any of the following eight compensatory behaviors to lose weight or avoid weight gain in the past 3 months: purging, medication use, fasting, hiding or throwing away food, exercising more, eating less during meals, skipping meals, and avoiding foods that make you “fat.” The frequency in which each of the eight compensatory behaviors occurred was dichotomized into “no occurrence” (0) and “any occurrence” (1) and summed to provide a count of the occurrence of compensatory behaviors (Generation R:  $\alpha = .73$ ; Gemini:  $\alpha = .70$ ).

### 2.3.2 | Binge-eating symptoms

#### *Subclinical binge-eating symptoms*

Adolescents self-reported their binge-eating symptoms—overeating and loss of control (LOC) eating—via the DAWBA (Moya et al., 2005). An overeating episode was first described to participants, who were then asked if this happens to them (“yes”/“no”). Participants who responded “yes” were asked how often this happened over the past 3 months. Frequency of overeating was rated on a 4-point Likert scale. Then, participants were asked whether they experienced LOC eating (i.e., felt like they couldn't stop eating once they started) to which they indicated “yes” or “no.” Participants who indicated “yes” were asked about the frequency of LOC, again on a 4-point Likert scale. Due to low endorsement of the high frequencies, responses were categorized into a count of symptoms experienced: “no symptoms” (0), “1 symptom” (1) or “2 symptoms” (2).

## 2.4 | Disordered eating behaviors

For all disordered eating behaviors, response options were anchored on a 4-point Likert scale and averaged.

### 2.4.1 | Restrained eating

Adolescents reported the frequency in which they restrict their food intake to manage their weight via the “restrained eating” subscale of the Dutch Eating Behavior Questionnaire (DEBQ) (10 items; Generation R:  $\alpha = .71$ ; Gemini:  $\alpha = .92$ ) (Van Strien et al., 1986).

### 2.4.2 | Uncontrolled eating

Adolescents reported the extent to which they felt that they ate in response to external food cues (disinhibition) or felt out of control and ate more than usual, using the “uncontrolled eating” subscale (9 items, Generation R:  $\alpha = .91$ ; Gemini:  $\alpha = .82$ ) from the Three Factor Eating Questionnaire (TFEQ), revised version of 18 items (de Lauzon et al., 2004).

### 2.4.3 | Emotional eating

Adolescents reported the extent to which they eat in response to negative feelings via the “emotional eating” subscale of the TFEQ (3 items, Generation R:  $\alpha = .80$ ; Gemini:  $\alpha = .78$ ) (de Lauzon et al., 2004).

### 2.4.4 | Covariates

In Generation R, child height and weight at 4 years were assessed by trained staff at community Child Health Centers. At 14 years, adolescent height and weight were assessed by research assistants at the researcher center visit. Sex- and age-adjusted BMIz scores were obtained at both 4 and 14 years based on Dutch reference growth curves (Fredriks et al., 2000). Mothers' height and weight was collected by trained research staff in the first trimester of pregnancy to calculate maternal BMI at baseline. Child ethnicity was based on the country of birth of both biological parents (“Dutch” or “non-Dutch”). Maternal education was classified into “low” (no education to high school), “medium” (lower vocational training), and “high” (higher vocational training to university-level). Information on household monthly income was categorized into “low” (<1600€), “medium” (1600–4000 €), and “high” (>4000€). Mothers' lifetime history of EDs (Anorexia Nervosa [AN] and/or Bulimia Nervosa [BN]) was self-reported during pregnancy and categorized into “history of EDs” or “no history of EDs.”

