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Factors Associated with the Intergenerational Transmission of Obesity

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Factors Associated with the Intergenerational Risk of Obesity

Jennifer Ramirez, Ph.D.

University of Connecticut, 2017

Research indicates that adolescents who have an obese mother have an increased risk of obesity. Despite genetic and ecological factors that may contribute to intergenerational transmission of obesity, many adolescents with an obese mother are not overweight/obese themselves. The current study examines three domains (i.e., SES/neighborhood factors, family context, and individual weight behaviors and attitudes) drawn from ecological models of health that may influence mother/daughter weight similarity. Participants included 181 low-income adolescent females and their biological mothers. Four dyadic groups were compared, including; 1. Obese mothers with an overweight/obese daughter (OM/OD), 2. Non-obese mothers with an overweight/obese daughter (NOM/OD), 3. Obese mothers with a non-overweight/obese daughter (OM/NOD), and 4. Non-obese mothers with a non-overweight/obese daughter (NOM/NOD). Multivariate and univariate analyses of covariance with planned contrasts and chi-square tests were used to test for group differences. Of particular interest were group differences in the three domains between OM/OD and OM/NOD groups.

Analyses demonstrated no significant group differences in SES/neighborhood factors. In the family context domain, there were group differences in the mother-daughter communication factors and in maternal mental health variables (i.e., Depression and PTSD). In contrast, family environment (shared family meals, dyadic decision

making about food, rules about eating) and mother-daughter relationship factors (maternal warmth and hostility, relationship style) were not significantly different among

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groups. In the individual weight behaviors and attitudes domain, there were significant group differences in the expected direction, but no group differences in mother or daughter exercise behavior. In the contrast of most interest (OM/OD versus OM/NOD), maternal mental health factors were the most robust distinguishing characteristic. In post hoc analyses, potential mediators of the link between maternal depression and adolescent overweight/obesity were explored.

Overall, results suggest maternal mental health may increase the likelihood for obesity among adolescent girls at elevated risk because of maternal obesity. Factors such as the functional impairment related to a mother's mental health (e.g., low motivation) or modeling of unhealthy coping strategies (e.g., emotional eating) could be mechanisms through which adolescents are at increased risk for obesity. Increased attention should be paid to family context of adolescent females as health care professionals develop and implement prevention and intervention efforts.

Factors Associated with the Intergenerational Transmission of Obesity

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B.A., University of Wisconsin- Madison, 2009

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APPROVAL PAGE

Doctor of Philosophy Dissertation

Factors Associated with the Intergenerational Transmission of Obesity

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Introduction

Obesity is one of the most common chronic health problems in the United States, particularly among women. More than sixty-five percent of adult women meet criteria for overweight (Body Mass Index (BMI) ≥ 25), and more than one-third meet criteria for obesity (BMI ≥ 30) (Ogden, Carroll, Kit, & Flegal, 2014). These rates are concerning because obesity is associated with many health problems such as Type 2 diabetes (Mokdad et al., 2003), heart disease (Whittemore, Jeon, & Grey, 2013; Dong et al., 2004; Van Gaal, Mertens, & De Block, 2006), and mental illness (Faith, Matz, & Jorge, 2002). Another reason for concern about obesity among women is because overweight/obesity is often “passed on” intergenerationally. Consequently, adult women who are obese are more likely to have children who are also overweight and obese, and early obesity can initiate a deleterious lifelong health trajectory. Although both maternal and paternal BMI predict children’s weight, maternal BMI seems to have a stronger influence (Burke, Beilin, Dunbar, 2001; Mamun, Lawlor, O’Callaghan, Williams, & Najman, 2005; Whitaker, Jarvis, Beeken, Boniface, Wardle, 2010). Overall, the cost of childhood and adolescent obesity, including prescription drugs, outpatient and inpatient care, and emergency room visits, is currently estimated to be at least \$14 billion annually (Marder & Chang, 2006; Trasande & Chatterjee, 2009). Given this high cost, research on the intergenerational transmission of obesity, particularly in relation to mothers, is critical.

Intergenerational risk processes associated with obesity begin early in development and are long-lasting. However, adolescence may be a particularly important developmental phase to focus research on the intergenerational transmission of obesity. The United States has seen a startling increase in adolescents’ body weight, with

adolescent obesity rates almost doubling from 1994 to 2008. Currently, approximately 21% of adolescent girls meet obesity criteria and 34% are at risk for obesity or obese (Ogden et al., 2014). Like adults, obese adolescents are at an increased risk for adverse health conditions, such as elevated blood pressure, diabetes, cholesterol, and obesity in adulthood. According to the life course development model (Halfon & Hochstein, 2002), these health outcomes may be the result of exposure to risks and protective factors during early critical periods. Adolescence has been identified as a possible critical period for the development of obesity due to the significant physical changes that occur with the onset of puberty. How an adolescent manages transitions such as puberty can lead to stress response patterns, and in turn contribute to poor health trajectories (Halfon & Hochstein, 2002). The teenage years are also a time when adolescents gain more independence, and thus have a bigger role in making health-related decisions for themselves; consequently, interventions targeting this period may have lasting beneficial effects (Holmbeck, 2002).

Obesity may be a particularly concerning among adolescent females. Females in their teenage years are a group that experiences unique co-morbidity of weight concerns and mental health problems. Unlike the inconsistent findings reported among studies of the general population, it has been widely cited that obese adolescent females are more likely than comparisons to report current and long-term depressive symptoms (Merten, Wickrama, & Williams, 2008). The association between obesity and depression may be partially accounted for by harmful weight related behaviors (i.e., dieting practices) that are perceived as more socially acceptable to females (Needham & Crosnoe, 2005).

