Predicting BMI in Young Children with Developmental Delay and Externalizing Problems: Links with Caregiver Depressive Symptoms and Acculturation

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Abstract

Background Caregiver depression is associated with increased risk for childhood obesity. However, studies assessing the relation between caregiver depression and childhood obesity have focused primarily on typically developing, school-aged children and have not examined the influence of cultural factors. **Objectives** To evaluate the association between caregiver depressive symptoms and body mass index (BMI) scores in young children with developmental delay (DD) and externalizing behavior problems, as well as the moderating role of acculturation and enculturation on this association. **Methods** We examined the association between caregiver depressive symptoms and child BMI scores in 147 3-year-old children with DD and elevated levels of externalizing behavior problems. Caregivers of all participating children self-identified as coming from cultural minority backgrounds. We also examined the association between caregiver depressive symptoms and child BMI across levels of caregiver acculturation and enculturation. **Results** Higher levels of caregiver depressive symptoms were associated with higher child BMI scores ($b = .189, p = .001$). Acculturation significantly moderated the association between caregiver depressive symptoms and child BMI scores ($b = .21, p = .01$), such that the association was stronger for more acculturated caregivers. Enculturation was not a significant moderator. **Conclusions** Caregiver depressive symptoms may confer elevated risk for child obesity when caregivers are highly acculturated to the United States, suggesting clinicians should consider levels of acculturation to optimize services for children and families from cultural minority backgrounds.

Key words: culture; depression; developmental perspectives; obesity.

Introduction

Early childhood obesity is a significant public health concern, with 10% of children ageing 2–5 years categorized as either overweight or obese (Ogden et al., 2016). Children who are overweight at younger ages are more likely to develop obesity during later childhood and adulthood (Braun et al., 2018). For

example, in a retrospective analysis of obese adolescents, the largest increase in body mass index (BMI) occurred between 2 and 6 years (Geserick et al., 2018). Furthermore, there are serious later physical and mental health concerns associated with obesity in early childhood, such as increased rates of blood

pressure and premature mortality (Reilly & Kelly, 2011), as well as depression, anxiety, and peer victimization (Jensen et al., 2013; Vander Wal & Mitchell, 2011). Given the high prevalence and negative impact of obesity in early childhood, understanding patterns and predictors associated with BMI in young children is critical, especially among young children with comorbid conditions (Suglia et al., 2013).

Children with developmental delay (DD) displayed increased rates of obesity when compared to their typically developing peers (Bandini et al., 2015). Additionally, young children with externalizing behavior problems (e.g., oppositional and aggressive behaviors), which are common among children with DD (Schroeder et al., 2014), displayed increased risk for obesity (Duarte et al., 2010). Furthermore, children from cultural minority backgrounds—which we define herein as identification of a racial or ethnic minority group or from a country/culture outside of the United States—are at higher risk for DD and externalizing behavior problems (Gudiño et al., 2009), as well as obesity in adulthood (Cuevas et al., 2020). However, no studies to our knowledge have examined the predictors of BMI in children with DD and externalizing behavior problems and from cultural minority backgrounds, such as caregiver depression.

Caregivers of children with co-occurring DD and externalizing behavior problems reported higher levels of depressive symptoms than caregivers of children with DD but without externalizing behavior problems (Feldman et al., 2007). Additionally, caregiver depression in a cultural minority sample was associated with greater DD and externalizing behavior problems in children (Huang et al., 2014). Although caregiver depressive symptoms were associated with increased risk for obesity among typically developing 5-year-old children from a low-income and cultural minority sample (Gross et al., 2013), research has not examined the impact of caregiver depressive symptoms on BMI in children with DD and externalizing behavior problems and from cultural minority backgrounds.

Consideration of acculturation and enculturation may be important when examining the associations between caregiver depressive symptoms and BMI among cultural minority populations. Acculturation is defined as the adoption of behaviors, attitudes, and values of the majority culture (Sussner et al., 2008). Enculturation refers to an individual's relationship with their native country/culture and may be displayed through use of native language, cultural values and practices, and identity with one's native culture (Yoon et al., 2013). Although it seems high levels of acculturation cannot occur simultaneously with high levels of enculturation, research provides support for a multidimensional view that acculturation and enculturation processes can occur in conjunction with one another

(Cabassa, 2003) and may play different roles, such as protective and risk factors for health outcomes (Schwartz et al., 2010).