In Gemini, electronic weighing scales, height charts, and detailed measurement instructions were sent to all families when their children were 2 years old and updated height charts were sent to all families when their children were 10 years old. Parents reported their child's weight and height at 5 years and 12–13 years, which was used to calculate BMIz scores based on the UK90 British Growth reference data (Freeman et al., 1995). Mothers self-reported their weight and height at baseline data collection to calculate BMI. Twins' ethnicity was categorized based on information about the ethnicity of both parents (“White British” or “non-White-British”). Maternal education was categorized as “low” (no qualifications or basic high-school education), “medium” (vocational or advanced high-school education), and “high” (university-level education). Annual household income was assessed at baseline and categorized into “low” (<30,000£), “medium” (30000–67,500£), “high” (>67,500£). Mothers' history of EDs (AN, BN, Binge-

Eating Disorder [BED], and/or another ED) were self-reported when the children were 12–13 years and categorized into “history of EDs” or “no history of EDs.”

## 2.5 | Statistical analyses

Analyses were conducted separately in each cohort using R (version 4.1.1; R Foundation for Statistical Computing). Missing data on covariates and outcomes were imputed using the *mice* (Buuren & Groothuis-Oudshoorn, 2010) package with a maximum of 50 iterations to create 20 imputed datasets. Variables were added to enhance imputation of the dataset such as maternal BMI, education and income at other waves, ethnicity of partner, education of partner, partner BMI, and child BMIz at other waves. In Generation R, additional auxiliary variables putatively associated with the outcome variables were parent-reported child restrained eating (Braet & Van Strien, 1997), internalizing and externalizing problems (Achenbach et al., 2011), and child appetitive traits (satiety responsiveness, food responsiveness, and emotional overeating; Wardle et al., 2001), all assessed at child age 10 years. In Gemini, additional auxiliary variables that were added to enhance the imputation of the outcomes were parent-reported child emotional regulation (Goodman, 2001), and child appetitive traits (satiety responsiveness, food responsiveness, and emotional overeating; Wardle et al., 2001), all assessed at child age 5 years. Pooled results from the imputed datasets are reported. Spearman's ranked correlation coefficients were used to examine associations between the ED outcomes.

Generalized linear models (GLM) were used to examine associations between parental feeding practices (exposure variables) with ED symptoms and disordered eating (outcome variables). For compensatory behaviors and binge-eating symptoms (ED symptoms), GLMs with *Poisson* errors were fitted to account for the count outcome data. For disordered eating (DEBQ restrained eating, TFEQ uncontrolled eating, and TFEQ emotional eating), GLMs with *Gamma* errors were fitted to account for the skewed distribution of the continuous outcome data. All analyses were adjusted for child sex, age at outcome, gestational age, ethnicity, BMIz at 4–5 years, and mothers' education, BMI at baseline, history of EDs and household income. In Gemini, models were additionally adjusted for clustering of twins within families using the *survey* package in R. This package allows for the clustered data (i.e., twins) to be specified when creating the survey design object. This information is used to adjust for the correlation among observations within the same cluster (i.e., twins within the same family). Several sensitivity analyses were undertaken. First, sex interactions were tested. Second, we additionally adjusted for adolescent BMIz at outcome assessment. Finally, we reran the analyses in both cohorts with participants who had full information on ED outcomes (Generation R:  $n = 2825$ ; Gemini:  $n = 876$ ).

This study was pre-registered on the Open Science Framework (OSF; <https://osf.io/e52xj>). In response to reviewer feedback, we revised our statistical approach from the OSF. First, we additionally adjusted for maternal history of EDs. Second, we used GLMs to

