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Examining the Interplay of Mental Health, Family Conflict, and Body Mass Index among Mexican Origin Families: A Cross-Lagged Model

Laura Margaret Lehman Distel

LOYOLA UNIVERSITY CHICAGO

EXAMINING THE INTERPLAY OF MENTAL HEALTH, FAMILY CONFLICT, AND BODY MASS INDEX AMONG MEXICAN ORIGIN FAMILIES: A CROSS-LAGGED MODEL

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ABSTRACT

Mexican-origin youth in the U.S. are at risk for obesity (Fryar et al., 2018) and mental health concerns (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). One key psychosocial process implicated in this health inequity is family conflict (Conger et al., 1999), which has been associated with both poor mental health outcomes (e.g. Santiago & Wadsworth, 2009) and overweight and obesity (Halliday et al., 2013). However, no research to date has examined the complex interplay of family conflict, mental health problems and body mass indices (BMI) over time. The present study examined cross-lagged associations among child z-scored BMI (zBMI), mental health problems (internalizing symptoms and externalizing symptoms) and family conflict at three time-points over the course of one year during middle childhood. Participants included 104 low-income Mexican-origin immigrant families with children ages 6-10 (M_{age} = 8.39; 61% female). Questionnaires, anthropomorphic measurements, and observational data were collected at three timepoints over the course of one year. Cross-lagged path analyses were conducted and equivalence testing was used to examine sex differences in model fit. Of the panel models examined, only one demonstrated significant cross-lagged associations over time: externalizing symptoms, food specific family conflict and child zBMI. Model fit was equivalent for males and females across models. Findings suggest that conflict about food choice and eating may be an important area of intervention for school-age youth with overweight or obesity, in particular, in its relationship with externalizing behaviors.

CHAPTER ONE

INTRODUCTION

There are currently two million children of Latinx immigrants in the U.S. today, and approximately 27% of foreign-born immigrants in the U.S. are from Mexico (Center for American Progress, 2014; Park, Zong & Batalova, 2018). Latinx youth have some of the highest rates of obesity and overweight in the U.S. (Ogden et al., 2020). This is concerning because childhood overweight and obesity are associated with several negative health consequences including pediatric metabolic disease, cardiovascular disease and several types of cancer in adulthood (Biro & Wien, 2010). Furthermore, Latinx youth are at increased risk for mental health problems compared to their non-Latinx counterparts due to systemic inequality (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). Mental health problems in childhood may interfere with important developmental milestones and are also linked to later mental and physical health problems (e.g. Carter et al., 2010). Thus, the experience of both obesity and mental health problems in childhood and adolescence places youth at high risk for life-long and chronic health problems. Research suggests that there are several "interlocking mechanisms" that perpetuate these health inequities, including discrimination, chronic stress, and lack of access to resources (Marks, Ejesi, & García Cole, 2014). In addition to and within this broader context, psychosocial processes also impact children's physical and mental health (Barajas-Gonzalez, Ayón, & Torres, 2018). One key psychosocial process that has been implicated in these health

inequities is family conflict (Conger et al., 1999), which has been associated with both poor mental health outcomes (e.g. Santiago & Wadsworth, 2009) and overweight and obesity (Halliday, Palma, Mellor, Green & Renzaho, 2014). Thus, it is essential to examine the interplay of these key factors (mental health, obesity and family conflict) over time.

Past research has found that children with overweight or obesity have higher rates of both externalizing and internalizing problems than their normal weighted peers (Kalarchian & Marcus, 2012). Additionally, family conflict has been implicated in both mental health problems for youth (e.g. Formoso, Gonzales, & Aiken, 2000) and overweight and obesity (e.g. Martin-Biggers et al., 2018). However, no research to date has examined the complex interplay of family conflict, mental health problems and body mass indices (BMI) over time. Thus, the present study aimed to expand upon previous research by exploring the interplay among child BMI, mental health symptoms and family conflict at three time-points over the course of one year during middle childhood. The present study tested this conceptual model using cross-lagged path analysis, which examined how family conflict, mental health and child BMI impact each other overtime among Mexican-origin youth.

CHAPTER TWO

REVIEW OF RELEVANT LITERATURE

There are currently two million children of Latinx immigrants in the U.S. today, and approximately 27% of foreign-born immigrants in the U.S. are from Mexico (Center for American Progress, 2014; Park, Zong & Batalova, 2018). Latinx youth have some of the highest rates of obesity and overweight in the U.S. (Ogden et al., 2020). This is concerning because childhood overweight and obesity are associated with several negative health consequences including pediatric metabolic disease, cardiovascular disease and several types of cancer in adulthood (Biro & Wien, 2010). Furthermore, Latinx youth are at increased risk for mental health problems compared to their non-Latinx counterparts due to systemic inequality (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). Mental health problems in childhood may interfere with important developmental milestones and are also linked to later mental and physical health problems (e.g. Carter et al., 2010). Thus, the experience of both obesity and mental health problems in childhood and adolescence places youth at high risk for life-long and chronic health problems. Research suggests that there are several "interlocking mechanisms" that perpetuate these health inequities, including discrimination, chronic stress, and lack of access to resources (Marks, Ejesi, & García Cole, 2014). In addition to and within this broader context, psychosocial processes also impact children's physical and mental health (Barajas-Gonzalez, Ayón, & Torres, 2018). One key psychosocial process that has been implicated in these health inequities is family conflict (Conger et al., 1999), which has been associated with both poor

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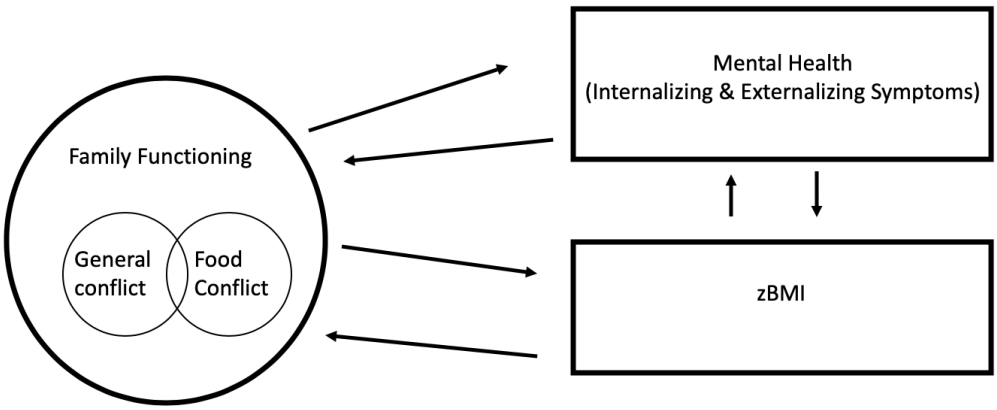
Figure 1. Conceptual model of interplay of mental health, conflict and zBMI



Theoretical and Empirical Foundation

Several models provide a framework for studying the physical and mental health inequities among low-income Mexican-origin youth. One such model is an ecological framework (Ecological Systems Theory; EST, Bronfenbrenner, 1979), which places children in the context of policy, community, and families. This model has been used to explain the multiple interrelated factors involved in child mental health and general adaptation as well as physical health outcomes (e.g. Stokols, Allen, & Bellingham, 1996). Utilizing an ecological model to contextualize health inequities in Mexican-origin families with low incomes is important given the risk for high levels of ecological stress in this population due to the experiences of poverty and immigrant-related stressors (Barajas-Gonzalez, Ayón, & Torres, 2018; Slack & Jensen, 2007; Yoshikawa, Suarez-Orozco & Gonzales, 2016). Mexican-origin youth from low-income backgrounds experience multiple levels of systemic inequalities that create vulnerabilities to obesity and mental health problems (Barajas-Gonzalez, Ayón, & Torres, 2018). Within this context, family level and personal level factors may also play a role in the maintenance of obesity and mental health problems over time. Several models have sought to understand how family functioning within a highly stressful context impacts children's health (e.g. Barajas-Gonzalez, Ayón, & Torres, 2018; Bates et al., 2018).

Ecological models such as the Family Stress Model (FSM; Conger et al., 2002) and Family Ecological Model (FEM; Davison, Jurkowski, & Lawson, 2013) have examined family functioning as a key context through which children's mental and physical health are impacted. FSM posits that poverty impacts children by disrupting parental and family functioning, which in turn negatively impacts child functioning (Conger et al., 2002). FSM is an important lens for

examining the development of Mexican-origin youth with low-income because it highlights how broader environmental influences, such as poverty and discrimination, impact family functioning, which in turn impacts child functioning. Similarly, in the obesity literature, FEM has been used to examine the family contextual factors related to obesity and focuses on the family as the center of the model and target of interventions (Davison, Jurkowski, & Lawson, 2013). In the development of FEM, Davison and colleagues (2013) surveyed a low-income sample and found that participants emphasized the impact of challenges in family functioning (e.g. stress around meal preparation, conflict among siblings, and differences in parenting strategies) on child weight management. Thus, FEM highlights the need to examine children's health within the context of their overall family functioning. Furthermore, social-ecological models of childhood obesity have underscored the transactional relations among children's emotional regulation and family feeding practices on children's weight management over the course of development (Bohnert, Loren, & Miller, 2020; Fiese & Jones, 2012; Fiese & Bost, 2016; Fiese & Sameroff, 1989). Thus, utilizing a family ecological approach is essential for understanding the multilevel systems at play in psychosocial and health functioning of Mexican-origin youth and their families.

These ecological models of health underscore the multiple factors that influence childhood obesity and mental health inequities for Mexican-origin youth from low-income backgrounds. While this study did not aim to test the ecological model as a whole, it utilized this lens to better understand the interplay of several key factors (mental health, BMI and family conflict) across time. Furthermore, ecological models also emphasize the impact of the child on his or her own environment. However, studies often fail to examine these bidirectional effects

(Pardini, 2008). As such, this study used an ecological lens with a focus on family functioning while using a cross-lagged approach to gain greater understanding into the dynamic interplay of child physical and mental health and family functioning. The present study aimed to examine individual and family level factors that affect youth development, as these are frequently targeted areas for intervention in the mental health and obesity literature (Mead et al., 2017). In particular, the present study aimed to examine how family conflict, as well as children's own mental health and BMI impacts one another over time.

