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The impact of maternal post-partum depressive symptoms on child diet at 18 months

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Abstract

Post-partum depression (PPD) is a serious mental health problem, which can impair maternal behaviours and adversely affect the cognitive, emotional and behavioural development of children. This study aims to explore the impact of maternal depressive symptoms at 3 months post-partum (baseline) on child diet at 18 months of age (follow-up). This study used longitudinal data from 263 first-time mothers from the Melbourne Infant Feeding, Activity and Nutrition Trial (InFANT) Extend. Women self-reported depressive symptoms (10-item Center for Epidemiological Studies Depression Scale [CES-D]) and child diet (fruits, vegetables and discretionary foods). Multiple linear regression analyses were used to explore the relationship between maternal depressive symptoms at baseline and child fruit and vegetable intake and discretionary food intake (g day^{-1}) at follow-up. Baseline maternal depressive symptoms were associated with higher childhood consumption of discretionary foods at 18 months of age (β = 0.45, 95% confidence interval [CI] 0.03 to 0.87, P = 0.034 [adjusted]). There was no evidence of association for maternal depressive symptoms and child intake of fruits and vegetables. Further longitudinal studies are warranted to confirm these findings, with the hope of translating this knowledge into optimal clinic care and improved physical and mental health for mother and child.

KEYWORDS
child health, depressive symptoms, diet quality, maternal health, post-partum depression

1 | INTRODUCTION

Post-partum depression (PPD) is a serious mental health problem, with a global prevalence of approximately 17.7% (Hahn-Holbrook et al., 2018). In general, PPD occurs within the first 4 weeks after childbirth (Stewart et al., 2003) but can develop anytime within 1–12 months after delivery (Stewart et al., 2003). The time following the birth of a child is one of the intense physiological and psychological changes for a mother. Although many studies have looked at possible aetiologies of PPD, including hormonal changes, biological vulnerability and psychosocial stressors, the specific aetiology remains unclear (Andrews-Fike, 1999). Symptoms may include depressed mood, loss of interest or pleasure in activities, sleep disturbance, appetite disturbance, loss of energy, feelings of worthlessness or guilt, poor concentration and memory, fatigue and irritability, and thoughts of suicide (American Psychiatric Association, 2000). PPD is the most common mental disorder observed following childbirth and can impair maternal behaviours and adversely affect the cognitive, emotional and behavioural development of children (Hahn-Holbrook et al., 2018). Mothers suffering from PPD may display hostility and negligence,

have lower tolerance and may be less responsive to their infants (Shorey et al., 2018). Consequently, mothers with PPD may exhibit disrupted mother–infant bonding (Shorey et al., 2018), which may limit the mothers' ability to respond appropriately when feeding her child, including early interruption of exclusive breastfeeding, less healthy feeding practices or early introduction of solids (El-Behadli et al., 2015; Slomian et al., 2019).

The first 1000 days, from conception to 2 years of age, are crucial factors in a child's neurodevelopment and lifelong mental health. Child and adult health risks, including obesity, hypertension and diabetes, may be programmed by nutritional status during this period (e.g., the process in which quality and/or quantity of nutrients consumed during this critical phase of development exerts changes to the physiology or metabolism of the child) (Langley-Evans, 2009; Schwarzenberg & Georgieff, 2018). Fruits and vegetables provide a widely accepted simple measure of diet quality (Garriguet, 2009) and are important components of a healthy diet providing an excellent source of important nutrients such as potassium, folate, fibre, vitamin A, vitamin C, vitamin K and many phytochemicals (Grimm et al., 2014). Diets rich in fruits and vegetables can lower children's energy intake and reduce the risk of obesity, as well as aiding in the prevention of chronic diseases including cardiovascular disease, stroke, diabetes and certain cancers (Holley et al., 2017). Conversely, discretionary foods are not an essential or necessary part of our dietary patterns as they are high in saturated fat, added sugars and/or added salt (National Health and Medical Research Council [NHMRC], 2013). Excess consumption can displace intake of nutritious foods, provide surplus energy resulting in weight gain and contribute to the development of chronic health conditions, including type 2 diabetes and cardiovascular disease (Johnson et al., 2017). Additionally, a high intake of discretionary foods increases the risk of poor mental health (in particular, depression, low mood and anxiety) in both adults and children (Li et al., 2017; O'Neil et al., 2014).