**TABLE 1** Final imputed sample characteristics.

	Generation R	Gemini
	( $n = 4900$ )	( $n = 2094$ )
<b>Adolescent</b>	<i>n</i> (%), mean $\pm$ SD or median (IQR)	
Sex (boys)	2455 (50.1)	1025 (48.9)
Birthweight, g	3443.1 $\pm$ 567.9	2468.5 $\pm$ 533.1
Gestational age, weeks	39.8 $\pm$ 1.8	36.3 $\pm$ 2.4
zBMI at 4–5 years	.08 $\pm$ .97	-.30 $\pm$ 1.12
zBMI at 12–14 years	.21 $\pm$ 1.12	.05 $\pm$ 1.34
Ethnicity	Dutch: 3237 (66.1)	White British: 1769 (84.5)
	Non-Dutch: 1663 (33.9)	Non-white British: 325 (15.5)
Age at measurement of feeding practices, years	4.1 $\pm$ .1	5.1 $\pm$ .1
Age at measurement of ED outcomes, years	13.6 $\pm$ .4	12.7 $\pm$ .4
Compensatory behaviors <sup>a</sup> , (possible range 0 to 8)	2 (0, 4)	2 (0, 2)
<b>Binge-eating symptoms<sup>a</sup></b>		
No symptoms	3923 (80.1)	1794 (85.7)
1 symptom	646 (13.2)	236 (11.3)
2 symptoms	331 (6.8)	64 (3.1)
Restrained eating <sup>b</sup> , (scale: 1 to 4)	1.80 (1.10, 2.90)	1.40 (1.00, 1.90)
Uncontrolled eating <sup>c</sup> , (scale: 1 to 4)	1.67 (1.33, 2.00)	1.50 (1.25, 1.88)
Emotional eating <sup>c</sup> , (scale: 1 to 4)	1.00 (1.00, 1.33)	1.00 (1.00, 1.33)
<b>Mother</b>		
Age at inclusion, years	31.5 $\pm$ 4.6	34.5 $\pm$ 4.8
BMI at baseline <sup>d</sup> , kg/m <sup>2</sup>	25.3 $\pm$ 4.8	24.8 $\pm$ 4.6
Educational level <sup>e</sup>		
High	3109 (63.5)	1039 (49.6)
Medium	1331 (27.2)	724 (34.6)
Low	460 (9.4)	331 (15.8)
Income <sup>f</sup>		
High	1931 (39.4)	505 (24.1)
Medium	2345 (47.9)	1019 (49.6)
Low	624 (12.7)	570 (27.2)
History of ED <sup>g</sup>	449 (9.2)	337 (18.0)
<b>Parental feeding practices</b>		
Pressure (scale: 1 to 5) <sup>h</sup>	3.11 $\pm$ .98	2.55 $\pm$ .71
Restriction (scale: 1 to 5 <sup>h</sup> or 1 to 7)	3.23 $\pm$ .90	5.14 $\pm$ 1.10
Instrumental feeding (scale: 1 to 5) <sup>h,j</sup>	2.22 $\pm$ 1.13	2.33 $\pm$ .63

<sup>a</sup>Measured via the development and wellbeing assessment.

<sup>b</sup>Dutch Eating Behavior Questionnaire.

<sup>c</sup>Three Factor Eating Questionnaire.

<sup>d</sup>Baseline is in the first trimester (Generation R) or at child age 8 months (Gemini).

<sup>e</sup>In Generation R: education measured at child age 5 years (“high”: higher vocational training/university; “medium”: lower vocational training; “low”: up to high school education); in Gemini: education measured at child age 8 months (“high”: university-level education; “medium”: vocational or advanced high-school education; “low”: no qualifications or basic high-school education).

<sup>f</sup>In Generation R: income measured at child age 5 years (“high”: >4000€/month; “medium”: 1600–4000€/month; “low”: <1600€/month), in Gemini: income measured at child age 8 months (“high”: >67,500€/year; “medium”: 30000–67,500€/year; “low”: <30,000€/year).

<sup>g</sup>In Generation R, Mothers' history of EDs (Anorexia Nervosa [AN] and/or Bulimia Nervosa [BN]) were self-reported during pregnancy and categorized into “history of EDs” or “no history of EDs.” In Gemini, mothers' history of EDs (AN, BN, Binge-Eating Disorder, and/or another ED) were self-reported when the children were 12–13 years and categorized into “history of EDs” or “no history of EDs.”

<sup>h</sup>Child Feeding Questionnaire measured in Generation R.

