The Picky Eating Questionnaire and Child-Reported Food Preference Questionnaire : Pilot validation in Australian-Indian mothers and children 7-12 years old

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[1] List of abbreviations

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[1]PEQ: The core food Picky Eating Questionnaire; C-FPQ: The Child-reported Food Preference Questionnaire; FPQ: The Food Preference Questionnaire; CFA: Confirmatory Factor Analysis; EFA: Exploratory Factor Analysis; CMIN/DF: Minimum Discrepancy per Degree of Freedom; TLI: Tucker-Lewis index; CFI: Comparative Fit Index; SRMR: Standardized Root Mean Square Residual; RMSEA: Root Mean Squared Error Approximation; LO90: RMSEA lower end of the 90% confidence interval; AVE: Average Variance Extracted; CR: Composite Reliability; b_1: Slope of the mean bias; CEBQ: The Children's Eating Behaviour Questionnaire; ICC: Intra-class Correlation Coefficient; WHO: World Health Organization

Abstract

Limited literature has examined parents' perceptions of children's pickiness in relation to all the five core food groups (vegetables, legumes/beans; fruits; dairy and alternatives; meat and alternatives; cereals), which is representative of a nutritionally balanced diet and critical for optimal growth and development in children. This study aimed to develop and validate two questionnaires in Australian-Indian mothers and children 7-12 years (N=482). The core food Picky Eating Questionnaire (PEQ), completed by mothers, identified maternal perceptions of their child's pickiness. The Child-reported Food Preference Questionnaire (C-FPQ) studied children's self-reported food preferences. The questionnaires comprised specific food items commonly available in Australia across the five core food groups (PEQ, N=32; C-FPQ, N=33) and discretionary foods (C-FPQ, N=11). Exploratory Factor Analysis identified the initial factor structure, and Confirmatory Factor Analysis provided construct validity. The PEQ observed five constructs, and C-FPQ observed three constructs for food items perceived as picky/non-preferred-green leafy vegetables; other vegetables, pulses/legumes; fruits; wholegrain/wholemeal cereals (PEQ only) and dairy (PEQ only). The PEQ and C-FPQ observed four constructs for food items perceived as not picky/preferred-green vegetables; other vegetables; fruits and nuts, and dairy. C-FPQ also observed savoury and sweet discretionary food constructs. All constructs observed acceptable reliability (test-retest, internal consistency) and validity (convergent, relative, predictive) testing. Mean scores indicated that mothers' perceptions of pickiness were positively correlated with their children's report of non-preference. In conclusion, this study pilot validated two questionnaires to examine maternal perceptions of pickiness and children's self-reported food preferences among Australian-Indians, Australia's largest ethnic community.

Keywords: Indian, picky, preference, children, questionnaire.

1. Introduction

In Australia, only 6.3% of children aged 2-17 years meet their daily recommended serve of vegetables, and only one in 17 (6.0%) meet guidelines for both fruit and vegetable consumption (Australian Bureau of Statistics). Nearly all Australian children aged 2-18 years (99%) consume at least one discretionary food per day with sweet biscuits (31%), potato crisps and sugar-sweetened beverages (25%) reported as the most popular (Johnson, Bell, Zarnowiecki, Rangan, & Golley, 2017). A cross-sectional study (N=203) on Australian-Indian children aged 1-5 years reported children on average consumed three discretionary foods in the last 24 hours prior to the study interview (Jani, Mallan, & Daniels, 2015). Lower intakes of fruits and vegetables and a higher intake of discretionary foods are associated with morbidities such as obesity, hypertension and prehypertension in Australian children as young as 11-12 years of age (Constantine, Tracy, & Sonia, 2018b; Sahoo et al., 2015). Although morbidity data specifically for Australian-Indian children is not available, in 2020, Indians were the second-largest migrant population (N=721,000) in Australia after British immigrants and currently represent the largest ethnic community in Australia (Australian Bureau of Statistics, 2019-20). A cost modelling analysis estimates that a reduction per week of one serve (375 mL) of sugar-sweetened beverages, one serve (35g) of sweet biscuits and one serve (40g) of cakes can yield healthcare cost savings of AUD793.4 million (589.1–976.0), 640.7 million (402.6–885.8) and 447.1 million (38.3–903.2), respectively (Lal et al., 2020). In summary, Australian children's dietary patterns do not align with dietary recommendations, which has detrimental health outcomes and long-term healthcare expenditures (Russell & Worsley, 2007).

An important explanatory variable for children's dietary patterns is their food preferences, of which taste is a key determinant (Nicklaus & Schwartz, 2019; Wardle & Cooke, 2008). Children's lower preferences for healthy foods (e.g., vegetables) may be perceived by their caregivers (e.g., parents) as their child being a picky eater (Dubois et al., 2013; Walton, Kuczynski, Haycraft, Breen, & Haines, 2017). However, there are constraints in the process of measuring caregivers' perceptions of their child's food pickiness and food preferences. Several existing questionnaires have predominantly focused on measuring parental perceptions of their child's food pickiness as a behavioural or appetitive trait (Appendix-A, Table A.1). Maternal perceptions of pickiness have been investigated within the Australian-Indian population, but only as a single-item question classifying young children 1-5 years as 'picky or not picky'(Jani, Mallan, Mihrshahi, & Daniels, 2014). Furthermore, picky eating appetitive traits have primarily been examined only in relation to children's vegetable intake or dislike (Mura, Caton, Vereijken, Weenen, & Houston-Price, 2017; Nicklaus & Schwartz, 2019). There is a dearth of literature examining parent's perception of their child's pickiness in relation to all the five core food groups (vegetables and legumes/beans; fruits; dairy and alternatives; meat and alternatives; cereals), which is representative of a nutritionally balanced diet and critical for optimal growth and development in children (Mura et al., 2017; National Health and Medical Research Council, 2013; Nicklaus & Schwartz, 2019).

With respect to food preferences, this has generally been measured in adults and children in terms of likeability of specific sensory taste properties such as sweetness, saltiness or fattiness (Deglaire et al., 2012; Lange et al., 2018). Only one questionnaire has measured maternal-reported food preferences among young British children (4-5 years old) for a range of foods typically consumed as part of their daily diet (Wardle, Sanderson, Gibson, & Rapoport, 2001) (Appendix-A, Table A.1). Although the literature suggests older children can accurately report their food preferences if they are guided in an age-appropriate manner, and that children aged six years and above can accurately report their food preferences on a 5-point or more Likert scale (Guinard, 2000; Ogden & Roy-Stanley, 2020), parent-reported questionnaires have mostly been used as a proxy in measuring children's food preferences (Wardle, Sanderson, et al., 2001).

In summary, most existing questionnaires developed to measure parental perceptions of picky eating and children's food preferences have limited reliability, validity testing and applicability within the Australian-Indian population (Appendix-A, Table A.1). Furthermore, there is a need to develop thoroughly validated questionnaires measuring parental perceptions of their child's pickiness for all five core food groups and examining children's food preferences in a culturally and age-appropriate manner. This study, therefore, aimed to identify 'picky' or 'not picky' food items as perceived by mothers and reported as 'non-preferred' or 'preferred' by children for each of the five core food groups and discretionary foods. This was achieved by developing, and pilot validating the mother-reported core food Picky Eating Questionnaire (PEQ) and Child-reported Food Preference Questionnaire (C-FPQ) in Australian-Indian mothers and children aged 7-12 years old.

2. Methods

2.1. Participants

Detailed participant eligibility criteria and recruitment strategies have been published earlier (Jani et al., 2020). Primary caregivers (i.e., mothers or fathers) and their school-aged children 7-12 years old were eligible to participate. Recruitment was undertaken using a convenience-based snowball sampling technique between December 2019-May 2021. Key recruitment sources included informal networks, e.g., friends and family (for study phase one-questionnaire development and piloting using semi-structured interviews); and Indian cultural centres, namely, places of worship (Indian temples) and Indian community associations in Canberra, Sydney, and Melbourne (for study phase two-questionnaire validation.

2.2. Phase one: Questionnaire development and piloting

Foods selected for inclusion in the PEQ and C-FPQ were based on the Australian Dietary Guidelines (National Health and Medical Research Council, 2013), national dietary intake data for Australian children (Australian Bureau of Statistics, 2017-18; Constantine, Tracy, & Sonia, 2018a; Fayet-Moore et al., 2020) and the Food Preference Questionnaire-FPQ (Wardle, Sanderson, et al., 2001). The PEQ aims to identify caregivers' perception of their child's pickiness, and C-FPQ aims to study children's self-reported food preferences, for specific foods commonly available in Australia, across the five core food groups and discretionary foods. The items included 'single' foods (e.g., broccoli) and 'mixed' foods (e.g., kale, spinach, lettuce); an approach previously used in the literature (Pliner & Pelchat, 1986; Wardle, Sanderson, et al., 2001). Items containing mixed foods were always grouped together in odd numbers, such as nuts (almonds, cashews, walnuts). Therefore, if primary caregivers considered their child to be picky for 'most' of the food items listed together, they could indicate this by selecting a higher score on the 10-point scale and vice versa. Similarly, if the child liked 'most' of the food items listed together, the child could indicate this by selecting a higher score (happier smiley face) on the 5-point smiley scale and vice versa. Instructions for 'mixed' food items and 'single' food items were provided in the Participant Information Sheet-PIS (excerpt from the PIS: The PEQ will have similar food items grouped together. For example, leafy greens (e.g., kale, spinach, lettuce). If your child is picky for most of the foods listed in the group, in this example, if your child does not like 2/3 leafy greens, your response could lean towards the 'Very strongly agree picky end of the scale'. The PEQ will also have single food items listed. For example, broccoli. If your child is not very picky about broccoli, your response could lean towards the 'Very strongly disagree picky end of the scale').

2.2.1. Face validity

Face validity of the food items included in the PEQ and C-FPQ were independently reviewed by four experienced dietitians (RB, PL, CKA, SM) to ascertain that the foods aligned with the purpose of the questionnaires and are commonly identifiable, accessible and available within Australia. RJ and SM are experienced dietitians of Indian origin. Primary caregivers (e.g., mothers, fathers) and their youngest child between the ages of 7-12 years (N=18) were invited to pilot the questionnaires and participate in a semi-structured face to face interview. Further details regarding the interview process have been published earlier (Jani et al., 2020) and are summarised in Appendix-B.

