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Confirmatory factor analysis and measurement invariance of the Child Feeding Questionnaire in low-income Hispanic and African-American mothers with preschool-age children[☆]

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Abstract

Validation work of the Child Feeding Questionnaire (CFQ) in low-income minority samples suggests a need for further conceptual refinement of this instrument. Using confirmatory factor analysis, this study evaluated 5- and 6-factor models on a large sample of African-American and Hispanic mothers with preschool-age children ($n = 962$). The 5-factor model included: ‘perceived responsibility’, ‘concern about child’s weight’, ‘restriction’, ‘pressure to eat’, and ‘monitoring’ and the 6-factor model also tested ‘food as a reward’. Multi-group analysis assessed measurement invariance by race/ethnicity. In the 5-factor model, two low-loading items from ‘restriction’ and one low-variance item from ‘perceived responsibility’ were dropped to achieve fit. Only removal of the low-variance item was needed to achieve fit in the 6-factor model. Invariance analyses demonstrated differences in factor loadings. This finding suggests African-American and Hispanic mothers may vary in their interpretation of some CFQ items and use of cognitive interviews could enhance item interpretation. Our results also demonstrated that ‘food as a reward’ is a plausible construct among a low-income minority sample and adds to the evidence that this factor resonates

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conceptually with parents of preschoolers; however, further testing is needed to determine the validity of this factor with older age groups.

Keywords

Child feeding questionnaire; African-American; Hispanic; Low-income; Validation

Introduction

Obesity rates among preschool-aged children (Centers for Disease Control and Prevention, 2013) have improved, but the prevalence of obesity (> 95th percentile) is still above 10% and 15% among African-American and Hispanic children (2–5 years), respectively (Ogden, Carroll, Kit, & Flegal, 2014). There is a continued need to understand more about modifiable obesity-related risk factors.

Factors that contribute to excessive weight gain during childhood are wide-ranging. The influential role of parents on child feeding habits and dietary intake is a particularly important factor (Anzman, Birch, & Rollins, 2010; Hurley, Cross, & Hughes, 2011; Vaughn, Tabak, Bryant, & Ward, 2013). A commonly administered measurement tool used to examine the relationship between parent feeding practices, children's dietary intake, and weight (de Lauzon-Guillain et al., 2012; Faith, Scanlon, Birch, Francis, & Sherry, 2004; Hurley et al., 2011) is the Child Feeding Questionnaire (CFQ) developed by Birch and colleagues (Birch et al., 2001). The CFQ is based on Costanzo and Woody's work on domain-specific parenting styles in children's obesity proneness (Costanzo & Woody, 1985) and consists of four factors that examine how a parent may elicit parental control in child feeding (i.e. Perceived Feeding Responsibility, Perceived Parent Overweight, Perceived Child Overweight, Concerns about Child Overweight) and three factors that assess dimensions of control in child feeding (i.e. restriction, monitoring, and pressure to eat) (Birch et al., 2001).

The development of the CFQ was largely based on non-Hispanic White families of middle to higher socioeconomic status (SES) with school-aged girls (Birch & Fisher, 2000; Birch et al., 2001). The factor structure of the CFQ has been extensively tested to examine the content validity of this instrument on a wide range of samples, varying by age, gender, socioeconomic status, and other factors (Anderson, Hughes, Fisher, & Nicklas, 2005; Boles et al., 2010; Corsini, Danthiir, Kettler, & Wilson, 2008; Geng et al., 2009; Kaur et al., 2006; Liu, Mallan, Mhrshahi, & Daniels, 2014; Nowicka, Sorjonen, Pietrobelli, Flodmark, & Faith, 2014). Given the higher rates of obesity among low-income African American and Hispanic children, identifying measures that are reliable and valid for these at risk populations are important. Some validation work has been conducted among African-American and Hispanic parents with school-age and preschool-age children (Anderson et al., 2005; Birch et al., 2001; Boles et al., 2010). Initially, Birch et al. examined the factor structure of the CFQ on a small sample of Hispanic mothers with school-age children, two items from 'pressure to eat' (i.e. PE 25: "my child should always eat all of the food on her plate", PE 26: "I have to be especially careful to make sure my child eats enough"; see