Although the potential consequences of PPD on child health outcomes are concerning, there is limited evidence from longitudinal studies exploring the impact of maternal PPD on early childhood diet. A recent systematic review of cross-sectional and longitudinal studies (Slomian et al., 2019) exploring the consequences of maternal PPD on maternal and infant outcomes found that PPD creates an environment that is not conducive to optimal development of a child (Slomian et al., 2019). Specifically, the two studies that reported on infant feeding showed that recommended feeding practices prior to 4 months of child's age were less likely to be followed (Balbierz et al., 2015; Zajicek-Farber, 2008) and demonstrated that depressed mothers were more likely to introduce water, juice or cereals to their infants' diets earlier (prematurely) than nondepressed mothers (Balbierz et al., 2015; World Health Organization [WHO], 2017; Zajicek-Farber, 2008). An additional study (Gaffney et al., 2014) of mother–infant dyads from the Infant Feeding Practices Study II ($n = 1447$) also found that mothers with PPD were 1.77 times (95% confidence interval [CI] 1.16 to 2.68) more likely to add cereal to their baby's bottle at 2 months of age than mothers without PPD. Yet, to our knowledge, no studies have reported on consequences of maternal PPD on early childhood diet quality. This Australian study aims to assess the association between maternal depressive symptoms and early childhood diet (fruits, vegetables and discretionary foods). The Melbourne Infant Feeding, Activity and Nutrition Trial (InFANT) Extend assessed maternal depressive symptoms at 3 months post-partum and child dietary intake at 18 months of age, providing a unique opportunity to address this knowledge gap. Presenting on diet (comprising three key food groups), rather than a single measure of overall diet quality, allows for exploration of the potential role and impact that maternal PPD plays on child consumption of individual food groups and supports hypothesis generation regarding potential mechanisms and targets for intervention.

Key messages

- To our knowledge, no studies have reported on consequences of maternal PPD on early childhood diet.
- Maternal depressive symptoms at 3 months post-partum were associated with higher childhood consumption of discretionary foods at 18 months.
- Diet can promote mental well-being for mother and child. Considering that parents are gatekeepers and can serve as role models, dietary recommendations targeted at mothers at risk of PPD should be easy-to-follow, considerate of lifestyle and social circumstances, and amenable to fluctuations in mood and motivation.
- Further longitudinal studies are warranted to confirm findings. Ideally, this knowledge will translate into improved physical and mental health for mother and child.

2 | METHODS

2.1 | Study design

This study utilised longitudinal data obtained from the InFANT Extend, a cluster randomised controlled trial, with data collected at 3 months post-partum (baseline) and at 18 months post-partum (follow-up). The InFANT Extend programme was a community-based, early childhood obesity prevention programme delivered to first-time parents (Campbell et al., 2016). The intervention comprised 6 × 2-h sessions delivered quarterly to first-time parents from when infants were approximately 3 months of age to approximately 18 months of age. Sessions were delivered within existing first-time parent groups,

established by community Maternal and Child Health nurses (MCHn) as part of the free universal healthcare system in Melbourne, Australia. The control group received usual care from their MCHn, as well as quarterly newsletters on general child health topics not related to obesity-promoting behaviours.

2.2 | Participants

In 2010 and 2011, participants were recruited from seven Victorian local government areas (LGAs) in the lowest tertile of disadvantage assessed by the group-level variable Socio-Economic Indexes for Areas within a 75-km radius of the research centre (Geelong, Australia). Mothers were eligible to participate if they gave informed written consent, were first-time mothers and were literate in English. InFANT Extend is an early childhood obesity prevention programme aimed at healthy individuals. Hence, infants with chronic health conditions (e.g., genetic disorders and endocrine diseases) likely to influence height, weight, levels of physical activity or eating habits were excluded from the study (Campbell et al., 2016).