2.3. Phase two: Questionnaire validation

2.3.1. Data preparation

In total, 482 mothers and children completed the PEQ and the C-FPQ, respectively. Little's MCAR test indicated that the data were missing at random (PEQ, n=9, $X^2(341)=247.17$, p=0.97; C-FPQ, n=12, $X^2(558)=468.76$, p=0.98). The Full-Information Maximum Likelihood method was implemented to address data missing completely at random (Arbuckle, 1996; Enders & Bandalos, 2001; Lange et al., 2018). The cut-off of 75% has been used extensively in the literature examining food preferences, in particular the Food Preference Questionnaire-FPQ (Wardle, Sanderson, et al., 2001). The FPQ proposed that if <75.00% of the children tried the food item, then the item could be considered novel and may not represent the children's daily dietary pattern. In our study, cultural dietary norms could be an additional underlying factor for children not trying specific food items (Appendix-B, Table B.1). Beef (PEQ=47.50%; C-FPQ=47.90%), chicken (PEQ=68.70%; C-FPQ=68.90%), fish (PEQ=70.30%; C-FPQ=70.10%) and bacon/ham/sausages (C-FPQ=52.1%) were tried by <75.00% of the children and therefore excluded from the analysis. Data considered not missing completely at random included eggs (never tried: PEQ=15.60%; C-FPQ=15.10%). The majority of the participants were Hindu (66.10%) and Sikh (28.50%) (Table 2) who may practice lacto-vegetarianism and hence not consume eggs (Davidson, 2003; Nesbitt, 2015). Eggs were therefore removed from the analysis. In the PEQ, some items showed nearly perfect correlation (cheese*low fat cheese $r_s=1.00$; yoghurt*low fat yoghurt $r_s=1.00$; milk*low fat milk $r_s=0.97$), which resulted in a not positive definite covariance matrix. As the mothers perceived these items to be redundant low-fat variants were removed, and only cheese, yoghurt and milk were retained for analysis (Bollen & Long, 1993; Lorenzo-Seva & Ferrando, 2021).

Normality for individual items was examined using kurtosis value (>3.00 non-normality) (Westfall & Henning, 2013). Multivariate normality was assessed using Mardia's normalised estimate of multivariate kurtosis (>5.00 non-normality) (Bentler, 2006). Multiple regression standardised residual statistics using ±2 standard deviations(SD) from the mean (Tabachnick & Fidell, 2019) and observations farthest from the centroid (Mahalanobis distance) identified the multivariate outliers. This process revealed n=20 and n=15 cases as extreme outliers in the PEQ and the C-FPQ, respectively. On further investigation of the outliers (PEQ, n=20; C-FPQ, n=15), we identified that almost all food items on the PEQ and C-FPQ were selected on the extreme ends of the Likert scale (e.g., children reporting 5/5 for all food items on the C-FPQ). As these cases could likely affect the Confirmatory Factor Analysis (CFA), they were excluded. The remaining valid cases were used for analysis (PEQ, N=462;

C-FPQ, N=467). Literature has advised that using a Likert scale with more points will minimise information loss on the raw data, and a rating out of 10 in adults is easy to comprehend, which may support the collection of accurate raw data (Leung, 2011; Wu & Leung, 2017). However, for analytical purposes, a Likert scale with more points is most suitable when the data is normally distributed (Wu & Leung, 2017). As our underlying distribution was non-normal (see data analysis section), we reduced our 10-point Likert scale to a five-point Likert scale (PEQ: 1=picky eater, very strongly disagree to 5=very strongly agree) for analytical purposes and to aid comparison with C-FPQ (1=dislike a lot to 5=like a lot) (Boone & Boone, 2012; De Winter & Dodou, 2010).

2.3.2. Construct validity

Exploratory Factor Analysis (EFA) on the complete dataset (PEQ N=462, C-FPQ N=467) with Varimax rotation was conducted on 32 items in the PEQ (17 single food items, 36 mixed food items); 33 items in the C-FPQ (18 single food items, 36 mixed food items) across the five core food groups; and on 11 discretionary food items in the C-FPQ (3 single food items, 21 mixed food items). The Bartlett Test of Sphericity (agreeable if $p<0.05$) and the Kaiser–Meyer–Olkin measure of sampling adequacy (≤0.50 poor-≥0.90 excellent) were examined to verify the uni-dimensionality of the constructs (Bartlett, 1954; Kaiser, 1970, 1974). The number of factors to be retained was determined from scree plots of the Eigenvalues. The items that substantially contributed to a given factor were selected based on their loading >0.40 (Guadagnoli & Velicer, 1988). Initial Eigenvalues from EFA were then compared to random data Eigenvalues using parallel analysis.

For CFA, the complete dataset (PEQ N=462, C-FPQ N=467) was randomly sampled into a training dataset (PEQ N=231, C-FPQ N=234) and a validation dataset (PEQ N=231, C-FPQ N=233) to enable cross-validation. For both questionnaires, following Lange et al.'s method (Lange et al., 2018), one-factor congeneric models were a meaningful approach for examining construct validity first on the training dataset, then on the validation dataset, and ultimately on the complete dataset as our theoretical framework was based on the Australian Dietary Guidelines which proposes that a healthy diet comprises food items consumed from each of the five core food groups (National Health and Medical Research Council, 2013). The goodness-of-fit indices to evaluate model fit included: CMIN/DF: Minimum Discrepancy per Degree of Freedom (χ^2/df: 1.0-2.0); TLI: Tucker-Lewis index (>0.90); CFI: Comparative Fit Index (>0.90); SRMR: Standardized Root Mean Square Residual (<0.06); RMSEA: Root Mean Squared Error Approximation (≤0.05) and PCLOSE (>0.05) to accept the test of close fit. If RMSEA lower end of the 90% confidence interval (LO90) was equal to zero, then the test of very good fit was supported (Bentler, 1989; Bentler & Bonett, 1980; Browne & Cudeck, 1992; Steiger, 1990). Model fit was considered acceptable if the majority of goodness-of-fit indices met the 'acceptable' cut-off criteria. Item-factor loadings, item variance, and critical ratios were also studied when evaluating model fit. When the goodness-of-fit indices were not satisfactory, modification indices, squared multiple correlations, and standardised residual matrix were carefully reviewed for the addition of any error covariance or deletion of items. The addition of error covariance was implemented only if it was theoretically sensible.

2.3.3. Convergent validity

Convergent validity was measured for the complete dataset (PEQ N=462, C-FPQ N=467). Convergent validity examines the degree to which two measures of the same concept are correlated. Convergent validity can be computed from factor loadings and calculating Average Variance Extracted (AVE) and Composite Reliability (CR) for each construct (Fornell & Larcker, 1981). AVE ≥0.50 reflects acceptable convergent validity, which means that the latent variable explains more than half of its indicators' variance. CR >0.70 indicates the acceptable degree to which the construct indicators reveal the latent variable (Fornell & Larcker, 1981; Hair, Ringle, & Sarstedt, 2011).

2.3.4. Relative validity

In the absence of a 'gold standard' measuring mothers' perceptions of food pickiness and children's self-reported food preferences, relative validity was assessed against real food items listed in the questionnaires. Assessing food preferences using real food items is an acceptable alternative approach to actual food tasting in children and adults (Guthrie, Rapoport, & Wardle, 2000; Laureati, Pagliarini, Toschi, & Monteleone, 2015; Piqueras-Fiszman & Jaeger, 2014). Food tasting was not permitted by the ethics committee as the data was collected amidst the coronavirus pandemic. Relative validity assessment was done two weeks (Median: 18.00 days, 25th-75th IQR: 15.00-29 days) after the first administration of the PEQ and C-FPQ, respectively (Magarey, Golley, Spurrier, Goodwin, & Ong, 2009; Wardle, Guthrie, Sanderson, & Rapoport, 2001). Mothers responded to the real food items on a 10-point Likert scale, and children responded on a 5-point smiley Likert scale. Spearman's correlation is reported to support comparison with the broader literature; however, high correlation does not necessarily mean good agreement; therefore the strength of agreement was reported using the Bland-Altman method (Bland & Altman, 1986; Peat, Mellis, Williams, & Xuan, 2020). The Bland-Altman plotted the differences (bias) between the scores on the PEQ/C-FPQ and scores derived from responses to the real food items versus the mean of the scores from the two assessment methods with limits of agreement being +2SD from the mean difference (Bland & Altman, 1986; Peat et al., 2020). Linear regression analysis was undertaken to assess if the slope of the mean bias (b_1) was significantly different to zero (Bland & Altman, 1986; Peat et al., 2020). Maternal responses to specific food items in the PEQ were also compared using Spearman's correlation to the well-established FPQ (Wardle, Sanderson, et al., 2001). This is termed as 'proxy' relative validity testing because the comparison was only possible between specific food items common across the PEQ and FPQ (Wardle, Sanderson, et al., 2001). Proxy relative validity testing was not possible for C-FPQ due to the lack of existing validated tools measuring food preferences directly reported by children. Proxy/relative validity testing was undertaken with N=51 mothers and N=50 children.

2.3.5. *Predictive validity*

Predictive validity was measured for the complete dataset (PEQ N=462, C-FPQ N=467). Predictive validity was measured using Spearman's correlation by correlating mean scores of the newly developed PEQ/C-FPQ constructs to the mean scores of the children's fussiness appetitive trait. The fussy appetitive trait was measured using the Children's Eating Behaviour Questionnaire (CEBQ) food fussiness construct (Wardle, Guthrie, et al., 2001). The food fussiness construct showed very good internal consistency in the current sample (Cronbach's alpha 0.94). It was predicted that constructs which were reflective of children's food pickiness (PEQ) and non-preference to specific food items (C-FPQ) would be correlated with higher CEBQ food fussiness mean scores (Wardle, Guthrie, et al., 2001).

2.3.6. *Test-retest reliability*

The Intra-class Correlation Coefficient (ICC) was calculated from the first and second administration of the PEQ (N=51 mothers) and C-FPQ (N=50 children). The mothers returned the PEQ along with C-FPQ completed by their child (Median: 16.00 days, 25^{th}-75^{th} IQR: 15.00-20.25 days). The duration between the first and second administration of the questionnaires was considered sufficient based on previous literature so that mothers and children would not simply replicate their earlier responses (Magarey et al., 2009; Wardle, Guthrie, et al., 2001). ICC values of <0.50 reflects poor, 0.50-0.75 moderate, 0.75-0.90 good, and >0.90 excellent reliability (Koo & Li, 2016).

2.3.7. *Internal consistency*

Internal consistency was measured for each construct of the complete dataset (PEQ N=462, C-FPQ N=467) using Cronbach's alpha coefficient (acceptable 0.5-0.7, good>0.7 values) (Cronbach, 1951; Hair et al., 2011).

2.3.8. *Mean scores*

The mean scale scores±SD were calculated for the newly formed constructs. For the PEQ, higher scores indicated mothers' higher agreement that they perceived their child as a picky eater for the specific food items within a construct. In contrast, for C-FPQ, higher scores indicated the child's higher preference for the specific food items within a construct. Spearman's correlation between common constructs of the PEQ and C-FPQ was undertaken to broadly examine whether mothers' perception of picky eating correlated with their children's food preferences.

2.4. *Data analysis*

The CFA was undertaken using the maximum likelihood and generalized least squares method (Olsson, Foss, Troye, & Howell, 2000). Olsson et al. advise that if more than one method provides similar parameter estimates, this supports additional confirmation that the models are accurate, i.e., there is good agreement between theoretical fit and empirical fit (Olsson et al., 2000). We observed similar parameter estimates and goodness-of-fit indices using both methods. Outcomes using the generalized least squares method are reported as it can support additional precision when dealing with a smaller sample size (Olsson et al., 2000; Olsson, Troye, & Howell, 1999) i.e., the training dataset (PEQ N=231, C-FPQ N=234) and the validation dataset (PEQ N=231, C-FPQ N=233), respectively. Due to non-normality, item-factor loadings using Bayesian statistics as well as generalized least squares method has been reported. CFA was undertaken using the bootstrapping approach, and Bollen-Stine bootstrapped chi-square are reported for both questionnaires (Bollen & Stine, 1992). CFA was performed in AMOS version 25. All other analyses were undertaken in SPSS version 25 (SPSS Inc., Chicago, USA). Significance was set at $p<0.05$.