Research has examined the association between acculturation and BMI in children from cultural minority backgrounds, but findings have been mixed. For example, children from later generation immigrant parents, who have lived in the United States for longer periods of time, are more likely to engage in sedentary behaviors and have larger and more rapid weight gain than less acculturated counterparts (Van Hook & Baker, 2010). These findings suggest acculturation is a risk factor for higher rates of obesity and are thus consistent with the acculturation paradox. Specifically, higher levels of acculturation to the United States are associated with increases in income and educational attainment, which are typically associated with lower rates of obesity (Van Hook et al., 2016). However, other studies utilizing acculturation questionnaires rather than the number of years residing in the United States did not show significant associations between child BMI and familial acculturation (Ciampa et al., 2013). Research also showed overweight status was significantly associated with higher levels of depressive symptoms among more highly acculturated adolescents compared to less acculturated adolescents (Xie et al., 2010). In adults, findings show that higher levels of depressive symptoms were associated with higher BMI scores among recently immigrated women (Anzman-Frasca et al., 2016). However, research has not examined the impact of caregiver acculturation on the association between caregiver depressive symptoms and child BMI.

Although high levels of acculturation to U.S. mainstream culture may confer risk among cultural minority families, enculturation may be a protective factor for negative outcomes (Vega & Sribney, 2008). For example, high levels of enculturation among individuals from cultural minority backgrounds have been associated with high levels of self-esteem and life satisfaction (Yoon et al., 2013). In a sample of indigenous Alaskan natives, more enculturated individuals were more physically active and experienced lower levels of psychological stress than less enculturated individuals (Bersamin et al., 2012). However, no research has examined the impact of caregiver enculturation on the association between caregiver depressive symptoms and child BMI. However, given positive associations between enculturation and mental and physical health (Bersamin et al., 2012; Yoon et al., 2013), it is possible that higher levels of enculturation would weaken the association between caregiver depressive symptoms and child BMI.

In this study, we examined the association between caregiver depressive symptoms and child BMI, as well as the extent to which acculturation and enculturation

moderate this association, in a sample of young children with co-occurring DD and caregiver-reported externalizing behavior problems and from cultural minority backgrounds. We hypothesized that caregivers with higher levels of depressive symptoms would have children with higher BMI scores. We also hypothesized that the association between caregiver depressive symptoms and child BMI would be stronger among more highly acculturated caregivers and weaker among more highly enculturated caregivers.

Methods

Participants and Procedure

Participating families were recruited at their child's exit evaluation from Part C Early Intervention (EI) services—a supplement to the Individuals with Disabilities Education Act that recommends statewide services to children birth to 3 years with DD. Early Intervention programs usually include home-based sessions to promote developmental outcomes and disproportionately serve ethnic and racial minority families living in low-income neighborhoods (Bringewatt & Gershoff, 2010). Study procedures were approved by the University Institutional Review Board and were approved by each EI site. Families in this study were recruited from three EI sites in a large city in the southeastern United States as part of recruitment for a clinical trial, evaluating a parenting intervention for young children with DD and externalizing behavior problems.

Participants were 3-year-old children aging out of EI services for DD and their primary caregiver. Study inclusion criteria were: (a) clinically significant score (i.e., $T\text{-Score} \geq 60$) on the Externalizing Problems subscale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001); and (b) the primary caregiver spoke English or Spanish. Families were excluded if: (a) the child was receiving medication for problem behaviors; (b) the child was deaf or blind or displayed physical impairments significantly impairing functioning; (c) the primary caregiver reported that the child displayed severe social communication deficits related to autism spectrum disorder as indicated by scores of >75 on the Social Responsiveness Scale (SRS-2; Constantino & Gruber, 2012); or (d) the primary caregiver scored a standard score of <4 on the vocabulary subtest of the Weschler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) or the La Escala de Inteligencia Wechsler Para Adultos—Third Edition (EIWA-III; Pons et al., 2008). Elevated child BMI or obesity status was not an inclusion criterion because this study is a secondary data analysis from a large treatment study, targeting child behavior problems.