2.3 | Maternal depressive symptoms—3 months post-partum

Maternal depressive symptoms were assessed using the 10-item Center for Epidemiological Studies Depression Scale (CES-D) (Andresen et al., 1994) at baseline. This scale is a commonly used self-reported measure of depressive symptoms with good retest reliability and predictive validity compared with the original 20-item version (Andresen et al., 1994; Andresen et al., 2013; Boey, 1999; Cheng & Chan, 2005; Irwin et al., 1999). Responses were reported using a 4-point Likert scale ranging from 'rarely/none of the time (less than 1 day)' (scored 0) to 'all of the time (5–7 days)' (scored 3). The total score was derived by calculating the sum of 10 items (possible scores range from 0 to 30), with higher scores indicating more depressive symptoms. In order to define mothers at risk for depression, depressive symptoms were also presented as a categorical variable with a score of ≥10 used to define risk of heightened depressive symptoms and <10 suggestive of low risk for clinical depression (Andresen et al., 1994; Boey, 1999). This cut-off value has been shown to produce good test–retest reliability (Andresen et al., 1994; Boey, 1999).

2.4 | Child diet—18 months of age

Child dietary intake was assessed using a Food Frequency Questionnaire (FFQ) food list developed from the 2007 National Children's Nutrition and Physical Activity Survey (NCNAPAS), which was the most recent and comprehensive data on dietary intakes of Australian children available at the time (Zheng et al., 2020). *Fresh fruits* (apples and pears; oranges, mandarins and other citrus fruits; bananas; grapes; strawberries; watermelon; kiwi fruit; peach, apricot, nectarine and plums; pineapple; and rockmelon), *vegetables* (potato, carrot, tomato, broccoli, peas, cauliflower, cucumber, capsicum, onion, corn, pumpkin, zucchini and mushroom) and *discretionary foods* (i.e., sugary drinks [regular soft drink, cordial, sports drinks and fruit juice drinks]; noncore sweets [chocolate, sweets and lollies; sweet biscuits; and cakes, muffins and scones]; and noncore savoury snacks [crisps, corn chips and Twisties; savoury biscuits]) were included in analyses as average daily intake (in grams).

To determine usual intake of fruits, vegetables and discretionary foods, mothers were asked to indicate 'in the past month, about how often has your child had the following', with nine options ranging from 'never or less than once a month' to '6 or more times a day'. Food and nutrient intakes from the FFQ were calculated using a purposed designed database incorporating AUSNUT 2007 food composition data. This database was then used to convert frequency of consumption of fruits, vegetables and discretionary items into consumption in grams (Zheng et al., 2020). The FFQ was validated against three 24-h recalls and has shown good validity for estimating food group intakes.

2.5 | Potential covariates

Maternal demographic and lifestyle variables (i.e., age; country of birth [Australia or overseas]; smoking status [never smoked or former, occasional and regular smoker]; sleep quality [very, fairly bad or fairly good or very good]; and relationship status [married, de facto or separated, divorced, widowed and never married]) were collected using a self-administered questionnaire at baseline. Consistent with previous analyses arising from the cohort, the highest maternal qualification achieved was categorised into preuniversity (no formal qualifications, year 10 or equivalent, year 12 or equivalent, trade/apprenticeship and certificate/diploma) or university (university degree and higher university degree), and it was included as a proxy measure of socio-economic position (Zheng et al., 2019). Anthropometric data were collected by a trained researcher who measured weight and height of participants at baseline using calibrated scales and stadiometer, respectively. Maternal prepregnancy body mass index (BMI) was calculated as weight (kg) divided by height (m^2) (Australian Institute of Health and Welfare [AIHW], 2020a). Finally, child birthweight (obtained through parent reporting of Child Health Record) and child sex were recorded. Low birthweight was defined as less than 2500 g (AIHW, 2020b).

2.6 | Statistical analysis

Analyses were conducted using SPSS software (Version 26.0, 2019, IBM Corp). The significance level was set at $P < 0.05$. Baseline characteristics of the final eligible subsample included in this analysis ($n = 263$) were compared with those of the excluded InFANT Extend

sample (n = 254). Additionally, baseline characteristics were described according to maternal reporting of baseline depressive symptoms (high risk for depression [n = 30] vs. low risk for depression [n = 233]). When comparing the two groups, chi-squared tests were used for categorical variables. Independent samples t tests were performed for continuous variables, or Mann–Whitney U test as the non-parametric alternative.

