Association between Australian-Indian mothers' controlling feeding practices and children's appetite traits

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Abstract

This cross-sectional study examined the association between controlling feeding practices and children's appetite traits. The secondary aim studied the relationship between controlling feeding practices and two proxy indicators of diet quality. Participants were 203 Australian-Indian mothers with children aged 1-5 years. Controlling feeding practices (pressure to eat, restriction, monitoring) and children's appetite traits (*food approach traits:* food responsiveness, enjoyment of food, desire to drink, emotional overeating; *food avoidance traits:* satiety responsiveness, slowness in eating, fussiness and emotional undereating) were measured using self-reported, previously validated scales/questionnaires. Children's daily frequency of consumption of core and non-core foods was estimated using a 49-item list of foods eaten (yes/no) in the previous 24 hours as an indicator of diet quality. Higher pressure to eat was associated with higher scores for satiety responsiveness (β=0.24, p= 0.004), slowness in eating (β=0.27, p<0.001), fussiness (β=0.31, p<0.001) and lower score for enjoyment of food (β=-0.28, p=0.001). Higher restriction was related to higher scores for food responsiveness (β=0.31, p=0.001) and emotional overeating (β=0.28, p<0.001). Higher monitoring was inversely associated with fussiness (β=-0.28, p<0.001), slowness in eating (β=-0.25, p=0.002), food responsiveness (β=-0.19, p=0.01) and emotional overeating (β=-0.26, p=0.001) and positively associated with enjoyment of food (β=0.18, p=0.01). Pressure to eat and monitoring were related to lower number of core (β=-0.18, p=0.02) and non-core foods (β=-0.22, p=0.01) consumed in the previous 24 hours, respectively. All associations remained significant after adjusting for maternal and child covariates (n=152 due to missing data). In conclusion, pressure to eat was associated with higher food avoidance traits and lower consumption of core foods. Restrictive feeding practices were associated with higher food approach traits. In contrast, monitoring practices were related to lower food avoidance and food approach traits and lower non-core food consumption.

Keywords: Feeding practices, Appetite traits, Children, Indian, Australia

Introduction

Childhood obesity is a complex global public health challenge, with both genetic and environmental determinants including ready availability and affordability of nutrient-poor, energy-dense (i.e. 'non-core') foods (Santos et al., 2011). It is widely agreed that prevention and hence interventions to modify the environmental determinants of childhood obesity are critical. Mothers are typically the primary "gatekeepers" of young children's food environment (Webber, Cooke, Hill, & Wardle, 2010). Therefore, the feeding practices mothers use to regulate the quality and quantity of food consumed by their children have received considerable attention over the last 10 years. Particularly, mothers' use of 'controlling' feeding practices (restriction, pressure to eat and monitoring) have been extensively examined due to theoretical and empirical links with the child's weight status (Ventura & Birch, 2008). In a prospective study (n=57), restriction at 5 years was associated with higher weight gain between 5 and 7 years, and pressure to eat and monitoring were associated with lower BMI z-scores at age 7, after controlling for baseline weight status (Faith et al., 2004). It has been postulated that the association between maternal feeding practices and the child's weight status may partly be explained (mediated) by child-related variables including eating behaviours (appetite traits) and diet quality (Ventura & Birch, 2008; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009; Webber et al., 2010).

The Children's Eating Behaviour Questionnaire (CEBQ) (Wardle, Guthrie, Sanderson, & Rapoport, 2001) is a psychometric tool widely used to assess multiple dimensions of children's eating behaviour. The CEBQ was developed in the UK with children aged 2-7 years, and has been validated in culturally diverse populations such as Portuguese (3-13 years) (Viana, Sinde, &

Saxton, 2008), Chilean (6-12 years) (Santos et al., 2011), and Chinese and Indian migrants residing in Australia (1-5 years) (Mallan et al., 2013). Eating behaviours in children are broadly conceptualised as traits indicative of *greater appetite* or *approach* towards eating (food approach traits: food responsiveness, desire to drink, enjoyment of food, emotional overeating) and eating behaviour traits reflecting *poor appetite* or *avoidance* of eating (food avoidance traits: satiety responsiveness, slowness in eating, fussiness, emotional undereating) (Webber et al., 2009, 2010). Food approach traits are postulated to reflect increased responsiveness to external food cues (Ashcroft, Semmler, Carnell, Van Jaarsveld, & Wardle, 2008), and therefore increase childhood obesity risk (Parkinson, Drewett, Le Couteur, & Adamson, 2010). In contrast, food avoidance traits may reflect an overall poor interest in food and eating (Gregory, Paxton, & Brozovic, 2010a), which, in turn has been associated with lower child weight status (Parkinson et al., 2010). In 418 British children, food approach traits (emotional overeating and desire to drink) and food avoidance traits (satiety responsiveness) at age 5-6 years were prospectively associated with higher and lower BMI at age 6-8 years, respectively after controlling for child age, gender and birth weight (children's weight at 5-6 years was not measured) (Parkinson et al., 2010).