3. Results

3.1. Phase one: Questionnaire piloting

Phase one participant characteristics are reported in Table 1. One father and 17 mothers having a child in the age range of 7-12 years, of Indian origin, participated in Phase one. Participant feedback during questionnaire piloting using semi-structured interview questions is detailed in Appendix-B, Table B.1. The key suggestion from the primary caregivers advised re-coding the 10-point Likert scale with a score of ten equal to 'picky eater, very strongly agree' (picky eater) and a score of one equal to 'picky eater, very strongly disagree' (non-picky eater). Thus, the higher the rating on the PEQ, the higher the mother's perception of her child's pickiness for specific food items. With regards to the C-FPQ, children (N=15/18) were unfamiliar with wholegrains namely, quinoa, barley, rye, and plant-based dairy alternatives. Overall, younger children (7-9 years, N=13/18) were not clear regarding the difference between 'low fat' milk/cheese/yoghurt and their regular counterparts. These items were therefore removed from the C-FPQ (Appendix-B, Table B.1).

3.2. Phase two: Questionnaire validation

3.2.1. Construct validity

Phase two participant characteristics are reported in Table 2. Only mothers having a child in the age range of 7-12 years, of Indian origin, participated in Phase two. As per EFA the factor loadings for each food item in the PEQ (Appendix-C, Table C.1) and C-FPQ (Appendix-C, Table C.2-3) are reported in the Appendix. For the PEQ, the factor loadings ranged between 0.84-0.54 and no cross-loadings >0.44 were identified. For C-FPQ the factor loadings ranged between 0.79-0.52 and no cross-loadings >0.49 were identified. The PEQ suggested three factors and C-FPQ suggested four factors in line with the five core food groups. Parallel analysis and EFA reported the same number of factors. In both the PEQ and C-FPQ, factor one consisted of green vegetables, other vegetables, fruits, and nuts perceived as 'not picky' by the mothers and reported as 'preferred' by the children. In both the PEQ and C-FPQ, factor two consisted of green-leafy vegetables, other vegetables and legumes, fruits, wholegrain/wholemeal cereals, and dairy items perceived as 'picky' by the mothers and reported as 'non-preferred' by the children. In both the PEQ and C-FPQ, factor three consisted of dairy items perceived as 'not picky' by the mothers and reported as 'preferred' by the children. In the C-FPQ, factor four exclusively consisted of flavoured milk as 'preferred', and the Likert scale responses reported that almost all (99.4%) of the children preferred flavoured milk. EFA on discretionary foods suggested three factors. Factor one consisted of savoury discretionary foods, factor two consisted of sweet discretionary foods and fruit juice/cordial, and factor three consisted of margarine/butter (Appendix-C, Table C.3).

One factor congeneric CFA modelling was deemed a suitable approach given this study aimed to identify food items perceived as 'picky' or 'not picky' by mothers and reported as 'non-preferred' or 'preferred' by children within each of the five core food groups and discretionary foods. CFA models are presented in Figure 1.1-9.2. For both questionnaires, acceptable model fit was reported with the training and validation datasets and with the complete dataset (Appendix-C, Table C.4-C.13). Where modification indices suggested the addition of a covariance, these are indicated in Figure 1.1-9.2.

The PEQ observed four constructs and C-FPQ observed three constructs for food items perceived as picky by the mother or reported as non-preferred by the children, respectively. These constructs were picky (three-items)/non-preferred (three-items)-green leafy vegetables (Figures 1.1; 1.2); picky (four-items)/non-preferred (four-items)-other vegetables, pulses, and legumes (Figures 2.1; 2.2); picky (three-items)/non-preferred (three-items)-fruits (Figures 3.1; 3.2); picky (three-items)-wholegrain/wholemeal cereals (Figures 4.1).

For the C-FPQ, as per the Likert scale responses and the EFA factor loadings, two items were not preferred by the children, namely wholegrain/wholemeal staples, and wholemeal breakfast cereals (Appendix-C, Table C.2). Similarly, as per the Likert scale responses and the EFA factor loading, one item, namely refined staples, was preferred by the children (Appendix-C, Table C.2). As CFA cannot be performed with only one or two items, refined staples, wholegrain/wholemeal staples, and wholemeal breakfast cereals were retained as single items.

The PEQ observed four constructs and C-FPQ observed four constructs for food items perceived as not picky by the mother or reported as preferred by the children, respectively. These constructs were not picky (four-items)/preferred (four-items)-green vegetables (Figure 5.1; 5.2); not picky (four-items)/preferred (four-items)-other vegetables (Figures 6.1; 6.2); not picky (four-items)/preferred (five-items)-fruits and nuts (Figures 7.1; 7.2); dairy construct (Figures 8.1; 8.2).

With respect to the dairy construct, CFA proposed a two-factor model for the PEQ (Figure 8.1). The ‘picky-dairy construct (two-items)’ was distinctive to the ‘not picky-dairy construct (two-items)’ and discriminant validity was recognised as the model fit was inferior when the two constructs were forced to constrain as one (CMIN/DF=43.48, TLI=0.15, CFI=0.57, RMSEA=0.30, p=0.005, SRMR=0.12). CFA proposed a one-factor preferred dairy model for C-FPQ (three-items, Figure 8.2). For the C-FPQ, the EFA factor loading suggested a single item, namely plain milk, as not preferred by the children (Appendix-C, Table C.2). As CFA cannot be performed with only one item, plain milk was retained as a single item. The C-FPQ observed two additional preferred discretionary food constructs. Namely, savoury discretionary foods and soft drinks construct (five-items) and sweet discretionary food construct (four-items) (Figure 9.1-9.2). The conceptual framework of the PEQ and the C-FPQ is illustrated in Figure 10.

3.2.2. Convergent validity

Across both questionnaires, acceptable convergent validity was observed for all constructs (AVE≥0.53, CR≥0.79) except the preferred sweet discretionary food construct which reached borderline convergent validity (AVE 0.40, CR 0.72) (Table 3, 4).

3.2.3. Relative validity

Relative validity was acceptable as the mean scores for participants fell within the 95% limits of agreement and the fitted regression line was non-significant, suggesting no systematic bias between the two methods of measurement (PEQ/C-FPQ vs report against real food items) (Table 3, 4). 'Proxy' relative validity was supported as Spearman correlations were significant for common food items across the PEQ and FPQ (Wardle, Sanderson, et al., 2001) (Appendix-C, Table C.14).

3.2.4. Predictive validity

With respect to core food groups, for both questionnaires, mean scores for 'picky ($r_s \geq 0.60$)/non-preferred ($r_s \geq 0.54$) food item' constructs were significantly correlated with high food fussiness appetitive trait. Similarly, mean scores for 'not picky($r_s \geq 0.65$)/preferred($r_s \geq 0.64$) food item' constructs were correlated with low food fussiness appetitive trait (Wardle, Guthrie, et al., 2001) (Table 3, 4).

3.2.5. Test-retest reliability

Across both questionnaires, the constructs showed good test-retest reliability (ICC≥0.92) (Table 3, 4).

3.2.6. Internal consistency

Across both questionnaires, all newly developed constructs reported good internal consistency (Cronbach's alpha≥70) (Table 3, 4).

3.2.7. Mean scores

For both questionnaires, mean scores for constructs are reported in Table 3, 4. As per Spearman's correlation, green leafy vegetables (rs=-0.88, p<0.001), other vegetables and pulses/legumes (rs=-0.83, p<0.001), fruits (rs=-0.86, p<0.001) perceived as 'picky' by mothers were also reported as 'non-preferred' by children. Green vegetables (rs= -0.92, p<0.001), other vegetables (rs=-0.90, p<0.001), fruits and nuts (rs=-0.92, p<0.001) and dairy items (rs=-0.81, p<0.001) perceived as 'not picky' by mothers were also reported as 'preferred' by the children. The validated PEQ and C-FPQ is provided in Appendix-D, Table D.1-2.

Discussion

This is the first study to develop and pilot validated questionnaires to assess mothers' perceptions of children's pickiness and child-reported food preferences across all five core food groups, representative of a nutritionally balanced diet. The study observed three key findings. (1) CFA suggested similar constructs for the PEQ and C-FPQ across the core food groups. The C-FPQ additionally reported savoury and sweet discretionary food constructs. (2) The constructs observed acceptable reliability and validity testing. (3) Mean scores of the PEQ and C-FPQ constructs indicated that mothers' perceptions of pickiness were positively correlated with their child's self-report of non-preference.

The CFA suggested similar constructs for the PEQ and C-FPQ across the core food groups. This indicates that mothers may be aware about their children's food preferences (perceived as 'not picky') and non-preferences (perceived as 'picky'). In our sample, only mothers chose to participate in the validation study, with the majority being homemakers (75.50%) and reported to be living with the child's father (99.20%) and their other children (69.70%). Mothers are therefore likely to be the principal caregiver regarding meal preparation and food provision. Furthermore, passive feeding (handfeeding the child beyond five-years of age even though the child can self-feed) is a common Indian cultural practice (Jani Mehta, Mallan, Mihrshahi, Mandalika, & Daniels, 2014; Jani, Mallan, et al., 2014; Mehta et al., 2003; Tuli & Chaudhary, 2010). These factors may therefore partly explain Australian-Indian mothers' awareness regarding their child's food preferences.

For picky/non-preferred vegetables we observed two distinct constructs categorised as green leafy vegetables vs other vegetables, pulses, and legumes. This distinct categorisation could be because cruciferous vegetables, like Brussel sprouts, broccoli, kale, belong to the same family Brassica oleracea, with the bitter tasting compound glucosinolate, which may partly explain the distinct green leafy vegetables construct (Golicz et al., 2016; Tepper et al., 2017). The development of a green leafy vegetable construct may indicate the need for tailored interventions to children to specifically enhance their preferences and intake of leafy greens (Capaldi-Phillips & Wadhera, 2014; De-Wild, De, & Jager, 2013). Across both questionnaires we observed a covariance between salad leaves and broccoli. This may reflect that the three items together not only measure pickiness/non-preference for specific bitter tasting green leafy vegetables but also indicate another factor. This is quite plausible as mothers and children's responses to Brussel sprouts (picky/very picky: PEQ:83.10%; dislike/dislike a lot: C-FPQ:84.20%) were more skewed in comparison to broccoli (PEQ:67.10%; C-FPQ:64.30%) and salad leaves (PEQ:65.10%; C-FPQ:65.90%). Therefore, Brussel sprouts distinctively is perceived and reported to be a disliked item. This aligns with the literature as Brussel sprouts has been commonly reported as non-preferred food item in adults and children (Howard, Mallan, Byrne, Magarey, & Daniels, 2012; Trinkaus & Dennis, 1991; Wieczorek, Walczak, Skrzypczak-Zielińska, & Jeleń, 2018).