Multiple linear regression analyses were used to explore the relationship between baseline maternal depressive symptoms (CES-D, continuous, exposure-independent variable) and child fruit and vegetable intake and discretionary food intake at 18 months of age (g day^{-1}, continuous, outcome-dependant variable). Crude/unadjusted models were first performed. Additionally, models adjusted for potential covariates (maternal age, maternal country of birth, maternal smoking status, maternal sleep quality, maternal relationship status, maternal highest qualification achieved, maternal prepregnancy BMI, child birthweight and child sex), selected a priori based on existing evidence that these variables are likely to play a role in post-partum depressive symptoms and/or childhood diet outcomes. The intervention and the control groups were pooled for the present analysis, and group allocation was also included as a potential covariate. Pearson correlation was conducted to assess the potential multicollinearity between independent variables. All correlations were <0.30; hence, all covariates were included in the model simultaneously.

2.7 | Ethical considerations

Ethical approval was granted by the Deakin University Human Research Ethics Committee (EC 175-2007) and by the Victorian Government Department of Human Services, Office for Children Research Co-ordinating Committee (CDF/07/1138). InFANT Extend is registered with the Australian Clinical Trials Registry (ACTRN12611000386932).

3 | RESULTS

Data were collected from a total of 517 first-time mothers. Of this sample, 302 mothers (58%) had complete data on maternal depressive symptoms and child diet outcomes. For the primary analysis, 263 (51%) mothers had complete data on maternal depressive symptoms, demographic, lifestyle, anthropometric variables and child diet outcomes. The study flow chart of participants included in the present analysis is displayed in Figure 1. Compared with those excluded from the present analysis, those included had lower levels of baseline maternal depressive symptoms, were slightly older (P = 0.007), were more likely to have completed university (P = 0.047) and were less likely to smoke (P = 0.012) (Table 1).

Comparison of maternal baseline characteristics and child diet outcomes according to risk for depression (high [CES-D ≥ 10] vs. low [CES-D < 10]) is shown in Table 2. Mothers at high risk for baseline depression were more likely to have very/fairly bad sleep quality, compared with women at low risk for depression (P < 0.0001). The groups were found to be similar for the remaining variables (Table 2).

3.1 | Maternal depressive symptoms and child diet outcomes

Baseline characteristics were described according to maternal reporting of baseline depressive symptoms (high risk for depression