<sup>i</sup>Poppets Restriction scale measured in Gemini.

<sup>j</sup>Parent Feeding Style Questionnaire measured in Gemini.



**TABLE 2** Pooled Spearman's rank correlation coefficients ( $\rho_s$ ) between eating disorder (ED) symptoms and disordered eating at 12–14 years in Generation R ( $n = 4900$ ) and Gemini ( $n = 2094$ ).

	Compensatory behaviors <sup>a</sup>	Binge-eating symptoms <sup>a</sup>	DEBQ restrained eating <sup>b</sup>	TFEQ uncontrolled eating <sup>c</sup>
Binge-eating symptoms <sup>a</sup>	.28*** .21***	1	-	-
DEBQ restrained eating <sup>b</sup>	.74*** .68***	.30*** .17**	1	-
TFEQ uncontrolled eating <sup>c</sup>	.26* .25**	.45*** .41***	.34** .28***	1
TFEQ emotional eating <sup>c</sup>	.29*** .35***	.34*** .35***	.33*** .33***	.42*** .46***

Note: Within each cell, the upper value indicates the coefficient from Generation R and the lower value indicates the coefficient from Gemini.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

<sup>a</sup>Measured via the Development and wellbeing assessment.

<sup>b</sup>Dutch Eating Behavior Questionnaire.

<sup>c</sup>Three Factor Eating Questionnaire.

examine associations between parental feeding practices and adolescent ED outcomes treated as continuous variables and count data. This approach improves statistical power and better conforms to the assumptions of our models, given the non-normal distribution of ED outcomes (instead of categorizing ED outcomes and using logistic/ordinal regression). Finally, we imputed missing data on ED outcomes to mitigate potential biases arising from loss to follow-up. Despite these changes, the primary aim and hypotheses remained as initially outlined in the OSF.

### 3 | RESULTS

Imputed participant characteristics are presented in Table 1 (see Additional File 1: Table S2 for non-imputed characteristics). Both cohorts had comparable characteristics with a few exceptions. Compared to the Generation R sample, children in Gemini had a lower birth weight, shorter gestational period and lower BMI<sub>z</sub> at parent feeding practice measurement and mothers were older at baseline, consistent with expected differences between twin and singleton samples (Liu & Blair, 2002; van Dommelen et al., 2008). ED symptoms and disordered eating in each cohort were positively correlated with one another (Table 2). Fully adjusted models showing the results of associations between each parental feeding practice and ED symptoms and disordered eating behaviors are presented in Tables 3–5.

#### 3.1 | Pressure to eat

In Gemini, pressure to eat was associated with compensatory behaviors occurring in adolescence (Table 3). Every one unit increase in pressure to eat z-score in early childhood was associated with a 12.4% increase in the frequency of compensatory behaviors.

**TABLE 3** Generalized linear models (GLMs) showing the association between pressure to eat at 4–5 years and eating disorder (ED) symptoms and disordered eating at 12–14 years.

	Pressure to eat <sup>b</sup>	
	Generation R ( $n = 4900$ )	Gemini ( $n = 2094$ )
	Exp $\beta$ (95% CI)	
ED symptoms		
Compensatory behaviors <sup>a</sup>	1.011 (.978, 1.045)	<b>1.124 (1.041, 1.213)</b>
Binge-eating symptoms <sup>a</sup>	1.007 (.980, 1.036)	.994 (.969, 1.020)
Disordered eating		
DEBQ restrained eating	1.000 (.983, 1.016)	1.017 (.980, 1.056)
TFEQ uncontrolled eating	.997 (.984, 1.010)	1.017 (.998, 1.036)
TFEQ emotional eating	.997 (.978, 1.016)	.989 (.967, 1.011)

Note: Significant values are presented in **bold**. Models adjusted for adolescent's sex, age at outcome assessment, gestational age at birth, ethnicity, BMI<sub>z</sub> at 4–5 years, and mothers' education, BMI at baseline, history of EDs and household income. In Gemini, all models are additionally adjusted to account for clustering of twins within families. GLMs with Poisson errors were fitted in the “prediction” of ED symptoms; GLMs with Gamma errors were used in the “prediction” of disordered eating. Abbreviations: DEBQ, Dutch Eating Behavior Questionnaire; TFEQ, Three Factor Eating Questionnaire.