With regards to the other vegetables, pulses, and legumes construct, both questionnaires observed a covariance between zucchini and capsicum. Covariance between zucchini (picky/very picky: PEQ:54.60%; dislike/dislike a lot: C-FPQ: 54.00%) and capsicum (PEQ:61.30%; C-FPQ:60.90%) may partly be explained by an almost equal proportion of mothers and children reporting pickiness/non-preference to these food items. In addition, Indian mothers may serve pulses, legumes and pumpkin together cooked as curries (e.g., *Sambhar*), whereas capsicum may be eaten both cooked and raw (Joshi & Shinde, 2009; Platel, 2020; Prasad et al., 2016).

For not picky/preferred vegetables we observed two distinct constructs categorised as green vegetables vs other vegetables. Other vegetables included avocadoes and red-orange vegetables (carrots, tomatoes, sweet potatoes), which could be eaten as a raw salad (avocadoes, carrots, tomatoes) or cooked together as a curry (e.g., *shakarkand sabji*: tomatoes, sweet potatoes, carrots) (Joshi & Shinde, 2009; Platel, 2020). In the PEQ we observed a covariance between tuber/root vegetables, sweet potato and carrots. Covariance between sweet potato (not picky/not picky at all: PEQ:51.10%;) and carrot (PEQ:54.10%) may partly be explained by an almost equal proportion of mothers reporting 'not picky' for these food items. In addition, particularly orange sweet potatoes and carrot have been reported to have similar taste, texture and aromatic properties, and therefore may have similar likability (Leksrisompong, Whitson, Truong, & Drake, 2012). Orange sweet potatoes (Beauregard) are the most common sweet potato variety available in Australia (Johnson et al., 2021).

With respect to other vegetables construct, across both questionnaires we observed a covariance between cabbage and cauliflower. Covariance between cabbage (not picky/not picky at all: PEQ:43.10%; like/like a lot: C-FPQ:49.90%) and cauliflower (PEQ:56.50%; C-FPQ:56.50%) may partly be explained by an almost equal proportion of mothers and children reporting not picky/preference to these food items. In addition, the construct comprised of cruciferous vegetables (cabbage and cauliflower) and Fabaceae vegetables (green beans and green peas) (Amron & Konsue, 2018; Soceanu et al., 2011), therefore measuring two distinct families of vegetables (Cruciferous vs Fabaceae) which may partly explain the covariance between cabbage and cauliflower. Cooking cruciferous vegetables like cabbage and cauliflower with seasonings and spices, is common in Indian cooking e.g., *phool/patta gobi ki sabzi* (Joshi & Shinde, 2009; Platel, 2020) and may increase palatability and mask bitterness (Feng et al., 2018; Hoppu, Puputti, & Sandell, 2021) thereby making them preferred vegetables over other cruciferous e.g., Brussel sprouts.

Across both questionnaires we observed a unique construct combining picky/not preferred sour tasting (citrus fruits), bland tasting (pawpaw) and textured (dried fruits) fruits together. Aversion to sour taste (e.g., citrus fruits) could partly be explained by children's innate preference for sweet taste and rejection of sour or bitter tastes (Anzman- Frasca, Ventura, Ehrenberg, & Myers, 2018; Wardle & Cooke, 2008). Literature has reported very young Australian children (2 years) to have 'never tried' novel foods such as pawpaw (Howard et al., 2012) but older Finnish children (11 years) to be familiar with and have willingly or unwillingly tried novel foods (e.g., pawpaw) (Tuorila & Mustonen, 2010). Children who are unwillingly but are made to try novel foods such as papaya may express non-preference for the food item (Tuorila & Mustonen, 2010), which supports the development of our picky/not preferred fruit construct. Our fruit construct was a combination of multiple taste and textured food items which may indicate that the construct was not representative of one specific sensory property (e.g., sourness) but may exhibit children's preferences towards a unified orosensory experience reflective of food types (Wardle, Sanderson, et al., 2001). For example, dried and chewy textured fruits, sour fruits and bland tasting fruits may not be preferred by children but sweet, fresh and juicy fruits such as melons and berries may be preferred by children (Wardle, Sanderson, et al., 2001). This notion is further supported by the literature which has reported texture and taste (sour, bitter, bland) to be key determinants explaining dislike for fruits and vegetables in Dutch children (4-12 years) (Zeinstra, Koelen, Kok, & De-Graaf, 2007).

Across both questionnaires we observed not picky/preferred fruits and nuts as part of one construct. This could be due to mothers serving fruits along with nuts as part of a healthy snack at home or school lunch (Australian Government Department of Health, 2014; National Health and Medical Research Council, 2013). In the PEQ we observed a covariance between 'not picky' fruits, berries (not picky/not picky at all:52.20%) and melons (51.90%). In Australia berries as frozen (all berries) and fresh (particularly strawberries), and melons are available nearly all year-round (Carey, Deuter, Zull, Taylor, & White, 2017; Simpson, 2018), whereas stone fruits are considered summer fruits with seasonal availability (Alan, 1999; Hale et al., 2014). Berries and melons may therefore by easily available and more commonly offered by mothers which may partly explain the covariance. In contrast, C-FPQ observed no such patterns, with children self-reporting preference for fresh, juicy, sweet fruits.

With respect to the PEQ, we observed a construct which highlighted that mothers' perceived their children to not prefer wholegrain/wholemeal cereals. This aligned with children's non-preference for wholegrain/wholemeal staples (dislike/dislike a lot: C-FPQ:57.40%) and wholemeal breakfast cereals (C-FPQ:62.10%). In addition, during phase one (semi-structured interviews), children reported that they were unaware of wholegrains such as quinoa, barley, rye. These findings are supported by a recent narrative review which reports that the key barrier to improving wholegrain intake in predominantly Caucasian children (3-18 years) is disliking the taste, texture, appearance, not being able to identify wholegrain foods and limited understanding about their health benefits (Meynier, Chanson-Rollé, & Riou, 2020).

Similar food items loaded for the not picky/preferred dairy construct in the PEQ (cheese, plain yoghurt) and C-FPQ (cheese, plain yoghurt, flavoured yoghurt). Likert scale responses highlighted that almost all children preferred flavoured milk (like/like a lot: C-FPQ:99.40%) and flavoured yoghurt (C-FPQ:91.90%) over plain milk (not picky/not picky at all: PEQ:32.60%; like/like a lot: C-FPQ:31.70%) and plain yoghurt (PEQ:73.60%; C-FPQ:70.20%). The Australia Dietary Guidelines acknowledges that sugar-sweetened flavoured milk provides nutrients but can be energy dense, and therefore recommends consumption of plain milk (National Health and Medical Research Council, 2013). As flavoured dairy products are highly preferred by children, food industries are encouraged to trial natural, non-nutritive sweeteners to provide reduced sugar, healthier alternatives (Mahato et al., 2020).

Food items on the sweet discretionary foods construct and savoury discretionary food and drinks construct loaded as expected. Soft drinks loaded with savoury discretionary foods (for example, pizza) most likely because these are consumed in combination with each other (Andreyeva, Kelly, & Harris, 2011; Gascoyne, Scully, Wakefield, & Morley, 2021). We observed a covariance between chocolate/candy/lollies and coco pops/fruit loops/coco puffs (i.e., refined cereal-based products). The Australia Dietary Guidelines classifies chocolate, cakes, pastries, and biscuits as discretionary refined cereal-based products, Refined breakfast cereals are not specifically mentioned, with a generic recommendation for 'high cereal fibre variants' as part of the core grain food group. Adults and children are encouraged to opt for wholegrain cereal-based products over refined cereal-based products and to review nutritional labels of refined cereal-based products for their sugar, sodium and saturated fat content. This is particularly important as nutritional evaluation of Australian breakfast cereals as a whole (Louie, Dunford, Walker, & Gill, 2012) and those targeted towards Australian children (Tong, Rangan, & Gemming, 2018) have been found to be high in sugar.

The sweet discretionary food construct reached borderline convergent validity (AVE:0.40). This could be due to the inclusion of children's breakfast cereal which should traditionally be categorised as a core food item however, as noted, are high in sugar (Louie et al., 2012; Tong et al., 2018). The WHO recommends adults and children reduce the intake of free sugars to less than 5% of total energy intake for health benefits. Children 7-12 years of age (955-1240 kcal/day) (National Health and Medical Research Council, 2006; World Health Organization, 2015) should therefore not be consuming more than 12-15g (2-3 teaspoons) of free sugars per day. One serve (30g) of breakfast cereals (National Health and Medical Research Council, 2013) such as coco pops/puffs provides 9.1g of total sugar, of which 9.00g is free sugar. Such refined breakfast cereals therefore cannot be classified as low sugar items (≤5g/100g) as per Food Standards Australia New Zealand (Food Standards Australia New Zealand, 2016), and limiting their suitability to be classified as a core food.

The strength of our study is that a few of our congeneric models observed a very good fit. Literature has emphasised that in simple one factor models, a RMSEA value of 0.00 or closer to zero is representative of a very good fit rather than overfit (Kline, 2016; Mulaik, 2009; Peugh & Feldon, 2020) as it reflects a decline in the ratio of the model chi-square to its degrees of freedom, which is true of the null model (Kenny & McCoach, 2003). This is further confirmed by the PCLOSE value (>0.05) and LO90=0.00 being in the acceptable reference range (Browne & Cudeck, 1992).

Robustness of the questionnaires was evident as our constructs demonstrated good results for a wide range of reliability and validity measures. Acceptable proxy/relative validity suggested that the questionnaires can be used in questionnaire-based research settings to assess maternal perceptions of food pickiness and children's self-reported food preferences as test-retest reliability indicated these were relatively stable across a brief period. Lastly, good internal consistency across both questionnaires indicated homogeneity of items within the constructs. Strong correlation between the mean scores of the PEQ and C-FPQ indicated that mother's perception of pickiness aligned with children's self-report of non-preferences. This could imply that older children have adequate cognitive ability to express their likes and dislikes (Guinard, 2000; Ogden & Roy-Stanley, 2020). Asking older children directly about their food preferences may support more accurate data collection (Lange et al., 2018). It could also be inferred that for Australian-Indian mothers, maternal report of their young child's (e.g., pre-schoolers) food preferences or pickiness may be reliable. Parental report of children's food preferences is a common research practice with the Caucasian population, for example, development and use of the FPQ (Wardle, Sanderson, et al., 2001) which measures British parents reported food preferences of their children aged four years.

Several limitations must be taken into consideration. Convenience base sampling and the cross-sectional nature of the study limits causal inferences and generalisability of the findings. All diet-associated (pickiness perceptions, food preferences) self-reported indices are subject to measurement error (Kant, 2004), therefore, multiple reliability and validity testing was undertaken to strengthen the tools. The food fussiness construct from the CEBQ (Wardle, Guthrie, et al., 2001) used as a measure of predictive validity is not validated with Australian-Indian children 7-12 years of age. However, the CEBQ has been validated with Australian-Indian children aged 1-5 years (Mallan et al., 2013), therefore future research could investigate the applicability of the findings with younger Australian Indian children.