It is important to acknowledge that children's appetite traits have a heritable component (Ashcroft et al., 2008; Webber et al., 2009, 2010) and mealtime interactions between mother and child are likely to be bidirectional in nature (Ventura & Birch, 2008). Therefore, maternal feeding practices may be both a reaction to (dependent variable) as well as an influence on (independent variable) children's appetite traits and diet quality (Ventura & Birch, 2008). However, modifying the mothers feeding techniques rather than child-related variables (appetite traits and diet quality) is likely to be a more pragmatic approach. Previous research, predominantly cross-sectional, has examined the relationship between maternal feeding practices and children's appetite traits, and diet quality. Higher restriction of non-core foods (e.g. cookies) has been related to higher food approach traits (e.g. food responsiveness), and higher pressure to eat core foods (e.g. vegetables) has been correlated with higher food avoidance traits (e.g. fussiness) in children (2-9 years) (Farrow, Galloway, & Fraser, 2009; Gregory et al., 2010a; Webber et al., 2010; McPhie et al., 2011). In contrast, to the numerous studies examining the relationship between restriction/pressure to eat and children's appetite traits, few studies exploring the relationships between maternal monitoring of non-core food intake and appetite traits of children (2-6 years) have reported no association (Farrow et al., 2009; McPhie et al., 2011).

There is evidence predominately from cross-sectional studies to suggest that specific controlling feeding practices may have repercussions for children's diet quality. In an experimental study, restriction of non-core foods was associated with higher consumption of the restricted food items even in the absence of hunger in American children (n=197) aged 5 years (Fisher & Birch, 2002). Pressure to eat core foods such as vegetables by American mothers (n=192) has been cross-sectionally correlated with their 5 year old children's lower consumption of that food (Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002). In contrast, monitoring children's non-core food intake, which is a relatively indirect (i.e. cannot easily be perceived by the young child) controlling feeding practice relative to restriction and pressure to eat has been cross-sectionally associated with higher intake of core foods such as vegetables and lower intake of sweet and savoury non-core foods in British children (n=434) aged 2-5 years (McGowan, Croker, Wardle, & Cooke, 2012).

Overall, the evidence suggests a relationship between maternal feeding practices and children's appetite traits and diet quality. Thus, it is conceivable that interventions that target maternal feeding practices may impact favourably on child-related variables (appetite traits and diet quality), thereby reducing children's risk of excess energy intake and excess weight gain in the longer term (Wen et al., 2007; Daniels et al., 2009). The CEBQ has been validated and its relationship with children's weight status has been explored in a number of culturally diverse samples (Viana et al., 2008; Santos et al., 2011). In comparison, few studies have examined the relationship between maternal feeding practices and child-related variables (appetite traits and diet quality) in culture-specific contexts. In particular, to our knowledge, no studies have examined these relationships in Indian mothers, and cross-cultural application of existing findings predominantly from Caucasian populations is unclear. In Australia, recent national data indicate that one in five children between 2-4 years of age are overweight or obese (Australian Bureau of Statistics, 2013). The national Australian health profile is significantly influenced by the health status of its major immigrant populations, of which Indians are the fourth largest (Australian Bureau of Statistics, 2011). Thus, examination of factors that may contribute to childhood overweight and obesity in Australian-Indians is warranted.

The study primarily aims to examine the association between Australian-Indian mothers' use of controlling feeding practices and children's appetite traits measured using the CEBQ (Wardle et al., 2001) which has been previously validated for use in the present study sample (Mallan et al., 2013). The secondary aim was to investigate the relationship between controlling feeding practices and two proxy indicators of children's diet quality, namely consumption of number of core and non-core foods.

Methods

Participants

This cross-sectional questionnaire-based study used a convenience sampling technique to recruit 230 Indian-born mothers residing in Australia for more than one year and less than eight years. Details of the recruitment strategies are published elsewhere (Jani, Mallan, Mihrshahi, Mandalika & Daniels, 2014a; Jani, Mihrshahi & Mallan, 2014b; Jani, Mallan, Mihrshahi & Daniels, 2014c). In brief, eligibility criteria were: born in India, older than 18 years of age, facility with written and spoken English, and a child aged 1-5 years perceived by mother as generally healthy. If the mother had more than one child in the age range, then she was asked to report on the youngest child only. This residence time frame was based on studies by Kannan, Carruth, & Skinner (1999, 2004) who suggested that Indian immigrant mothers living in the US for one to eight years may benefit from receiving nutritional intervention in the host country regarding appropriate child feeding.

Potential participants were approached through Indian community and university associations, media networks (e.g. newspapers), places of worship (e.g. temples), retail outlets (e.g. Indian grocery stores), networks of friends and family and online social networks. The questionnaire (hardcopy and online version) was developed in English only and was piloted with 14 mothers. Completion of the questionnaire indicated informed consent. A greater proportion (77%) of the mothers completed the online version of the questionnaire. Calculating the response rate was possible only for the questionnaire hardcopies, therefore a target response (questionnaire hardcopies plus softcopies distributed and received) rate could not be calculated. The response rate via questionnaire hardcopies was 12.5% (received: 58, distributed: 463 copies).