<sup>a</sup>Measured via the development and wellbeing assessment.

<sup>b</sup>Measured via the Child Feeding Questionnaire.

#### 3.2 | Restriction

In Generation R, parental restriction was positively associated with compensatory behaviors, DEBQ restrained eating, TFEQ uncontrolled

**TABLE 4** Generalized linear models (GLMs) showing the association between restriction at 4–5 years and eating disorder (ED) symptoms and disordered eating at 12–14 years.

	Restriction <sup>b,c</sup>	
	Generation R (n = 4900)	Gemini (n = 2094)
	Exp $\beta$ (95% CI)	
ED symptoms		
Compensatory behaviors <sup>a</sup>	<b>1.070 (1.033, 1.109)</b>	1.043 (.961, 1.132)
Binge-eating symptoms <sup>a</sup>	1.018 (.991, 1.045)	.993 (.966, 1.022)
Disordered eating		
DEBQ Restrained eating	<b>1.027 (1.010, 1.043)</b>	1.015 (.974, 1.057)
TFEQ Uncontrolled eating	<b>1.021 (1.007, 1.034)</b>	.992 (.952, 1.033)
TFEQ Emotional eating	<b>1.021 (1.005, 1.037)</b>	1.003 (.961, 1.047)

Note: Significant values are presented in **bold**. Models adjusted for adolescent's sex, age at outcome assessment, gestational age at birth, ethnicity, BMIz at 4–5 years, and mothers' education, BMI at baseline, history of EDs and household income. In Gemini, all models are additionally adjusted to account for clustering of twins within families. GLMs with Poisson errors were fitted in the “prediction” of ED symptoms; GLMs with Gamma errors were used in the “prediction” of disordered eating. Abbreviations: DEBQ, Dutch Eating Behavior Questionnaire; TFEQ, Three Factor Eating Questionnaire.

<sup>a</sup>Measured via the development and wellbeing assessment.

<sup>b</sup>Child Feeding Questionnaire measured in Generation R.

<sup>c</sup>Poppets Restriction scale measured in Gemini.

eating, and TFEQ emotional eating in adolescence (Table 4). Every one unit increase in parental restriction z-score was associated with a 7.0% increase in the frequency of compensatory behaviors; a 2.7% increase in the DEBQ restrained eating score; and a 2.1% increase in the TFEQ uncontrolled eating and TFEQ emotional eating scores.

### 3.3 | Instrumental feeding

In Generation R, instrumental feeding was positively associated with TFEQ uncontrolled eating and TFEQ emotional eating (Table 5). Every one unit increase in instrumental feeding z-score was associated with a 1.9% increase in the TFEQ uncontrolled eating score, and a 2.7% increase in the TFEQ emotional eating score. No other parental feeding practices were significantly associated with ED symptoms or disordered eating in any cohort.

### 3.4 | Sensitivity analyses

There were no significant sex interactions. Repeating the main analyses with additional adjustment for adolescent BMIz at 12–14 years

**TABLE 5** Generalized linear models showing the association between instrumental feeding at 4–5 years and eating disorder (ED) symptoms at 12–14 years.