Appendix S1) and two items from ‘restriction’ [i.e. R21: “I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior”, R22: “I offer my child her favorite foods in exchange for good behavior”; see Appendix S1] were removed to produce acceptable fit (Birch et al., 2001). Later, Anderson et al. tested the CFQ on African-American (n = 101) and Hispanic parents with preschoolers (n = 130) and needed to remove two entire factors (i.e. ‘perceived parent weight’ and ‘perceived child weight’) and dropped five lowloading items within the ‘restriction’ factor (i.e. R19, R20, R21, R22, R24; see Appendix S1) (Anderson et al., 2005) to fit their model. Similarly, Boles and colleagues administered three factors of the CFQ (i.e. restriction, pressure to eat, and concern about child weight) to African-American mothers with preschool-age children (n = 296) and were not able to replicate the factor structure within their sample (Boles et al., 2010). They attributed poor fit to factors significantly cross loading on other factors. These previous studies provide evidence that modifications to the CFQ may be required when administering this measurement tool to lower-income African American and Hispanic mothers. To further strengthen this evidence base, we sought to replicate the factor structure for five CFQ factors on an even larger group of lower-income African-American (n = 666) and Hispanic mothers (n = 296) with preschool-age children. Factorial invariance was also tested in order to evaluate how well the two groups associated survey items within each CFQ factor. This will help to determine if the same trait is being measured across groups and allow for meaningful comparison between groups (Gregorich, 2006; Millsap & Kwok, 2004). Lastly, we also tested a model that included “food as a reward” as one proposed solution for handling low loading items from the restriction factor (i.e. R21, R22; see Appendix S1) previously reported in many studies (Anderson et al., 2005; Birch et al., 2001; Corsini et al., 2008; Geng et al., 2009; Kaur et al., 2006; Nowicka et al., 2014). This idea was first introduced by Corsini et al. (2008) and has since been tested on two different Australia-based samples (Corsini et al., 2008; Liu et al., 2014); ours was the first study to do so in a US-based sample.

Methods

Participants

Mothers in this analytic sample were drawn from three different studies conducted in Chicago, Illinois. A description of each cohort is provided below.

A cohort of three hundred and sixty mothers (n = 171 Hispanic, n = 189 African-American) were in a longitudinal cohort study that assessed diet changes among low-income, African American and Hispanic mother–child dyads following the first 18 months of food package revisions enacted by the Special Supplemental Nutrition Program for Women, Infants, and Children program (WIC) in 2009 (Kong et al., 2013, 2014). Mother–child dyads were recruited for the longitudinal study from twelve different WIC clinics in Chicago, IL before implementation of WIC food package revisions. Parents with children between 2 and 3.5 years participating in WIC were eligible for this study. This age range was chosen to ensure that children would be old enough to be consuming solid foods regularly, yet still WIC eligible at the 18 month follow up.

A second cohort were mothers of preschoolers (African American $n = 477$, Hispanic $n = 15$) who participated in the Hip-Hop to Health Jr. Obesity Prevention Effectiveness Trial (Fitzgibbon et al., 2011). This was a randomized controlled trial testing the effectiveness of a 14-week teacher-delivered nutrition and physical activity intervention for preschoolers implemented in eighteen Head Start classrooms administered through Chicago Public Schools (CPS). A third cohort of 110 Hispanic mothers participated in a 14-week, family-based weight gain prevention pilot designed for 3 to 5 year old Hispanic children and their parents (Fitzgibbon et al., 2013). Families from the pilot study were recruited from four Head Start programs administered through CPS. In both of these studies, parent– child dyads were eligible as long as parents of children in participating classrooms provided written informed consent. The total study sample from all three cohorts consisted of 666 African-American and 296 Hispanic mothers with preschool-age children (2–5 years) who completed the CFQ at *baseline*.

Demographics and anthropometrics

Demographic information, including age, race/ethnicity, and parents' marital and educational status, was collected. Baseline measurements of children's heights and weights were used for this study. Trained data collectors weighed children without shoes and in light clothing on a digital scale and measured height using a portable stadiometer. Height (nearest 0.1 cm) and weight (nearest 0.1 kg) were measured twice and averaged for analyses. BMI percentiles for age and gender and z-scores, based on the 2000 Centers for Disease Control (CDC) Growth Charts, were calculated using a SAS program developed by the CDC. [<http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm> accessed 4/4/2014].

Child feeding questionnaire

The Child Feeding Questionnaire (CFQ) was developed to measure child-feeding practices and attitudes of parents and their perception of their child's weight using a 5-point Likert scale (Birch et al., 2001). For this study, we examined five factors of the CFQ for model fit. A full description of CFQ factors, items, and frequency distributions are found in Appendix S1. The factors were: perceived feeding responsibility (PR1–3), concerns about child overweight (C14–16), restriction (R17–24), pressure to eat (PE25–28), and monitoring (M29–31). We excluded 'perceived parent weight' and 'perceived child weight' because these factors were only collected on a subsample of the study sample. Since previous research indicates instability with some of the items within the 'restriction' factor (Anderson et al., 2005; Boles et al., 2010; Corsini et al., 2008; Geng et al., 2009; Nowicka et al., 2014), we also tested a modified model that takes these two items (R21–22) from 'restriction' to form its own factor (i.e. Food as a reward) (Corsini et al., 2008; Liu et al., 2014) to form a 6-factor model.