Although the prevalence of obesity has increased in all socioeconomic and racial/ethnic groups, individuals living in a low-income household have the highest

obesity rate. A review of 144 studies demonstrated an inverse relationship between socioeconomic status and obesity among women in developed countries (Sobal & Stunkard, 1989), and when measured at the population level, socioeconomic status accounts for almost 40% of the variance in obesity among adolescents (Goodman, Slap, & Huang, 2003). In addition to income, race/ethnicity has also been identified as an important predictor of the onset of overweight and obesity (Rehkopf, Laraia, Segal, Braithwaite, & Epel, 2011). Among people of color, individuals who identify as African-American and Latina are disproportionately affected by this epidemic. In a nationally representative sample of female adolescents, 43% of African-Americans, 37% of Latinas, and 31% of Whites were at-risk for obesity, as indicated by BMI >85th percentile (Ogden, Carroll, Kit & Flegal, 2014). Consequently, research on intergenerational patterns of obesity among low-income families is particularly important.

There is a strong genetic component to the intergenerational transmission of obesity. It is therefore not surprising that parental BMI before pregnancy is predictive of offspring BMI during childhood, adolescence, and adulthood (Laitinen, Power, Ja rvelin, 2001; Magarey, Daniels, Boulton, & Cockington, 2003; Salsberry & Reagan, 2007). Studies of concordance in the BMI of monozygotic and dizygotic twins indicate that both genetic and environmental factors contribute to weight (Nelson, Gordon-Larsen, North, & Adair, 2006). Further research has identified certain genes, such as the FTO gene, which is hypothesized to increase susceptibility to overweight and obesity from childhood to adulthood (Frayling et al., 2007). Although there is clear evidence for genetic causal factors, twin and adoption studies also highlight the importance of environmental factors. For example, there is a significant correlation between adoptive

parent and children weight (Silventoinen, Rokholm, Kaprio, & Sorensen, 2010), and both monozygotic and dizygotic adolescent twins living apart are less likely to have similar BMIs, physical activity, and fast food consumption than twins living together (Nelson et al., 2006). Overall, results from these studies suggest that environmental factors account for about 50% of the observed variation in weight and 8-10% of observed variation in weight related behaviors.

Obesity is increasingly viewed within the context of an ecological model of health, incorporating biological, psychological, social, and ecological factors. Earlier health and medical models of weight focused on individual factors, such as predisposition, or lack of information or motivation. In the past decade, however, ecological models have gained increasing evidentiary support (for reviews, see Ellen, Mijanovich, & Dillman, 2001; Schaefer-McDaniel, Caughy, O'Campo, & Gearey, 2010). Ecological models acknowledge the importance of individual level behaviors, but also emphasize the influence of the contextual variables that shape these behaviors, including community and family factors (Koplan, Liverman, Kraak, 2005).

Risk and Protective Factors

Despite genetic and ecological factors that may contribute to intergenerational transmission of obesity, many adolescents with an obese parent are not overweight or obese themselves. In other words, parental obesity increases the risk in offspring, but does not determine outcomes. According to the life course health development model, health is an adaptive process involving multiple genetic and other factors that act collectively (Halfon & Hochstein, 2002). The way in which genes are expressed depends on a person's physical, social, and psychological environment (Faith, 2008; Kandel,

1998). Thus, the synergy of these factors likely work together to increase the risk for the onset and maintenance of overweight or obesity among adolescents who have an obese mother (Burke et al., 2001; Bouchard, 2009; Qi & Cho, 2008).

Understanding when the intergenerational transmission of obesity does or does not occur can help identify specific factors that may be intervention targets for disrupting this cycle. The goal of the current study is to better understand individual and family factors that may influence an adolescent's risk of obesity if they already have the predisposition for obesity, as indicated by having an obese mother. Specifically, three domains of factors, drawn from ecological models of health, that may increase or decrease the likelihood of intergenerational weight similarity between mothers and their teenage daughters will be examined: SES/neighborhood factors, family context, and individual weight behaviors and attitudes.

SES/Neighborhood Factors

Weight related behaviors are developed and maintained through the economic, social, and physical environment in which the family lives. Research indicates that family socioeconomic status influences both adolescent and adult weight (Franklin et al., 2012). A review of the economic environment factors related to adolescents' home/family and physical activity, which includes 100 independent samples, indicates that family income is correlated to adolescent physical activity (Ferreira et al., 2006). Family income is also associated with the availability of healthy foods in the home, and in turn availability of healthy foods is associated with fruit and vegetable intake in adolescents (Ding et al., 2012). In one study, mothers with a lower income were less accurate in identifying an overweight silhouette of a child in comparison to higher

income mothers (Warschburger & Kroller, 2009). Parental education is also associated to weight. Several review studies indicate that parental education is associated with adolescent fat and fruit/vegetable intake (van der Horst et al., 2007) and adolescent physical activity (Ferreira et al., 2006). It is clear that in families with socioeconomic disadvantage, both adults and adolescents in the family are at higher risk of unhealthy weight behaviors and excess weight. It is less clear if certain socioeconomic factors increase the likelihood of concordance between parent and adolescent weight status. One possible clarification has been offered by Lohman, Stewart, Gundersen, Garasky, & Eisenmann (2009), who found that among food insecure families, increased maternal stressors also increased an adolescent's chance of being overweight or obese. These findings suggest that it may be a complex interaction of poverty and family stress that increases the likelihood, and possibly concordance, of weight status among family members.