Mental Health and Childhood Obesity

The increased incidence of mental health problems among children who are obese has led researchers to examine the relations between weight and mental health problems. For example, past research has found overall higher rates of attention deficit hyperactivity disorder (ADHD), depression and binge eating disorders among children who are obese (Kalarchian & Marcus, 2012; Puder & Munsch, 2010). However, mental health concerns and obesity are not consistently correlated at a single time point, and it is still unclear what developmental processes are involved in this relation (Kalarchian & Marcus, 2012). Previous research has found that emotion regulation strategies, which underlie several mental health conditions, are also important factors in preventing excessive weight gain in childhood (Fiese & Bost, 2016; Power et al., 2016), and improving self-regulation skills has been used as an intervention strategy for obesity prevention in young children (Miller et al., 2012; Miller, Rosenblum, Retzloff, & Lumeng, 2016). Emotion-regulation deficits, which have been identified as key areas of intervention for childhood obesity, also increase risk for mental health concerns. Given the increased incidence of mental health concerns among children with overweight or obesity and research suggesting emotion regulation

deficits among this population, it is important to examine how these factors may affect one another over time.

Internalizing symptoms and overweight. Internalizing problems, which are conceptualized as social withdrawal, anxious and depressive symptoms, may impact childhood obesity over time. Past research has found correlational associations between depression and obesity (e.g. Fiese, Everhart, & Wildenger, 2009; Atlantis & Baker, 2008). Several factors have been proposed to explain the relation between overweight/obesity and depression, including the use of food as coping with depressive symptoms (Camfferman et al., 2016). Other hypotheses include a common underlying biological predisposition for both overweight/obesity and internalizing concerns (Kalarchian & Marcus, 2012). Researchers have also highlighted effects of obesity on self-esteem: one study examining obese children found that they were significantly more likely to have low self-esteem four years later compared to normal-weighted peers (Wang, Wild, Kipp, Kuhle, & Veugelers, 2009). A meta-analytic study of adults found that depression significantly increases the odds ratio of becoming overweight or obese longitudinally (De Wit, et al., 2010). However, directionality is unclear as the study also found that having overweight or obesity significantly increases odds ratio of becoming depressed longitudinally (De Wit, et al., 2010).

Three studies have examined the cross-lagged longitudinal associations between BMI and internalizing symptoms among youth, with mixed evidence for directionality of the association. One large study of multiethnic U.S. children from 24 months to sixth grade used cross-lagged path analyses to examine interrelations between internalizing and BMI over seven time-points (Bradley et al. 2008). The researchers found that beginning in first grade, BMI was positively

associated with later internalizing symptoms (Bradley et al., 2008). Furthermore, Bradley and colleagues (2008) found that internalizing symptoms did not predict later BMI. However, other research has found evidence for the opposite direction of the effect: A study of Dutch children at 18 months, three and six years found that internalizing symptoms at 18 months were predictive of overweight at age three, and internalizing symptoms at age three were predictive of overweight at age six (Camfferman et al., 2016). Finally, one study found no association between internalizing and BMI: a large Norwegian study examined the cross-lagged effects of internalizing and BMI for toddlers at 18 months and 36 months and found no association (Garthus-Niegel, Hagtvet, & Vollrath, 2010). As such, while previous research has examined the interrelations between internalizing symptoms and BMI using cross-lagged models, these studies have primarily focused on preschool-aged youth and have had mixed findings.

Externalizing symptoms and overweight. Externalizing symptoms, which are conceptualized as disruptive and behavioral problems, have also been found to be associated with childhood obesity and overweight. For example, one German study found higher rates of ADHD among teens (ages 11-17) with overweight or obesity compared to peers with normal weight. Additionally, a large U.S. study of children ages 5-17 found that children with ADHD who did not use stimulant medications were more likely to be overweight than those who did not have ADHD or those who received stimulant medications (Waring & Lapane, 2008). Furthermore, a study examining overweight children and young adolescents in the U.S. found that symptoms of ADHD were significantly positively associated with binge eating behaviors (Egbert et al., 2018). Hypotheses for the underlying mechanisms for these associations include differences in impulsivity, aggression and hyperactivity (Camfferman et al., 2016). Underlying

problems with executive functioning, such as response inhibition may also contribute to high rates of obesity among children with ADHD (Nederkoorn et al., 2006). A large body of research has found evidence for the impact of self-regulation and self-control in childhood weight management over time (e.g. Golan & Bachner-Melman, 2011; Datar & Chung, 2018). Difficulties with executive control, such as response inhibition, self-regulation and control, may impact externalizing symptoms as well as weight management.

Beyond executive functioning difficulties, past research suggests that externalizing symptoms may play a causal role in the development of pediatric obesity (Aguirre Castaneda et al., 2016; White et al., 2012); however, there is limited use of cross-lagged analyses to examine this complex relationship. Only two studies have examined the interplay between BMI and externalizing problems in children: In Camfferman and colleagues' 2016 study of Dutch children at 18 months, three and six years, the researchers found that externalizing symptoms at three years old were associated with overweight at age six. However, another cross-lagged study of toddlers at 18 months and 36 months found no longitudinal associations between BMI and externalizing symptoms (Garthus-Niegel, Hagtvet, & Vollrath, 2010). Therefore, although there is some evidence to suggest associations between externalizing symptoms and BMI among children, research has been mixed in regards to cross-lagged longitudinal studies, and no research has specifically focused on an at-risk population such as Mexican-origin school aged youth living in low-income homes.

Family Conflict and Childhood Obesity

Family conflict may be a particularly important variable when studying low-income Mexican-origin youth's development, as broad contextual factors such as acculturation gaps as

well as poverty have been associated with increased family conflict, particularly among adolescents (Gonzales, Deardoff, Formosos, Barr, & Barrera, 2006; Voydanoff & Donnelly, 1988). The presence of high family conflict may place children at risk for overweight/obesity given that multiple indicators of family environment have been linked with child weight in a systematic review of the literature (Bates et al., 2018). Family functioning has long been targeted by interventions and prevention efforts for childhood obesity (Mead et al., 2017). In fact, eating family meals as a family is a commonly used obesity prevention strategy (Hammons & Fiese, 2011). Furthermore, research examining family functioning during mealtimes has found that calm mealtimes are associated with better quality diets for children (Boutelle, Birnbaum, Lytle, Murray, & Story, 2003; Burnier, Dubois, & Girard, 2011). Thus, conflictual family environments may play an important role in the development and maintenance of overweight/obesity during childhood. Finally, family conflict is a broad construct that likely encompasses both overall family discord within the home as well as struggles related to specific disagreements around parental expectations for children. While specific conflicts, such as those around eating and food choices, may not be indicative of overall family discord, it is likely that these constructs impact one another.

General family conflict. General family conflict has been found to be related to childhood weight problems. Family conflict is broadly defined in the literature as a "pervasive environment of anger and discord in home" where "interrelations are characterized by anger and conflict" (Jaycox & Repetti, 1993, p.344), and past research has tied it to several negative health sequelae, including increased risk of metabolic syndrome (Penedo et al., 2015). Several links have been found between childhood obesity and family conflict. For example, Martin-Biggers

and colleagues (2018) found that families with higher conflict had increased prevalence of several risk factors for childhood obesity including eating together as a family less often and consuming more total fat and salty/fatty snack servings and fewer fruit/vegetable servings than families with lower conflict. Furthermore, Hanson and colleagues (1990) found that higher family conflict, as measured by broad conflict scales, was positively correlated with child BMI. Another study found that higher family conflict as rated on a broad family conflict scale was associated with both adolescent and mother BMI (Hooper et al., 2009). A 2007 study comparing obese youth and normal weighted youth found that obese youth had higher general family conflict than normal weighted comparisons (Zeller et al., 2007). However, there is some evidence to suggest that this association may not be consistent (e.g., Gibson et al, 2007; Herzer et al., 2010; Stradmeijer et al., 2000). Despite these compelling findings, very few longitudinal studies have been conducted to examine how general family functioning impacts childhood weight management over time nor how child obesity may be linked to conflict across time (Halliday et al., 2014). In their 2014 systematic review of the impact of family functioning on child obesity, Halliday and colleagues found only one longitudinal study examining relation between family functioning and childhood obesity and overweight. To date, no cross-lagged panel analyses have been conducted to assess the interplay of general family conflict and child weight. More research is needed to further examine the longitudinal and bidirectional role of family conflict on children's weight management.

Food specific family conflict. Management of diet for children with overweight or obesity may become an area of conflict in families, and some past research has focused on family conflict specifically related to eating. One qualitative study in which researchers

interviewed obese adolescents and their families identified family conflict about adolescent autonomy in management of feeding (food choice and quantity) as a major theme (Ramalho, Lachal, Bucher-Maluschke, Moro, & Revah-Levy, 2016). Furthermore, the researchers found that adolescents felt distant from other family members at mealtime, particularly when they were required to eat different foods than other members of the family (Ramalho et al., 2016). Quantitative studies examining eating specific conflict has found that mealtimes with families of children with overweight and obesity have more hostility than for those with children of normal weight (Berge et al., 2014). Additionally, Zeller and colleagues (2007) found that mothers of youth who were obese reported greater mealtime challenges than those of youth who were not obese. However, there is a lack of research examining the longitudinal relations between food specific family conflict and youth BMI, and no research to date has examined this association using cross-lagged path analyses. As such, little is known regarding the directionality of this association: greater conflict about what types of food children eat may in turn lead to greater difficulties with weight management. Thus, eating and food specific conflict, in addition to general family conflict, may add to the complex interplay of child mental health and BMI.

Family Conflict and Child Mental Health

There is a longstanding research base on the role of family conflict on child mental health and adaptation (e.g., Grych & Fincham, 1990; Jouriles, Farris, & McDonald, 1991; Reid & Crisafulli, 1990). Highly conflictual family environments have been associated with child externalizing problems (e.g., Jaycox & Repetti, 1993), and this association has been found in diverse samples of children, including Mexican American youth (e.g., Formoso, Gonzales, & Aiken, 2000). For example, one study of adolescents found that increased mother-child conflict

was associated with more adolescent conduct problems (Caples & Barrera, 2006). Furthermore, within a context of high-risk neighborhoods, family conflict has been found independently predict children's externalizing symptoms over time (Mason, Cauce, Gonzales, Hiraga, & Grove, 1994). Family conflict has also been associated with internalizing symptoms—a study of families from diverse ethnic backgrounds found that family conflict within the context of poverty related stress was significantly associated with child internalizing symptoms (Santiago & Wadsworth, 2009). Furthermore, previous research specifically focusing on Mexican-origin youth has found that greater family conflict predicted child depressive symptoms (Dumka, Roosa, & Jackson, 1997) and internalizing symptoms in general (Roosa et al., 2005). Thus, there is strong evidence that highly conflictual households may increase children's risk for developing both internalizing and externalizing problems.