Previously, the internal consistencies of CFQ factors based on data from 394 mothers and fathers of 5–9 year old non-Hispanic white girls as reported by Birch et al. were as follows: 0.88 (Perceived responsibility), 0.75 (Concern about Child's Weight), 0.73 (Restriction), 0.70 (Pressure to eat), and 0.92 (Monitoring) (Birch et al., 2001). Boles et al. later reported the internal consistency of three factors on a sample of low-income, African-American

mothers with preschoolers ($n = 296$) and reported alpha coefficients of 0.58 (Pressure to Eat), 0.69 (Restriction), and 0.81 (Concern about Child's Weight) (Boles et al., 2010).

Statistical analyses

The main objectives of these analyses were: 1) to replicate the factor structure of the CFQ in a large sample of African American and Hispanic mothers with preschool-age children using confirmatory factor analysis and 2) to test measurement invariance between the two racial/ethnic groups. The CFQ consists of standard Likert-type items. As shown in Appendix S1, many of these items are highly skewed and in any case, their ordered categorical nature means that it would be difficult to satisfy the multivariate normality assumption underlying standard confirmatory factor analysis routines based on maximum likelihood (ML) methods (Muthén & Kaplan, 1985; Schmitt, 2011). Thus, all analyses reported are based on methods for ordered categorical data as implemented in Mplus version 7.11 (Muthén and Muthén, 2013). Both the 5-factor and modified 6-factor model were estimated using mean and variance adjusted weighted least squares (i.e., the Mplus "WLSMV" option).

The models were tested on the combined sample and by race/ethnicity. Chi-square tests of significance were used to assess models, with a non-significant test indicating adequate fit. However, since the chi-square statistic is sensitive to sample size, commonly used fit indices less affected by these factors were obtained including Root Mean Square Error of approximation (RMSEA), Bentler's Comparative Fit Index (CFI), the Tucker Lewis Index (TLI) and Weighted Root Mean Square Residual (WRMR) were also evaluated (Hu & Bentler, 1999). The following cutoff values suggest 'acceptable' model fit: less than 0.08 for RMSEA, near 0.95 for CFI and TLI, and 1 or below for WRMR (Finney & DiStefano, 2013; Hu & Bentler, 1999).

Tests of measurement invariance between groups involved a series of four hierarchical multi-group models. We followed the identification rules for multi-group factorial invariance in ordinal categorical variables developed by Millsap & Yun-Tein (2004) and elaborated in Millsap (2011). The first model (Model 1) reflected equivalence in factor structure only. Model 1 was the least restrictive of the four models because factor loadings, thresholds, and error terms were allowed to vary across groups. Greater restrictions were placed on each successive model. Model 2 assumed equivalence of factor loadings. Model 3 constrained thresholds to equality in addition to factor loadings. Lastly, Model 4 constrained residual variances to equality in addition to the constraints specified in Model 3.

Results

Participant characteristics

Table 1 presents participant characteristics by race/ethnicity. Hispanic and African-American women were similar in age; however, more African-American women were employed full time and had at least a high school degree. A higher proportion of Hispanic mothers reported being 'married or living with a partner' compared to African-American mothers (75.9% vs. 18.3%). More Hispanic children were above the 95th percentile for BMI (23.2%) than African-American children (13.3%) and Hispanic children were slightly

younger (mean years: 3.49, SD: 0.99) than African-American children (mean years: 3.85, SD: 0.86).

Confirmatory factor analysis

We began by examining the CFQ factor structure of a 5-factor, 21 item model in the combined sample. This model had ‘acceptable’ fit only based on RMSEA, but had poor fit based on all other indices. To improve model fit, we dropped two low loading items (i.e. $R21 = 0.27$ and $R22 = 0.23$) found within the ‘restriction’ factor and omitted PR1 from the ‘perceived responsibility’ factor due to low variance (e.g. none of the Hispanic mothers chose “never” for item PR1 and 93% of responses fell within two categories). The 5 factor, 18 item model had ‘acceptable’ fit based on RMSEA, TLI, and CFI indicators (χ^2 P value <0.0001 ; RMSEA = 0.07; CFI = 0.94; TLI = 0.95) (Table 2). This model was also evaluated by racial/ethnic group and demonstrated ‘acceptable’ fit for both groups.