Families were initially screened during their child's exit evaluation for EI Services, which occurred within 3 months of the child's 3rd birthday, and then participated in a home-based baseline assessment once the child turned 3 years old and EI services got terminated. During the exit evaluations, written consent was obtained for 805 families, and 683 completed screening. Of the screened families, 197 (29.0%) met study eligibility criterion, and 486 were ineligible (81.5% scored <60 on the CBCL Externalizing Problems subscale, 14.6% scored >75 on the SRS-2, 2.1% of caregivers scored <4 on the WASI/EIWA vocabulary subtest, and 1.8% met other exclusion criteria). Of the 197 eligible families, 150 families (76.0%) completed the baseline assessment and were randomized in the larger clinical trial. The 150 families that were randomized did not significantly differ on demographic or study characteristics from the 47 eligible families that were not randomized.

For this study, we included 147 families (98% of those randomized in the larger trial) in which the primary caregiver identified as being from a cultural minority background. Specifically, primary caregivers in this sample identified a country or culture of origin outside of the United States (e.g., Cuban, Venezuelan, Colombian, Polish) on a self-reported demographic questionnaire. Primary caregivers reported to be of Latinx ethnicity/White race (61.6%), Non-Latinx ethnicity/Black race (19.2%), Foreign-born, Non-Latinx/White (e.g., Moldovan, French, Polish, 4.8%), or Other (e.g., non-Latinx Asian; 14.4%). On average, the participating primary caregivers were 34.6 years old ($SD = 6.3$) and reported the following relationship with their child: biological mother (84.9%), biological father (10.8%), grandparent (2.2%), or adoptive mother or stepmother (2.2%). In terms of language spoken, 48% reported being bilingual, which included speaking English and Spanish or English and another language (e.g., Creole, French, Russian, Romanian, Tamil, Urdu). In total, 27% reported speaking English only, and 25% reported speaking Spanish only. The majority of primary caregivers reported household incomes of $\leq \$30,000/\text{year}$ (60.6%), and most completed high school/GED (41.0%) or college (49.3%), with 9.7% not completing high school. Primary caregivers completed questionnaires via RedCap on a tablet provided by the study, or on their own device, and received \$100 for their participation.

Primary Measures

Child BMI

Height and weight (in metric measurement) were measured by a research assistant using a stadiometer during the home visit. Consistent with prior research examining BMI in children (Must & Anderson, 2006), we used BMI z -scores for analyses. We calculated

age- and sex-specific BMI z -scores using the Children's Hospital of Philadelphia Pediatric z -score calculator (2019) based on the Center for Disease Control's growth charts from 2010.

Caregiver Depressive Symptoms

The Depression, Anxiety, & Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is a 21-item self-report questionnaire with three subscales: depression, anxiety, and stress. Items are rated on a 4-point Likert-style scale from 0 (did not apply) to 3 (applied very much or most of the time). Research showed that the 7-item DASS-21 depression subscale to be valid with nonclinical US samples (Sinclair et al., 2011). In this study, we used the DASS-21 depression subscale to assess primary caregiver depressive symptoms, and internal consistency in this sample was good ($\alpha = .88$).

Acculturation and Enculturation

The Abbreviated Multidimensional Acculturation Scale (AMAS-ZABB; Zea et al., 2003) is a 42-item questionnaire that was used to assess the levels of acculturation and enculturation of primary caregivers across the three dimensions of identity, language competence, and cultural competence. Items are rated on a 4-point Likert-style scale from 1 (strongly disagree, not at all) to 4 (strongly agree, extremely well). The AMAS-ZABB is a bilinear measure, assessing acculturation and enculturation as distinct dimensions. The total acculturation score assesses the extent to which respondents identify with and can successfully navigate U.S.-mainstream culture and exhibit English language competency. The total enculturation score assesses the extent to which respondents identify with and are proficient in their stated "culture of origin." Research showed that the AMAS-ZABB has a reliable factor structure and strong validity with Latinx samples (Zea et al., 2003) and other cultural samples, such as Chinese, Korean, and Japanese samples (Miyoshi et al., 2015). In this sample, internal consistency was excellent ($\alpha_{\text{Acculturation}} = .96$, $\alpha_{\text{Enculturation}} = .94$).