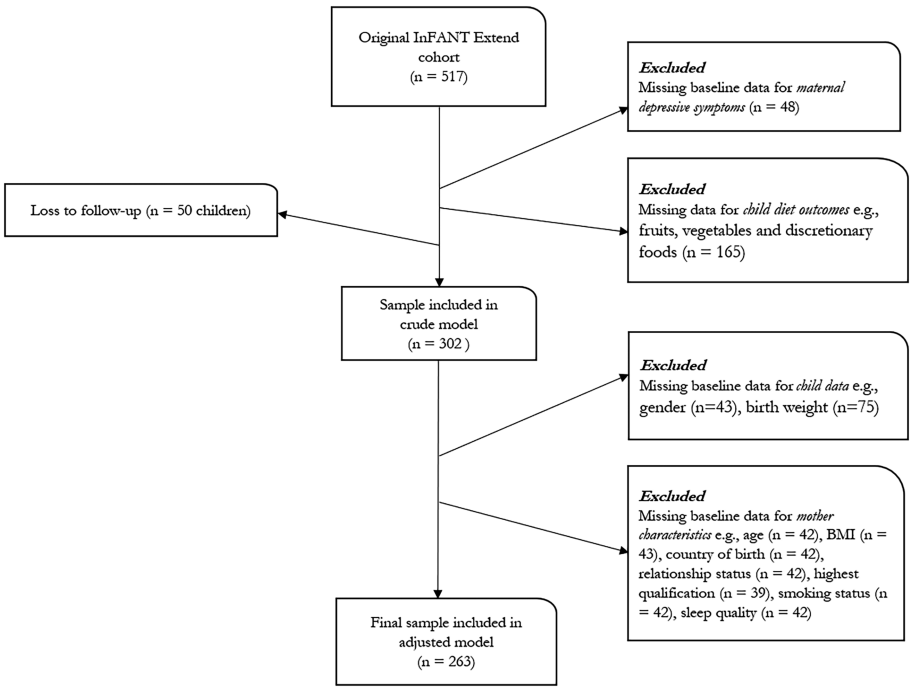

FIGURE 1 Flow chart of participant inclusion and exclusion into the study. BMI, body mass index; InFANT, Infant Feeding, Activity and Nutrition Trial

TABLE 1 Baseline characteristics of the final eligible subsample included in this analysis compared with the excluded InFANT Extend sample

Baseline characteristics	Included (*n* = 263)	Excluded (*n* = 254)	*P*[a]
Mother			
Group allocation, intervention, % (*n*)	51.7 (136)	50.4 (128)	0.832
Depression (CES-D), mean (SD), range	5.3 (3.7)	6.2 (3.6)	**0.001**
Age (years), mean (SD)	32.6 (4.2)	31.5 (4.5)	**0.007**
Born in Australia, % (*n*)	79.5% (209)	72.2% (153)	0.080
Relationship status, % (*n*)			
Married, de facto	96.6% (254)	95.3% (202)	0.474
Separated, divorced, widowed, never married	3.4% (9)	4.7% (10)	
Highest qualification completed, % (*n*)			
Preuniversity	38.4% (101)	47.4% (102)	**0.047**
University	61.6% (162)	52.6% (113)	
Smoking status, % (*n*)			
Never smoked	66.9% (176)	55.7% (118)	**0.012**
Former, occasional, regular smoker	33.1% (87)	44.3% (94)	
Sleep quality, % (*n*)			
Very, fairly bad	23.2% (61)	26.9% (57)	0.101
Fairly good	59.7% (157)	62.7% (133)	
Very good	17.1% (45)	10.4% (22)	
BMI (kg m^{-2}), mean (SD), range	26.2 (5.0)	26.3 (5.0)	0.609
Child			
Sex (male), % (*n*)	52.1% (137)	52.6% (111)	0.985
Birthweight (g), mean (SD), range	3314 (622.7)	3425 (537)	0.068

Note: Values provided in bold indicate statistical significant findings (e.g., $P < 0.05$).
Abbreviations: BMI, body mass index; CES-D, Center for Epidemiological Studies Depression Scale; InFANT, Infant Feeding, Activity and Nutrition Trial.
[a]Chi-squared tests used for categorical variables. Independent samples *t* tests performed for continuous variables, or Mann–Whitney *U* test as the non-parametric alternative.

[*n* = 30] vs. low risk for depression [*n* = 233]). No difference in maternal depressive symptoms and child diet outcomes between the intervention and control groups was found. Hence, the intervention and control groups were pooled for linear regression analysis, and group allocation was included as a covariate.

The crude linear regression model indicated a positive relationship, such that baseline maternal CES-D score (depressive symptomatology) was associated with higher childhood discretionary food intake (g day^{-1}) at 18 months of age ($\beta = 0.58$, 95% CI 0.18 to 0.97, $P = 0.005$). Adjusting for covariates, the magnitude of the association remained similar ($\beta = 0.45$, 95% CI 0.03 to 0.87, $P = 0.034$) (Table 3), whereby baseline maternal depressive symptoms were associated with higher childhood consumption of discretionary foods at 18 months of age. Every 1-point increase in maternal CES-D was associated with 0.45-g increase in child intake of discretionary foods. There was no evidence of association for maternal depressive symptoms and child intake of fruits ($\beta = 1.25$, 95% CI −3.84 to 6.33, $P = 0.630$) and vegetables ($\beta = 1.20$, 95% CI −0.88 to 3.28, $P = 0.256$).