We also tested a modified model with 6 factors, 21 items on the full sample and then by race/ethnicity. Similar to the 5 factor model, PR1 was omitted due to low variance. Unlike the 5 factor model, items R21 and R22 had factor loadings well above 0.50 for both Hispanic and African American mothers; therefore, we retained these items. The 6 factor, 20 item model had acceptable fit based on RMSEA, CFI, and TLI indicators (χ^2 P value <0.0001 ; RMSEA = 0.06; CFI = 0.95; TLI = 0.94) (Table 2). Fit indices also reflected ‘acceptable’ fit by racial/ethnic group.

Measurement invariance

The following step was to examine measurement invariance between groups, or in other words, to determine whether the factors of the CFQ were measuring the same constructs across groups. To accomplish this, we tested hierarchical models (models 1–4) and reported the results of the multi-group analyses in Table 2. Model 1 had ‘acceptable’ fit based on RMSEA, CFI and TLI indicators. Fit indices worsened as additional constraints were introduced in each successive model (Models 2–4), which suggests Model 1 was the best fitting model. Furthermore, the chi square difference test compared Models 1–4 and Model 1 (i.e. least constrained) significantly differed from all four models which means it cannot be presumed that even factor loadings are equal between the two groups. As a result, we presented factor loadings separately by racial/ethnic group for the final model (i.e. Model 1) in Table 3. We also tested measurement invariance using the same approach for the modified model (6 factors, 20 items). Similarly, model 1 demonstrated better fit than the more constrained models (models 2–4).

Internal consistency

Internal consistency was estimated by racial/ethnic group (Table 3). Among Hispanic mothers, Cronbach’s alpha for each factor were as follows: 0.75 (‘perceived feeding responsibility’), 0.76 (‘concerns about child’s weight’), 0.65 (‘restriction’ with items R17–24), 0.74 (‘restriction’ with items R17–20 and R23–24), 0.63 (‘pressure to eat’), 0.85 (‘Monitoring’), 0.55 (‘food as a reward’). The inter-item reliability for African-American mothers was as follows: 0.70 (‘perceived feeding responsibility’), 0.84 (‘concerns about

child's weight'), 0.63 ('restriction' with items R17–24), 0.65 ('restriction' with items R17–20 and R23–24), 0.54 ('pressure to eat'), 0.79 ('monitoring'), and 0.55 ('food as a reward').

Inter-factor correlations

Inter-factor correlations based on the final models are presented in Table 4. Inter-factor correlations ranged from 0.02 to 0.48. Among African-American mothers, 'concern about child's weight' was positively correlated with 'restriction' ($r = 0.48$, $p < 0.01$), 'food as a reward' ($r = 0.21$, $p < 0.01$), 'pressure to eat' ($r = 0.29$, $p < 0.01$), and 'monitoring' ($r = 0.15$, $p < 0.01$). Among Hispanic mothers, 'concern about child's weight' was only positively correlated with 'restriction' ($r = 0.44$, $p < 0.01$) and 'pressure to eat' ($r = 0.24$, $p < 0.01$). In addition to being correlated with 'concern about child's weight', 'pressure to eat' was also positively correlated with 'restriction' and 'food as a reward' for both Hispanic ('restriction': $r = 0.47$, $p < 0.01$, 'food as a reward': $r = 0.48$, $p < 0.01$) and African-American mothers ('restriction': $r = 0.31$, $p < 0.01$, 'food as a reward': $r = 0.35$, $p < 0.01$).

Factor correlations with BMI

In general, children's BMI z-scores were not highly correlated with CFQ factors for either Hispanic or African-American mothers (Table 4). We examined both correlations adjusted for parental characteristics (e.g. age, marital status, employment, and education) and unadjusted correlations and found similar results; therefore, only unadjusted correlations are reported. BMI z-score was weakly correlated with "concern about child's weight" for both groups (Hispanic: $r = 0.15$, $p < 0.05$, African-American $r = 0.21$, $p < 0.01$) and with "restriction" ($r = 0.09$, $p < 0.05$), but only among African-American mothers. "Pressure to eat" was inversely weakly correlated with BMI z-score (Hispanic: $r = -0.16$, $p < 0.01$, African-American $r = -0.15$, $p < 0.01$).