The real-world implications of our questionnaires could support health professionals in identifying foods least preferred across the five core food groups and allow for uniquely tailored interventions. For example, behavioural techniques for the management of food selectivity such as food chaining/associative conditioning or fading could be implemented starting with 'moderately challenging' non-preferred food items (e.g., wholegrain cereals), then progressing to 'more challenging' non-preferred food items (e.g., green leafy vegetables) (Fishbein et al., 2006; Milano, Chatoor, & Kerzner, 2019). Similarly, behavioural theory-based nutrition education interventions could be implemented to increase intake of non-preferred foods across the core food groups (especially wholegrain breakfast cereals) and not just vegetables (e.g., try adding one yellow-orange vegetable to your lunch and one wholegrain cereal to your breakfast or dinner at-least 3 times a week) to achieve holistic food behaviour change in children (Cullen, Baranowski, & Smith, 2001; Enright, Allman-Farinelli, & Redfern, 2020). Lastly, applicability of the questionnaires could be expanded by including culturally specific recipes (e.g., Indian curries), cooking methods (e.g., steamed, raw) and seasonal availability to promote intakes of non-preferred food items. Further research is warranted to understand the questionnaires generalisability to other primary caregivers (fathers, grandparents) and cultural groups.

4. Conclusion

This is the first study to develop, and pilot validated questionnaires to examine maternal perceptions of their child's pickiness, and child-reported food preferences, across all five core food groups and discretionary foods. In addition, this study furthers the existing evidence base regarding the measurement of food pickiness and food preferences among the Australian-Indian population, providing insights into culturally and age-appropriate ways in which to undertake such research.

Ethics approval and consent to participate

Written consent from the mothers and written assent initialled by the mothers and children was obtained. This study was approved by the Human Research Ethics Committee of the University of Canberra (Approval number: 20191984).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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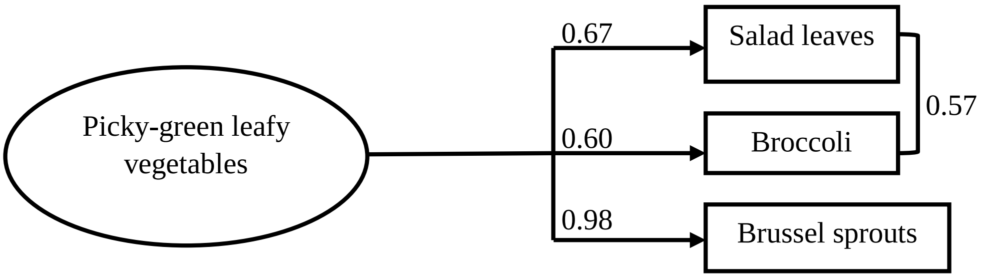

Figure 1.1: Confirmatory Factor Analysis model for the picky-green leafy vegetables construct. Mother-reported Picky Eating Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=0.19, TLI=1.0, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.80), p=0.63, SRMR=0.003. Note: Salad leaves: Leafy greens (e.g., kale, spinach, lettuce).

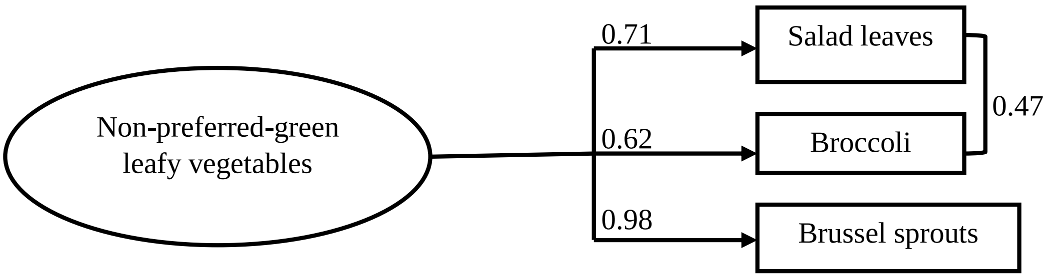

Figure 1.2: Confirmatory Factor Analysis model for the non-preferred-green leafy vegetables construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=1.64, TLI=0.99, CFI=0.99, RMSEA=0.04 (LO 90=0.00, PCLOSE=0.43), p=0.21, SRMR=0.009. Note: Salad leaves: Leafy greens (e.g., kale, spinach, lettuce).

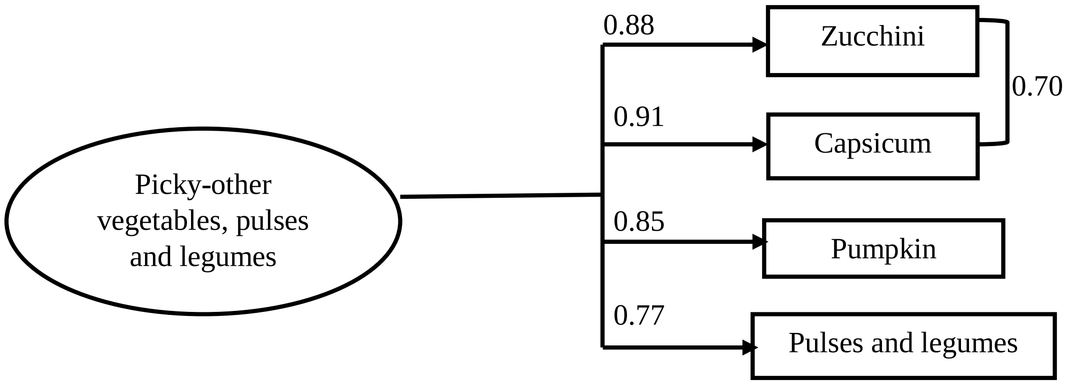

Figure 2.1: Confirmatory Factor Analysis model for the picky-other vegetables, pulses and legumes construct. Mother-reported Picky Eating Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=1.32, TLI=0.99, CFI=0.99, RMSEA=0.03(LO 90=0.00, PCLOSE=0.59), p=0.28, SRMR=0.005. Note: Pulses and legumes: Legumes/beans (e.g., baked beans, chickpeas, black beans).

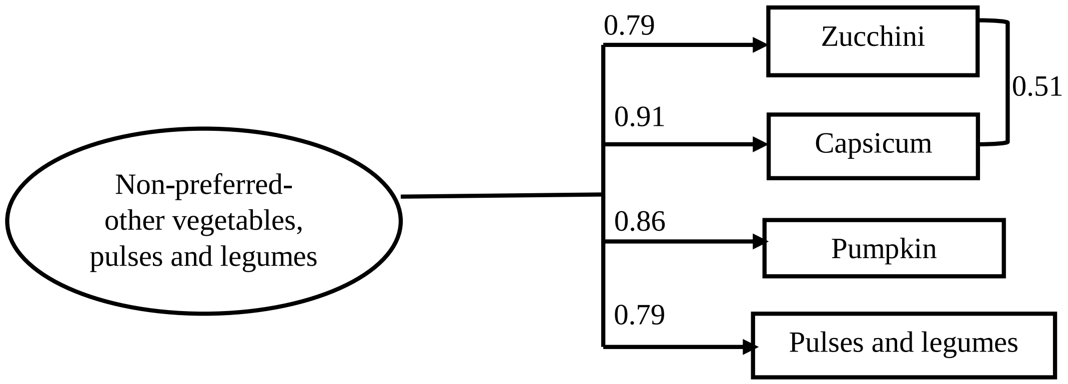

Figure 2.2: Confirmatory Factor Analysis model for the non-preferred-other vegetables construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=1.65, TLI=0.98, CFI=0.99, RMSEA=0.04 (LO 90=0.00, PCLOSE=0.43), p=0.20, SRMR=0.005. Note: Pulses and legumes: Legumes/beans (e.g., baked beans, chickpeas, black beans).

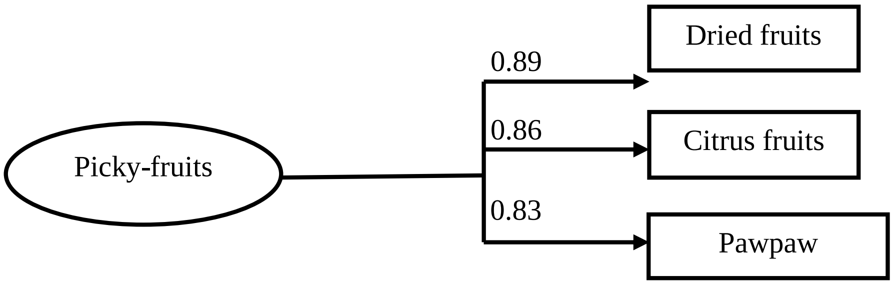

Figure 3.1: Confirmatory Factor Analysis model for the picky-fruits construct. Mother-reported Picky Eating Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=0.17, TLI=1.01, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.82), p=0.69, SRMR=0.002. Note: Dried fruits: Dried fruit (e.g., dried apricots, dried peaches, dates); Citrus fruits: Citrus fruit (e.g., oranges, lemons, grapefruit).

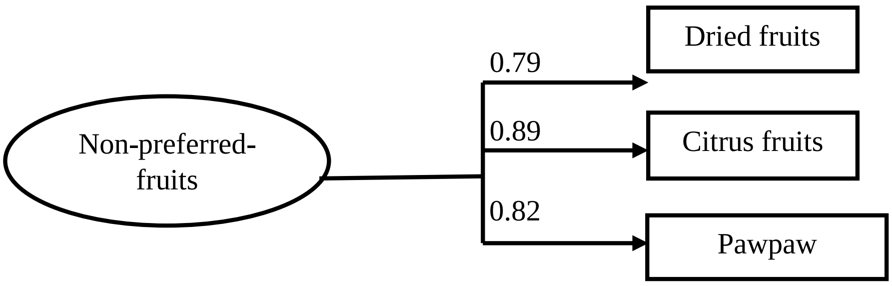

Figure 3.2: Confirmatory Factor Analysis model for the non-preferred-fruits construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=1.82, TLI=0.99, CFI=0.99, RMSEA=0.04 (LO 90=0.00, PCLOSE=0.40), p=0.39, SRMR=0.009. Note: Dried fruits: Dried fruit (e.g., dried apricots, dried peaches, dates); Citrus fruits: Citrus fruit (e.g., oranges, lemons, grapefruit).

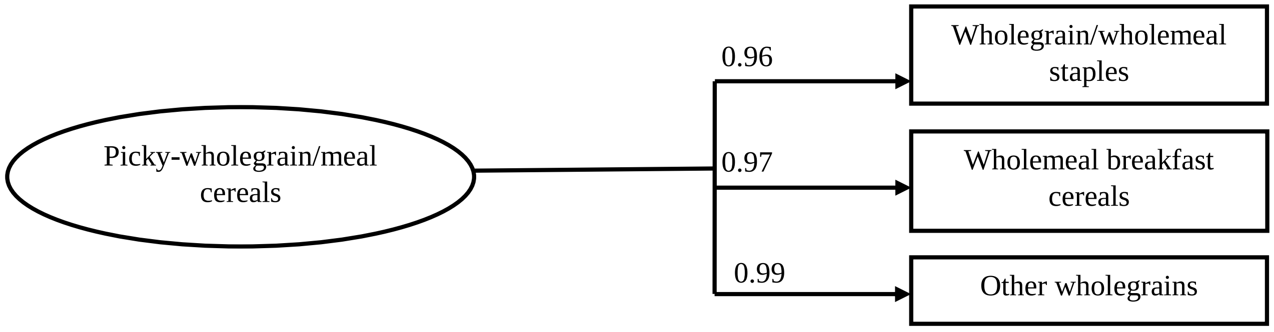

Figure 4.1: Confirmatory Factor Analysis model for the picky-wholegrain/meal cereals construct. Mother-reported Picky Eating Questionnaire. Child-reported Food Preference Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=0.74, TLI=1.01, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.76), p=0.33, SRMR=0.0006. Notes: Wholegrain/wholemeal staples: Wholemeal or multigrain bread, brown rice, wholemeal pasta; Wholemeal breakfast cereals: Oats, muesli, bran flakes; Other wholegrains: Quinoa, barley, rye.