Maternal and child characteristics

Maternal characteristics included age (years), self-reported height (cm) and weight (kg) (converted to BMI) (International Diabetes Federation, 2006), length (years) of residency in Australia, education (university level vs not university level), religion (Hindu vs others) and questionnaire format (online vs hardcopy).Child characteristics self-reported by the mother included age (months), gender, weight (kg) (converted to WAZ-score by researcher) (World Health Organisation, 2008), place of birth (Australia vs India) and number of siblings (single child vs siblings).

The Children's Eating Behaviour Questionnaire (CEBQ) (Wardle et al., 2001)

The CEBQ has previously been validated in the present sample (Mallan et al., 2013). The CEBQ measures four 'food approach' traits (Webber et al., 2009, 2010): enjoyment of food (4 items, e.g. *My child enjoys eating*, α= 0.88), food responsiveness (5 items, e.g. *Even if my child is full up, he/she finds room for his/her favourite food*, α=0.64), desire to drink (3 items, e.g. *If given the chance, my child would drink continuously throughout the day*, α=0.76) and emotional overeating (4 items, e.g.*my child eats more when worried*, α=0.70). Four 'food avoidance' traits (Webber et al., 2009, 2010) are also measured: food fussiness (6 items, e.g. *My child refuses new foods at first*, α=0.79), satiety responsiveness (5 items, e.g. *My child cannot eat a meal if s/he has had a snack just before*, α=0.60), slowness in eating (4 items, e.g. *My child takes more than 30 minutes to finish a meal*, α=0.70), emotional undereating (4 items, e.g. *My child eats less when upset*, α=0.71). The response options ranged from (1) Never to (5) Always.

Children's diet quality

Proxy indicators of diet quality were assessed by number of food items from a pre-specified list of core (n= 25) and non-core (n= 24) foods consumed (yes/no) by children in 24 hours prior to completion of the questionnaire. The food items were sourced from previous research (Hebert et al., 1999; Chan, Magarey, & Daniels, 2011). According to the Australian Guide to Healthy Eating (National Health and Medical Research Council, 2013) core foods and beverages are items that fall into any one of five food groups namely, (1) bread, cereals, rice, pasta, noodles; (2) vegetables, legumes; (3) fruit; (4) milk, yoghurt, cheese and (5) meat, fish, poultry, eggs, nuts, legumes. Non-core food and beverages are 'discretionary choices' that do not fit into these food groups and are typically high in fat, salt and sugar with high energy and low nutrient density; for example, pizza, cookies and soft drinks (National Health and Medical Research Council, 2013). Indian ethnic foods according to the aforementioned definition were also classified as core (e.g. chapatti: Indian flat bread made from whole-wheat flour) and non-core (e.g. Samosa: fried potato patty). For this paper the two proxy indicators of children's diet quality will be termed as 'number of core foods' and 'number of non-core foods' consumed. The list of core and non-core foods included in the study is presented in the Appendix.

The Child Feeding Questionnaire (Birch et al., 2001)

Two scales were selected: restriction (8 items, e.g. *I have to be sure that my child does not eat too many sweets,* α= 0.65) and monitoring (3 items, e.g. *How much do you keep track of the high fat food that you child eats?* α= 0.94). The response options ranged from (1) Disagree to (5) Agree and (1) Never to (5) Always, for restriction and monitoring, respectively.

The Comprehensive Feeding Practices Questionnaire (CFPQ) (Musher-Eizenman, & Holub, 2007)

The pressure to eat scale (4 items, e.g. *My child should always eat all of the food on his/her plate*, α= 0.53) was selected. The response option ranged from: (1) Disagree to (5) Agree. The rationale for using the pressure scale from the CFPQ rather than the CFQ (Birch et al., 2001) has been published elsewhere (Jani et al., 2014a). In brief, all four items of the pressure to eat scale from the CFPQ are intended to measure 'coercive' feeding strategies. In contrast, 2/4 items (*If I did not guide or regulate my child's eating, she would eat much less than she should; I have to be especially careful to make sure my child eats enough*) of the pressure to eat scale from the CFQ (Birch et al., 2001) are focused on regulatory aspects of child feeding, and not specifically coercion. In our current sample the Cronbach α for the scale was 0.53. Values between 0.50-0.60 are considered acceptable for early research (Nunnally, 1967). In addition, the pressure to eat scale (Musher-Eizenman, & Holub, 2007) with similar internal consistency (α= 0.53) has been used in a previous study with Mexican mothers (Matheson, Robinson, Varady, & Killen, 2006).