Discussion

This study examined the factor structure of five original factors of the CFQ in two large samples of low-income African-American ($n = 666$) and Hispanic mothers ($n = 296$) with preschool-aged children and tested for measurement invariance between the two groups. There was acceptable fit after removing two low loading items within the 'restriction' factor (i.e. R21, R22) and dropping an item with very low variance in the 'perceived feeding responsibility' factor (i.e. PR1). Multi-group analysis used to test for measurement invariance demonstrated significant differences in factor loadings, residual variances, and thresholds between African-American and Hispanic mothers in this sample; therefore, factor loadings were presented separately by race/ethnicity in the final model (5 factors, 18 items). We also tested a 6-factor, 20-item model that separated the two low loading 'restriction' items into a separate factor ('food as a reward'), and this model also demonstrated 'acceptable' fit. Similar to previous studies, modifications to the CFQ were needed in order to produce 'acceptable' model fit. In particular, it was necessary to drop two low loading items (R21, R22) from the 'restriction' factor because they generated factor loadings of less than 0.20 among Hispanic mothers and around 0.30 for African American mothers. Poor factor loadings of these items have also been reported in other studies that varied across race/ethnicity and age (Anderson et al., 2005; Birch et al., 2001; Corsini et al.,

2008; Kaur et al., 2006). It may be that these items are related to “food as a reward” and measures a construct distinct from “restriction” (Corsini et al., 2008; Liu et al., 2014). We tested this premise and found ‘acceptable’ model fit (based on fit indices) and significant factor loadings above 0.50 for both items among mothers in our sample. This is an improvement over the very low loadings (<0.30) observed in the previous model when R21 and R22 were part of the ‘restriction’ factor. These findings are consistent with previous validation work testing “food as a reward” as an additional factor in the CFQ. Corsini et al. administered the CFQ to Australian parents of 4–5 year olds and demonstrated high factor loadings (>0.80) for items within this additional factor and concluded that the model with the additional factor produced a better fit than the model without this factor. Liu et al. administered the CFQ to a population of Chinese-Australian mothers with young children (1–4 years) and similarly concluded that the model with the additional factor resulted in the best fit (Liu et al., 2014). While this six factor model produced acceptable fit, generally a factor consisting of only two items might be conceptually and/or statistically limited; therefore, cognitive testing may be needed to further enhance our understanding of this factor. Furthermore, none of the studies, including ours, found any correlations between ‘food as a reward’ and children’s BMI (Corsini et al., 2008; Liu et al., 2014). Future work should also determine if this construct mediates children’s dietary intake and ultimately weight status and how it fares with parents of older children (i.e. school age, adolescents).

In addition, the potential for social desirability bias is a concern that previous authors suggest may be influence parental responses with the “food as a reward” items. Two previous studies (Corsini et al., 2008; Nowicka et al., 2014) found that an overwhelming percentage of respondents answered “disagree” or “slightly disagree” (>70%) to the “food as a reward” items, while only a very small percentage agreed with these statements. In contrast to these studies, the mothers in our study were as likely to respond that they agreed with these statements (i.e. R21 (offer sweets): 47% African- American, 39% Hispanic, R22 (offer favorite foods): 44% African- American, 54% Hispanic) as they were to disagree with them (i.e. R21 (offer sweets): 48% African-American, 56% Hispanic, R22 (offer favorite foods): 44% African-American, 42% Hispanic). While we cannot rule out the threat of social desirability bias, our data suggest that this threat was not as obvious in our study as in previous samples.

Results from our measurement invariance analyses differ from Anderson et al., who found no differences by factor loadings between racial/ethnic groups. Both studies examined the factor structure and measurement invariance between low-income, African-American and Hispanic mothers with preschool-age children, but our results were based on a much larger sample size (231 vs. 962) and used categorical data methods, which could account for the difference. The response options on the CFQ are based on a 5-point Likert Scale (e.g. never, rarely, sometimes, mostly, and always) so we treated them as ordered categorical variables and used mean and variance-adjusted weighted least-squares (WLSMV) estimation. Likert-type variables are frequently treated as normally distributed continuous variables in factor analysis (Muthen & Kaplan, 1985). However, when the assumption of normality is violated, which is often the case with these variables (Muthen & Kaplan, 1985; Schmitt, 2011), treating these variables as continuous and using conventional ML estimation methods may lead to biased estimates such as inflated chi squares and/or standard errors of factor loadings

(Beauducel & Herzberg, 2006; Bollen, 1989) and may result in misleading conclusions when making group comparisons (Lubke & Muthén, 2004). Therefore, categorical data methods may be preferable in such cases.