	Instrumental feeding <sup>b,c</sup>	
	Generation R (n = 4900)	Gemini (n = 2094)
	Exp $\beta$ (95% CI)	
ED symptoms		
Compensatory behaviors <sup>a</sup>	1.026 (.990, 1.064)	1.065 (.996, 1.138)
Binge-eating symptoms <sup>a</sup>	1.021 (.995, 1.047)	.998 (.976, 1.021)
Disordered eating		
DEBQ restrained eating	1.012 (.994, 1.029)	1.018 (.990, 1.047)
TFEQ uncontrolled eating	<b>1.019 (1.008, 1.030)</b>	1.013 (.983, 1.045)
TFEQ emotional eating	<b>1.027 (1.004, 1.050)</b>	1.000 (.973, 1.026)

Note: Significant values are presented in **bold**. Models adjusted for adolescent's sex, age at outcome assessment, gestational age at birth, ethnicity, BMIz at 4–5 years, and mothers' education, BMI at baseline, history of EDs and household income. In Gemini, all models are additionally adjusted to account for clustering of twins within families. GLMs with Poisson errors were fitted in the “prediction” of ED symptoms; GLMs with Gamma errors were used in the “prediction” of disordered eating.

Abbreviations: DEBQ, Dutch Eating Behavior Questionnaire; TFEQ, Three Factor Eating Questionnaire.

<sup>a</sup>Measured via the development and wellbeing assessment.

<sup>b</sup>Child Feeding Questionnaire measured in Generation R.

<sup>c</sup>Parental Feeding Style Questionnaire measured in Gemini.

mirrored the results of the main analyses. Additionally, the sensitivity analyses with participants who had full information on ED outcomes mirrored the results of the main analysis in both cohorts (data not shown).

## 4 | DISCUSSION

This is the first exploratory study to investigate longitudinal associations between early childhood (4–5 years) parental feeding practices and adolescent (12–14 years) ED symptoms and disordered eating in two population-based cohorts. Several nonresponsive feeding practices were associated with a greater reported frequency of some ED symptoms, namely compensatory behaviors, DEBQ restrained eating, TFEQ uncontrolled eating, and TFEQ emotional eating; however, overall, the effect sizes were small and failed to replicate consistently across both cohorts. Parental feeding practices were not associated with binge-eating symptoms. Inconsistent findings between the cohorts indicate the need for replication and to clarify prospective associations between early life parental feeding practices and ED

symptoms in adolescence. Caution is therefore recommended when interpreting the results. Overall, the study findings suggest that early feeding practices, and the broader social (e.g., family dynamics) and environmental (e.g., food availability) context in which they occur, may be important prevention targets for ED symptoms.

The relationship between early parental feeding practices and ED symptoms in adolescence is complex, and such relationships are influenced by a broad range of factors. The current study covers a wide-ranging developmental period—almost one decade—and the lack of or inconsistent findings may be attributed to the multiple influences on eating that become increasingly salient as the social world of adolescents expand (Salvy et al., 2012). Parent–child feeding interactions evolve throughout development, and the influence of early parental feeding practices on child eating behaviors may diminish overtime (Larsen et al., 2015). Nonetheless, in corroboration with previous studies suggesting that nonresponsive feeding practices are associated with suboptimal child outcomes (e.g., weight (Ruzicka et al., 2021), eating in the absence of hunger (Birch et al., 2003)), the current findings provide further support for the need to guide parents of young children to respond appropriately (rather than coercively) to their child's appetitive cues. Randomized controlled trials show that nonresponsive feeding practices can be reduced and responsive practices promoted (Daniels et al., 2013; Savage et al., 2018), with positive consequences on child eating behaviors (Harris et al., 2020; Magarey et al., 2016). Thus, future work on the promotion of responsive feeding practices and prevention of ED symptoms is warranted.