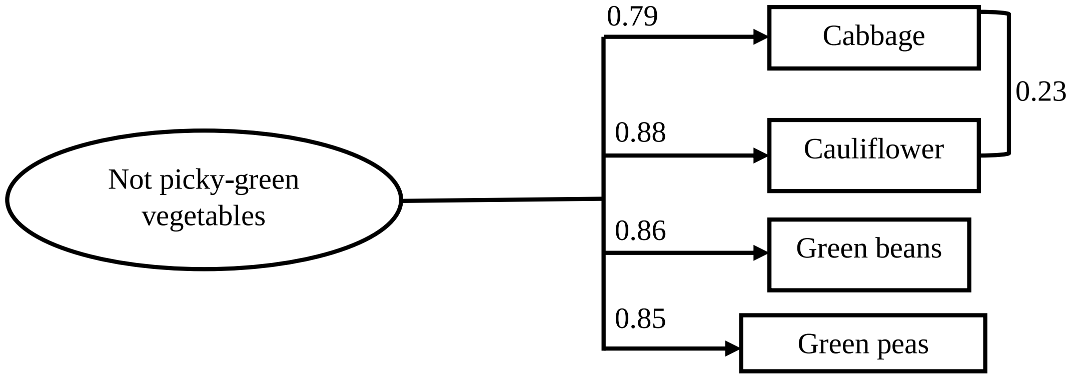

Figure 5.1: Confirmatory Factor Analysis model for the not picky-green vegetables construct. Mother-reported Picky Eating Questionnaire. Child-reported Food Preference Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=1.89, TLI=0.97, CFI=0.99, RMSEA=0.04 (LO 90=0.00, PCLOSE=0.49), p=0.18, SRMR=0.009.

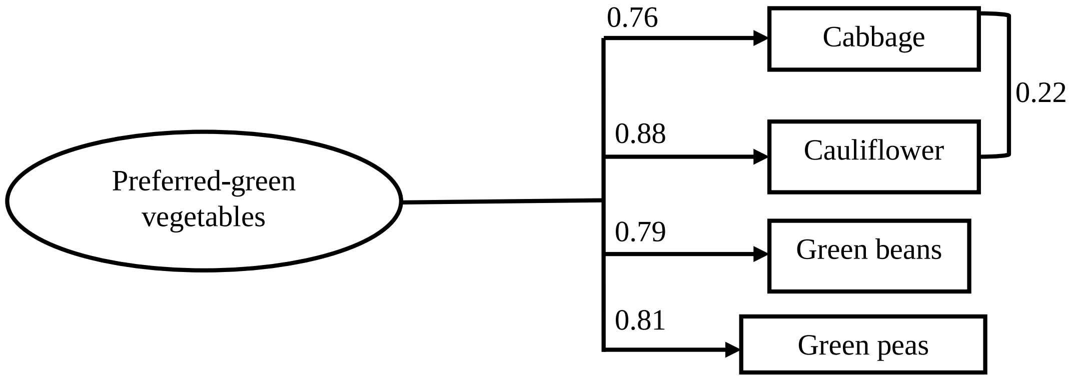

Figure 5.2: Confirmatory Factor Analysis model for the preferred-green vegetables construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=2.24, TLI=0.96, CFI=0.98, RMSEA=0.05 (LO 90=0.00, PCLOSE=0.40), p=0.13, SRMR=0.01.

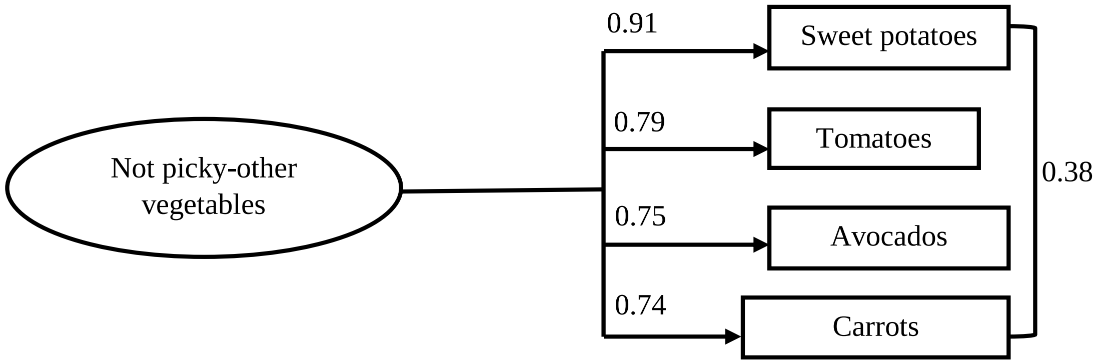

Figure 6.1: Confirmatory Factor Analysis model for the not picky-other vegetables construct. Mother-reported Picky Eating Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=0.38, TLI=1.02, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.72), p=0.65, SRMR=0.03.

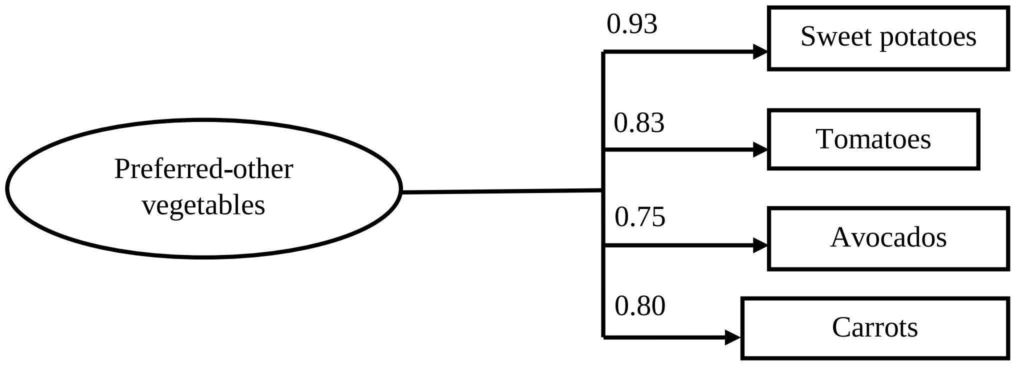

Figure 6.2: Confirmatory Factor Analysis model for the preferred-other vegetables construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=0.04, TLI=1.03, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.99), p=0.98, SRMR=0.002.

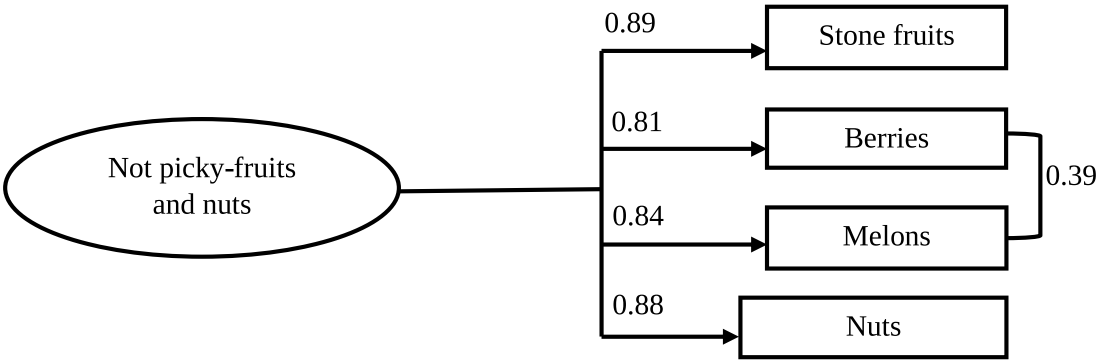

Figure 7.1: Confirmatory Factor Analysis model for the not picky-fruits and nuts construct. Mother-reported Picky Eating Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=0.05, TLI=1.03, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.91), p=0.86, SRMR=0.0006. Note: Stone fruits; Peaches, nectarines, plums; Berries; Berries (e.g., strawberries, blueberries, raspberries); Melons: Melons (e.g., watermelon, rockmelon. sweet melon); Nuts: Nuts (e.g., almonds, cashews, walnuts)

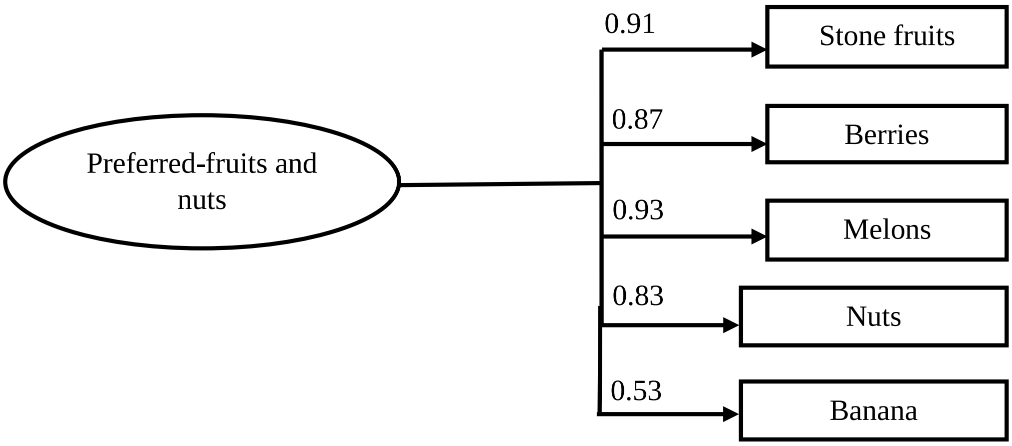

Figure 7.2: Confirmatory Factor Analysis model for the preferred-fruits and nuts construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=1.64, TLI=0.97, CFI=0.98, RMSEA=0.04 (LO 90=0.00, PCLOSE=0.63), p=0.25, SRMR=0.01. Note: Stone fruits; Peaches, nectarines, plums; Berries; Berries (e.g., strawberries, blueberries, raspberries); Melons: Melons (e.g., watermelon, rockmelon. sweet melon); Nuts: Nuts (e.g., almonds, cashews, walnuts)

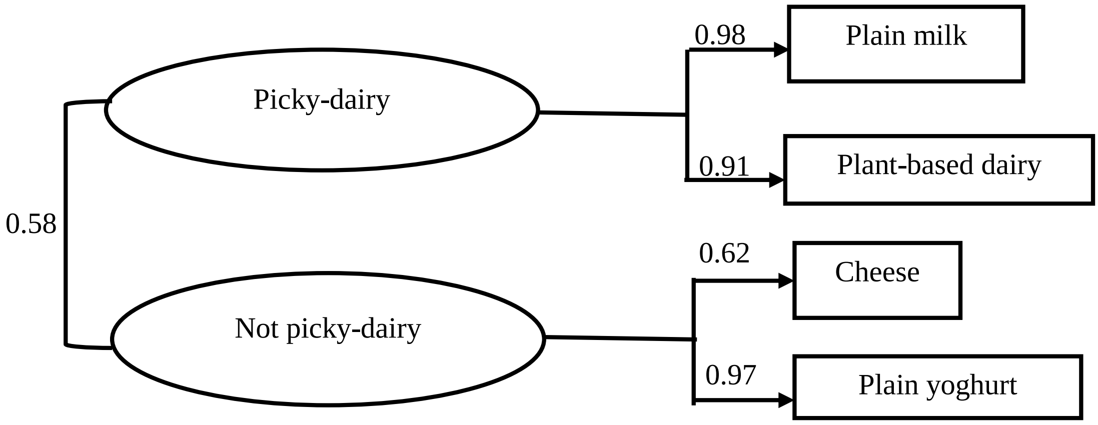

Figure 8.1: Confirmatory Factor Analysis model for the dairy construct. Mother-reported Picky Eating Questionnaire. Complete data set (N= 462), fit indexes CMIN/DF=0.38, TLI=1.01, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.89), p=0.11, SRMR=0.008. Note: Plant-based diary: Plant-based milk alternative: soymilk, almond milk, coconut milk.