Children with internalizing and externalizing disorders may also influence family functioning and increase overall levels of conflict within the household. Children's internalizing and externalizing symptoms may lead to family conflict by increasing the burden of the family system (Carter et al., 2010). Past research has examined how children's mental health problems may increase parenting stress over time (Neece, Green, & Baker, 2012). Additionally, research has found reciprocal relations between youth internalizing and externalizing symptoms and quality of parent child relationships over time (Zhang, Chen, Zhang, Zhou, & Wu, 2008). One study that used cross-lagged analyses found that sixth and seventh grade children's internalizing and externalizing symptoms were related to worse parent-child relationships over time (Fanti, Henrich, Brookmeyer, & Kuperminc, 2008). Furthermore, the researchers found that parent-child relationships also impacted youth externalizing and internalizing symptoms (Fanti et al., 2008).

Therefore, the effects of family conflict and mental health may be bidirectional, with both family functioning and child symptoms impacting each other over time.

Family Conflict Methodology

Previous research on family conflict and BMI has used singular methods to measure family conflict including self-report surveys, individual interviews, and observations during mealtime (Skouteris et al, 2012). Single methods of examining family conflict may not accurately represent the broad construct of conflict within the family system. Observational data provides a greater level of ecological validity than quantitative measurement alone (Whitley & Kite, 2013), and this may be particularly important when examining complex family interactions (Lindahl, 2000). Furthermore, separating general family conflict from food-specific conflict may allow for a more nuanced examination of the bidirectional relations between family functioning and child zBMI and mental health symptoms. Measuring family conflict outside the context of meals may provide a broader, more general measurement of family conflict while utilizing a self-reported measure of food-related conflict may provide a more subjective measurement of conflict related to eating behaviors within at-risk families. As such, the present study will use a multi-method approach by analyzing both family conflict using video-coded observational data as well as self-reported levels of food related conflict.

The Role of Sex

Sex may impact the relations among child mental health, BMI and family conflict. Development of both physical and mental health conditions may vary based on sex, due to social norms based on assigned gender roles, behaviors and expectations, and possibly due to biological physiology (Tannenbaum, Clow, Haworth-Brockman & Voss, 2017). Past research has found

that females may be more susceptible to mental health problems in relation to weight than males (Wang, Wild, Kipp, Kuhle, & Vuegelers, 2009). For example, research examining the linear relation between behavioral problems and obesity found an association for female adolescents, but not males (Lawlor et al., 2005). However, other research has found that the fit of cross-lagged models between mental health problems and overweight were similar for males and females (Camfferman et al., 2016; De Wit et al., 2010; Bradley et al., 2008). Additionally, there may be sex differences in the relation between family conflict and BMI: One study found that the association between poorer family functioning and obesity varied by sex (Halliday et al., 2014). Furthermore, from a cultural lens, research suggests that Latinx immigrant parents may exhibit different gender-specific feeding practices for sons and daughters, which may be due to gendered beliefs and preferences about weight and size of males and females (Van Hook & Baker, 2010). Past research has found that Latinx immigrant parents may be more permissive with feeding practices among sons (Van Hook & Baker, 2010). As such, the bidirectional effects of family conflict and BMI among females may be more pronounced than for males. Finally, sex may also impact the interrelations between family conflict and mental health problems over time: Past research examining family conflict has found differing results, with some research indicating equivalent effects of family conflict on males and females (e.g., Smojver-Ažić & Bezinović, 2011; Burt, McGue, Krueger, & Iacono, 2005) and others indicating differences (e.g., Formoso, Gonzales, & Aiken, 2000). Thus, there is mixed evidence on the effect of sex on the complex interplay of child mental health, BMI, and family conflict and further research is needed to examine whether transactional effects of mental health, obesity and family conflict are similar among school aged males and females.

Limitations of Prior Research and Present Study

The present study examined cross-lag associations of three key factors (mental health, obesity and family conflict) over time. Although research has examined the interplay of mental health on childhood weight management, several gaps in the research remain. Past research has analyzed changes in weight over a broad time span, examining changes from toddlerhood to adolescence (e.g., Garthus-Niegel, Hagtvet & Vollrath, 2010; Camfferman et al., 2016). While this approach provides insight into early risk and long-term effects of mental health, it is essential to understand the immediate impacts of mental health and childhood obesity on each other during middle childhood. In particular, studying school age may be particularly important as this is a time in childhood when responsibilities around eating increase and prevalence of mental illness (Ghandour et al., 2019) and obesity (Fryar et al., 2019) also rise. Research also suggests that late childhood and early adolescence is a critical developmental period in which overweight/obesity racial and ethnic inequities increase (Huh, Stice, Shaw & Boutelle, 2012). Family conflict has also been implicated in both mental health problems for youth (e.g., Formoso, Gonzales, & Aiken, 2000) as well as overweight and obesity (e.g. Martin-Biggers et al., 2018). However, no research to date has examined the complex interplay of family conflict, mental health problems and BMI over time in one model. The present study aimed to expand upon previous research exploring the interrelations between child BMI and mental health problems as well as family conflict and mental health at three time-points over the course of one year during middle childhood. This study aimed to test a novel model that examines how family conflict, mental health and BMI affects each other overtime within a high-risk population: Mexican-origin youth in low-income homes.

Longitudinal cross-lagged path analysis allows for the examination of the direction of influence among variables that are measured over time. Drawing on a dataset that included three time points over one year provides a unique opportunity to examine the interplay among childhood BMI, mental health and family conflict among an at-risk sample. Path analysis offers flexibility in modeling repeated measures designs because it accounts for the interdependence of covariances over time through stability paths (Kline, 2005). Additionally, cross-lagged path analysis provides an ability to test models of covaried factors that may be bidirectional (Selig & Little, 2012). Such opportunity is essential where there is mixed evidence of directionality (Selig & Little, 2012). Thus, the present study utilized a cross-lagged path analysis in order to examine the complex interrelations of these family and individual factors over time.

Aims and hypotheses. Aim 1 of this study was to test a cross-lagged model examining the transactional effects zBMI, internalizing symptoms and food specific family conflict in school-aged Mexican-origin children over three time points over the course of a year (see Figure 2). It was hypothesized that there would be cross-lagged effects among these variables over time. It was hypothesized that higher zBMI, internalizing symptoms and food specific family conflict would lead to higher zBMI, internalizing symptoms and food specific conflict cross-lagged effects over time. **Aim 2** of this study was to examine the interplay of zBMI, externalizing symptoms and food specific family conflict children over three time points over the course of a year (see Figure 3). It was hypothesized that there would be positive cross-lagged associations of zBMI, externalizing symptoms and food specific family conflict over time. **Aim 3** of this study was to examine zBMI, internalizing symptoms, and general family conflict over three time points over the course of a year (see Figure 4). It was hypothesized that there would be

significant positive cross-lagged effects of zBMI, internalizing symptoms and general family conflict over the course of the year. **Aim 4** of this study was to examine the transactional effects of zBMI, externalizing symptoms, and general family conflict over three time points over the course of a year (see Figure 5). It was hypothesized that there will be significant, positive cross-lagged effects of zBMI, externalizing symptoms and general family conflict over the three time points.

Figure 2. Model 1 cross-lagged model of zBMI, internalizing symptoms and food specific family conflict

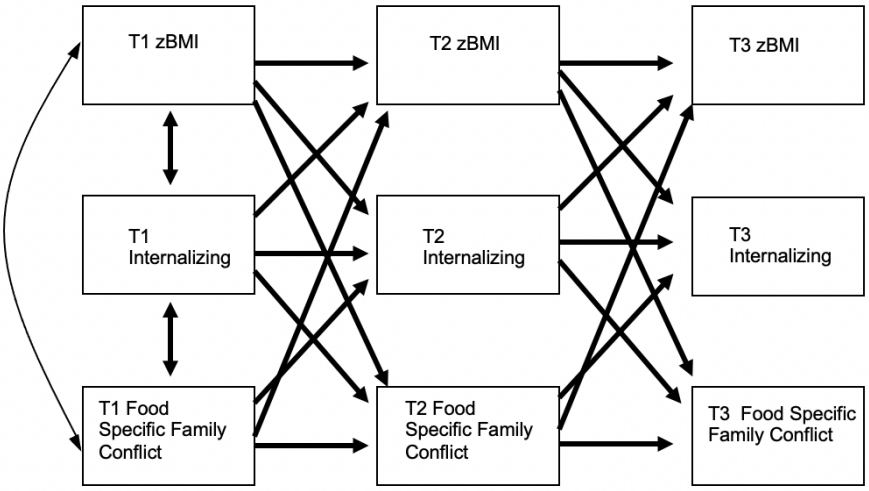


Figure 3. Model 2 cross-lagged model of zBMI, externalizing symptoms and food specific family conflict

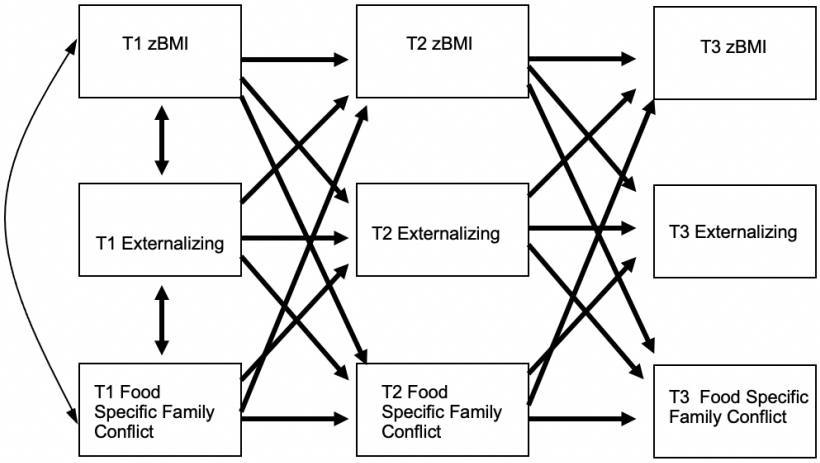


Figure 4. Model 3 cross-lagged model zBMI, internalizing symptoms, and general family conflict