Data analysis

For the purposes of this study the child-related variables, i.e., children's appetite traits (eight scales: food responsiveness, enjoyment of food, desire to drink, emotional overeating, satiety responsiveness, slowness in eating, fussiness and emotional undereating) and proxy indicators of diet quality (two items: number of core and non-core foods consumed) were treated as the dependent variables. The children's appetite traits (all eight scales) were normally distributed and expressed as means±SD. The two items measuring proxy indicators of diet quality were not normally distributed, and therefore were log transformed and reported as geometric means with 95% confidence intervals. The controlling feeding practices (three scales: restriction, monitoring, and pressure to eat) were normally distributed, expressed as means±SD and treated as the independent variables. Adjusted (for maternal and child covariates) analyses were examined using hierarchical linear regression. The regression analyses were controlled for the following maternal and child characteristics: mothers' age, BMI (maternal reported height and weight), education, religion, questionnaire type, child's age, WFA Z-score (maternal reported child weight), gender, birth place and number of siblings. The findings were not adjusted for the *exact* length of stay (years) in Australia as a large proportion (54%, n= 124) of the mothers did not respond to the question. Due to missing data the unadjusted analyses included 203 of the 230 participants. For the adjusted analyses the sample was further reduced to 152 participants. To assess potential retention bias comparisons were made between mothers with incomplete vs complete data. There were no differences on maternal and child covariates (e.g. age, education) between those with incomplete data (n=78) versus those with complete data (n=152).

In the regression analyses the covariates were entered in the first block and the three controlling feeding practices in the second block. With respect to multivariate outliers and influential data points, all cases had Mahalanobis values below 25 and Cook's D values below one. Hence, all cases were included in the final analyses (Field, 2009). No concerns regarding multicollinearity were noted, i.e. the variance inflation factor for all variables were below 10 (Field, 2009). Significance was set at $p<0.05$ and analyses were conducted using SPSS version 21 (SPSS Inc., Chicago, USA).

Results

Participants' characteristics, child-related dependent variables and maternal controlling feeding practices are reported in Table 1. The mothers mean length of stay in Australia was 4±1.9 years. With respect to the self-reported anthropometrics, 63% of mothers were overweight/obese according to the Indian BMI cut-offs (International Diabetes Federation, 2006) and 11% of the children were overweight/obese based on maternal-reported weights.

Tables 2 and 3 reports the adjusted (n= 152) associations between the three controlling feeding practices (independent variable) and the child-related dependent variables (eight scales: appetite traits; two items: number of core and non-core foods consumed). The adjusted results were controlled for mothers' age, BMI (self report height, weight), education, religion, questionnaire type, child's age, WFA z-score (maternal report weight), gender, birth place and number of siblings. The patterns of significant associations were the same as those for the unadjusted analysis (n= 203, data not shown).

With respect to the food approach traits, results showed that higher pressure to eat was associated with lower enjoyment of food (β=-0.28, p=0.001). Higher restriction was related to higher emotional overeating (β=0.28, p<0.001) and higher food responsiveness (β=0.31, p=0.001) in children. Higher monitoring was associated with higher 'enjoyment of food' (β=0.18, p=0.01), lower emotional overeating (β=-0.26, p=0.001) and lower food responsiveness (β=-0.19, p=0.01) in children. None of the controlling feeding practices showed significant relationship with the children's desire to drink appetite traits (Table 2).

With regard to the food avoidance traits, higher pressure to eat was associated with higher fussiness ($\beta=0.31$, $p<0.001$), higher satiety responsiveness ($\beta=0.24$, $p= 0.004$), and higher slowness in eating ($\beta=0.27$, $p<0.001$) appetite traits in children. Higher monitoring was related to lower fussiness ($\beta=-0.28$, $p<0.001$) and lower 'slowness in eating' ($\beta=-0.25$, $p=0.002$). None of the feeding practices were associated with the children's emotional undereating appetite traits (Table 2).

In relation to children's proxy indicators of diet quality findings highlighted that monitoring and pressure to eat were inversely related to number of non-core foods consumed ($\beta=-0.22$, $p=0.01$) and number of core foods consumed ($\beta=-0.18$, $p=0.02$), respectively (Table 3).

Discussion

This is the first study to our knowledge that has examined the association between migrant Indian mothers' use of controlling feeding practices and child-related dependent variables (appetite traits and number of core and non-core foods consumed). The principal findings showed that higher pressure to eat was associated with higher levels of food avoidance traits and higher restriction was related to higher levels of food approach traits. Higher monitoring appeared to be associated with lower levels of both food avoidance and food approach traits. With regard to proxy indicators of diet quality, higher pressure to eat and monitoring were associated with a lower number of core foods and non-core foods consumed in the past 24 hours, respectively. These findings were independent of key maternal and child covariates (e.g. age, education, self-reported weight status, etc). Overall the patterns of associations for pressure and restriction are generally similar to those reported in previous research, predominantly with Caucasian mothers (Webber et al., 2010; Gregory et al., 2010a), suggesting that the complex relationships between the specific controlling feeding practices and children's appetite traits are not markedly different for Indian mothers who have recently (1-8 years) migrated to Australia. However, in contrast to the previous literature which generally observed no association between monitoring and the children's appetite traits (Farrow et al., 2009; McPhie et al., 2011), the present study observed monitoring to be associated with several of the food approach and food avoidance traits.