Even though factor loadings differed by race/ethnicity in our study, the implications of these differences for most items (e.g. PR2, C16) were fairly inconsequential because loadings for both groups were high (i.e. 0.75). One item that did not fall into this category was PE 25 (i.e. my child should always eat all of the food on his/her plate). The factor loading was 0.60 among Hispanic mothers, but only 0.29 among African-American mothers. This suggests, at least for African-American mothers, that this item did not represent the factor of “pressure to eat” as well as the other items. This low loading item also explains why the internal consistency of “pressure to eat” was particularly low for this construct among African-American mothers ($\alpha = 0.54$). Our finding was consistent with two other studies that also found notably lower inter-item reliability ($\alpha = 0.54, 0.58$) for this factor among lower-income African-American mothers with preschool age children (Boles et al., 2010; Powers, Chamberlin, van Schaick, Sherman, & Whitaker, 2006).

As expected, children’s BMI-z score was inversely correlated with “pressure to eat” in both groups. This finding is fairly robust across racial/ethnic groups, age, and socioeconomic status (Anderson et al., 2005; Blissett & Haycraft, 2008; Carnell & Wardle, 2007; Corsini et al., 2008; Farrow & Blissett, 2008; Francis, Hofer, & Birch, 2001; Galloway, Fiorito, Francis, & Birch, 2006; Hennessy, Hughes, Goldberg, Hyatt, & Economos, 2010; Jansen et al., 2012; Keller, Pietrobelli, Johnson, & Faith, 2006; Lee, Mitchell, Smiciklas-Wright, & Birch, 2001; Nowicka et al., 2014; Powers et al., 2006; Santos et al., 2009; Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002). Conversely, significant positive correlations between children’s BMI z-score and “concern about child’s weight” were observed for African American ($r = 0.21, p < .01$) and Hispanic mother–child dyads ($r = 0.15, p < .05$). This relationship has been previously observed in younger and older multi-ethnic samples (Anderson et al., 2005; Mulder, Kain, Uauy, & Seidell, 2009; Santos et al., 2009; Spruijt-Metz et al., 2002; Webber, Hill, Cooke, Carnell, & Wardle, 2010). Interestingly, the study by Anderson et al., whose study population is most comparable to ours (i.e. sample of African American and Hispanic mothers with preschool age children), had correlations similar in magnitude to our study. For instance, both studies observed weaker correlations among Hispanic parent–child dyads compared to their African American counterparts. Although our larger sample size allowed us to observe a statistically significant positive correlation among Hispanic mother–child dyads ($r = 0.15, p < 0.05$), the size and direction of the correlation were similar to Anderson et al. ($r = 0.14, p > 0.05$). There is some evidence to suggest that “concern about child weight” is related to child BMI primarily through its relationship with parental feeding practices, most notably, restriction (Cachelin & Thompson, 2013; May et al., 2007; Webber et al., 2010). A study by Cachelin and Thompson (2013) examined these relationships by testing an obesity-proneness model in both non-Hispanic white and Hispanic mothers, respectively. Among non-Hispanic white mothers, concern about child weight was positively associated with maternal control of child’s feeding (specifically restriction and monitoring) and maternal control of child’s feeding positively predicted child BMI. Among Hispanic mothers, concern about child weight was also positively associated with maternal control of child’s feeding, but maternal

control of child's eating did not predict child BMI in Hispanic mothers as it did among non-Hispanic white mothers. All of this may suggest that the obesity-proneness model on which the CFQ is based (Birch et al., 2001; Costanzo & Woody, 1985) may not capture some of the pertinent factors that contribute to excessive weight gain among Hispanic children and other models or pathways, particularly ones that address cultural beliefs and norms, should also be considered (Lindsay, Sussner, Greaney, & Peterson, 2011).

These findings need to be viewed in light of some limitations. These results may not generalize beyond lower-income African-American and Hispanic mothers of preschool-age children residing in urban settings. Additionally, we did not have data on a non-Hispanic white sample for further ethnic comparison. Two of the factors ('perceived child overweight' and 'perceived parent overweight') were not measured on the full sample and therefore were not evaluated. However, this study used appropriate categorical data methods to confirm the factor structure of the CFQ and tested for measurement invariance between two large samples of lower-income African-American and Hispanic mothers with preschoolers. Also the children's weights reported in this study were observed and not based on self-report.

Overall, confirmatory factor analysis of the CFQ in two large groups of African-American and Hispanic mothers with preschool-age children demonstrated 'acceptable' fit following some modifications (i.e. dropping two low loading items from the restriction factor). As suggested by previous studies (Corsini et al., 2008; Liu et al., 2014), an alternative to dropping the low loading items from the restriction factor was to separate these items into its own factor ('food as a reward'). Ours was the first study to test this modified model in a US-based sample and similar to Corsini and Liu et al. (Corsini et al., 2008; Liu et al., 2014), our model demonstrated 'acceptable' fit without substantial modifications. Based on our measurement invariance analysis, significant differences in factor loadings between groups indicate there may be racial/ethnic differences in item interpretation in the CFQ, particularly within the "pressure to eat" factor. Qualitative methods such as cognitive interviews could help to highlight culture specific item interpretation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Appendix: Supplementary material

Supplementary data to this article can be found online at [doi:10.1016/j.appet.2015.02.027](https://doi.org/10.1016/j.appet.2015.02.027).