The physical environment in the community is also an important factor to consider. In one study of adolescent's perceptions of neighborhood conditions, less favorable perceptions of the physical environment in which they live (e.g., lack of sidewalks) was associated with excess weight (Powell-Wiley et al., 2013). Objective measures of the physical environment are also related to obesity. Police reported neighborhood crime is associated with less physical activity among youth, and children who live in a low crime area of the community report 40 minutes more of moderate to vigorous physical activity than children who live in a high crime area (Kneeshaw-Price et al., 2015).

Due to the high risk of obesity among families who are low income and low

educational attainment, the current study will focus on women and adolescents who fall in this group. However, within low-income families, there is still considerable variability in economic and neighborhood factors potentially associated with health (e.g., perceived neighborhood safety). Several of these socioeconomic and neighborhood variables will be examined as factors that may increase the likelihood of obesity among some adolescents.

Family Context

The broader family context also contributes to an adolescent's weight related behaviors and risk for obesity. The term obesogenic environment has been used to describe a family context that is less socially supportive and structured and has fewer positive family meal practices (Martinson et al., 2011). Parental control is one aspect of structure within the family context that can serve as a mechanism in the transmission of weight (Martin, 2008). Rules or expectations in the household are correlates of adolescent weight, suggesting adolescents living in a less structured household, with a permissive discipline style and less confidence managing their children's lifestyle choices are at greater risk for obesity (Morawska & West, 2013). Parental engagement in family activities is associated with healthier weight among adolescents (Huang, Lanza, & Anglin, 2014) and among girls, but not boys. Parental encouragement of physical activity is associated with adolescent exercise behavior (Seabra et al., 2013).

Parent-adolescent communication is another important aspect of the family context. A model proposed by Riesch, Anderson, & Krueger (2006) suggests that children who perceive communication with their parent(s) to be open and have the ability to solve conflict may be less likely to engage in risky health behavior. Adolescents who

perceive low parental communication, less caring from parents, or conflict-laden communication also report more unhealthy weight control behaviors (Ackard, Neumark-Sztainer, Story & Perry, 2006). Almost half of obese adolescent females report weight related teasing by family members, and overweight adolescent females in particular are a group that report being bothered by this type of teasing (Neumark-Sztainer et al., 2002). An observational study of family functioning during mealtime indicates that in comparison to parents of normal weight children, parents of overweight children are less supportive during mealtime (Moens, Braet, & Soetens, 2007). Children who lose control while eating are more likely to be overweight or obese, and these children are more likely to have parents who express weight related critique (Hilbert, Tuschen-Caffier, & Czaha, 2010). These studies indicate that in families with less parent-child communication, negative communication, and more critique the adolescents are more likely to be overweight or obese.

Psychological factors, such as maternal psychopathology, may also have a significant impact on the intergenerational transmission of obesity (Martinson et al., 2011). A recent review found that chronic maternal depression is associated with overweight in children (Lampard, Franckle, & Davison, 2014). Maternal mental health may have a direct or indirect influence on child weight. Studies demonstrate that factors such as parenting quality and related patterns of children's physical activity can mediate the effects of maternal depression on children's BMI (McConley et al., 2011). It is also possible that women who are depressed may struggle more than healthy parents to create a structured environment for their children, and monitor their child's food intake less or set fewer limits (Gross, Velazco, Briggs, Racine, 2013). Children of depressed mothers

may be more prone to parentified roles within the family, or they may spend more time away from home. There is a complex interplay between maternal mental health and child physical health. However, identifying more distal maternal risk factors (e.g., posttraumatic stress disorder) can provide insight into potential mechanisms of influence. Few studies document the association between maternal anxiety or posttraumatic stress disorder on child weight outcomes. However, due to the well-documented co-occurrence of mental health symptoms (Kessler, Chiu, Demler, & Walters, 2005), there has been a call for additional research on the effects of anxiety and other maternal mental health factors on child weight outcomes (Gross et al., 2013).

Although the factors previously discussed have the most direct relevance to adolescent obesity, there are also other factors that may influence weight similarity in mothers and their daughters. Increasing evidence is supportive of an association between the stress response system and obesity among adolescents (De Vriendt, Moreno, De Henauw, 2009). High amounts of perceived chronic stress or an ineffective stress response system may influence the functioning of physiological systems that regulate weight (Warne, 2009). A child's attachment to their parent influences the child's stress response system and ability to regulate their emotions, with securely attached children having healthier emotion regulation and psychological responses to stress (Kochanska, 2001; Schore, 2001). Thus, the quality of the parent-child relationship has an indirect, but powerful, interaction with a child's body's ability to regulate weight. In a longitudinal study of parent-child attachment, toddlers identified as securely attached were less likely to be obese at 4.5 years-old in comparison to children who were identified as insecurely attached (Anderson & Whitaker, 2011). Although much of this

research has been conducted with children, adolescents who experience a low quality parental relationship, as measured by insecure attachment and low maternal sensitivity, during the first few years of life, are more likely to be obese during adolescence (Anderson, Gooze, Lemeshow, & Whitaker, 2012). In a study of mother and daughter BMI, children who reported feeling more connected to their mother had relative weights similar to their mother (Rozenkranz, Bauer, Dzewaltowski, 2010). In an intervention study, Van Ryzin & Nowicka (2013) found an indirect effect of improved parent-adolescent relationship quality on obesity, through mechanisms of reduced maladaptive eating attitudes, reduced depression, and enhanced health behaviors. These findings suggest the quality of parent-child relationship may play a role in intergenerational similarity in weight.