Higher pressure to eat was associated with higher food avoidance traits (3/4: fussiness, satiety responsiveness and slowness in eating) and lower food approach traits (1/4: enjoyment of food). Our findings are consistent with the wider literature. With respect to children's appetite traits,

Table 4 reports that a positive cross-sectional association was observed between pressure to eat and satiety responsiveness, slowness in eating, and fussiness, and a negative association with enjoyment of food. It should be noted that all cross-sectional studies, except two (Gregory et al., 2010a; Webber et al., 2010) treated pressure to eat as the independent variable and the children's appetite traits as the dependent variable. A single prospective cohort study (N=156) was identified that investigated Australian mothers' pressure to eat as the independent variable. Higher pressure feeding at 3.3 years was associated with lower interest in foods at 4.3 years after controlling for children's appetite traits and other maternal and child covariates at baseline (Gregory et al., 2010b). The 'interest in foods' scale consisted of 4 items sourced from the fussiness scale of the CEBQ (Wardle et al., 2001). According to the authors the items were structured with a positive connotation which specifically examined the child's willingness to try new food and enjoy a variety of foods (Gregory et al., 2010b).

Secondary findings highlighted that higher pressure to eat was associated with lower number of core food consumed by the children in 24 hours. These findings are in line with previous research. Two cross-sectional studies and a one-year prospective cohort study reported that higher pressure to eat was associated with lower core (fruits and/or vegetables) food intake among American (N= 192, 5 years) (Fisher et al., 2002), Belgium (N= 56, 3.5 years) (Vereecken, Rovner, & Maes, 2010) and Australian children (N= 60, 1-2 years) (Gregory, Paxton, & Brozovic, 2011) of comparable age groups (1-5 years).

The concept of 'cognitive aversion' has been proposed to explain the relationship of pressure feeding practices with children's food avoidance traits (e.g. fussiness) and lower intake of core foods (e.g. vegetables) (Gregory et al., 2010a). Children may develop 'cognitive aversion' when they perceive that they are being coerced to eat certain types (e.g. vegetables) and amounts of foods (Gregory et al., 2010a). Therefore, they may exhibit food avoidance traits (fussiness, slowness in eating) and/or develop dislike towards foods which they are coerced to consume (e.g. vegetables), which in turn my lower their intake of coerced foods. The theory of cognitive aversion offers a potential explanation of why children who are pressured to eat may exhibit lower 'enjoyment of food' traits or show lower 'interest in foods'. Moreover, maternal and child feeding interactions are further complicated by potential bidirectional associations. For instance, on one hand pressure feeding could *lead to* fussy eating or lower intake of coerced foods. On the other hand, parental perceptions of their child's food avoidance traits or diet quality may in turn *drive* their feeding practices (Ventura & Birch, 2008). In summary, it is highly plausible that mothers faced with a child who is fussy, eats slowly, appears not to enjoy or be interested in foods, and who seems to eat less core foods may use feeding practices intended to encourage or coerce their child to eat more amounts or different foods.

Higher restriction was associated with higher food approach traits (2/4: food responsiveness, emotional overeating), but in contrast with pressure, none of the food avoidance traits. Two cross-sectional studies in British (N= 213, 7-9 years) (Webber et al., 2010) and Australian (N=183, 2-4 years) (Gregory et al., 2010a) children also showed a positive association between restriction and food responsiveness. It is noteworthy that in contrast to our models, these studies treated children's food responsiveness as the independent variable. One prospective cohort study (N= 60), similar to our study, examined restriction as an independent variable, and reported a positive bivariate association with food responsiveness at baseline (3.3 years) and endpoint (4.3 years) (Gregory et al., 2010b). Our finding that higher restriction was associated with higher emotional overeating is contrary to the limited literature. Only one cross-sectional study (N= 80, 3-6 years) was identified which reported that emotional overeating traits did not differ between American siblings, and therefore was non-significantly associated was restriction (Farrow et al., 2009). These findings exemplifies the bi-directional nature of maternal and child feeding interactions. Experimental evidence has shown that overtly restricting (independent variable) intake of energy-dense foods may increase the desire and the preference for the restricted food item (Fisher & Birch, 1999), i.e. elicit food approach eating traits such as higher food responsiveness. However, it is equally likely that children exhibiting high food responsiveness or emotional overeating may compel their mothers to practice restriction to regulate their intake of non-core foods. Therefore, maternal and child feeding relationships require longitudinal exploration.

No association was observed between restriction and number of core and non-core foods consumed by the children. These findings were contrary to the literature, which has observed associations between restriction and children's diet quality (Coulthard & Blissett 2009; Sud, Tamayo, Faith, & Keller, 2010). A small (N= 57) prospective cohort study observed that restriction was used by American mothers whose children (5 years) were at high risk of overweight (based on mean maternal BMI: 30.0±4.2), and was positively associated with the children's BMI z-scores at 7 years. In contrast, monitoring and pressure to eat were used by mothers whose children (5 years) were at low risk of overweight (mean maternal BMI: 19.5±1.1), and were inversely associated with the children's BMI z-scores at 7 years, after controlling for baseline weight status (Faith et al., 2004). In our study the majority (89%) of the children albeit based on maternal reports could be classified as low risk (not overweight/obese).

Therefore, it could be suggested that mothers in the present study may have preferred to use monitoring and pressure feeding practices in comparison to restriction to regulate their children's consumption of core and non-core foods.