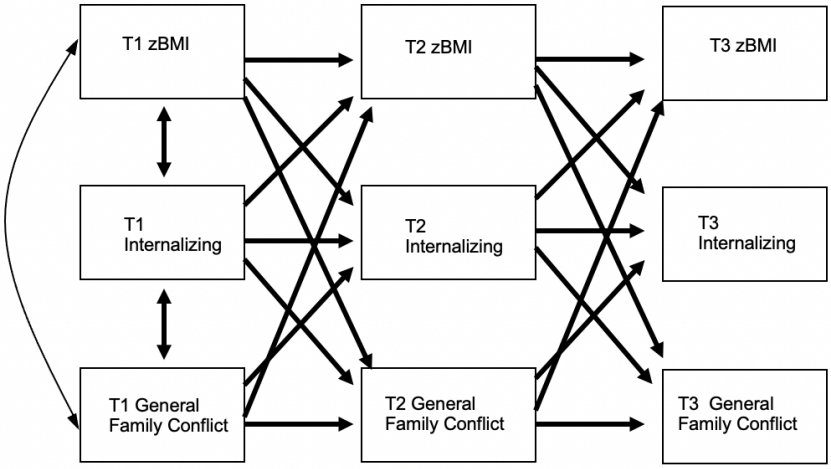
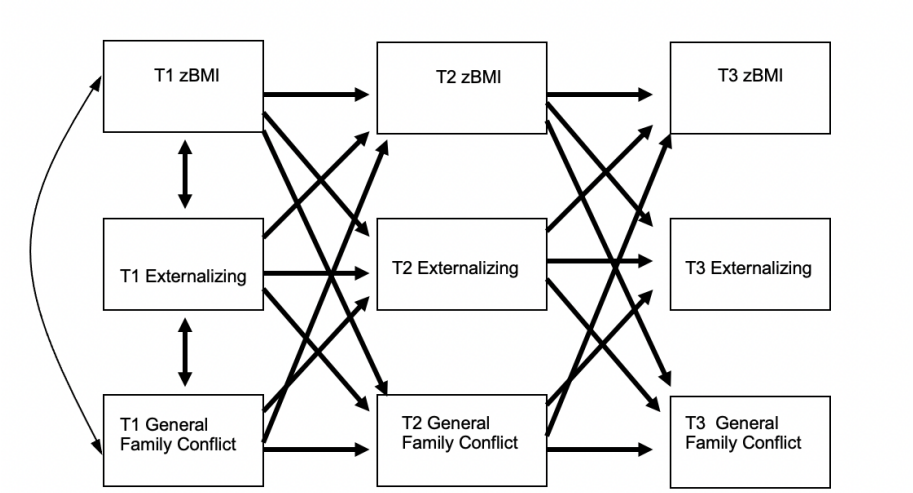


Figure 5. Model 4 cross-lagged model of BMI, externalizing symptoms, and general family conflict



Aim 5 of this study was to explore how models of the interrelations among family conflict, zBMI and mental health may vary based on child sex. It was hypothesized that mental health symptoms and zBMI would be more interrelated for females than for males. Thus, equivalence tests were conducted to determine if sex impacted model fit. Due to limited observations for the parameters that were estimated, these analyses were treated as exploratory.

CHAPTER THREE

RESEARCH METHODS

This research was approved and conducted in compliance with the Loyola University Chicago's Institutional Review Board and the school district's research review committee.

Participants

Eligible families had at least one Mexican-origin immigrant parent and one child between 6-10 years of age. Only one parent was required to be a Mexican-origin immigrant for the family to participate, but both parents were encouraged to participate in the study. Grandparents or aunts/uncles living in the home and providing care to the child were also included as secondary caregivers if no father was present in the home. Single parent families were also eligible to participate in the study. At T1, 98.1% of primary caregivers were mothers (one uncle and one father were primary caregivers) and 79.2% of secondary caregivers were fathers (there was one mother, nine grandparents, three aunts or uncles, one older sibling, and one stepfather). The majority of children were born in the U.S. (97.1%) and three were born in Mexico (2.9%). Family income was at or below 150% of the federal poverty line at the time of consent. The mean monthly income at T1 for primary caregivers was $1806.53 for an average of 3.98 family members supported. Out of 162 interested participants, 58 did not meet eligibility criteria, were no longer interested, or were not able to be contacted or scheduled, yielding a final sample of 104 families for T1. In the final sample, at T1, children's ages ranged from 6 to 10 years, (M_{age} = 8.39; 61% female).

Procedures

Data collection consisted of three, three-hour home visits, spaced six months apart. After initial eligibility screening, the family was scheduled for a home visit to complete audio- and video-recorded observational interaction tasks and questionnaires. Bilingual research assistants administered the questionnaires verbally to parents to overcome any language or literacy barriers. Parents completed a parent-report questionnaire packet and parents and children completed audio- and videotaped family interaction tasks together. At the end of the visit, children had their height and weight measured if they had assented to this and their parents consented. BMI measurement was conducted in the privacy of the home, and children were given the option to step into a room away from the other family members with the research assistants if they preferred (some children preferred to stay with their parent).

Interaction task. Families (mother and/or father, youth) completed a set of audio- and video-recorded interaction tasks. The family conflict task is based on the Family Social Interaction Task (Smetana, Yau & Hanson, 1991). Prior to the conflict task, parents and children completed the Parent-Adolescent Conflict (PAC) Scale, which is a15-item brief version of the Issues Checklist (Prinz, Foster, Kent, & O'Leary, 1979), where they indicated the frequency and intensity of discussion of various issues over the past 4 weeks (e.g., bedtime, chores). Frequency by intensity scores were created for each issue and the five issues with the highest weighted scores across family members were presented to families. Each family selected three of these issues for a 10-minute discussion.

Measures

Demographics. Parents reported on demographic information, including parent and child age, sex, and race/ethnicity. Parents also provided information about their education, job, and income.

Body Mass Indices. Children were weighed and measured for their height during an initial home visit (T1), 6 months later (T2) and follow-up visit 1 year later (T3). The following anthropometric measurements were collected at each time point: weight, measured to the nearest 0.1 kg (Seca 770, Hamburg, Germany); and height, measured to the nearest 0.1 cm (e.g. Invicta Stadiometer, Invicta, London, UK) and used to calculate BMI (kg/m2). Anthropometric measurements were used to calculate child z-scored BMI (zBMI) based on CDC growth charts (Kuczmarski et al., 2002). zBMI has been identified as an appropriate measurement of adiposity for youth in previous research as it takes into consideration youth's body mass and height in relation to normed growth charts (e.g. Kakinami, Henderson, Chiolero, Cole, & Paradis, 2014). At T1, 11 children declined to participate in the anthropometric measurements, and at T3, 12 children declined to participate or were unable to be reached for follow-up.

Food specific family conflict ratings. Food specific family conflict was rated as part of the Parent-Adolescent Conflict (PAC) Scale, which is a15-item brief version of the Issues Checklist (Prinz, Foster, Kent, & O'Leary, 1979). The PAC is composed of a list of potential conflicts often discussed in families with a preadolescent child (e.g., whether or not the child does chores around the house). Each item requires three responses. The family member first responds "yes" or "no" according to whether or not the issue was discussed during the last two

weeks. If yes, the family member indicates the number of times the issue was discussed and the average intensity of the discussion. Intensity is rated on a 5-point Likert scale (ranging from "calm" to "angry"). Frequency X intensity ratings were scored for the parents and child and then averaged across raters to create a total conflict score at the family level. For this study, food specific family conflict was measured using the average frequency x intensity rating across family members for conflict around what the child eats.

Observed general family conflict. Observed general family conflict was coded using a global-coding method called the Family Interaction Macro-coding System (FIMS; Holmbeck, Zebracki, Johnson, Belvedere, Hommeyer, 2007). FIMS has established reliability and construct validity with various samples of youth and their families (Kaugars et al., 2011). The conflict code is defined in the FIMS coding manual as conflict as evidenced by both verbal (statements that indicate a verbally defensive reaction; interrupting abruptly another member's speech to impose own ideas; speaking loudly to another member) and nonverbal behaviors (looking bothered; body gestures indicating hesitation or excitement; tension between family members) (Holmbeck et al., 2007). Amicable conflict (e.g., dyad is supportive of each individual despite the conflict, mood continues to be relatively light even with the conflict) was scored lower than disagreeable conflict. A score of "1" would indicate no conflict and a score of "5" would indicate the highest level of conflict and disagreement. Videos were coded by trained, Spanish-English bilingual research assistants. All research assistants followed the same coding methodology and were trained by the same study coordinator.

Research assistants were trained for a minimum of 10 hours prior to coding videos. Training involved reviewing five previously coded interactions and thoroughly discussing each item from the coding manual with an expert coder. After completing training, research assistants independently coded five new interactions which had been coded previously by expert coders. If 90% agreement with expert coders was reached during this trial (agreement = concordance across coders within one point on the Likert scale), research assistants could proceed independently. All interactions were coded by two research assistants. Interrater reliabilities were computed across coders and tasks for each family coping code by calculating the percent agreement (within 1 point on the Likert scale) and Intraclass correlations (ICCs). Conflict was rated separately between each dyad (i.e., primary caregiver and child, secondary caregiver and child, and primary and secondary caregivers). All dyads at all three time points demonstrated acceptable ICCs (>.40) based on standards set forth by Cichetti and colleagues (1994): T1 primary caregiver and child conflict (ICC = .69); T2 primary caregiver and child conflict (ICC = .71); T3 primary caregiver and child conflict (ICC = .65); T1 secondary caregiver and child conflict (ICC = .63); T2 secondary caregiver and child conflict (ICC = .58); T3 secondary caregiver and child conflict (ICC = .72); T1 primary and secondary caregiver conflict (ICC = .54); T2 primary and secondary caregiver conflict (ICC = .82); T3 primary and secondary caregiver conflict (ICC = .90).

Child mental health. Primary caregivers reported children's internalizing and externalizing behaviors over the past 6 months using the Child Behavior Checklist for Ages 6–18 (CBCL; Achenbach and Rescorla 2001). The internalizing scale consists of 32 items that assess

anxiety, depression, and somatic symptoms. The externalizing scale consists of 35 items that assess aggressive and rule-breaking behavior. Items were rated by caregivers using a three-point scale (0 = not true, 1 = somewhat or sometimes true, 2 = very true or often true). Raw scores were used in present analyses. The CBCL has previously demonstrated excellent reliability and validity (Achenbach and Rescorla 2001) and moderate agreement with youth reports (Huang 2017). In the current sample, internal consistency was high. Alphas ranged from .82 to .89 for the internalizing scale and .83 to .87 for the externalizing scale.

Children reported on depression symptoms using the Children's Depression Inventory (CDI; Kovacs, 1992). The CDI is a 27-item measure; however, for this study one item assessing suicidal ideation was removed. Children selected statements that best described their thoughts, feelings and behaviors over the past two weeks. For example, children selected either "I am sad once in a while," "I am say many times," or "I am sad all the time." Although the CDI is validated with children ages 7-17 (Kovacs, 1992), this measure has been used with 6-year-olds (e.g., Langley et al., 2015). In the present study, the alphas ranged 0.77 to 0.81.