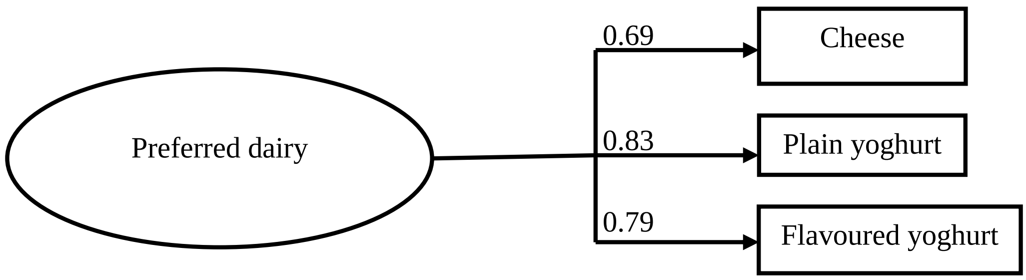

Figure 8.2: Confirmatory Factor Analysis model for the preferred dairy construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=0.11, TLI=1.02, CFI=1.00, RMSEA=0.00 (LO 90=0.00, PCLOSE=0.86), p=0.83, SRMR=0.003.

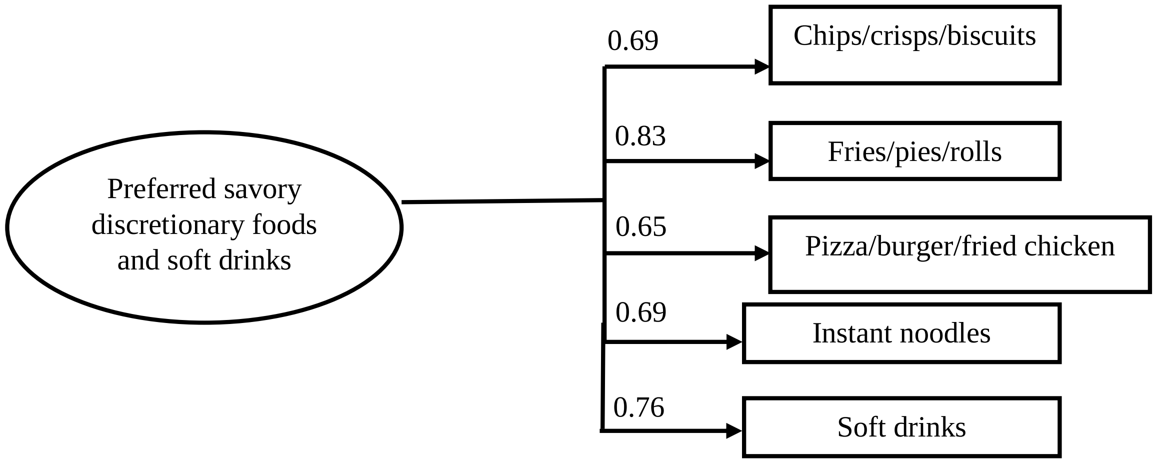

Figure 9.1: Confirmatory Factor Analysis model for the preferred savory discretionary food construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=1.91, TLI=0.95, CFI=0.96, RMSEA=0.04 (LO 90=0.00, PCLOSE=0.55), p=0.31, SRMR=0.04.

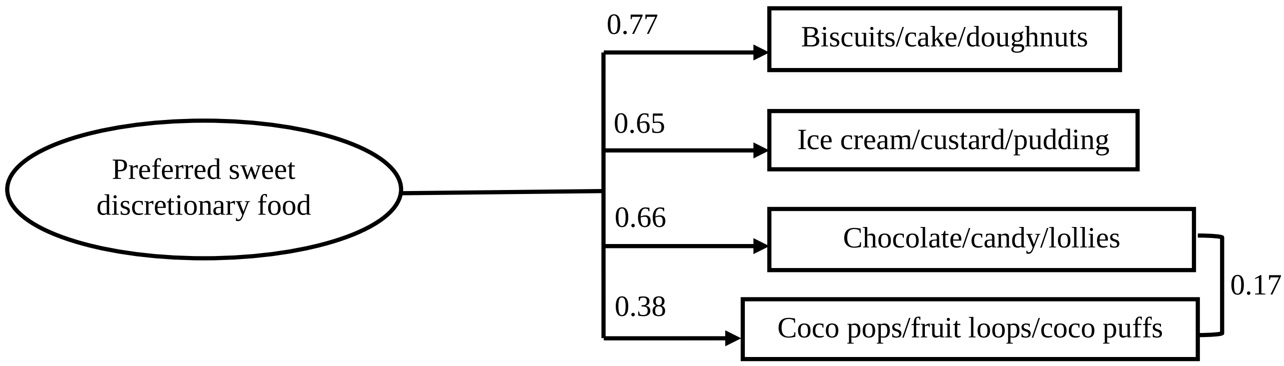

Figure 9.2: Confirmatory Factor Analysis model for the preferred sweet discretionary food construct. Child-reported Food Preference Questionnaire. Complete data set (N= 467), fit indexes CMIN/DF=1.92, TLI=0.96, CFI=0.99, RMSEA=0.04 (LO 90=0.00, PCLOSE=0.39), p=0.41, SRMR=0.01.

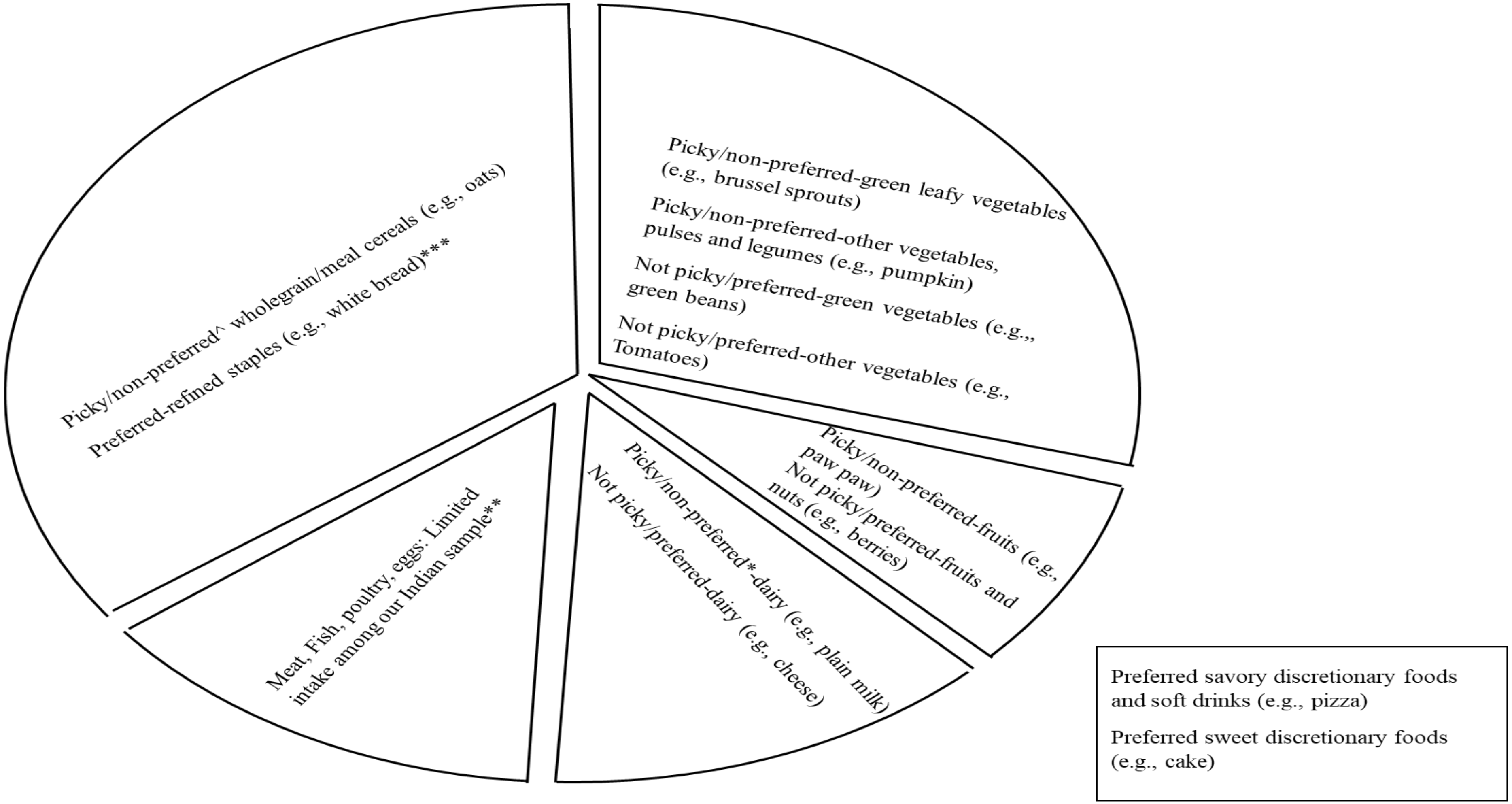

Figure 10: Conceptual framework of the PEQ and the C-FPQ within the context of the five core food groups and discretionary foods.

* Non-preferred dairy: Only plain milk reported as non-preferred dairy item by children; retained as a single item.

** The majority of participants were Hindu (66.10%) and Sikh (28.50%) and may not consume beef (never tried: PEQ=52.50%; C-FPQ=52.10%), chicken (never tried: PEQ=31.30%; C-FPQ=31.1%), fish (never tried: PEQ=29.7%; C-FPQ=29.9%) and eggs (never tried: PEQ=15.60%; C-FPQ=15.10%).

*** Refined staples (White bread, white rice, white pasta) reported as preferred by children; retained as a single item.

^ Wholegrain/wholemeal staples and wholemeal breakfast cereals reported as not preferred by children; retained as single items.