Individual Weight Behaviors & Intention

Decades of research have documented the influence of individual weight related behaviors such as physical activity and food intake on overweight and obesity. Adolescent's exercise and eating behaviors are directly associated to the development and maintenance of overweight and obesity, and parents likely directly influence these behaviors. Research has identified parent-child similarities in eating behaviors (e.g., dietary restraint) and overall fat intake (Snoek, van Strien, Janssens, Engels, 2009; Kral & Rauh, 2010; van der Horst et al., 2007; Reed, Dancy, Holm, Wilbur, & Fogg, 2012). A review of the literature suggests that parental modeling of intake of fruits and vegetables is associated with child and adolescent intake of fruits and vegetables.

Although research on the association between physical activity between parents and their children has produced mixed results, there is some evidence to suggest that

children with a physically active parent are more likely to participate in organized sports and are less likely to meet criteria for obesity (Eriksson, Nordqvist, Rasmussen, 2008; Erkelenz, Kobel, Kettner, Drenowatz, & Steinacker, 2014). Parental modeling of other weight related behaviors is also highly correlated with other correlates of weight in youth (e.g., child screen time, physical activity, snack intake, and fruit consumption) (Rodenburg, Oenema, Kremers, van de Mheen, 2013). It is possible that among overweight and obese mothers, those who also report less healthy eating and exercise behaviors are more likely to have obese daughters due to the intergenerational transmission of weight related behaviors.

It is also possible that some adult women who are obese do not perceive their weight to be a problem, and do not believe it is necessary to engage in weight loss behaviors. African American women report a smaller discrepancy between their current and preferred body size in comparison to White women (Flynn & Fitzgibbon, 1998), suggesting they are happier with their body size regardless of whether or not it is considered medically unhealthy. If a woman has a larger body size herself, and her community is accepting of her body size, she is likely to pass her perception of this larger ideal weight to her daughter. In addition, minority mothers perceive their children to be thinner than they actually are (Killion, Hughes, Wendt, Pease, & Nicklas, 2006). Obese mothers are also less likely to accurately identify their child's weight problems. Among obese mothers with overweight children, almost 80% of the mothers underestimated the weight of their child and reported that their child was a normal weight (Warschburger & Kroller, 2009). Thus, certain mothers are less likely to perceive their daughter's weight to be a problem, and this may in turn influence the guidance they provide to their daughters

about weight maintenance. Adolescent girls are also perceptive of their mother's weight and weight related behaviors. Children who perceive their mothers to be dieting to control their weight report more weight concern themselves, more unhealthy weight control behaviors, and more healthy weight control behaviors (Keery, Eisenberg, Boutelle, Neumark-Szainer, & Story, 2006).

Current Study

Within families with an obese mother there is variability in adolescent weight. This suggests there are factors other than high maternal BMI that contribute to an adolescent's vulnerability for excess weight (Whitaker, 2004). Comparisons of families with different patterns of mother-daughter obesity concordance may provide insight into characteristics that potentially increase or decrease the risk of intergenerational similarity in obesity. This line of inquiry can provide insight into characteristics that may be important to address in intervention and prevention programs targeting adolescents and their families. The current exploratory cross sectional study is modeled after case-control designs examining the children of high-risk parents (e.g., mothers with schizophrenia) often used in developmental psychopathology research to better understand differences in offspring who do, versus those who do not develop the same disorder (e.g. Schubert & McNeil, 2003). Although this approach cannot address causality, it has been particularly useful for understanding resiliency in developmental psychopathology literature (e.g., by comparing children of affected mothers who themselves are affected versus those who are not affected) and developing hypothesis about potential causal mechanisms.

In this study, four dyadic groups with different obese mother (OM) and overweight/obese daughter (OD) combinations were compared, including; 1. Obese

mothers with an overweight/obese daughter (OM/OD group), 2. Non-obese mothers with an overweight/obese daughter (NOM/OD group), 3. Obese mothers with a non-overweight/obese daughter (OM/NOD group), and 4. Non-obese mothers with a non-overweight/obese daughter (NOM/NOD group).

	Obese Mother (OM)	Non-obese Mother (NOM)
Overweight/Obese Daughter (OD)	OM/OD N= 57	NOM/OD N = 29
Non overweight/Obese Daughter (NOD)	OM/NOD N= 43	NOM/NOD N = 49

The goal of this comparison is to identify potential group differences in the three domains described above: SES/neighborhood factors, family context, and individual weight behaviors and intention. Of particular interest are differences in these factors between OM/OD group and OM/NOD group since these may be important targets for intervention with adolescents at high risk for obesity because of parental obesity. Other comparisons are also of secondary interest. For example, differences between OM/NOD group and NOM/NOD group in daughters' characteristics (e.g., frequent dieting) may highlight specific behaviors that adolescents who are at risk for obesity by nature of having an obese mother may engage in to maintain a normal weight that may not be part

of what normal weight girls without an obese mother have to do. Similarly, among adolescents who are overweight or obese, some have mothers who are obese and others do not, and a comparison between these groups will help us identify differences in attitudes and behaviors of mothers who have overweight/obese daughters (comparison of group OM/OD vs. NOM/OD). Although not of primary interest, these differences may provide additional preliminary information relevant to family approaches to adolescent health. I predict there will be group differences in all three domains, although given the exploratory nature of the study it is not clear which groups will differ. Differences in individual health behaviors are expected between families in which the mother or daughter is obese versus normal weight, however I am particularly interested in the risk and protective factors associated to mother and daughter weight more generally.