Covariates

Health and Environmental Opportunity Index

The Child Opportunity Index was created by diversitydatakids.org, in conjunction with the Kirwin Institute at the Ohio State University, to assess opportunity in educational, health and environmental, and social and economic domains in relation to the surrounding metropolitan area based on zip code (Acevedo-Garcia et al., 2014). We used the health and environmental opportunity subscale, which assesses the proximity of the following in relation to a family's home: (a) health food stores, (b) toxic waste sites, (c) amount of toxic waste, (d) parks and open spaces, (e)

vacant housing, and (f) health care facilities. Scores range from 0 (least opportunity) to 7 (most opportunity).

In addition to the health and environmental opportunity subscale, other primary caregiver demographic variables (e.g., race and ethnicity), as well as child sex, were included as covariates, given previous research showing associations between these demographic variables and child BMI scores. Child age was not included as a covariate because all children in this study were 3 years old during the time of the baseline evaluation. Caregiver age and caregiver sex were not significantly correlated with caregiver depressive symptoms, acculturation, or enculturation, and thus were also not included as covariates.

Data Analysis

Analyses were conducted in SPSS version 25. Linear regression was used to examine the association between caregiver depressive symptoms and child BMI z -scores. Caregiver DASS-21 depression scores and the covariates (see above) were included as predictors of child BMI z -scores. The PROCESS macro (Hayes, 2012) in SPSS was used to examine potential moderating effects of caregiver acculturation and enculturation. Main and interactive effects of caregiver depressive symptoms (as measured by the DASS-21 depression scale) and caregiver acculturation/enculturation (as measured by the AMAS), along with the covariates, were entered as predictors of the association between caregiver depressive symptoms and child BMI z -scores. Separate moderation models were run for acculturation and enculturation. The significance of main and interactive effects was determined using bias-corrected bootstrapped 95% confidence intervals (CIs) based on 5,000 bootstrapped samples (Hayes, 2012). Significant effects for caregiver depressive symptoms $\times$ acculturation and caregiver depression $\times$ enculturation were interpreted as evidence of moderation.

Results

Missing Values Analysis and Covariates

Missing value analysis showed that missingness was consistent with a missing at random pattern (Rubin, 1976). Table I summarizes means and standard deviations for demographic and model variables, as well as zero-order correlations between demographic variables and model variables. Primary caregiver race and ethnicity, child sex, and the health and environmental opportunity subscale were controlled for in all subsequent models, as mentioned in the *Health and Environmental Opportunity Index* section.

Table I. Means, Standard Deviations and Correlations Among Variables

Variables	M (SD)	2	3	4	5	6	7	8	9	10
1 Caregiver race	.53 (1.12)	0.39**	-.02	-.02	-.15	.25**	-.06	.21*	-.27**	-.07
2 Caregiver ethnicity	.72 (.45)	–	-.13	.14	.15	-.11	-.004	-.08	.22**	-.02
3 Child sex	.27 (.44)	–	–	.14	.08	.06	.17*	.02	-.02	-.14
4 Caregiver age	34.66 (6.29)	–	–	–	-.33**	.10	-.09	.002	.10	.04
5 Caregiver education	5.46 (1.58)	–	–	–	–	.10	.02	.06	.16	.01
6 H.E.Oi	3.08(1.35)	–	–	–	–	–	.07	.22**	-.04	-.06
7 Depression	1.49 (1.95)	–	–	–	–	–	–	.21*	.07	-.22**
8 BMI z-Score	.53 (1.55)	–	–	–	–	–	–	–	.05	-.06
9 Acculturation	3.14 (.71)	–	–	–	–	–	–	–	–	.03
10 Enculturation	3.20 (.62)	–	–	–	–	–	–	–	–	–

Note. H.E.Oi = Health and Environmental Opportunity Index.

* $p < .05$; ** $p < .01$.

