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## Research report

# Confirmatory factor analysis of the Baby Eating Behaviour Questionnaire and associations with infant weight, gender and feeding mode in an Australian sample <sup>☆</sup>

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## ABSTRACT

The aim of this study was to evaluate the factor structure of the Baby Eating Behaviour Questionnaire (BEBQ) in an Australian community sample of mother–infant dyads. A secondary aim was to explore the relationship between the BEBQ subscales and infant gender, weight and current feeding mode. Confirmatory factor analysis (CFA) utilising structural equation modelling examined the hypothesised four-factor model of the BEBQ. Only mothers ( $N = 467$ ) who completed all items on the BEBQ (infant age:  $M = 17$  weeks,  $SD = 3$  weeks) were included in the analysis. The original four-factor model did not provide an acceptable fit to the data due to poor performance of the *Satiety responsiveness* factor. Removal of this factor (three items) resulted in a well-fitting three-factor model. Cronbach's  $\alpha$  was acceptable for the *Enjoyment of food* ( $\alpha = 0.73$ ), *Food responsiveness* ( $\alpha = 0.78$ ) and *Slowness in eating* ( $\alpha = 0.68$ ) subscales but low for the *Satiety responsiveness* ( $\alpha = 0.56$ ) subscale. *Enjoyment of food* was associated with higher infant weight whereas *Slowness in eating* and *Satiety responsiveness* were both associated with lower infant weight. Differences on all four subscales as a function of feeding mode were observed. This study is the first to use CFA to evaluate the hypothesised factor structure of the BEBQ. Findings support further development work on the *Satiety responsiveness* subscale in particular, but confirm the utility of the *Enjoyment of food*, *Food responsiveness* and *Slowness in eating* subscales.

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## Introduction

Nutrition and growth in early life are associated with subsequent risk of obesity and chronic disease (Leunissen, Kerkhof, Stijnen, & Hokken-Koelega, 2009). Four systematic reviews (Baird et al., 2005; Fisher et al., 2006; Monteiro & Victora, 2005; Ong et al., 2006) have

described consistent associations between rapid infant weight gain and obesity risk in childhood and later life. Rapid infant weight gain is also independently associated with increased adiposity, central fat mass, and cardiovascular risk factors, including insulin resistance in early adulthood (Ekelund et al., 2006; Leunissen et al., 2009; Ong & Dunger, 2004). Energy intake, more so than physical activity, is a key determinant of weight gain in infancy (Ong et al., 2006; Stunkard, Berkowitz, Stallings, & Schoeller, 1999). Although infants may be born with the capacity to self regulate their energy intake (DiSantis, Hodges, Johnson, & Fisher, 2011), genetic and environmental factors (Lillicrop & Burdge, 2011) contribute to variability in infant appetite (Parkinson, Drewett, Le Couteur, & Adamson, 2010) and eating behaviours (Llewellyn, van Jaarsveld, Johnson, Carnell, & Wardle, 2010) which may have consequences for food intake and subsequent rate of weight gain.

Although individual differences in eating behaviour are evident in infancy, research has predominantly focused on eating behaviours in childhood (>2 years) and beyond. Indeed, the study of children's eating behaviours throughout childhood has emerged as an important avenue for investigation in the area of child obesity prevention and treatment. Both carer-report questionnaire (Wardle,

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Guthrie, Sanderson, & Rapoport, 2001) and observational methods (Carnell & Wardle, 2007) have consistently indicated that eating behaviours characterised by high food responsiveness (i.e., high 'food approach' behaviour) and poor satiety responsiveness (i.e., low 'food avoid' behaviour) correspond with higher weight status in children (3–12 years of age) (Birch & Fisher, 1998; Carnell & Wardle, 2008; Sleddens, Kremers, & Thijs, 2008; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2008). Given the practical limitations associated with observational studies of eating behaviours, the predominance of the validated parent-report tool, the *Children's Eating Behaviour Questionnaire* (CEBQ) (Wardle et al., 2001), has arguably made a substantive impact on the proliferation of research in this area. However, until recently there was no equivalent tool for use in children under 2 years of age.

The *Baby Eating Behaviour Questionnaire* was developed by Llewellyn, van Jaarsveld, Johnson, Carnell, and Wardle (2011) to address the need for a reliable tool to measure eating behaviours of both breastfed and bottle-fed infants. Constructs reflective of 'infant appetite' were based on (stage appropriate) existing subscales of the CEBQ, a review of the literature and interviews with a small sample ( $n = 10$ ) of mothers with infants <6 months. Both a concurrent and retrospective version of the questionnaire have been developed (<http://www.ucl.ac.uk/hbrc/diet/resources.html>) in order to assess infant appetite specifically during the milk-feeding stage of the first few months of life. The final 18 item BEBQ (retrospective version) was completed by families participating in the Gemini birth cohort study (Van Jaarsveld, Johnson, Llewellyn, & Wardle, 2010) and data on one randomly selected twin (mean age 8,  $SD = 2$  months) was then included in a Principal Components Analysis (PCA). Based on the PCA, four constructs emerged on which 17 items loaded: *Enjoyment of food*, *Food responsiveness*, *Slowness in eating* and *Satiety responsiveness*. An additional item (*My baby has a big appetite*) cross-loaded on all four factors so was deemed as an indicator of 'general appetite'. The labelling of the four subscales of the BEBQ corresponds with two 'food approach' subscales of the CEBQ (*Enjoyment of food* and *Food responsiveness*) and two 'food avoidance' subscales of the CEBQ (*Slowness in eating* and *Satiety responsiveness*).