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Table 1

Participant characteristics by race/ethnicity.

	Total n = 962		Hispanic n = 296		African American n = 666	
	Mean	sd or % n	Mean	sd or % n	Mean	sd or % n
Parent characteristics						
Age at study entry (yrs), mean <i>sd</i> ^a	30.5	8.1	30.9	6.3	30.3	8.8
High school degree/GED, N % yes ^{b,f}	72.7%	698	56.1%	166	80.1%	532
Full time employed, N % yes ^{c,f}	26.5%	255	18.6%	55	30.1%	200
Married/living with partner, N % yes ^{d,f}	36.0%	346	75.9%	224	18.3%	122
Child characteristics						
Gender N % female	50.3%	484	48.6%	144	51.5%	343
Age at study entry (years), mean <i>sd</i> ^f	3.7	0.9	3.5	1.0	3.8	0.9
> = 95th percentile BMI % yes ^{e,f}	16.3%	155	23.2%	67	13.3%	88
Children's BMI z-score ^{e,f}	0.68	1.1	0.90	1.1	0.58	1.1

^a Age: total n = 959; n = 296 (Hispanic); n = 663 (African-American).

^b Education status: total n = 960; n = 296 (Hispanic); n = 664 (African-American).

^c Employment status: total n = 96 ; n = 296 (Hispanic); n = 665(African-American).

^d Marital status: total n = 961; n = 295 (Hispanic); n = 666 (African American).

^e Child body mass index (BMI): total n = 950; n = 289 (Hispanic); n = 661 (African American).

^f Indicates p < 0.001.

Table 2

Fit indices for confirmatory factor and measurement invariance analyses (n = 962).

5 factor model							
Confirmatory factor analysis ^a	χ^2	d.f.	p value	RMSEA	CFI	TLI	WRMR
5 factors, 18 items, full sample	429.86	68	<.0001	0.07	0.94	0.95	1.56
5 factors, 18 items, Hispanic	157.34	53	<.0001	0.08	0.93	0.95	1.05
5 factors, 18 items, African-American	321.77	65	<.0001	0.08	0.94	0.95	1.40
Multi-group analysis ^b	χ^2	d.f.	p value	RMSEA	CFI	TLI	WRMR
Model 1	762.59	250	<.0001	0.07	0.95	0.94	1.75
Model 2	855.74	267	<.0001	0.07	0.94	0.93	1.87
Model 3	1051.72	312	<.0001	0.07	0.93	0.93	2.08
Model 4	1140.02	330	<.0001	0.07	0.92	0.92	2.22
Model comparison ^c	χ^2	d.f.	P value	Interpretation			
Model 1 vs. Model 2	112.58	17	<.0001	Factor loadings differ by group			
Model 1 vs. Model 3	335.44	62	<.0001	Factor loadings and thresholds differ by group			
Model 1 vs. Model 4	423.67	80	<.0001	Factor loadings, thresholds, variances differ by group			
6 factor model							
Confirmatory factor analysis ^a	χ^2	d.f.	p value	RMSEA	CFI	TLI	WRMR
6 factors, 20 items, full sample	686.47	155	<.0001	0.06	0.95	0.94	1.33
6 factors, 20 items, Hispanic	331.38	155	<.0001	0.06	0.94	0.93	1.04
6 factors, 20 items, African-American	529.40	155	<.0001	0.06	0.95	0.94	1.33
Multi-group analysis ^b	χ^2	d.f.	p value	RMSEA	CFI	TLI	WRMR
Model 1	926.58	315	<.0001	0.06	0.94	0.93	1.76
Model 2	1014.40	329	<.0001	0.07	0.93	0.92	1.86
Model 3	1174.54	378	<.0001	0.07	0.92	0.92	2.01
Model 4	1269.83	398	<.0001	0.07	0.91	0.92	2.14
Model comparison ^c	χ^2	d.f.	P value	Interpretation			
Model 1 vs. Model 2	112.04	14	<.0001	Factor loadings differ by group			
Model 1 vs. Model 3	151.93	26	<.0001	Factor loadings and thresholds differ by group			

5 factor model			
Model 1 vs. Model 4	258.265	46	<.0001
Factor loadings, thresholds, variances differ by group			

^aThe models were estimated with mean and variance-adjusted weighted least-squares (WLSMV) using Mplus version 7.11.