Methods

Participants and Procedures

Study participants included 181 adolescent females and their biological mothers residing in a mid-sized, low-income city in the Northeast U.S. These dyads were participating in a larger study of adolescent health disparities; however, only biologically related mothers and daughters were included in the current analysis. Female adolescents entering 9th through 11th grade were eligible for participation, with the average age of adolescent participants at 15.4 years (SD=1.05; Range = 13-17) and average age of mothers at 41.6 years (SD = 8.04). Fifty-eight percent of adolescent participants identified as Latina (primarily Puerto Rican), 28% as African-American/Black, and 16% as White. Of the mothers, 58% were Latina, 22% were African-American, and 20% were non-Hispanic White. Thirty percent of adolescents were living in a home that included

both biological parents at the time of participation. Educationally, 22% of mothers had not completed high school, 67% had a high school degree, and 11% had a bachelor's degree. The majority of adolescents (87%) qualified for free or reduced lunch at school. Sample characteristics are consistent with city demographics.

Participants were recruited from city schools, community centers, health centers, YWCA, local media outlets, and word-of-mouth. Interviews were conducted in English and Spanish (20%) based on participant preference. Interviews were available in Polish to accommodate one of the largest immigrant groups in the area, although no mothers chose this option. When possible, measures were selected that have been validated with Spanish-speaking populations in previous studies. All measures were translated and back translated and then piloted with local residents in an iterative process, following recommendations by the World Health Organization. Mothers and daughters participated separately in a semi-structured interview, which was audiotaped and later transcribed verbatim, and then completed survey instruments privately using Audio Computer Assisted Survey Instruments (ACASI) programmed in their preferred language. Next, they participated in a videotaped dyadic interaction task. Interviews took approximately 2 hours, and participants were paid \$40 each for their time. All procedures were approved by the University of Connecticut Institutional Review Board.

Measures

BMI. Mothers and daughters had their weight measured without shoes to the nearest .1 pound using a digital scale (BT-350e; Tanita, Arlington Heights, IL). Height was measured to the nearest .25 inch using a height rod on a standard spring scale. Weight and height were converted to BMI as kg/m² and were categorized (normal

weight, overweight, obese) using CDC percentiles (CDC, 2011).

I. SES/Neighborhood Factors.

Demographics.

Mothers provided detailed demographic information. Maternal education, marital status, receipt of public assistance housing, receipt of free/reduced lunch, and food insecurity were used to reflect socioeconomic differences. Mothers and daughters indicated all of the racial/ethnic groups they identified with, and mothers also reported on birthplace for their daughter, themselves, and their parents.

Perceived Neighborhood Variable Descriptions.

Mothers responded to perceived neighborhood environment questions that were used in the Trial of Activity in Adolescent Girls (TAAG) study, which is a large federally funded study designed to test a physical activity intervention. A total of 9 questions were used to assess perceived safety (e.g., safe to walk or jog in neighborhood, other children playing outdoors, crime), availability of opportunities to be physically active (e.g., biking or walking trails in neighborhood), and transportation (e.g., there are places I go within walking distance) (Evenson et al., 2006). Response options for each item were on a five point scale (1= not at all and 5 = very much true).

II. Family Context.

Family Communication.

Parent Encouragement of Physical Activity. Parent encouragement of physical activity was measured using five items modified from the Amherst Health and Activity Study for the TAAG study (Lytle et al., 2009; Sallis, Prochaska, & Taylor, 2000).

Daughters provided responses on the following five questions including: “During a

typical week, how often has a parent encouraged you to..." (1) "do physical activities or play sports?" (2) "Done a physical activity or [played sports with you?]" (3) "provided transportation to a place where you can do physical activities or play sports?" (4) "watched you participate in physical activities or sports?" (5) "told you that you are doing well in physical activities or sports?" All five items were rated on a five point likert scale (1 = not at all and 5 = almost every day). The Cronbach alpha was 0.84.

Mother/daughter Communication about Food. Mothers and daughters were asked about the frequency of communication about food and nutrition, modeled after Ennett, Bauman, Foshee, Pemberton, & Hicks (2001). Mothers were asked "How often do you and your daughter talk about food and nutrition?" They selected one of the following responses: never or rarely, once in a while, once a month, once a week, or several times a week.

Mother Daughter Communication about Weight Loss and Appearance. Adolescents responded to perceived mother/daughter communication about weight change and appearance questions that were used in the TAAG study. A total of four questions were included in the current study, including how often has your mother encouraged you to lose weight, how often has your mother encouraged you to gain weight, how often is there negative communication about appearance, and how often is there positive communication about appearance. Response options for each item were on a five point scale (1= never and 5 = always). Variables were analyzed separately.

Rules and Routines in the Family.

Rules about Eating. As part of a semi-structured interview, mothers were asked to briefly describe the rules and expectations in their household about meals and food,

and why they have those rules. If mothers reported that they did not have any rules for a particular area, they were asked to explain why this was the case. Interviewers clarified questions and/or prompted mothers for elaboration when deemed appropriate. Interviews were audio-recorded and transcribed verbatim. Preliminary themes for coding were derived from reading 20 randomly selected interviews and identifying themes in the participant's response to this question. Themes about rules/expectations in the house about food reflected three domains: schedule for eating (e.g., rules/expectations that the family eats dinner together), food choices/types of food the adolescent is allowed to eat (e.g., no junk food allowed), and quantity of food (e.g., mother encourages/expects less eating). Responses to this open-ended question were coded by two research assistants independently and reliability scores were calculated. Coders first identified whether the participant reported rules in the house about food. If the participant responded affirmatively, coders then identified which themes were reflected in the response.