Descriptive Analyses

Descriptive analyses examined the distribution of caregiver depressive symptoms and child BMI z -scores. According to the CDC classifications of BMI scores (Kuczmarski et al., 2002), 5.4% of children in this sample were classified as underweight, 58.5% of children were classified as normal weight, and 35.9% of children were classified as overweight or obese (16.9% overweight and 19.0% obese). According to the DASS-21 classifications of depression, most (77.2%) caregivers were in the “normal” range of symptoms, whereas 8.1% were in the mild depression range, 6.9% were in the moderate depression range, 6.8% were in the severe depression range, and 1.4% were in the extremely severe depression range. Table I includes the mean and standard deviations for the AMAS-ZABB, which demonstrated sufficient variability in this sample. Tests to examine the normality and homoscedasticity of the residuals indicated assumptions for normality were met.

Association Between Caregiver Depressive Symptoms and Child BMI

A linear regression controlling for race, ethnicity, child sex, and health and environmental opportunity index indicated primary caregiver depressive symptoms significantly and positively predicted child BMI z -scores, $b = .189$, $F(5, 135) = 3.29$, $p = .001$, CI [.08, .30]. Specifically, caregivers reporting higher levels of depressive symptoms had children with higher BMI z -scores than caregivers reporting lower levels of depressive symptoms.

Moderating Effect of Acculturation and Enculturation

After accounting for covariates, acculturation significantly predicted both caregiver depressive symptoms and child BMI z -scores. In addition, the caregiver depressive symptoms $\times$ acculturation interaction term significantly predicted child BMI z -scores, $b = .21$, $F(7, 127) = 2.65$, $p = .01$, CI [.05, .37], indicating

acculturation levels moderated the association between caregiver depression and child BMI. Specifically, as shown in Figure 1, caregiver depressive symptoms significantly positively predicted child BMI z -scores when caregiver acculturation to mainstream U.S. culture was at the mean or one standard deviation above the mean ($p < .001$), but not when caregiver acculturation was one standard deviation below the mean ($p = .91$). A similar model assessing the moderating effect of enculturation on the relation between caregiver depressive symptoms and child BMI z -scores was not significant ($p = .88$), suggesting that the association between caregiver depressive symptoms and child BMI was robust across various levels of caregiver identification proficiency with their stated “culture of origin.”

Discussion

This study provided an examination of the association between caregiver depressive symptoms and child BMI, as well as the important role of caregiver acculturation, among cultural minority families with children with DD and externalizing behavior problems. Despite research showing caregiver depressive symptoms to be associated with child BMI in typically developing children (Gross et al., 2013), research has not examined the relation between caregiver depressive symptoms and BMI scores in children with DD and elevated behavior problems. Consistent with our hypotheses and previous research, findings revealed a significant association between caregiver depressive symptoms and child BMI, such that caregivers reporting higher levels of depressive symptoms had children with higher BMI scores.

Despite the cross-sectional design of this study, these findings provide preliminary support that caregiver depressive symptoms may negatively impact child's weight outcomes, and future studies should explore this association with a longitudinal design. Additionally, findings suggest that consideration of

Figure 1. Moderating effect of caregiver acculturation to the United States on the association between caregiver depressive symptoms and child BMI z-scores.

the family unit as a whole may be important when targeting early childhood obesity, especially for diverse families with children with DD and behavior problems. Treatment strategies, such as behavioral parenting interventions or family systems therapy, target the family unit as a whole, and thus may effectively address a range of child and family outcomes (Shaw et al., 2009), as well as early childhood activity levels and elevated child BMI scores (Brotman et al., 2012).

In addition, the findings in this study, drawn from a diverse sample of cultural minority families, underscore how the association between caregiver depressive symptoms and child BMI is not uniform across varying levels of caregiver acculturation. Despite research showing the impact of acculturation on the association between depressive symptoms and obesity in adulthood (Anzman-Frasca et al., 2016), no study to our knowledge has examined the moderating effect of acculturation on the association between caregiver depressive symptoms and child BMI scores. Findings suggest that targeting caregiver depressive symptoms as part of multicomponent intervention efforts to reduce the risk of child obesity in cultural minority families may be important when caregivers are more highly acculturated. In contrast, focusing on caregiver depressive symptoms in less acculturated families may yield limited gains with regard to child obesity outcomes. The findings in this study also highlight value in systematically measuring acculturation when assessing family functioning factors relevant to child weight.