Table 1: Characteristics of participants who participated in study phase one questionnaire development and piloting (N=18).

Participant characteristics (n)	Median (25^{th}, 75^{th} IQR) or n (%)
Primary caregivers' age (years) (18)	39.00 (38.00, 41.00)
Primary caregivers' gender (18)	
Father	1 (5.56)
Mother	17 (94.44)
Primary caregivers' BMI (kg/m^2) (18)	28.15 (24.21, 31.60)
Primary caregivers' BMI categories (kg/m^2) (18)	
Healthy weight	11 (61.11)
Overweight	4 (22.22)
Obese	3 (16.67)
Primary caregivers' place of birth (18)	
Australia	1 (5.56)
India	17 (94.44)
Primary caregivers' Migration status (18)*	
Long term (>10 years)	18 (100)
Primary caregivers' religion (18)	
No religious affiliation	1 (5.56)
Hindu	16 (88.88)
Christian	1 (5.56)
Marital status (18)	
Married	18 (100)
Primary caregivers' education (18)**	
Postgraduate degree	17 (94.44)
Postgraduate diploma/certificate	1 (5.56)
Family annual income (18)***	
$75001 - $100000 per year	17 (94.44)
$100001 - $150000 per year	1 (5.56)
Primary caregivers' occupation (18)^	
Home maker	14 (77.77)
Fulltime work	4 (22.23)
Other family members (18)^^	
Husband	18 (100.00)
Other children (excluding the study child)	15 (83.33)
Children's age (years) (18)	9.00 (8.00, 10.00)
Children's BMI z-score (kg/m^2) (18)	0.67 (0.04, 1.52)
Children's BMI z-score categories (18)	
Healthy weight	15 (83.33)
Overweight	3 (16.67)
Children's place of birth (18)	
Australia	18 (100)
Children's gender (18)	
Girl	8 (44.44)
Boy	10 (55.56)

Reference:

***** Australian Bureau of Statistics. (2019). Characteristics of Recent Migrants, Australia methodology. In. Canberra, Australia.
** Australian Bureau of Statistics. (2020). Education and Work, Australia. In. Canberra, Australia.
******* Australian Bureau of Statistics. (2017-18). Household Income and Wealth, Australia. In. Canberra, Australia.
^Top three most common primary caregivers' occupation reported.
^^Top three most common family member composition reported.

Table 2: Characteristics of participants who participated in study phase two questionnaire validation (N=482).

Participant characteristics (n)	Median (25th, 75th IQR) or n (%)
Mothers' age (years) (482)	40.00 (39.00, 41.00)
Mothers' BMI (kg/m^2) (482)	26.65 (23.22, 32.69)
Mothers' BMI categories (kg/m^2) (482)	
Underweight	4 (0.80)
Healthy weight	232 (48.10)
Overweight	40 (8.30)
Obese	206 (42.70)
Mothers' place of birth (474)	
Australia	62 (13.10)
India	327 (69.00)
Others	85 (17.90)
Mothers' Migration status (435)*	
Recent (≤10 years)	4 (0.90)
Long term (>10 years)	431 (99.10)
Mothers' religion (481)	
No religious affiliation	1 (0.20)
Hindu	318 (66.10)
Sikh	137 (28.50)
Christian	25 (5.20)
Marital status (482)	
Married	479 (99.40)
Divorced	2 (0.40)
Widowed	1 (0.20)
Mothers' education (427)**	
Postgraduate degree	148 (32.00)
Postgraduate diploma/certificate	248 (61.30)
Undergraduate degree	31 (6.70)
Family annual income (482)***	
$75001 - $100000 per year	318 (66.00)
$100001 - $150000 per year	164 (34.00)
Mothers' occupation (474)^	
Home maker	358 (75.50)
Parttime work	129 (27.20)
Fulltime work	48 (10.10)
Other family members (482)^^	
Husband	478 (99.20)
Grandparents	134 (27.80)
Other children (excluding the study child)	336 (69.70)
Children's age (years) (482)	10.00 (8.00, 11.00)
Children's BMI z-score (kg/m^2) (482)	0.65 (0.02, 1.49)
Children's BMI z-score categories (482)	
Underweight	92 (19.10)
Healthy weight	212 (44.00)
Overweight	125 (25.90)
Obese	53 (11.00)
Children's place of birth (435)	
Australia	398 (91.50)
Others	37 (8.50)
Children's gender (482)	
Girl	252 (52.30)
Boy	230 (47.70)

Reference:

***** Australian Bureau of Statistics. (2019). Characteristics of Recent Migrants, Australia methodology. In. Canberra, Australia.
** Australian Bureau of Statistics. (2020). Education and Work, Australia. In. Canberra, Australia.
******* Australian Bureau of Statistics. (2017-18). Household Income and Wealth, Australia. In. Canberra, Australia.
^Top three most common mothers' occupation reported.
^^Top three most common family member composition reported.
Note: All mothers and children completed hardcopy questionnaire at Indian cultural centres (Indian temples and Indian community associations).

Table 3: Convergent, relative, predictive validity, test-retest reliability, internal consistency, and mean scores for the mother-reported Picky Eating Questionnaire:

Constructs	Convergent validity (N= 462)		Relative validity (N= 51)					Predictive validity (N= 462)		Test-retest reliability (N= 51)		Internal consistency (N= 462)	Mean scores (N= 459)
	AVE	CR	r_s	p value	Bias (95% LOA)	Slope of b_1	p value	r_s	p value	ICC (95% CI)	p value	Cronbach's alpha	Mean±SD
Picky-green leafy vegetables	0.59	0.80	0.94	<0.001	-0.07 (0.46, -0.59)	-0.06	0.66	0.60	<0.001	0.97 (0.99, 0.96)	<0.001	0.84	3.93±1.26
Picky-other vegetables, pulses and legumes	0.73	0.91	0.96	<0.001	0.02 (0.41, -0.37)	-0.17	0.24	0.68	<0.001	0.98 (0.99, 0.97)	<0.001	0.92	3.38±1.59
Picky-fruits	0.74	0.89	0.96	<0.001	-0.04 (0.30, -0.38)	-0.07	0.63	0.62	<0.001	0.98 (0.99, 0.97)	<0.001	0.89	3.70±1.32
Picky-whole grain/meal cereals	0.95	0.98	0.98	<0.001	-0.05 (0.39, -0.48)	-0.001	0.99	0.67	<0.001	0.98 (0.99, 0.97)	<0.001	0.98	3.21±1.91
Not picky-green vegetables	0.72	0.91	0.97	<0.001	-0.03 (0.39, -0.46)	-0.24	0.09	0.65	<0.001	0.98 (0.99, 0.95)	<0.001	0.91	2.55±1.42
Not picky-other vegetables	0.64	0.88	0.96	<0.001	-0.02 (0.38, -0.41)	-0.23	0.11	0.70	<0.001	0.98(0.99, 0.97)	<0.001	0.88	2.60±1.63
Not picky-fruits and nuts	0.73	0.92	0.99	<0.001	-0.03 (0.37, -0.43)	-0.19	0.19	0.69	<0.001	0.98 (0.99, 0.97)	<0.001	0.92	2.52±1.58
Picky-dairy	0.89	0.94	0.96	<0.001	-0.07 (0.45, -0.59)	-0.20	0.15	0.74	<0.001	0.98 (0.99, 0.97)	<0.001	0.91	3.65±1.42
Not picky-dairy	0.66	0.79	0.94	<0.001	0.01 (0.43, -0.41)	-0.16	0.25	0.67	<0.001	0.98 (0.99, 0.97)	<0.001	0.74	1.63±1.34

Abbreviations: AVE: Average Variance Extracted; CR: Composite Reliability; b_1= Slope of the mean bias, r_s = Spearman's correlation; ICC= intra-class correlation coefficient. Note: Mean scores computed from five-point Likert scale (1=picky eater, very strongly disagree to 5=picky eater, very strongly agree).

Table 4: Convergent, relative, predictive validity, test-retest reliability, internal consistency and mean scores for the Child-reported Food Preference Questionnaire:

Constructs	Convergent validity (N= 467)		Relative validity (N= 50)					Predictive validity (N= 467)		Test-retest reliability (N= 50)		Internal consistency (N= 467)	Mean scores (N= 459)
	AVE	CR	r_s	p value	Bias (95% CI)	Slope of b_1	p value	r_s	p value	ICC (95% CI)	p value	Cronbach's alpha	Mean±SD
Non-preferred-green leafy vegetables	0.62	0.82	0.89	<0.001	0.08 (0.76, -0.60)	-0.19	0.17	-0.54	<0.001	0.98 (0.99, 0.96)	<0.001	0.84	2.11±1.08
Non-preferred-other vegetables, pulses and legumes	0.70	0.91	0.96	<0.001	-0.02 (0.09, -0.12)	-0.19	0.17	-0.67	<0.001	0.98 (0.99, 0.97)	<0.001	0.91	2.62±1.11
Non-preferred-fruits	0.69	0.87	0.98	<0.001	0.013 (0.36, -0.34)	-0.21	0.15	-0.67	<0.001	0.97 (0.98, 0.95)	<0.001	0.86	2.23±1.00
Preferred-green vegetables	0.66	0.88	0.97	<0.001	0.04 (0.57, -0.49)	-0.12	0.41	-0.66	<0.001	0.98 (0.99, 0.97)	<0.001	0.88	3.34±1.05
Preferred-other vegetables	0.69	0.89	0.96	<0.001	0.01 (0.43, -0.41)	-0.21	0.15	-0.69	<0.001	0.98 (0.99, 0.97)	<0.001	0.89	3.30±1.22
Preferred-fruits and nuts	0.68	0.91	0.94	<0.001	0.02 (0.73, -0.69)	0.002	0.98	-0.69	<0.001	0.98 (0.99, 0.97)	<0.001	0.90	3.65±1.12
Preferred dairy	0.59	0.82	0.92	<0.001	-0.01 (0.83, -0.85)	0.009	0.95	-0.64	<0.001	0.98 (0.99, 0.97)	<0.001	0.81	4.27±0.98
Preferred savoury discretionary foods and soft drinks	0.53	0.85	0.93	<0.001	0.004 (0.40, -0.39)	0.06	0.67	0.02	0.559	0.96 (0.98, 0.86)	<0.001	0.83	4.23±0.65
Preferred sweet discretionary foods	0.40	0.72	0.68	<0.001	-0.05 (0.57, -0.67)	-0.05	0.75	0.02	0.56	0.92 (0.96, 0.78)	<0.001	0.70	4.50±0.43

Abbreviations: AVE: Average Variance Extracted; CR: Composite Reliability; b_1= Slope of the mean bias, r_s = Spearman's correlation; ICC= intra-class correlation coefficient. Note: Mean scores computed from five-point smiley Likert scale (1=dislike a lot to 5=like a lot).

The Picky Eating Questionnaire and Child-reported Food Preference Questionnaire: Pilot validation in Australian-Indian mothers and children 7-12 years old.

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Ethics approval and consent to participate

Written consent from the mothers and written assent initialled by the mothers and children was obtained. This study has been approved by Human Research Ethics Committee of the University of Canberra (Approval number: 20191984).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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