The inconsistent findings between cohorts may be partially explained by the distinct cohort characteristics. First, both parental feeding practices and ED symptoms are culturally influenced (Anderson et al., 2005; Musher-Eizenman et al., 2009). While the Netherlands and the UK are geographically close, there are likely differences in the food and built environments (e.g., food availability, portion sizes, and active transport), social norms, school curricula (e.g., regarding food and nutrition), and public health programs (e.g., the National Child Measurement Programme in the UK). However, it is difficult to quantify how specific cultural influences operate in the context of feeding and ED symptoms. Future work could attempt to elucidate these cultural influences at a country-level to shed light on socio-cultural differences in parental feeding practices and ED symptoms. Second, exposure and outcome variables were assessed at slightly different ages between cohorts. Parental feeding practices were assessed at a younger age in Generation R (4 years) compared to Gemini (5 years), and may reflect variations related to age-dependent eating behaviors (Cardona Cano et al., 2015). Moreover, Generation R adolescents were slightly older on average (14 years) than Gemini adolescents (13 years), possibly contributing to the higher observed prevalence of ED symptoms in Generation R (Swanson et al., 2011). This considered, and taking into account the larger sample size of Generation R, small yet statistically significant associations might have been better detected in Generation R compared to Gemini. Finally, there are likely to be practical differences in coordinating the feeding of twins compared to singletons. Twins are more likely to be born pre-term, with lower birthweights and may

have more feeding difficulties in early life (Grumbach et al., 1986; van Dommelen et al., 2008). A history of feeding difficulties may produce anxiety in children or parents around mealtimes, and heighten the emotional climate of the feeding environment (Kerzner et al., 2015), thus potentially impacting parental feeding practices.

In Gemini, but not in Generation R, adolescents whose parents pressured them to eat in early childhood reported engaging in a greater number of compensatory behaviors. It is worth noting that while the pressure to eat subscale was derived from the same questionnaire across both cohorts (Birch et al., 2001), yet the internal reliability was below the standard acceptable threshold of  $\alpha = .70$  in both cohorts. Given the observational study design, we are unable to make causal inferences about the relationship between parental feeding practices and ED symptoms and can only demonstrate temporality and speculate about possible mechanisms at play. For instance, the associations observed may reflect parents' responding to their child's predispositions toward EDs which are already present in early childhood, such as low weight and picky eating (Herle et al., 2020; Selzam et al., 2018). While parents' pressure to eat is relatively stable across child development (Eichler et al., 2019), the long-term consequences of parents' pressure to eat are unclear.

Self-imposed (e.g., dieting) and environmentally-imposed (e.g., food availability) food restriction has been linked with overeating and weight-control ED symptomology in youth (Andres & Saldana, 2014; Hazzard et al., 2022). Building on this evidence, the Generation R findings showed that parental-imposed food restriction was also associated with both overeating and weight-control ED symptoms. In the current context, it may be that children internalize parents' perceptions about the valence (i.e., “goodness” or “badness”) of foods (Loth et al., 2014) underpinned by societal norms, public messaging, and expectations of thinness and health. This could incite guilt when eating the restricted foods or facilitate inflexible eating patterns (Oliveira et al., 2019). The prospective associations observed in this study suggest that parents may benefit from receiving advice about practical strategies to gently guide their child's eating habits without causing inadvertent harm, such as setting limits and structure around mealtimes. Any guidance needs to be provided in the context of the current obesogenic food environment, as well as wider socioeconomic and environmental factors that may influence parental feeding practices such as health inequalities and weight stigma.

Parents' instrumental feeding was associated with uncontrolled and emotional eating in Generation R, but not in Gemini. To the authors' knowledge, instrumental feeding in the context of ED symptoms has not previously been examined. Observational research in younger children suggests that foods offered as a reward are typically palatable and energy-dense (Raaijmakers et al., 2014). The pleasurable feeling elicited from eating energy-dense food could teach children to eat for reasons unrelated to hunger such as to offset negative emotions (Farrow et al., 2015). This may also be dependent on children's affinity for food: parents may be more willing to use food as a contingency for reward if children have higher food cue responsiveness or tendency to emotional overeat (Jansen et al., 2020). At the same time,



offering certain foods as rewards induces intrinsic wanting for those particular foods via the assignment of motivational salience to that food as a reward (Schultz, 2015). Further research is required to replicate and extend the understanding of instrumental feeding in childhood; and how this is related to children's appetite self-regulation and reward sensitivity.