Data Analytic Strategy

Preliminary data analyses. Prior to hypothesis testing, the psychometric properties of all measures were evaluated in SPSS. Descriptive statistics were computed for all outcome measures to determine basic distributional properties. Need for data transformation and reduction techniques was examined. Descriptive analyses of mental health, zBMI, and family conflict were conducted using frequency measures and Pearson's bivariate correlations. Eleven participants were missing zBMI measurements at T1 due to changes in data gathering procedure during the

initiation of home visits. *T*-tests was used to determine if participants missing zBMI at T1 differed significantly from those with data at that timepoint. Missing data procedures were handled in Mplus version 8.3 (Muthén & Muthén, 2017). Under the assumption that data is Missing at Random (MAR), Mplus has the capability to adjust for the relatively small amount of missing data using full information maximum estimation (Muthén & Muthén, 2017). Full information maximum estimation likelihood (FIML) allows for all cases to be retained in analysis (Kline, 2008); however, it does not impute new data (Hayes, Montoya & Rockwood, 2017). This method of multivariate estimation for incomplete data has been found to generally outperform traditional imputation methods (Peters & Enders, 2002).

Path Analyses. Path analyses (Aims 1-5) were estimated using structural equation modelling (SEM) through Mplus version 8.3 (Muthén & Muthén, 2017). Cross-lag path analyses allow for examining interplay among variables over time while avoiding bias related to assumptions about the direction of the effects (Selig & Little, 2012). Each model included "stability paths" (beta coefficients for a variable at one time point regressed on the same variable at the next time point) from one time point to the next (e.g., T1 Externalizing to T2 Externalizing) and cross-lagged paths (e.g., T1 Externalizing to T2 zBMI). Models initially had six stability paths and 18 cross-lagged paths. A seventh stability path was added due to high stability of zBMI over time (see Preliminary Analyses under Results).

Model fit was assessed using several fit statistics, including the chi-square goodness of fit statistic. For chi-square testing of model fit, non-significance of chi-square indicates good fit (Kenny, 2020). Several other measures of model fit were assessed. The root mean square error of

approximation (RMSEA; Browne & Cudeck, 1992) and the Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1999) are measures of absolute fit, which measure how close the model is to perfect fit. For RMSEA, values less than .06 indicate good fit and values less than .10 indicate adequate fit (Hu & Bentler, 1999; Browne & Cudeck, 1992; MacCallum, Browne, & Sugawara, 1996). SRMR values less than .08 can be considered indicators of good model fit to the data (Hu & Bentler, 1999). Two measures of relative model fit, the Bentler's comparative fit index (CFI) and the Tucker-Lewis Index (TLI), were conducted. Measures of relative fit measure how much better the given model fits compared to a "null" model (i.e. a model that assumes that sampling error alone accounts for the correlations) (Thill et al., 2003). According to Hu and Bentler (1999), CFI values above .90 indicate good fit. TLI values above .95 indicate good fit and values above .90 indicate adequate fit (Awang, 2015).

Analytic strategy for Aim 1. Two cross-lagged path models (using parent reported and child reported internalizing symptoms separately) were conducted examining the interplay among zBMI, internalizing symptoms, and food specific family conflict (see Figure 2). **Analytic strategy for Aim 2**: To examine the interplay of zBMI, externalizing symptoms, and food specific family conflict, a cross-lagged model was conducted (see Figure 3). **Analytic strategy for Aim 3:** To assess the interplay zBMI, internalizing symptoms, and general family conflict, two cross-lagged models (using parent reported and child reported internalizing symptoms) were conducted (see Figure 4). **Analytic strategy for Aim 4:** To assess the interplay zBMI, externalizing symptoms, and general family conflict, a cross-lagged model was conducted (see Figure 5). **Analytic strategy for Aim 5.** Models with good and adequate fit were tested using

equivalence testing to examine differential fit of the model for males and females. To determine equivalence between model fit for girls and boys, post-hoc multiple group invariance tests were conducted. These comparisons were accomplished by comparing model fit when parameters were freely estimated across groups (i.e. males and females) to models where parameters are constrained to be equal across groups. The overall model was determined to fit well across groups if the change in chi-square ($\Delta\chi^2$) is not significant (Cheung & Rensvold, 2002).

Power for RMSEA for the proposed models were estimated using the method described by Preacher and Coffman (2006). The model showed 84.75% power with a sample size of 104 and 24 degrees of freedom (a = .05, $RMSEA_{null} = 0$, $RMSEA_{alt} = .1$). Rule of thumb for SEM indicates that the ratio of sample size to number of free parameters should be at minimum 5 to 1 (Bentler & Chou, 1987). Although the present study falls just on the minimum observations required (4.95 to 1), a power analysis, a more rigorous method of measuring ability to detect model fit indicated sufficient power to conduct analyses (>80%).

CHAPTER FOUR

RESULTS

Preliminary Analyses

All independent and dependent variables were tested for skewness. Results indicated that general family conflict, food specific conflict, zBMI, externalizing, and internalizing symptoms were not highly skewed. Specifically, skewness values of general family conflict, food specific conflict, zBMI, externalizing, and internalizing symptoms ranged from -0.82 to 1.70. Thus, it was not necessary to transform these variables in order to conduct analyses. All variables were also tested for kurtosis. Results revealed that the general family conflict, food specific conflict, zBMI, externalizing, and internalizing variables were not highly platykurtic or leptokurtic. Kurtosis values ranged from -1.02 to 1.65. Independent *t*-tests and chi-square tests revealed that those missing zBMI scores at T1 did not significantly differ from those with zBMI scores at that timepoint in sex (χ^2= 1.18, p = .278), age (t =1.61, p = .111), or income (t = 0.14, p = .889).

Descriptive statistics and correlations for variables included in this study's primary baseline analyses can be found in Table 1. Children's T1 zBMI scores ranged from -1.66 to 2.72 with a mean of 1.00. Forty-two percent of children were normal weight, 14% were overweight (BMI > 85th percentile) and 37% were obese (BMI > 95th percentile). Using a clinical cutoff score of $t \geq 63$, 21% of children at T1 met the clinical cutoff for internalizing symptoms and 7% met the cutoff for externalizing symptoms.

Table 1. Descriptive Statistics and Correlations for Study Variables

	n	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Age	104	8.39	1.33																			
2. Gender[t]	104	**	**	-0.17	_																	
3. T1 PC Internalizing	102	7.29	7.10	-0.02	0.12	_																
4. T1 PC Externalizing	102	5.06	5.57	-0.13	0.16	0.72**	_															
5. T1 CDI	103	10.77	5.45	-0.18+	0.46	-0.04	0.02	_														
6. T2 PC Internalizing	98	5.78	5.90	0.004	0.19	0.76**	0.48**	0.02	_													
7. T2 PC Externalizing	98	4.02	4.69	-0.16	1.98+	0.52**	0.71**	0.03	0.64**	_												
8.T2 CDI	97	10.52	5.50	-.29**	-1.78+	0.06	0.11	0.53**	0.06	0.11	_											
9. T3 PC Internalizing	96	6.18	6.24	-0.08	0.28	0.70**	0.45**	-0.04	0.72**	0.45**	.10	_										
10. T3 PC Externalizing	96	4.19	5.39	0.02	1.12	0.58**	0.59**	-0.02	0.64**	0.71**	-0.01	0.68**	_									
11. T3 CDI	97	10.17	5.49	-0.43**	0.01	0.08	0.12	0.46**	0.08	0.17+	0.57**	0.17	0.07	_								
12. T1 Family Conflict	100	1.55	0.61	-0.05	1.34	-0.11	0.07	-0.00	0.04	0.15	-0.08	0.01	0.08	-0.08	_							
13. T2 Family Conflict	94	1.52	0.63	0.04	-0.27	-0.12	0.07	-0.06	0.00	0.11	-0.03	-0.02	0.12	-0.09	0.13	_						
14. T3 Family Conflict	93	1.76	0.65	-0.11	0.70	0.28**	0.11	-0.08	0.37**	0.21*	0.05	0.43**	0.29**	0.03	0.25*	0.08	_					
15. T1 Food Conflict	104	4.45	3.24	-0.16	1.22	0.88	0.22*	0.21*	0.16	0.17+	0.10	0.12	0.12	0.15	0.02	-0.08	-0.07	_				
16. T2 Food Conflict	95	4.01	2.86	-0.08	1.19	0.02	0.17	0.04	0.09	0.26*	0.23*	-0.09	-0.01	0.04	0.12	-0.13	0.00	0.34**	_			
17. T3 Food Conflict	93	3.96	3.22	-0.19+	0.68	0.14	0.27**	0.06	0.26*	0.31**	0.25*	0.27*	0.31**	0.11	0.10	0.06	0.05	0.34**	0.34**	_		
18. T1 zBMI	93	1.00	1.06	-0.05	1.94+	-0.02	0.04	0.01	-0.03	0.05	0.10	0.16	0.14	-0.03	0.14	-0.10	0.18	0.10	0.29**	0.32**	_	
19. T2 zBMI	92	0.95	1.06	-0.04	1.54	0.04	0.00	0.02	0.03	0.05	0.09	0.14	0.10	0.03	0.17	-0.16	0.12	0.06	0.24*	0.29**	0.95**	_
20. T3 zBMI	92	0.95	1.07	-0.08	1.64	0.00	0.06	0.05	0.01	0.12	0.14	0.14	0.12	0.10	0.16	-0.13	0.15	0.10	0.20+	0.31**	0.94**	0.92**

Note: ** p<.01; * p<,05; + p<.10; [t] t-test

Further analyses examined the degree of association between child sex and age with other variables included in the analyses. There were no significant associations between income to needs and key study variables. Child age was significantly correlated with T2 child reported depression sum (r = -.291, p = .004) and T3 child reported depression sum (r = -.426, p<.001). Thus, primary analyses using child reported depressive symptoms were run with age as a covariate. There were no significant differences between males and females for the variables examined. However, there were trends for males having higher externalizing symptoms at T2 (M_{males} = 5.26, SD = 5.59, $M_{females}$ = 3.23, SD = 3.99, t = 1.98, p = .052), females having higher self-reported depressive symptoms at T2 (M_{males} = 9.35, SD = 4.39, $M_{females}$ = 11.23, SD = 6.01, t

= -1.78, p = .079) and boys having higher zBMI at T1 (M_{males} = 1.27, SD = 1.00, $M_{females}$ = .84, SD = 1.08, t = 1.94, p = .056). Post-hoc multiple group invariance tests between males and females were conducted to assess differences in the developmental processes by examining differences in overall model fit for boys and girls. zBMI was highly correlated across timepoints, thus demonstrating very high stability over time. T1 and T3 zBMI were correlated at (r =.94 , p<.001). Thus, a pathway was included from T1 to T3 zBMI in cross-lagged models to account for this high stability over time.

Cross-lagged Path Analyses

A total of nine cross-lagged path models were conducted (described below). Six models were run to test Aims 1-4 and three models were run to examine Aim 5. See Table 2 for summary of model fit for models.