Based on the available literature to date, the proposed factor structure of the BEBQ derived from PCA in the Gemini birth cohort (Llewellyn et al., 2011) has not been validated using the 'gold standard' method of Confirmatory factor analysis (CFA). The CFA method has been used previously to evaluate the acceptability of the CEBQ (Wardle et al., 2001) factor structure in diverse populations (Mallan et al., 2013; Sparks & Radnitz, 2012) and is commonly used in the context of childhood obesity research (e.g., Child Feeding Questionnaire; (Francis, Hofer, & Birch, 2001). Thus, the aim of this study was to evaluate the hypothesised factor structure and internal reliability of the concurrent version of the BEBQ in an Australian sample of mothers with young infants in the exclusively or predominantly milk-feeding stage. We also aimed to explore associations between the BEBQ subscales and infant gender, weight and feeding mode. No specific predictions regarding infant gender were made, however it was predicted that 'food approach' subscales may be associated with higher infant weight whereas 'food avoid' subscales may be associated with lower infant weight. It was also predicted that infants exclusively or fully breastfed would score lower on 'food approach' subscales and higher on 'food avoid' subscales.

## Methods

### Study design and participants

This study reports analysis of data collected as part of the *New Beginnings: Healthy Mothers and Babies* study – a prospective, observational study. Participant recruitment and methods have been

described previously (de Jersey, Nicholson, Callaway, & Daniels, 2012). In brief, a consecutive sampling framework was used to recruit eligible pregnant women receiving antenatal care at the Royal Brisbane and Women's Hospital (RBWH) between August 2010 and January 2011. Two recruitment strategies were implemented: (1) an information sheet was sent by Maternity Outpatients administrative staff to all women receiving antenatal care at the RBWH and (2) a consecutive sample of eligible women was also approached in the waiting room of the antenatal clinic by a researcher. Eligibility criteria included  $\geq 18$  years of age, no pre-existing type 1 or 2 diabetes and sufficient language skills to complete questionnaires in English. Women who miscarried or went on to deliver an infant preterm ( $\leq 32$  weeks completed gestation) and/or with major health concerns were later excluded. In total 664 women receiving antenatal care at the RBWH consented to participate and provided at least some baseline data, representing a 63% response rate. Due to ethical restrictions it was not possible to collect data from women who declined participation. Participants were broadly representative of the Queensland obstetric population for age, marital status, ethnicity, parity and anthropometric characteristics (Health Statistics Centre, 2011).

Data were collected at four time points, including at approximately 16 weeks gestation (T1), 36 weeks gestation (T2), upon delivery (T3) and 4 months post-partum (T4). T1, T2 and T4 consisted of self-administered questionnaires. Follow up calls were provided to women who did not return a questionnaire within a 2–4 week period. T3 data were collected from an obstetric database. Retention at T4 was 77% ( $n = 513$ ). Based on status at T4, non-completers were younger (28 vs 30 years,  $p = 0.002$ ), less likely to have a university education (34% vs 47%,  $p = 0.025$ ), more likely to be born overseas (22% vs 14%,  $p = 0.020$ ) and less likely to be married or in a de facto relationship (88% vs 95%,  $p = 0.005$ ) than completers. There were no differences between completers and non-completers in terms of self-reported maternal pre-pregnancy weight status ( $p = 0.91$ ), other children ( $p = 0.74$ ) or infant gender ( $p = 0.44$ ).

Ethical approval was obtained from the RBWH (HREC/10/QRBW/139) and Queensland University of Technology (1000000558) Human Research Ethics Committee.

### Measures

#### *Baby Eating Behaviour Questionnaire* (Llewellyn et al., 2011)

The BEBQ is an 18 item questionnaire with 17 items designed to measure four aspects of infant feeding behaviour and a single item measuring general appetite. Mothers are asked to respond according to how they would describe their baby's feeding style at a 'typical daytime feed'. Response options range from never (1) to always (5). Scoring requires calculation of mean scores for each subscale with higher mean scores indicating greater reported expression of the feeding behaviour. The four distinct factors are *Enjoyment of food* (four items; e.g., My baby seems contented while feeding), *Food responsiveness* (six items; e.g., My baby frequently wants more milk than I provide), *Slowness in eating* (four items; e.g., My baby takes more than 30 minutes to finish feeding) and *Satiety responsiveness* (three items; My baby gets full up easily). A full list of the items including two reverse scored items appears in Table 1. The factor structure of the BEBQ was established via PCA (Llewellyn et al., 2011). Internal reliability estimates of the four factors in the original development paper were acceptable (Cronbach's  $\alpha = 0.73$ – $0.81$ ).

#### Participant characteristics

Socio-demographic data were collected at first participant contact (T1), including maternal age, marital status (dichotomised into married/de facto vs other), education level (dichotomised into university education vs no university education), total household income

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