^bMutli-group analysis with theta parameterization in Mplus was used to test for measurement invariance.

^cChi-square difference test (DIFFTEST command in Mplus) was used for model comparisons.

d f.: degrees of freedom; RMSEA: Root Mean Square Error of Approximation; CFI: Bentler's Comparative Fit Index; TLI: Tucker Lewis Index; WRMR: Weighted Root mean square residual.

Model 1: equivalence in factor structure.

Model 2: equivalence in factor loadings.

Model 3: equivalence in factor loadings and thresholds.

Model 4: equivalence in factor loadings, thresholds, and residual variances.

Table 3

Internal consistency, standardized loadings and residual variances of Child Feeding Questionnaire factors by race/ethnicity.

Factor	5-factor, 18 item model						6-factor, 20 item model					
	Internal consistency		Item	Factor loadings		Residual variance		Factor loadings		Residual variance		
	Hispanic	AA		Hispanic	AA	Hispanic	AA	Hispanic	AA	Hispanic	AA	
Perceived responsibility	0.75	0.70	PR2	0.97	0.81	0.07	0.35	0.98	0.80	0.03	0.36	
			PR3	0.76	0.82	0.42	0.34	0.75	0.82	0.44	0.33	
Concern about child's weight	0.76	0.84	C14	0.78	0.80	0.39	0.35	0.78	0.80	0.39	0.35	
			C15	0.88	0.92	0.23	0.16	0.88	0.92	0.23	0.15	
			C16	0.75	0.92	0.44	0.15	0.75	0.92	0.44	0.16	
Restriction (R17–24)	0.65	0.63	R17	0.82	0.71	0.32	0.49	0.82	0.70	0.33	0.51	
Restriction (R17–20, 22–24)	0.74	0.65	R18	0.83	0.79	0.31	0.38	0.83	0.79	0.31	0.38	
			R19	0.51	0.56	0.74	0.69	0.51	0.56	0.74	0.69	
			R20	0.63	0.57	0.60	0.68	0.64	0.57	0.60	0.67	
			R23	0.79	0.66	0.37	0.57	0.80	0.66	0.36	0.57	
			R24	0.79	0.64	0.37	0.59	0.80	0.65	0.37	0.58	
Pressure to eat	0.63	0.54	PE25	0.60	0.29	0.64	0.92	0.63	0.32	0.60	0.90	
			PE26	0.78	0.88	0.39	0.22	0.78	0.87	0.39	0.24	
			PE27	0.51	0.48	0.75	0.77	0.49	0.49	0.76	0.76	
			PE28	0.76	0.69	0.42	0.52	0.75	0.68	0.44	0.54	
Monitoring	0.85	0.79	M29	0.85	0.91	0.27	0.18	0.86	0.91	0.27	0.18	
			M30	0.94	0.93	0.12	0.13	0.93	0.93	0.13	0.13	
			M31	0.80	0.70	0.36	0.51	0.80	0.70	0.36	0.51	
“Food as a reward”	0.55	0.55	R21	–	–	–	–	0.69	0.83	0.52	0.31	
			R22	–	–	–	–	0.72	0.58	0.48	0.67	

p < .0001 italicized. Sample size: n = 962, Hispanic n = 296, AA n = 666.

Internal consistency estimated with Cronbach's alpha.

Table 4

Interfactor and factor correlations with children's BMI by race/ethnicity.

	1	2	3	4	5	6	7
1. Perceived responsibility	–	0.04	<i>0.17</i>	0.03	0.12	<i>0.34</i>	0.03
2. Concerns about child's weight	0.02	–	<i>0.48</i>	<i>0.21</i>	<i>0.29</i>	<i>0.15</i>	<i>0.21</i>
3. Restriction	<i>0.18</i>	<i>0.44</i>	–	<i>0.28</i>	<i>0.31</i>	<i>0.26</i>	<i>0.09</i>
4. "Food as a reward"	–0.06	0.05	0.15	–	<i>0.35</i>	–0.05	0.01
5. Pressure to eat	<i>0.18</i>	<i>0.24</i>	<i>0.47</i>	<i>0.48</i>	–	0.10	<i>–0.15</i>
6. Monitoring	<i>0.33</i>	0.06	<i>0.42</i>	<i>–0.21</i>	0.05	–	0.04
7. Children's BMI z score	–0.06	<i>0.15</i>	0.03	–0.06	<i>–0.16</i>	–0.01	–

p < .05 italicized; p < .01 italicized and bold; Interfactor correlations for Hispanic mothers shaded and below the diagonal.

Sample size for all factors: n = 296 (Hispanic), n = 666 (African-American).