Higher monitoring was associated with lower food avoidance traits (2/4: slowness in eating, fussiness), lower food approach traits (3/4: food responsiveness, emotional overeating) and higher enjoyment of food. Our findings are contradictory to the literature. Three cross-sectional (Farrow et al., 2009; Gregory et al., 2010a; McPhie et al., 2011) and one prospective cohort study (Gregory et al., 2010b) reported no association between monitoring and any of the children's appetite traits. Only Farrow et al. (2009) justified the non-significant association in their cross-sectional study (N= 80, 3-6 years); monitoring feeding practices may be used for both siblings, and therefore, may not be related to differences in siblings' appetite traits. Our findings published elsewhere (Jani et al., 2014a) has shown that nearly 50% of migrant Indian mothers in Australia were *generally* concerned (not specifically overweight or underweight) about their child's weight status. It could be speculated that this generic health-related concern about the child's weight may potentially promote the mothers use of monitoring. This suggestion needs further qualitative and quantitative investigation to identify the mothers' reasons for monitoring in relation with children's appetite traits.

Higher monitoring was also associated with lower number of non-core foods consumed in the past 24 hours. Our findings are consistent with the literature. Four cross-sectional studies reported that higher monitoring by British (N= 434, 2-5 years) (McGowan et al., 2012), (N= 812, 6 years) (Arredondo et al., 2006), American (N= 53, 4-7 years) (Klesges, Stein, Eck, Isbell, & Klesges, 1991), and Dutch (N= 2026, 5 years) (Gubbels et al., 2011) mothers was associated with children's lower intake of sweet and savoury non-core foods and beverages.

In *theory* monitoring was considered one of the three scales (with restriction and pressure to eat) conceptualised to be obesogenic in nature (Birch et al., 2001). In contrast, *evidence* has shown favourable associations between monitoring and children's lower intake of unhealthy food choices (Arredondo et al., 2006; Gubbels et al., 2011; McGowan et al., 2012). In comparison to pressure to eat and restriction, monitoring is a relatively *indirect* feeding practice. Indeed, it could be argued that monitoring is an antecedent to either pressure or restriction, i.e. a mother has to monitor or notice what her child is eating prior to *directly* applying pressure or restriction. Furthermore, young children may not recognise that their mothers are keeping track of their dietary pattern, which in turn may lower the probability for children to develop an increased 'desire' for (e.g. cookies) or 'aversion' (e.g. vegetables) to specific foods. However, further prospective studies are needed to confirm a directional relationship.

This study has a number of limitations that must be considered. We treated maternal feeding practices as the independent variable. It is important to acknowledge that the cross-sectional design precludes us from making any conclusions regarding the extent to which mothers *respond to* or *influence* their children's appetite traits. The internal reliability of the pressure to eat scale (Musher-Eizenman & Holub, 2007) was only fair (α= 0.53), although previous research have used the pressure to eat scale (Musher-Eizenman & Holub, 2007) with similar psychometrics

(Matheson et al., 2006). Measuring children's dietary intake as number of core and non-core foods consumed (yes vs no) in the past 24 hours has been used previously (Chan et al., 2011) but it may not capture children's diet quality as comprehensively as other measures such as 24-hour dietary recall (Ponza, Devaney, Ziegler, Reidy, & Squatrito, 2004) and food frequency questionnaires (Arredondo et al., 2006; Gubbels et al., 2011). Social desirability bias associated with the use of a self-report questionnaire cannot be ruled out, but is likely to have been minimised by anonymous completion of the questionnaires. The anthropometric maternal (BMI) and child (WAZ-scores) covariates may be subjected to self-reporting errors (Jani, Mihrshahi, Mandalika, & Mallan, 2014d, e). Missing data in the final analysis needs to be acknowledged. The bivariate analysis yielded a total sample size of n=203 (from the original sample size of n=230), whereas the multivariable analysis was conducted on 152 mothers. However, no differences on maternal and child demographic characteristics (covariates) were found between those with complete data (n=152) and those with missing data (n=78). The convenience sampling technique, limits the generalisation of the findings to well-educated Indian mothers of children 1-5 years living in Australia. However, in Australia migrant Indians are likely to be well-educated due to immigration policies encouraging skilled immigrants (www.immi.gov.au). Furthermore, according to the national data, Indian born Australians are three times more likely to attain a bachelor's degree or higher in comparison to all other Australians (Australian Bureau of Statistics, 2006). A target response rate could not be calculated, but it is important to recognize that the response rate calculated from only the questionnaire hardcopies was low (12.5%).

Notwithstanding the limitations, the sample comprised young children whose age range covers the crucial period when eating behaviours and dietary patterns are established (Satter, 2000). Moderate effect sizes (β=0.22-0.31) were noted for almost all of the associations, independent of a comprehensive range of key covariates. In addition, the three controlling feeding practices explained 6-18% variance, whereas the overall model (key covariates and feeding practices) accounted for 11-32% of variance in children's appetite traits and core and non-core food consumption variables.