Table 2. Summary of Structural Equation Models

Model	χ2	DF	TLI	CFI	SRMR	RMSEA
zBMI, CR Internalizing, Food Conflict (controlling age)	31.16	18	.943	.974	.070	.084
zBMI, PR Internalizing, Food Conflict	22.99	11	.938	.979	.034	.102
zBMI, Externalizing, Food Conflict	12.79	11	.990	.997	.038	.040
zBMI, CR Internalizing , General Conflict (controlling age)	27.43	18	.956	.980	.060	.070
zBMI, PR Internalizing, General Conflict	28.25	11	.908	.969	.04	.123
zBMI, Externalizing, General Conflict	13.79	11	.984	.995	.033	.049

Note: PR = parent reported; CR = child reported; shaded area indicates reasonably good fitting models.

Aim 1: zBMI, Internalizing Symptoms and Food Specific Family Conflict. Two models were conducted to test the aim that zBMI, internalizing symptoms and food specific family conflict would have cross-lagged associations over time (Aim 1). When accounting for age at T2 and T3 child reported depressive symptoms, model fit was approaching acceptable fit where $\chi 2$ (18) = 31.16, p = .028; CFI = 0.974; TLI = 0.943; RMSEA = 0.084; SRMR = 0.07. Although CFI and SRMR indicated good fit and RMSEA and TLI indicated adequate fit, $\chi 2$ was poor. A model using parent reported depressive symptoms was also approaching acceptable fit, where $\chi 2$ (11) = 22.99, p = .018; CFI = 0.979; TLI = 0.938; RMSEA = 0.102; SRMR = 0.034. CFI and SRMR indicated good fit, TLI indicated adequate fit, however, $\chi 2$ and RMSEA indicated poor fit. No pathways were interpreted for models tested for Aim 1 because fit indices did not reach appropriate level of acceptability.

Aim 2: zBMI Externalizing Symptoms and Food Specific Family Conflict. To examine the interplay of zBMI, externalizing symptoms and food specific family conflict (Aim 2), one cross-lagged model was conducted. Model fit was reasonably good for $\chi 2$, indices of absolute fit (SRMR and RMSEA) and indices of relative fit (TLI and CFI) ($\chi 2$ (11) = 12.79, p = .307; CFI = 0.997; TLI = 0.990; RMSEA = 0.04; SRMR = 0.038). As model fit was reasonably good, pathways were examined (see Table 3 for all pathway coefficients and correlated residual variance). As expected, stability pathways for zBMI, externalizing symptoms and food conflict were significant over time. Examination of cross-lagged paths revealed several significant pathways. T1 zBMI predicted higher food conflict at T2 (b = 0.65, p = .013) and T2 zBMI predicted higher food conflict at T3 (b = 0.72, p= .012) and higher externalizing symptoms at T2

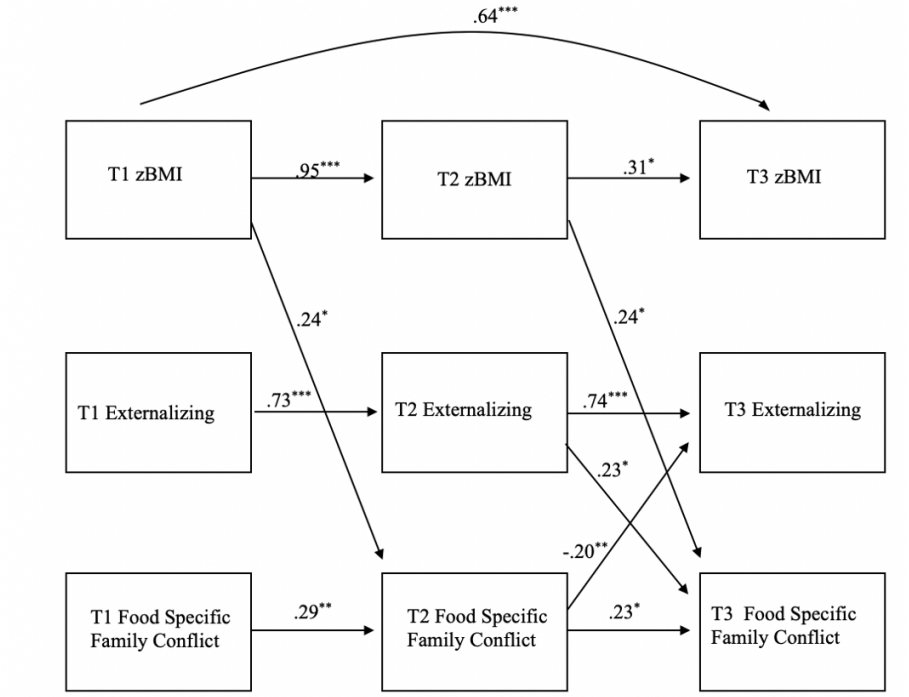
predicted higher food conflict at T3 (b = .148, p = .02). However, T2 food conflict predicted lower externalizing symptoms at T3 (b = -0.37, p = 0.007). Figure 6 depicts significant pathways.

Table 3. Unstandardized value, standardized value, standard error of unstandardized value, and significance for all path coefficients and correlated residual variances for zBMI, externalizing symptoms and food specific family conflict.

Path Coefficients					
Outcome	**Predictor**	***b***	***SE***	***β***	***p***
T2 zBMI	T1 zBMI	0.97	0.03	0.95	< .001***
	T1 Externalizing	-0.01	0.01	- 0.03	.428
	T1 Food Conflict	-0.01	0.01	-0.01	.870
T3 zBMI	T2 zBMI	0.32	0.14	0.31	.019*
	T1 zBMI	0.66	0.14	0.64	< .001***
	T2 Externalizing	0.01	0.01	0.03	.547
	T2 Food Conflict	-0.01	0.15	-0.04	.347
T2 Externalizing	T1 Externalizing	0.65	0.06	0.73	< .001***
	T1 zBMI	0.32	0.33	0.07	.334
	T1 Food Conflict	0.02	0.11	0.01	.844
T3 Externalizing	T2 Externalizing	0.82	0.08	0.74	< .001***
	T2 zBMI	0.58	0.37	0.11	.114
	T2 Food Conflict	-0.37	0.14	-0.20	.007
T2 Food Conflict	T1 Food Conflict	0.26	0.08	0.29	.002**
	T1 Externalizing	0.04	0.05	0.08	.416
	T1 zBMI	0.65	0.26	0.24	.013*
T3 Food Conflict	T2 Food Conflict	0.25	0.11	0.23	.021*
	T2 Externalizing	0.15	0.06	0.23	.020*
	T2 zBMI	0.72	0.29	0.24	.012*
Correlated Residual Variance					
Variable 1	**Variable 2**	**Unstd.Value**	***SE***	**Std.Value**	***p***
T1 Externalizing	T1 zBMI	0.23	0.58	0.04	.688
	T1 Food Conflict	3.77	1.80	0.21	.036*
T1 zBMI	T1 Food Conflict	0.36	0.33	0.11	.273
T3 Externalizing	T3 zBMI	-0.15	0.16	-0.11	.358
	T3 Food Conflict	2.06	1.06	0.21	.052^{+}
T3 zBMI 2	T3 Food Conflict	0.03	0.12	0.03	.811

Note: *p<.05, **p<.01, ***p<.001, ^{+}p<.10

Figure 6. Standardized structural equation modeling results for the relations among zBMI, externalizing symptoms and food specific family conflict.



Note: Only significant pathways are depicted. Parameter estimates are standardized. *p<.05, **p<.01, ***p<.001.

Aim 3: zBMI, Internalizing Symptoms and General Family Conflict. Two models were conducted to test the aim that zBMI, internalizing symptoms and general family conflict would have cross-lagged associations over time (Aim 1). A model was run using child reported depressive symptoms, zBMI and general family conflict while accounting for age. Model fit was reasonably good for all measures of fit, where $\chi 2$ (18) = 27.43 p = .071; CFI = 0.980; TLI = 0.956; RMSEA = 0.07; SRMR = 0.06. Thus, pathways were examined (see Table 4 for all pathway coefficients and correlated residual variance). As predicted, stability paths among zBMI and child reported depressive symptoms across all three timepoints were significant. However, stability paths for general family conflict were not significant over time. There were no

significant cross-lagged pathways. In the second model, model fit was poor when examining zBMI, parent reported internalizing symptoms and general family conflict with $\chi 2$ (11) = 28.25, p = .003; CFI = 0.969; TLI = 0.908; RMSEA = 0.123; SRMR = 0.04. While CFI, SRMR and TLI indicated good fit, $\chi 2$ and RMSEA indicated poor fit. No pathways were examined as model fit did not reach sufficient level of acceptability.

Table 4. Unstandardized value, standardized value, standard error of unstandardized value, and significance for all path coefficients and correlated residual variances for zBMI, child reported depressive symptoms and general family conflict with controlling for age.

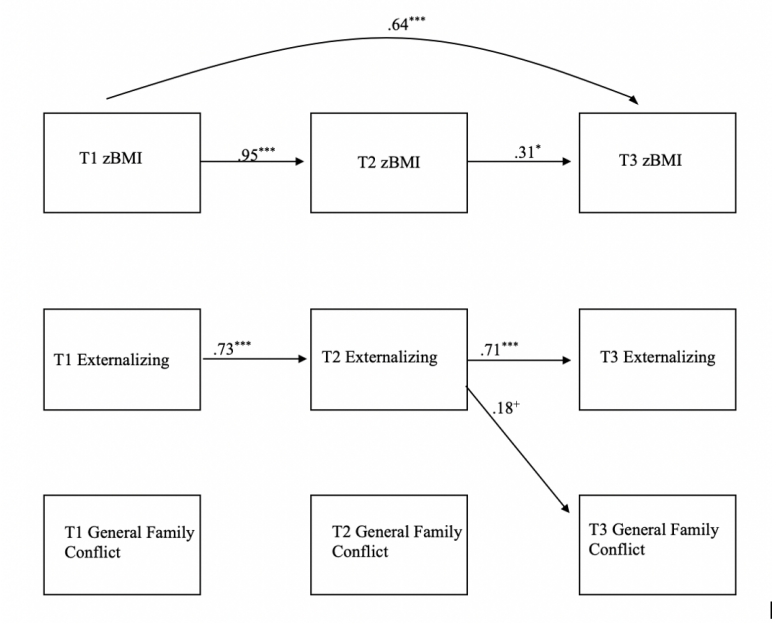
Path Coefficients					
Outcome	**Predictor**	***b***	***SE***	***β***	***p***
T2 zBMI	T1 zBMI	0.97	0.04	0.95	<.001***
	T1 CDI	0.01	0.01	0.03	.330
	T1 Gen Fam Conflict	0.04	0.06	0.02	.537
T3 zBMI	T2 zBMI	0.29	0.14	0.29	<.001***
	T1 zBMI	0.66	0.14	0.66	.034
	T2 CDI	0.01	0.01	0.05	.227
	T2 Gen Fam Conflict	-0.00	0.07	-0.00	.986
T2 CDI	T1 CDI	0.49	0.08	0.50	<.001***
	T1 zBMI	0.60	0.44	0.12	.174
	T1 Gen Fam Conflict	-1.01	0.79	-0.11	.203
	T1 Age	-0.85	0.35	-0.21	.016*
T3 CDI	T2 CDI	0.47	0.09	0.47	<.001***
	T2 zBMI	-0.23	0.43	-0.05	.590
	T2 Gen Fam Conflict	-0.64	0.79	-0.08	.381
	T1 Age	-1.09	0.35	-0.27	.002**
T2 Gen Fam Conflict	T1 Gen Fam Conflict	0.15	0.12	0.15	.180
	T1 CDI	-0.01	0.01	-0.06	.547
	T1 zBMI	-0.09	0.06	-0.15	.147
T3 Gen Fam Conflict	T2 Gen Fam Conflict	0.09	0.11	0.09	.401
	T2 CDI	0.01	0.01	0.05	.598
	T2 zBMI	0.08	0.06	0.14	.194
Correlated Residual Variance					
Variable 1	**Variable 2**	**Unstd. Value**	***SE***	**Std.Value**	***P***
T1 CDI	T1 zBMI	-0.06	0.55	-0.01	.917
	T1 Gen Fam Conflict	-0.03	0.34	-0.01	.924
T1 zBMI	T1 Gen Fam Conflict	0.08	0.06	0.13	.204
T3 CDI	T3 zBMI	0.29	0.18	0.18	.108
	T3 Gen Fam Conflict	-0.08	0.29	-0.03	.795
T3 zBMI 2	T3 Gen Fam Conflict	-0.01	0.03	-0.03	.809