Shared family meals. Adolescents were asked "on average, how many days a week do you and your family eat dinner together?" They reported an average from 0-7 days per week. This item was drawn from the 2009 Youth Risk Behavior Surveillance System (YRBSS; Eaton et al., 2010).

Dyadic decision making about food. Mothers were asked "In your family, how are decisions made about when and what she eats?" Responses include: parents decide, parents decide after discussing it with daughter, parents and daughter decide together, daughter decides after discussing it with parents, or daughter decides all by herself. This question was created for this study and was part of a larger set of questions asking about autonomy in decision making on various topics relevant to adolescents.

Maternal Mental Health.

Maternal depressive symptoms. Depressive symptoms were assessed with the 9-item Patient Health Questionnaire (PHQ-9; Spitzer, Kroenke, & Williams, 1999), for which mothers rated the frequency of depressive symptoms over the previous two weeks on a 4-point Likert scale (*1=not at all, 2=several days, 3=more than half the days, 4=nearly every day*). PHQ-9 items were derived from DSM-IV diagnostic criteria for Major Depressive Disorder. The Cronbach alpha was 0.84.

Maternal Anxiety Symptoms. The 6-item *Anxiety* subscale of the Brief Symptom Inventory (BSI; Derogatis, 1975) assessed mothers' self-reported anxiety symptoms. Mothers rated the frequency that they experienced various anxiety symptoms over the previous two weeks on a 5-point Likert scale (*0=not at all, 1=a little bit, 2=moderately, 3=quite a bit, 4=extremely*). An additional item was added for which mothers rated on the same scale how often they had felt anxious or worried over the past two weeks. Chronbach's alpha was 0.87.

Maternal Posttraumatic Stress Disorder Symptoms. The 17-item Posttraumatic Checklist-Civilian (PCL-C; Weathers, Litz, Huska, & Keane, 1994) assessed self-reported PTSD symptoms from the three symptom domains of the Diagnostic and Statistical Manual of Mental Disorders, fourth edition Text Revision (DSM-IV-TR; American Psychiatric Association, 2000): criteria B (reexperiencing), criteria C (avoidance and numbing), and criteria D (hyperarousal). Mothers rated how much each symptom had bothered them over the past month on a 5-point Likert scale (*1=not at all, 2=a little bit, 3=moderately, 4=quite a bit, 5=extremely*). Cronbach alpha was 0.95.

Mother/Daughter Relationship.

Maternal Warmth and Hostility. Adolescents reported on mother-daughter relationship quality using the Quality of Parental Relationships Inventory (Conger et al., 1994) as adapted for use by the NICHD Study of Early Child Care. The measure includes 17 items reflecting support/warmth (9 items, $\alpha = .91$) and hostility (8 items, $\alpha = .84$). Responses are on a 5-point scale with higher scores reflecting greater warmth or hostility.

Preoccupied and Dismissive Relationship Style. Domains from the Behavioral Systems Questionnaire (BSQ; Furman & Wehner, 1999) were used to reflect adolescents' preoccupied and dismissive relationship style with parents. The concept of relational styles is conceptually similar to adult attachment anxiety and avoidance in reflecting attitudes towards intimacy and closeness within close relationships. Preoccupation reflects over involvement and ongoing concerns about maintaining closeness; dismissiveness reflects avoidance of intimacy and minimization of the importance of relationships (Furman & Wehner, 1999). An example of a dismissing item is, "I rarely turn to my mother when upset"; an example of a preoccupied item is, "I get too wrapped up in my mother's worries". In previous studies, these domains relate to mother and child reports of relationship characteristics in ways consistent with attachment theory, with higher scores increasing the risk for psychopathology (e.g., Milan, Zona, & Snow, 2013). Adolescents responded separately for maternal preoccupation (5 items, $\alpha = .69$) and maternal dismissiveness (5 items, $\alpha = .68$). Higher scores reflect more preoccupation and dismissiveness.

III. Individual Weight Behaviors & Intention.

Daughter Weight Behaviors & Intention.

Daughter Exercise Behaviors. Daughters reported on their physical activity on the Frequency of Physical and Sedentary Activity measure, which includes four multiple choice items drawn from the 2009 Youth Risk Behavior Surveillance System (YRBSS; Eaton et al., 2010), a national survey of high school students conducted by the Center for Disease Control (CDC). Four items were used to create a combined score. For these items, daughters rated their frequency of physical activity over the past week (number of days physically active for at least an hour per day), frequency of sedentary activities daily (number of hours on the average school day spent watching television and playing video games/using the computer), and sports team and physical education class participation over the past year. Cronbach alpha of the standardized scores was 0.49.

Daughter Weight Change Intent. Daughters were asked to report on their own weight loss intent with items drawn from the 2009 Youth Risk Behavior Surveillance System (YRBSS; Eaton et al., 2010). Daughters responded to the item “which of the following are you trying to do about your weight?” and selected from the following responses: lose weight, gain weight, stay the same weight, or not do anything.

Mother Weight Behaviors & Intention.

Mother Exercise Behaviors. Multiple choice items were adapted for parental report from the 2009 Youth Risk Behavior Surveillance System (YRBSS; Eaton et al., 2010), a national survey of high school students conducted by the Center for Disease Control (CDC). Mothers were asked to report on their own frequency of physical activity (e.g., during the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?). Although this measure is designed for adolescence, the same questions were asked to mothers given lower literacy rates and to have similar

information from mothers and daughters.