4 | DISCUSSION

This is one of the first studies to explore the prospective association between maternal depressive symptoms at 3 months post-partum and early childhood diet at 18 months post-partum. Baseline maternal depressive symptoms were associated with higher childhood consumption of discretionary foods (sugary drinks, noncore sweets and noncore savoury snacks) at 18 months of age, while adjusting for multiple potential confounders. Specifically, every 1-point increase in maternal CES-D was associated with a 0.45-g increase in child intake of discretionary foods. No evidence of association was observed for maternal depressive symptoms and child intake of fruits and vegetables.

In this study, baseline maternal depressive symptoms were associated with higher intake of childhood discretionary foods including regular soft drink, cordial, sports drinks, fruit juice drinks, chocolate, sweets, lollies, sweet biscuits, cakes, muffins, scones, crisps, corn chips, Twisties and savoury biscuits. These discretionary foods are not an essential or necessary part of our dietary patterns as they are high

TABLE 2 Baseline characteristics and child diet outcomes according to maternal risk for depression

Baseline characteristics	High risk for depression (CES-D ≥ 10) (*n* = 30)	Low risk for depression (CES-D < 10) (*n* = 233)	*P*[a]
Mother			
Group allocation, intervention, % (*n*)	43.3 (13)	52.8 (123)	0.435
Age (years), mean (SD)	33.9 (4.1)	32.4 (4.2)	0.070
Born in Australia, % (*n*)	76.7% (23)	79.8% (186)	0.870
Relationship status, % (*n*)			
Married, de facto	96.7% (29)	96.6% (225)	0.977
Separated, divorced, widowed, never married	3.3% (1)	3.4% (8)	
Highest qualification completed, % (*n*)			
Preuniversity	33.3% (10)	39.1% (91)	0.544
University	66.7% (20)	60.9% (142)	
Smoking status, % (*n*)			
Never smoked	63.3% (19)	67.4% (157)	0.657
Former, occasional, regular smoker	36.7% (11)	32.6% (76)	
Sleep quality, % (*n*)			
Very, fairly bad	56.7% (17)	18.9% (44)	**<0.0001**
Fairly good	36.7% (11)	62.7% (146)	
Very good	6.7% (2)	18.5% (43)	
BMI (kg m^{-2}), mean (SD)	28.5 (7.3)	25.9 (4.6)	0.118
Child			
Sex (male), % (*n*)	40.0% (12)	53.6% (125)	0.225
Birthweight (g), mean (SD)	3348 (606)	3310 (626)	0.859
Diet outcomes (g)			
Fruits, mean (SD)	297.8 (157.8)	264.6 (135.4)	0.305
Vegetables, mean (SD)	123.4 (84.3)	109.3 (52.7)	0.657
Discretionary foods, median (IQR)	9.77 (4.13–17.36)	8.70 (3.19–16.68)	0.054

Note: Chi-squared tests used for categorical variables. Independent samples *t* tests performed for continuous variables, or Mann–Whitney *U* test as the non-parametric alternative. Values provided in bold indicate statistical significant findings (e.g., $P < 0.05$).
Abbreviations: BMI, body mass index; CES-D, Center for Epidemiological Studies Depression Scale; IQR, interquartile range.
[a]High risk for depression, mean (SD): 13.1 (2.8); low risk for depression, mean (SD) 4.3 (2.4).

TABLE 3 Linear regression analysis between maternal depressive symptoms (CES-D) at baseline (3 months post-partum) and childhood diet at 18 months of age

	Fruit intake (g)		Vegetable intake (g)		Discretionary foods (g)	
Depressive symptoms (continuous, CES-D)	***β* (95% CI)**	***P***	***β* (95% CI)**	***P***	***β* (95% CI)**	***P***
Crude/unadjusted (*n* = 302)	0.59 (–3.78 to 4.96)	0.790	1.04 (–0.70 to 2.78)	0.239	**0.58 (0.18 to 0.97)**	**0.005**
Adjusted (*n* = 263)	1.25 (–3.84 to 6.33)	0.630	1.20 (–0.88 to 3.28)	0.256	**0.45 (0.03 to 0.87)**	**0.034**