Notably, enculturation did not moderate the association between caregiver depressive symptoms and child BMI scores. Despite research suggesting that higher levels of enculturation can be a protective factor in cultural minority populations (Bersamin et al., 2012), findings in this sample did not suggest that high caregiver enculturation impacted the association between caregiver depressive symptoms and child BMI. This study sample was unique in that all primary caregivers identified non-U.S. countries and/or minority races, ethnicities, or religions as their primary

culture of origin. However, this sample was recruited from a city in which roughly 70% of the population is Latinx (U.S. Census Bureau, 2018), and the majority of the sample spoke English. Thus, it is possible that enculturation was not a significant moderator because it functioned differently in this sample than it might in a region that is not “majority minority.” Additionally, given that we did not examine differences between Latinx subgroups, it is possible that enculturation may be a protective factor for some subgroups.

This study included a predominantly cultural minority sample living in a predominantly ethnic minority city, which was both a strength and a limitation. The study targeted an underserved and underrepresented population, but the nature of the sample limits generalizability of findings to Latinx families in other regions. Additionally, the cultural diversity of this sample provided the opportunity to study acculturation and enculturation, but we did not have sufficient power to assess differences between individual cultures or subgroups within cultures. Within the Latinx community, for example, research showed that cultural differences impact mental health outcomes among subgroups, such as Cubans, or differences based on immigration status (Alegria et al., 2017). Thus, it is possible acculturation and enculturation may function differently depending on cultural norms and values specific to the culture of origin or subgroups within a culture.

Given the complexity of acculturation measurement (Alegria, 2009), future research should also assess individual components or constructs similar to acculturation and enculturation. For example, acculturative stress, which is a measure of psychological distress individuals may feel in relation to their own level of acculturation, may provide a more nuanced view of the interplay between cultural norms and societal pressures that help to explain the context through which caregiver depressive symptoms impact child BMI. Additionally, we did not collect information about family immigration status and/or the amount of

time or number of family generations living in the United States. Such information may be meaningful in explaining links between caregiver acculturation and depressive symptoms and their links with child outcomes in future research.

Another limitation of this study is that we did not include a measure of caregiver BMI. Given that research has documented significant associations between caregiver BMI scores and child BMI scores in early childhood (Lindkvist et al., 2015), future research should examine how caregiver depressive symptoms may impact child BMI over and above the impact of caregiver BMI, as well as the impact of acculturation and enculturation on this longitudinal association. Additionally, we did not collect information about whether the children had any chronic medical conditions (e.g., asthma), which may increase the risk for obesity (Chen et al., 2010). We also did not collect information about specific eating patterns in the family, such as parent and/or child addictive eating behaviors, which has been shown to be associated with increased risk of obesity in children (Burrows et al., 2017).

The cross-sectional design of this current study precluded the examination of prospective relations across variables and cannot clarify issues of temporal precedence between caregiver depressive symptoms and child BMI scores. Additionally, the cross-sectional design did not allow for examination of potential mediational pathways that can help elucidate the mechanisms through which caregiver depressive symptoms impact child BMI. For example, given that research has documented that parenting quality in the parent-child relationship mediated the effect of parental depression on child BMI (McConley et al., 2011), it is possible that the examination of the parent-child relationship in this study may further explain the associations between caregiver depressive symptoms and child BMI. Future research should examine potential mechanisms, such as parenting quality, through which caregiver depressive symptoms impact child BMI for young children with DD and externalizing behavior problems.

Conclusion

Despite these limitations, this study fills a critical gap in the literature by documenting a significant association between caregiver depressive symptoms and child BMI in young children with DD and externalizing behavior problems at elevated risk for obesity. Results from this sample of cultural minority families suggest that higher acculturation to mainstream U.S. culture is a risk factor that predicts a stronger link between caregiver depressive symptoms and child BMI. Such findings highlight the potential benefit of adopting

broadened psychosocial, family-focused strategies when targeting child health outcomes in cultural minority populations, particularly when working with more highly acculturated families.

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