Conclusions

The study highlighted that Indian mothers' pressure to eat and restrictive feeding practices were positively associated with food avoidance and food approach traits, respectively. In contrast, Indian mothers' higher monitoring practices appeared to be related to lower food avoidance and food approach traits. Secondary findings using proxy indicators of children's diet quality showed that higher pressure to eat was associated with poor dietary choices (lower number of core foods consumed), whereas higher monitoring was related to favourable dietary choices (lower number of non-core foods consumed). Overall, these findings are consistent with the wider literature examining mother-child feeding interactions in Caucasian (Gregory et al., 2010a) and non-Caucasian (Ainuki & Akamatsu, 2011) populations. Further cross-cultural longitudinal studies are required to confirm the preliminary findings and test the direction of associations observed here. It is highly plausible that the feeding dynamic is bidirectional and it is clear that children's appetite traits are to some degree heritable (Ashcroft et al., 2008; Webber et al., 2009, 2010). However, it is maternal feeding practices that are the feasible target for interventions which aim to reduce appetite traits associated with increased obesity risk in young children. The results of this study suggest that such interventions may also be relevant to and useful for migrant Indian mothers in countries like Australia.

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Table 1: Descriptive statistics of the study variables (N=203, mean child age: 34±14.0 months)

Participant characteristics ***(n)***	**Mean±SD or** ***% (n)***
Mothers age (years) *(173)*	32±3.3
Mothers BMI (kg/m^2) *(186)*	24±3.9
Mothers education (tertiary degree) *(202)*	95 (191)
Mothers religion (Hindu) *(203)*	75 (153)
Child's age (months) *(203)*	34±14.0
Child's WFA z-scores *(195)*	0.24±1.79
Child's gender (female) *(203)*	51 (103)
Child's birth place (India) *(199)*	25 (50)
Number of siblings (single child) *(203)*	63 (128)
Children's eating behaviours[a] *(203)*	
Enjoyment of food (4 items), α= 0.88	3.4± 0.8
Emotional overeating (4 items), α=0.70	1.6± 0.6
Food responsiveness (5 items), α=0.64	2.0± 0.6
Desire to drink (3 items), α=0.76	2.6± 0.9
Fussiness (6 items), α=0.79	2.9± 0.7
Satiety responsiveness (5 items), α=0.60	3.3± 0.6
Slowness in eating (4 items), α=0.70	3.1± 0.9
Emotional undereating (4 items), α=0.71	3.1± 0.8
Proxy diet quality indicators *(203)*	
Number of core food consumed (Maximum: 25)	8.7 (9.1-8.3)
Number of non-core food consumed (Maximum: 24)	3.6 (3.9-3.3)
Maternal controlling feeding practices *(203)*	
Pressure to eat (4 items)[b], α= 0.53	3.1±0.9
Restriction (8 item)[c], α= 0.65	3.5±0.8
Monitoring (3 item)[c], α= 0.94	3.9±1.0

[a]The Children's Eating Behaviour Questionnaire (Wardle et al., 2001)

[b]Comprehensive Feeding Practice Questionnaire (Musher-Eizenman & Holub, 2007)

[c]Child Feeding Questionnaire (Birch, et al., 2001)

Mean score±SD: children's eating behaviours and maternal controlling feeding practices

Geometric mean (95% CI): log transformed proxy diet quality indicators

Comparative groups in brackets, categorisation details in the method section, italicised *n* value denotes data obtained

Table 2: Adjusted (n= 152) associations between controlling feeding practices (independent variables) and children's food approach and food avoidance traits (mean child age: 34±14.0 months)

Feeding practices	**Food approach traits[a]**			
	Enjoyment of food	Emotional overeating	Food responsiveness	Desire to drink
Pressure to eat[b]	β=-0.28, **p=0.001**	β=0.00, p=0.96	β=-0.06, p=0.44	β=0.09, p=0.19
Restriction[c]	β=-0.02, p=0.81	β=0.28, **p<0.001**	β=0.31, **p=0.001**	β=0.07, p=0.34
Monitoring[c]	β=0.18, **p=0.01**	β=-0.26, **p=0.001**	β=-0.19, **p=0.01**	β=-0.12, p=0.07
Step 2: Δ R^2 feeding practices	0.12, Δ F (3, 138)= 7.2, **p<0.001**	0.09 Δ F (3, 138)= 5.0, **p=0.002**	0.10 Δ F (3, 138)= 5.2, **p=0.002**	0.02 Δ F (3, 138)= 1.2, p=0.29
Full Model R^2 (R^2_{Adj})	0.25 (0.17) F (13, 138)= 3.5, **p<0.001**	0.18 (0.09) F (13, 138)= 2.3, **p=0.01**	0.14 (0.06) F (13, 138)= 2.0, **p=0.04**	0.13 (0.05) F (13, 138) = 1.6,p=0.09
	Food avoidance traits[a]			
	Fussiness	Satiety responsiveness	Slowness in eating	Emotional undereating
Pressure to eat[b]	β=0.31, **p<0.001**	β=0.24, **p=0.004**	β=0.27, **p<0.001**	β=-0.05, p=0.53
Restriction[c]	β=0.08, p=0.26	β=-0.01, p=0.93	β=0.04, p=0.55	β=0.03, p=0.66
Monitoring[c]	β=-0.28, **p<0.001**	β=-0.09, p=0.17	β=-0.25, **p=0.002**	β=-0.05, p=0.54
Step 2: Δ R^2 feeding practices	0.18 Δ F (3, 138)= 12.3,**p<0.001**	0.06, Δ F (3, 138)= 3.5, **p= 0.02**	0.13 Δ F (3, 138)= 7.5,**p<0.001**	0.02 Δ F (3, 138)= 1.0, p=0.38
Full Model R^2 (R^2_{Adj})	0.32 (0.26) Δ F (13, 138)= 5.0,**p<0.001**	0.17 (0.10) Δ F (13, 138)= 2.2, **p=0.01**	0.21 (0.13) F (13, 138)= 2.8, **p=0.001**	0.11 (0.04) F (13, 138) = 1.4,p=0.15