Note: * p<.05, ** p<.01, *** p<.001, ^{+}p<.10

Aim 4: zBMI, Externalizing Symptoms and General Family Conflict . To assess the interplay of zBMI, externalizing symptoms, and general family conflict (Aim 4), one cross-lagged model was conducted. The model fit was reasonably good: $\chi 2$ (11) = 13.789, p = .245;

CFI = 0.995; TLI = 0.984; RMSEA = 0.049; SRMR = 0.033. Thus, pathways were examined (see Table 5 for all pathway coefficients and correlated residual variance). Stability paths for zBMI and externalizing symptoms were significant. However, stability paths for general family conflict were not significant. Examination of cross-lagged paths revealed a trend of T2 externalizing symptoms predicting T3 general family conflict (b = .024, p= .076) (see Figure 7). There were no significant cross-lagged pathways.

Figure 7. Standardized structural equation modeling results for the relations among zBMI, externalizing symptoms and general family conflict.



Note: Only significant pathways are depicted. Parameter estimates are standardized. $^{+}p<.10$, $^{*}p<.05$, $^{***}p<.001$

Table 5. Unstandardized value, standardized value, standard error of unstandardized value, and significance for all path coefficients and correlated residual variances for zBMI, externalizing symptoms and general family conflict.

Path Coefficients					
Outcome	**Predictor**	***b***	***SE***	***β***	***p***
T2 zBMI	T1 zBMI	0.97	0.04	0.95	< .001***
	T1 Externalizing	-0.01	0.01	-0.03	.357
	T1 Gen Fam Conflict	0.04	0.06	0.03	.496
T3 zBMI	T2 zBMI	0.31	0.14	0.31	.027*
	T1 zBMI	0.65	0.14	0.64	< .001***
	T2 Externalizing	0.00	0.01	0.01	.763
	T2 Gen Fam Conflict	-0.01	0.07	-0.00	.933
T2 Externalizing	T1 Externalizing	0.65	0.06	0.73	< .001***
	T1 zBMI	0.28	0.33	0.06	.400
	T1 Gen Fam Conflict	0.39	0.57	0.05	.493
T3 Externalizing	T2 Externalizing	0.76	0.08	0.71	< .001***
	T2 zBMI	0.40	0.37	0.08	.277
	T2 Gen Fam Conflict	0.38	0.62	0.05	.538
T2 Gen Fam Conflict	T1 Gen Fam Conflict	0.15	0.12	0.15	.194
	T1 Externalizing	-0.01	0.01	0.07	.503
	T1 zBMI	-0.09	0.06	-0.15	.160
T3 Gen Fam Conflict	T2 Gen Fam Conflict	0.07	0.11	0.07	.485
	T2 Externalizing	0.02	0.01	0.18	.076^{+}
	T2 zBMI	0.08	0.06	0.13	.211
Correlated Residual Variance					
Variable 1	**Variable 2**	**Unstd. Value**	***SE***	**Std.Value**	***p***
T1 Externalizing	T1 zBMI	0.18	0.58	0.03	.751
	T1 Gen Fam Conflict	0.19	0.36	0.06	.597
T1 zBMI	T1 Gen Fam Conflict	0.08	0.06	0.13	.197
T3 Externalizing	T3 zBMI	-0.10	0.16	-0.07	.558
	T3 Gen Fam Conflict	0.47	0.24	0.20	.055^{+}
T3 zBMI 2	T3 Gen Fam Conflict	-0.01	0.03	-0.03	.810

Note: * p<.05, ** p<.01, *** p<.001, $^{+}$ p<.10

Aim 5. Equivalence Testing for Sex. For models with reasonably good fit, post-hoc multiple group invariance tests between males and females were conducted to assess differences in developmental trajectories. Thus, the model examining zBMI, externalizing symptoms and food specific family conflict was analyzed using equivalence testing to assess the impact of sex on model fit. When sex was held constant in the model, model fit did not significantly worsen $\Delta\chi^2$ **(**29) = 14.94, p= .985), indicating that model fit was equivalent for males and femlaes. Equivalence testing was also conducted with the model examining zBMI, child reported

depressive symptoms and general family conflict while controlling for age. When multiple group invariance tests were run on this model, the model did not significantly worsen when sex was held constant *(*$\Delta\chi^2$ (18) = 23.40, p= .114), Finally, a multiple group invariance test between males and females was conducted on the model examining zBMI, externalizing symptoms and general family conflict. When sex was held constant in the model, model fit did not significantly worsen ($\Delta\chi^2$(30) = 40.55 p= .094), indicating that model fit was equivalent for males and females.

CHAPTER FIVE

DISCUSSION

This study aimed to examine the complex interplay among child weight, mental health symptoms and family conflict among Mexican-origin families with low-incomes. Previous research has established significant associations among all three of these factors (e.g., Camfferman et al., 2016; Garthus-Niegel et al., 2010; Halliday et al., 2014; Carter et al., 2010), but research had yet to examine all three factors in a single model across time. To examine this interplay, the present study used cross-lagged path analysis. Furthermore, sex differences in developmental trajectories were examined.

Externalizing Symptoms, Family Conflict and zBMI (Aim 2, Aim 4)

Of the panel models examined, only one demonstrated significant cross-lagged associations over time: externalizing symptoms, food specific family conflict and child zBMI. Higher zBMI at T1 predicted higher family conflict about eating three months later at T2, and higher zBMI at T2 predicted higher family conflict about eating three months later at T3. This finding is consistent with previous literature suggesting that weight management of youth can lead to increased family conflict regarding food choices and eating habits (e.g., Ramalho et al., 2016). This finding expands on previous literature in that it demonstrates how childhood weight management impacts the functioning of the family as a whole, even in a short time period. Furthermore, previous literature has focused on family conflict about eating among adolescents with overweight/obesity, where struggles for independence in decision making may play a

large role in this conflict. However, this finding highlights the impact of weight on the family functioning of children in middle childhood. School-aged youth may begin to take increased independence around food, through making food choices at school and in other activities outside of the home. For children as young as 6, concerns regarding weight management may lead to greater family conflict. Within a first-generation Mexican American population, other factors such as cultural conflict around food choice might play a role in this interplay of zBMI on family conflict. For example, the acculturation gap between children and parents may impact conflict around eating and food choices. Research suggests that parents and youth have different rates of acculturation to the dominant culture, which can lead to conflict and stress among immigrant families (Hwang, 2006; Dondero & Van Hook, 2016). Typically, children of immigrants acculturate to the new dominant culture, such as cultural dietary practices, quicker than parents due to exposure to school, peers and the media (Hwang, 2006; Dondero & Van Hook, 2016). Research has found that acculturation to a dominant-culture American diet is associated with increased intake of fat and added sugar (Perez-Escamilla, 2011). Parents who are less acculturated to the dominant (U.S.) culture may show greater authoritarian feeding styles (Power, O'Connor, Fisher & Hughes, 2015). Thus, the increase of conflict related to higher zBMI may be in part influenced by stress associated with an acculturation gap in eating/feeding practices among parents and youth. Interestingly, family conflict around food did not predict later zBMI, suggesting that the conflict measured around eating is mainly driven by the child's weight status. That is, families with children with overweight or obesity may experience conflict around eating practices. Yet, in this sample, family food-related conflict did not predict later weight status. Importantly, this study was limited in its short time span (1 year), and zBMI was

relatively stable over the course of the year. Therefore, the limited study time frame may not have captured the longitudinal nature of this relationship. Thus, it is possible that in addition to the identified association between child zBMI and later family food conflict, a similar pattern between family food conflict and later child weight status may emerge over a longer time span.

Counter to study hypotheses, zBMI and externalizing symptoms were not associated over time in this cross-lagged panel model. zBMI and externalizing may have a relatively smaller association that develops over longer periods of development. Previous literature has found increased rates of externalizing problems among youth with overweight/obesity, and this finding was hypothesized to be related to differences in self-regulation that co-occur in obesity and externalizing disorders, such as ADHD (e.g., Golan & Bachner-Melman, 2011; Datar & Chung, 2018). However, in the present study which examined the short-term interplay of weight and externalizing symptoms, family conflict around eating appeared to be the more salient effect of elevated zBMI. As such, research focusing on the impact of externalizing concerns on childhood weight management may benefit from examining the possible intermediary effects of family conflict over time.

Although zBMI was not directly associated with externalizing symptoms over time, a more complex picture emerged about the association among food-specific family conflict and externalizing symptoms over time: higher externalizing symptoms at T2 predicted higher food specific family conflict at T3, however, higher food specific family conflict at T2 predicted lower externalizing symptoms at T3. This finding partially supports the hypothesis that externalizing symptoms would lead to increased family conflict, specifically related to eating. However, conflict around food may not in and of itself lead to increased behavioral problems.