Mother Weight Change Intent. Mothers were asked to report on their own weight loss intent with items drawn from the 2009 Youth Risk Behavior Surveillance System (YRBSS; Eaton et al., 2010). Mothers responded to the item “which of the following are you trying to do about your weight?” and selected from the following responses: lose weight, gain weight, stay the same weight, or not do anything.

Mother Perception of Daughter Weight. Mothers were asked to report on their daughter’s weight with items adapted from the 2009 Youth Risk Behavior Surveillance System (YRBSS; Eaton et al., 2010). Mothers responded to the item “how do you describe your daughter’s weight?” Responses included: very underweight, slightly underweight, about the right weight, slightly overweight, and very overweight.

Control variables. Race/ethnicity, marital status, and an SES risk composite (no HS degree, living in subsidized housing, child receives free/reduced lunch) will be used as control variables as deemed necessary in initial analysis.

Data Analysis

MANCOVAS, ANCOVAS, and Chi-square analyses were used to test for potential group differences with the dyadic weight group classification as the independent variable (with four groups) and each of the three domains included in turn as dependent variables. Analyses controlled for SES variables as indicated in preliminary analysis. Post hoc contrasts were conducted to determine which specific groups differ (e.g., OM/OD group versus OM/NOD group) on variables that are found to be significantly different in the analyses. Effect sizes were computed.

Weight classifications for adolescent girls were based on existing standards for

overweight and obese (85th and 95th percentile, respectively). However, this involved making categories out of a continuous variable (BMI); consequently, there may be many girls who are likely to be overweight soon (e.g., around 80th percentile) but were classified as "normal." To address this possibility, I created a restricted "normal" group that only includes girls up to the 75th percentile. Analysis were rerun with this grouping to ensure consistent results.

Power Analysis

Based on Cohen's sample size recommendations (2003), an ANOVA with four groups will have sufficient power ($1 - \beta = 0.80$) to detect a medium size effect ($d = .35$) with alpha set at .05 with 45 members per group (180 total). Based on these recommendations, the current study should have sufficient power (>180 total, approximately 50 members in 3 groups and 29 in the other) to detect medium size effects, although contrasts including the smallest group ($n = 29$) may be somewhat underpowered. All variables were examined for normality with univariate and graphical measures. Based on the results, the mental health variables were positively skewed and were log transformed for the analyses.

Results

Description of Dyadic Weight Groups

In total, 181 mothers and daughters participated in the study, almost half of the daughters met criteria for overweight or obesity, and majority of mothers met criteria for overweight or obesity. Adolescent BMI ranged from 15.20-48.00 ($M = 25.49$, $SD = 6.21$) and 47.8% of the adolescents met the CDC criteria for overweight at the 85th percentile for weight (Kuczmarski, Ogden, Guo, et al., 2002). Approximately 29% of adolescents

met criteria for obesity at the 95th percentile when compared to their peers, and there were an additional 7.6% of adolescents whose weight fell at the 75th percentile, which indicated that their weight was approaching an overweight status, but did not quite meet the CDC cutoff. These adolescents may be at risk for overweight in the future. Mother BMI ranged from 17.29-49.44 ($M = 31.84$, $SD = 6.97$) and 82.2 percent of the mothers were overweight or obese in this sample, with 54.9% of the sample meeting criteria for obesity using the CDC BMI cutoff of 30.00 (CDC; 2011). As noted above, the mean BMI for mothers fell within the obese range ($M = 31.85$, $SD = 6.97$), and for daughters the mean BMI fell within the overweight range ($M = 25.55$, $SD = 6.22$).

The four weight groups identified the weight make-up of the mother-daughter dyads. Weight OM/OD group was composed of dyads in which the mother met criteria for obesity with a BMI over 30.00 ($M = 36.62$, $SD = 4.54$), and the daughter met criteria for overweight or obesity with a BMI over the 85th percentile based on their age ($M = 30.70$, $SD = 5.53$). The NOM/OD weight group was composed of dyads in which the mother did not meet criteria for obesity ($M = 25.86$, $SD = 2.82$), but notably many of the mothers in the NOM/OD weight group met criteria for the overweight BMI classification. The daughters in the NOM/OD group met criteria for overweight or obesity with a BMI over the 85th percentile cutoff ($M = 30.00$, $SD = 4.78$). The OM/NOD weight group is composed of mothers who met criteria for obesity ($M = 37.13$, $SD = 5.42$) and daughters who did not meet criteria for overweight or obesity ($M = 21.01$, $SD = 1.95$). The OM/NOD weight group had the largest discrepancy between the average BMI of the mothers and the average BMI of the daughters. The NOM/NOD weight group was

composed of non-obese mothers ($M = 25.50$, $SD = 3.17$) and normal weight daughters ($M = 20.82$, $SD = 2.25$).

Group Differences in Demographic Characteristics

Preliminary analyses examined the composition of the sample to detect potential differences by weight group in socioeconomic status or other possible confounding variables in the overall sample (see Table 1).

Mothers ranged from 29-66 years old, which significantly differed by weight group, $F(3, 181) = 163.90$, $p = .03$. OM/OD group mothers ($M = 41.61$, $SD = 6.85$) and OM/NOD group mothers ($M = 43.45$, $SD = 7.84$) were significantly older than NOM/NOD group mothers ($M = 38.93$, $SD = 7.03$). In other words, obese mothers were older than non-obese mothers. Socioeconomic factors included free school lunch eligibility, maternal education greater than high school, and section 8 subsidized housing status. As reported by mothers, weight groups did not differ on these socioeconomic factors.