[a]The Children's Eating Behaviour Questionnaire (Wardle et al., 2001)

[b]Comprehensive Feeding Practice Questionnaire (Musher-Eizenman & Holub, 2007)

[c]Child Feeding Questionnaire (Birch, et al., 2001)

Hierarchical linear regression: covariates at step 1: mothers' age, BMI (self report height, weight), education, religion, questionnaire type, child's age, WFA z-score (maternal report weight), gender, birth place, number of siblings. Step 2: feeding practices (mean scale score)

Note: The patterns of significant associations were the same as those for the unadjusted analysis (n= 203, data not shown)

Table 3: Adjusted (n= 152) associations between controlling feeding practices (independent variables) and children's proxy diet quality indicators (mean child age: 34±14.0 months)

Feeding practices	Number of non-core foods consumed[c]	Number of core foods consumed[c]
Pressure to eat[a]	β=-0.07, p=0.36	β=-0.18, **p=0.02**
Restriction[b]	β=0.06, p=0.43	β=-0.06, p=0.47
Monitoring[b]	β=-0.22, **p=0.01**	β=0.03, p=0.66
Step 2: Δ R^2 feeding practices	0.12, Δ F (3, 138)= 7.2, **p<0.001**	0.10 Δ F (3, 138)= 5.2, **p=0.002**
Full Model R^2 (R^2_{Adj})	0.25 (0.17) F (13, 138)= 3.5, **p<0.001**	0.14 (0.06) F (13, 138)= 2.0, **p=0.04**

[a]Comprehensive Feeding Practice Questionnaire (Musher-Eizenman & Holub, 2007)

[b]Child Feeding Questionnaire (Birch, et al., 2001)

[c]Number of food items consumed (Yes/No) in 24 hour prior to completion of the questionnaire, total number of possible food items: core=25, non-core=24

Hierarchical linear regression: covariates at step 1: mothers' age, BMI (self report height, weight), education, religion, questionnaire type, child's age, WFA z-score (maternal report weight), gender, birth place, number of siblings. Step 2: feeding practices (mean scale score)

Note: The patterns of significant associations were the same as those for the unadjusted analysis (n= 203, data not shown)

Table 4: Cross-sectional literature examining the association between pressure to eat and children's appetite traits:

Author, year, study design, country	Participants' characteristics	Food Avoidance Trait: Satiety responsiveness	Food Avoidance Trait: Slowness in eating	Food Avoidance Trait: Fussiness	Food Approach Trait: Enjoyment of food
Webber et al., 2010, UK	N= 213 Age= 7-9 year	+	+	+	-
Powell, Farrow, & Meyer, 2011, UK	N= 104 Age= 3-6 years	+		+	
Farrow et al., 2009, US	N= 80 Age= 3-6 years	+	+	+	-
Gregory et al., 2010a, Australia	N= 183 Age= 2-4 years	+		+	
McPhie et al., 2011, Australia	N= 175 Age= 2-4 years	+		+	-
Van der Horst, 2012, Switzerland	N= 305 Age= 6-12 years	+		+	
Ainuki & Akamatsu, 2011, Japan	N= 614 Age= 3-6 years	+			-

+/- Positive/negative association between pressure to eat and children's appetite traits

Appendix: List of core and non-core food items included in the study

Core food items (n= 25)	Non-core food items (n= 24)
Indian	***Indian***
Rice	Samosa
Idli	Pav bhaji
Chapatti	Pakoda
Dal	Dhebra
Paneer	Chevda
Khadi	Bhel-puri
Butter milk	Pickles
Non-Indian	Papad
White meat	Lassi
Red meat	Indian sweets
Fish	Ghee
Egg	***Non-Indian***
Baked beans	Sweet biscuit
Nuts	Savoury biscuits
Breakfast cereal	Chocolates
Bread	Chips
Muesli bars	Hot chips
Pasta	Pizza
Raw veggie	Noodles
Cooked veggie	Burger
Fruits	Soft drink
Water	Fruit juice
Plain milk	Flavoured milk
Milk without sug	Milk with sugar
Yoghurt	Ice-cream
Cheese	

Note: Proxy indicators of diet quality were assessed from a pre-specified list of core and non-core foods consumed (yes/no) by children in 24 hours prior to completion of the questionnaire (Hebert et al., 1999; Chan et al., 2011).