While this finding is in contrast with previous literature indicating positive bidirectional associations over time between family conflict and externalizing symptoms (e.g., Burt et al., 2005), this study examined the impact of family conflict specifically related to eating, which as a construct may be separate from general family conflict. In fact, in bivariate correlations, food specific family conflict and general family conflict were not significantly associated. Additionally, externalizing symptoms in this sample were on average low, with only 7% of the sample meeting the clinical cutoff at T1. In families with youth with relatively low levels of behavioral concerns, conflict around the topic of eating may lead to fewer externalizing symptoms later on, since reported conflict may in fact represent an increase in parental management and rule setting around food. In the short term, increased family level conflict around eating may be associated with increased externalizing symptoms, however, conflict around eating practices within the family may be due to increased parental supervision and thus fewer externalizing symptoms later on. Furthermore, this unexpected finding may be due to culturally-specific family processes at play in this population: some past research has shown that hierarchical parenting styles, or use of clear parental authority, reduces externalizing symptoms among Latinx families but not non-Latinx white families (Holtrop, Smith, & Scott, 2015). It has been hypothesized that the cultural value of *respeto*, or respect for parental authority, is an important protective factor for externalizing symptoms among Latinx groups (Holtrop et al., 2015). Children in families in which there is high value placed on parental authority may seek to avoid increased conflict and thus demonstrate a reduction in externalizing symptoms in the short term. Increased food specific family conflict may represent an increase of culturally normative

parental authority over children's eating habits, which in turn may reduce externalizing symptoms among this population.

Counter to the study's hypotheses, there were no significant cross-lagged associations across time for youth's externalizing symptoms, zBMI and general family conflict. Although there was a trend of T2 externalizing symptoms predicting higher T3 general family conflict, this finding did not reach statistical significance. Thus, although findings supported the complex interplay of externalizing symptoms, zBMI and family reported conflict surrounding food and eating, this study did not find evidence to support these associations for general family conflict as observed during a video-taped interaction. Despite the lack of cross-lagged associations among these three variables across time when all variables are included in the model, bivariate associations revealed significant positive associations between T2 externalizing symptoms and T3 general family conflict as well as T3 externalizing symptoms and general family conflict. As such, general, observable family conflict, may be associated with externalizing symptoms broadly, whereas food specific family conflict may independently contribute to the development of externalizing symptoms overtime within the context of childhood overweight and obesity.

Internalizing Symptoms, Family Conflict and zBMI (Aim 1, Aim 3)

Model fit was inadequate to interpret pathways for the models examining the cross-lagged associations among internalizing symptoms (both child reported and parent reported), food specific family conflict and zBMI. Thus, this study does not provide support for the hypothesis that internalizing symptoms, food specific family conflict and zBMI would have positive, cross-lagged associations over time. However, analyses revealed positive bivariate associations among food specific family conflict and both parent and child reported internalizing

symptoms at multiple timepoints. Furthermore, as discussed above, there were bivariate correlations among zBMI and food specific family conflict across multiple timepoints. Bivariate correlations did not reveal any significant associations among zBMI and internalizing symptoms at any timepoints. Finally, there was no evidence to suggest a cross-lagged association among general family conflict, internalizing symptoms and zBMI for both parent and child reported internalizing symptoms. A model with parent reported internalizing symptoms, general family conflict and zBMI also did not reach adequate fit. For child reported symptoms, the model had adequate fit, however, there were no significant cross-lagged paths. Bivariate correlations revealed significant associations among T3 general family conflict and internalizing symptoms at all three time points. However, internalizing symptoms were not associated with general family conflict at T1 or T2. Furthermore, zBMI was not correlated with internalizing symptoms or general family conflict. Taken together, these findings suggest that although internalizing symptoms may be associated with both general and food related family conflict, they do not directly impact zBMI within this short time frame. Additionally, internalizing symptoms may be less salient in the context of weight management for school-aged children. Research has found that internalizing symptoms increase significantly between ages 12 and 17, whereas rates of externalizing symptoms are highest between the ages of 6 and 11 (Ghandour et al., 2019). Thus, the interplay of zBMI, family conflict and mental health symptoms for school-aged youth may be reflected in externalizing, rather than internalizing symptoms during this developmental period.

Sex Differences (Aim 5)

The final aim of this study was to explore the differences between males and females in the associations among zBMI, mental health and family conflict. This study hypothesized that developmental trajectories would vary based on children's sex, specifically that there would be stronger fit for females than males. However, equivalence testing of models did not reveal any significant differences between males and females in developmental trajectories. It is possible that sex differences do not emerge in middle childhood; rather, these differences may emerge as children enter adolescence when sex differences in mental health problems, such as internalizing symptoms, increases (Ghandour et al., 2019). However, given the small sample size and the number of parameters estimated in these models, there is not sufficient evidence to indicate that no such sex difference exists. Previous literature suggests that the associations between weight status and mental health symptoms may vary based on sex (e.g., Lawlor et al., 2005). However, other literature has not found this moderating effect (e.g., Camfferman et al., 2016; De Wit et al., 2010; Bradley et al., 2008). There have been similarly mixed findings with the moderating effect of sex on the associations among mental health and family conflict (e.g., Smojver-Ažić et al., 2005; Formoso, Gonzales, & Aiken, 2000). Future research with sufficient sample sizes is needed to better understand how family processes, such as conflict, impact these associations over time.

Implications

The present study has several important implications for intervention with youth and families. Conflict about food choice and eating may be an important area of intervention for school-age youth with overweight or obesity. For Mexican-origin youth, family functioning

around meals may be particularly important as an intervention target, as family is recognized as a central source of support in this population (e.g., Sabogal et al. 1987; Smith-Morris et al. 2013). Although many interventions for pediatric obesity include parental involvement, such as providing education on strategies to support children in dietary changes and physical activity, meta-analyses have shown that these family-centered programs' have effect sizes that range from small to medium (Janicke et al., 2014). Results from the present study underscore that broader family functioning, such as conflict around eating, may be an important additional target of family-based interventions. Indeed, researchers have argued that broader family context may moderate treatment outcomes (Fiese, Hammons, & Gigsby-Toussaint, 2012; Kitzmann, Dalton, & Buscemi, 2008). As such, family-based interventions may benefit from not only focusing on supporting parents and children in behavioral strategies for improving healthy eating and exercise habits, but also through focusing on the overall level of family conflict related to eating within the home. Furthermore, the present study highlights the impact of family conflict around food on children's mental health. Externalizing problems were found to have a dynamic relation with family conflict around food, and culturally specific factors, like deference for parental authority among Mexican-origin populations, may impact how conflict and externalizing symptoms relate to one another over time. This finding underscores the need for screening for mental health symptoms when addressing pediatric obesity, even for youth as young as 6 to 10 years old. Furthermore, it highlights the importance of using a culturally-sensitive lens when working on family functioning with youth from diverse backgrounds.

Strengths and Limitations

There were several strengths of the present study. First, this study utilized a longitudinal design, which provided the ability to examine the dynamic process of development among an at-risk population across time. Furthermore, the study examined youth during an important developmental time period, school-age, in which greater independence around eating and food choices begins to place children at risk for obesity (Fryar et al., 2019). This time period precedes adolescence, in which a dramatic increase in mental health symptoms appears (Ghandour et al., 2019). Thus, examining youth and their interactions with their parents during this period may provide important insight into dynamics that may predispose or impact youth later on in development. Additionally, constructs in this study were examined using multiple forms of measurement, including multiple informants (parents and children) and well as the use of observational and anthropomorphic data. Finally, this study uses a community sample of youth who are at increased risk for obesity and mental health concerns due to factors of poverty and systemic xenophobia toward Mexican-origin individuals with low incomes in the U.S. (Yoshikawa et al., 2017). By examining family systems within the context of poverty, discrimination and chronic stress, research may gain greater insights into the processes in which youth incur risk for both physical and mental health concerns.

While this study adds to the literature on the impact of mental health, family conflict and BMI, there are several limitations to the present study. Sample size was one major limitation to this study. To examine cross-lagged paths, the study fell just below the acceptable number of observations to parameters examined for SEM (Bentler & Chou, 1987). Thus, the present study had low power to detect small effect sizes. Next, the present study was conducted over a

relatively short time span: one year. As such, given the small sample size and short time span, the present study may not have had the sufficient power to detect a small effect size that might occur during such a short time span. Furthermore, zBMI was examined, which has been identified as an appropriate measurement of adiposity for youth in previous research (e.g. Kakinami et al., 2014). However, additional measurements of overweight/obesity, such as waist circumference and DEXA-derived adiposity would provide additional evidence to understand this dynamic interplay (Kakinami et al., 2014). Also, although sex and age were accounted for in models, pubertal timing, which may affect BMI as well as mental health symptoms, was not measured in this sample. Finally, this sample of Mexican-origin families with low incomes from an urban environment may not generalize to other populations. This sample had relatively low reports of externalizing symptoms, which also may not make it representative of other populations.

Future Directions

Future research should aim to further understand this complex interplay among youth's BMI and mental health with family functioning. Firstly, future research would benefit from larger sample sizes to improve power to detect small effects over shorter time spans, which was limited in the present study. Specifically, larger sample sizes would allow for more nuanced observations of difference among males and females in regards to developmental trajectories. Research would also benefit from examining additional timepoints to better understand how this interplay develops and changes over early adolescence, as the interplay of internalizing symptoms, family conflict and BMI may be more salient for adolescents. Finally, studies on culturally-specific factors, such as *respeto* or acculturative gaps would add to a more complete

understanding on how family functioning for Mexican-origin youth impacts mental health and weight management over time.

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VITA

Dr. Laura M. L. Distel completed her PhD at Loyola University Chicago in clinical psychology with a specialization in children and families. She received her B.A. in Psychology and Latin American and Caribbean Studies from University of Michigan, Ann Arbor and graduated with highest distinction in 2013. She completed her Masters in Clinical Psychology at Loyola University of Chicago in 2018. Her master's thesis investigated the roles of chronic stress, hair cortisol and parental warmth on childhood obesity among Mexican-origin youth with low incomes. Dr. Distel has been actively involved in multiple research projects including a longitudinal research study investigating stress and family coping among Mexican-origin immigrant families and trauma-focused interventions for children in schools. Dr. Distel's most recent research has focused on the intersection of physical and mental health and the impact of family environment on chronic medical conditions. Dr. Distel's research endeavors have resulted in multiple conference presentations and several publications that have been accepted, are in preparation, or are under review. Clinically, Dr. Distel focuses on working with youth with chronic medical conditions and providing evidence-based intervention for youth and families experiencing comorbid mental health concerns. Dr. Distel is currently completing her clinical internship in pediatric psychology at Children's Hospital of Philadelphia and will begin her postdoctoral fellowship at Boston Children's Hospital in the Fall of 2021.