Note: Adjusted for group allocation, maternal age, maternal prepregnancy BMI, maternal country of birth, maternal smoking status, maternal sleep quality, maternal highest qualification achieved, maternal relationship status, child birthweight and child sex. Values provided in bold indicate statistical significant findings (e.g., $P < 0.05$).
Abbreviations: CES-D, Center for Epidemiological Studies Depression Scale; CI, confidence interval.

in saturated fat, added sugars and/or added salt. Excess consumption can displace intake of nutritious foods (vegetables, fruit, whole grains, dairy, meats and alternatives), provide excess energy leading to weight gain in children and contribute to the development of chronic health conditions, including type 2 diabetes and cardiovascular disease (Johnson et al., 2017). Global rates of childhood obesity continue to rise, which may partly be explained by maternal depressive symptoms and the associated suboptimal parenting practices (Balbierz et al., 2015) including less healthy feeding behaviours; poorer healthcare and safety practices; and disengaged, uninvolved,

permissive parenting practices (Benton et al., 2015). Alarmingly, a high intake of discretionary foods/unhealthy dietary patterns has also been shown to be associated with poorer mental health in both adults and children (Li et al., 2017; O'Neil et al., 2014). Acknowledging the high prevalence of PPD, our findings, which show that every 1-point increase in maternal CES-D was associated with a 0.45-g increase in child intake of discretionary foods, are of interest, especially when considering that discretionary food intakes are generally low in this age group (Campbell et al., 2013) and that the Australian Dietary Guidelines for children 1–2 years of age recommend that consumption of nutrient-poor discretionary foods be *avoided* (NHMRC, 2012). With this novel information, health professionals (e.g., maternal and child health nurses and allied health) who regularly work with families in the early years of life can play an important role in promoting a healthy lifestyle. Moreover, antenatal services provide an opportune time to educate and inform pregnant women and parents to be on the relationship between diet, mental and physical health.

The lack of an association for maternal depressive symptoms and childhood fruit and vegetable consumption contributes evidence towards the currently scarce and mixed literature. For example, one cross-sectional study conducted in children aged 3 to 5 years who are from families with incomes below the poverty guidelines found that maternal depression was associated with increased risk for poor child fruit and vegetable intake (Ward et al., 2020). Whereas another cross-sectional study of maternal depressive symptoms and child obesity in low-income urban families (mothers with 5-year-old children) did not find significant relationships between maternal depressive symptoms and child fruit and vegetable consumption (Gross et al., 2013). Discrepancies in findings may relate to the varying ages of included study populations (e.g., 18-month-old children have different dietary intakes and requirements to older children; NHMRC, 2013) and differing measures of PPD (e.g., CES-D compared with Patient Health Questionnaire-2, Ward et al., 2020, and Patient Health Qestionnarire-9, Gross et al., 2013). Additionally, the relationship between diet and mental health is complex and likely bidirectional (Jacka et al., 2015), and cross-sectional analysis is unable to determine causality. Hence, more high-quality research in this area is warranted, including rigorously designed longitudinal studies and RCTs, which provide insights into the temporal order of the relationship between maternal depressive symptoms and later childhood diet outcomes.

Our observed study findings regarding maternal PPD and child consumption of discretionary foods may be partly explained by the following proposed mechanisms. Maternal depression can result in disrupted mother–infant interactions (e.g., reduced sensitivity, responsivity and interaction), resulting in negative effects on the child's diet (Marshall et al., 2018). Depressive symptoms, characterised by low energy or low motivation, may also lead to a less responsive feeding style. Such characteristics may limit the ability of a mother to respond appropriately when feeding her child, including more controlling less sensitive feeding practices with their children (El-Behadli et al., 2015; Hughes et al., 2005). This feeding style may otherwise be overly indulgent, allowing the child to control selection and intake of food (Hughes et al., 2005). Mothers with depressive symptoms may also be less motivated to shop for healthy foods or prepare healthy meals (Ljungberg et al., 2020). This can be highly problematic when considering that parents are gatekeepers and can serve as role models for their children's health related behaviours (Marshall et al., 2018). Further, maternal depression is commonly associated with stress and appetite changes, typically resulting in an increased intake of fatty, sugary and salty foods and a lower intake of fruits and vegetables (Christensen, 2001; El-Behadli et al., 2015). Parental food preferences and dietary intake have been shown to influence children's eating behaviours, whereby young children may imitate their parents in their choice of diets (El-Behadli et al., 2015).