Study strengths include the use of two large population-based cohorts, with psychometric measures of parental feeding practices and harmonized measures of ED symptoms collected at similar ages, and pre-registration of the methodological approach. Feeding practices were parent-reported and adolescent ED symptoms were self-reported which removes shared-reporter bias, although social desirability bias cannot be ruled out. However, there are also some limitations. A major limitation was that different subscales were used for parental restriction and instrumental feeding between Generation R and Gemini. Poor internal consistencies of the pressure to eat (CFQ) and instrumental feeding (PFSQ) subscales may limit the interpretability of results. As is common with longitudinal cohorts, the samples were of medium- to high-socioeconomic positions and may not be fully representative of families from more disadvantaged backgrounds in their respective populations. Further replication in large representative cohorts is needed to clarify the associations observed.

Further research is needed to clarify the direction of associations between parental feeding practices and ED symptoms using repeated measures across childhood development. The mediating or moderating role of child appetite traits or weight in these associations could also provide a greater understanding of mechanisms at play. It would be prudent for future research to examine the full range of parental feeding practices, including structure-based and responsive feeding practices, to understand potential preventative pathways.

This is the first exploratory study to investigate longitudinal associations between early childhood parental feeding practices and adolescent ED symptoms and disordered eating behaviors in two geographically distinct population-based cohorts. Nonresponsive feeding practices were associated with a greater frequency of some ED symptoms, although effect sizes were small and inconsistent between cohorts. In line with previous research, our findings suggest that nonresponsive parental feeding practices may reduce a child's autonomy over their food intake and may predispose to ED-related behaviors. It would be prudent for clinical and public health and professionals to emphasize parental feeding practices that are responsive to children's hunger and satiety.

## AUTHOR CONTRIBUTIONS

**Holly A. Harris:** Formal analysis; investigation; methodology; writing – original draft; writing – review and editing. **Alice Kininmonth:** Formal analysis; investigation; methodology; writing – original draft; writing – review and editing. **Zeynep Nas:** Investigation; validation; writing – review and editing. **Ivonne Derks:** Investigation; validation; writing – review and editing. **Fiona Quigley:** Methodology; validation; writing – review and editing. **Pauline W. Jansen:** Conceptualization; data curation; funding acquisition; methodology; supervision; writing – review and editing. **Clare Llewellyn:** Conceptualization;

data curation; funding acquisition; methodology; project administration; supervision; writing – review and editing.

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## CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

## OPEN RESEARCH BADGES



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## DATA AVAILABILITY STATEMENT

For Generation R, data described in the manuscript, code book, and analytic code can be made available upon request to [datamanagementgenr@erasmusmc.nl](mailto:datamanagementgenr@erasmusmc.nl) and will be discussed in the Generation R Study Management Team. For Gemini, data described in the manuscript, code book and analytic code can be made available upon request to the Gemini team. Please visit the Gemini website and complete a data request form (<https://www.geministudy.co.uk/data-access>). This will then be reviewed through the Gemini Executive Committee in accordance with the Gemini Data Access Policy.

## ORCID

**Holly A. Harris**  <https://orcid.org/0000-0002-8304-1064>  
**Alice R. Kininmonth**  <https://orcid.org/0000-0002-1145-525X>  
**Zeynep Nas**  <https://orcid.org/0000-0002-6675-621X>  
**Ivonne P. M. Derks**  <https://orcid.org/0009-0009-0137-3697>  
**Fiona Quigley**  <https://orcid.org/0000-0003-1725-3007>  
**Pauline W. Jansen**  <https://orcid.org/0000-0001-7747-5803>  
**Clare Llewellyn**  <https://orcid.org/0000-0002-0066-2827>

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## SUPPORTING INFORMATION

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

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