Diet, as an adjunctive treatment strategy, can promote mental well-being for both mother and child (Baskin et al., 2015; O'Neil et al., 2014; Opie et al., 2020). Although improving diet quality is fraught with barriers and challenges (Christensen, 2001; El-Behadli et al., 2015), recent intervention studies have demonstrated that dietary improvement can be achieved in individuals with depressive disorders (Opie et al., 2018; Parletta et al., 2017). One way of improving maternal dietary choice for one's infant may be through the implementation of educational interventions. Recommendations should be easy to follow, practical and considerate of individual lifestyle and social circumstances, while being culturally sensitive and amenable to potential fluctuations in mood state and motivation levels (Opie et al., 2018). Importantly, barriers to accessing nutrition and dietetic services must be addressed, to support and enable people with (or at risk of) mental illness to improve their health and to develop their capacity to actively take part in the care of their family (Australian Government Productivity Commission, 2020).

4.1 | Strengths and limitations

The prospective design of this study provides preliminary insights into the temporal order of the relationship between earlier maternal influences and later childhood diet outcomes. Given the observational nature of the study, unmeasured and residual confounding cannot be ruled out. However, we included a range of potential confounders, such as sociodemographic factors, lifestyle behaviours and anthropometric measures. The use of a validated dietary assessment tool, and the inclusion of both healthy and unhealthy food items, is a strength of our study. The depression scale (CES-D) is also a previously validated tool; however, we were limited by lack of information regarding depression history, depression chronicity or antidepressant medication use. Importantly, in our study, 11% of women reported a high risk of depression (≥10 on the CES-D), which is very similar to the 13% prevalence estimate reported in a large meta-analysis examining rates and risk of PPD (O'hara & Swain, 2009). In addition, generalisability of fruit and vegetable intake in our study was comparable with national daily averages for children aged 2–3 years, which report 2.0 serves (∼300 g) of fruit and 1.4 serves (∼105 g) of vegetables for boys and 1.6 serves (∼240 g) of fruit and 1.1 serves (∼83 g) of vegetables for

girls (AIHW, 2018). Similarly, for discretionary foods, intakes by our study participants were highly comparable with the original InFANT cohort (Campbell et al., 2013). Additionally, other cohort studies of young Australian children (between 12 and 36 months) report that only 4% to 11% of children are nonconsumers (Byrne et al., 2014; Coxon et al., 2020), which is similar to the proportion (6.1%) of discretionary food nonconsumers ($\leq$0 g day^{-1}) observed in our study. Finally, our study sample was limited to first-time mothers with singleton pregnancies who considered themselves in good general health, and a large proportion (62%) of women in the current study were highly educated (holding a university degree). Therefore, results may not be generalisable to less educated women, multiparous mothers or mothers with poor general health. When considering that lower maternal education levels have been linked with poorer diet quality (Wachs & McCabe, 2001) and that in families of low socio-economic status (SES), selection of nutritious food choices at the lowest cost typically requires greater effort and caregiver involvement, which is less likely to occur in mothers with depression (El-Behadli et al., 2015), it is recommended that future studies be conducted among socioeconomically disadvantaged families.

5 | CONCLUSION

This study has shown that maternal depressive symptoms at 3 months post-partum were associated with higher childhood consumption of discretionary foods at 18 months of age. However, no evidence of association was observed for fruit and vegetable intake. These findings relating to high intake of discretionary foods pose long-term health risks such as weight gain, type 2 diabetes, cardiovascular disease and poorer mental health for both adults and children. Further longitudinal studies are warranted to confirm these study findings. Ideally, this knowledge generation will translate into optimal clinic care and improved physical and mental health for both mother and child.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

RSO analysed and interpreted the data (under guidance from MZ), and RSO was a major contributor in writing the manuscript. All authors contributed to draft versions and read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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