Another characteristic that differed by weight group was the race of the mother; there was a significant difference in which weight groups included mothers who identified as Black, $\chi^2(3, N = 181) = 9.66$, $p = .02$. OM/OD group and OM/NOD group, which were the groups that were composed of obese women, included more Black women than NOM/NOD group, which was composed of non-obese women. There were no differences among the weight groups on other racial factors (e.g., mother identifies as Latina or daughter's racial identity). Since this racial difference may be a confound in later tests of weight group differences, this variable was used as a control in subsequent analyses testing for group differences in the three domains.

Domain I: SES/Neighborhood Factors

Analyses of covariance (ANCOVAs) were calculated on two dependent variables; adolescent's report on her neighborhood environment and a composite score of food insecurity. Results for both neighborhood environment and food insecurity were insignificant, demonstrating no significant difference in SES/neighborhood factors between the weight groups (Table 3).

Domain II: Family Context

Domain two included mother-daughter communication factors (communication about food, communication about weight loss and appearance, encouragement of physical activity), rules and routines in the family (shared family meals, dyadic decision making about food, rules about eating), maternal mental health factors (depressive symptoms, anxiety symptoms, PTSD symptoms), and mother-daughter relationship factors (maternal warmth and hostility, relationship style). Two MANCOVAs were performed to investigate weight group differences in mother-daughter communication and mother-daughter relationship factors. Maternal age and race were used as covariates. Seven variables were used in the MANCOVA testing for mother-daughter communication: frequency of mother-daughter communication about food per the mother's report, frequency of mother-daughter communication about food per the daughter's report, frequency with which the mother encouraged her daughter to lose weight, frequency with which the mother encouraged her daughter to gain weight, encourage daughter to engage in physical activity, negative communication about appearance, and positive communication about appearance. There was a significant difference between the weight groups in the communication domain, $F(18, 464.35) = 3.77, p < 0.001$. Post hoc

univariate tests indicated group differences in multiple variables including: adolescent report of mother daughter communication about food, $F(3, 174) = 3.87, p = .01$, mother encouragement of daughter to lose weight, $F(3, 174) = 16.81, p < .001$, and mother encouragement to gain weight $F(3, 174) = 4.29, p = .006$. Post hoc ANCOVA analyses were run to identify which groups differed on the three significant variables. These analyses identified significant differences between OM/OD group ($M = 2.54, SD = 0.91$) and OM/NOD group ($M = 2.00, SD = 0.72$) and significant differences between OM/OD group ($M = 2.54, SD = 0.91$) and NOM/NOD group ($M = 2.10, SD = 0.94$) on the adolescent report of mother daughter communication about food variable. In the area of mother encouragement of the daughter to lose weight, group differences were apparent between the OM/OD group ($M = 2.77, SD = 1.29$) and OM/NOD group ($M = 1.85, SD = 1.00$), OM/OD group and NOM/NOD group ($M = 1.51, SD = 0.87$), NOM/OD group ($M = 2.83, SD = 1.02$) and OM/NOD group ($M = 1.85, SD = 1.00$), as well as NOM/OD group ($M = 2.83, SD = 1.02$) and NOM/NOD group ($M = 1.51, SD = 0.87$). In the area of mother encouragement of the daughter to gain weight, group differences were apparent between the OM/OD group ($M = 1.29, SD = .71$) and OM/NOD group ($M = 1.73, SD = 0.96$), OM/OD group ($M = 1.29, SD = .71$) and NOM/NOD group ($M = 1.76, SD = 1.11$), NOM/OD group ($M = 1.23, SD = 0.63$) and OM/NOD group ($M = 1.73, SD = 0.96$), and NOM/OD group ($M = 1.23, SD = 0.63$) and NOM/NOD group ($M = 1.76, SD = 1.11$) (See Table 4).

The second MANCOVA was performed to explore the differences between weight groups in mother-daughter relationship factors. Four dependent variables were included: adolescent report of maternal warmth, adolescent report of maternal hostility,

adolescent report of relationship preoccupation with mother, and adolescent report of relationship dismissiveness with mother. There was not a statistically significant difference between the weight groups in the domain of mother-daughter relationship factors, $F(12, 452.72) = 1.16, p = .31$; Wilk's Lambda = 0.92 (see Table 5).

One-way analyses of covariance (ANCOVA) analyses were conducted to investigate the differences in maternal mental health symptoms between the four groups. The mental health variables were examined separately because diagnostic tests in MANCOVA indicated high multicollinearity impacting results. There was not a significant difference in maternal anxiety symptoms between the groups. However, there were significant differences in maternal depressive symptoms $F(3,173)=3.35, p = .02$. Post-hoc analyses were used to determine which specific groups differ, and revealed a significant difference in depressive symptoms between OM/OD group ($M = 16.60, SD = 7.20$) and OM/NOD group ($M = 13.20, SD = 8.00$) and OM/OD group ($M = 16.60, SD = 7.20$) and NOM/NOD group ($M = 12.83, SD = 5.14$). There was also a significant difference in PTSD symptoms between weight groups $F(3,172)=3.52, p = .02$. Post hoc analyses revealed a significant difference between OM/OD group ($M = 36.58, SD = 18.38$) and OM/NOD group ($M = 29.20, SD = 13.68$) as well as the OM/OD group ($M = 36.58, SD = 18.38$) and NOM/NOD group ($M = 27.38, SD = 12.49$) (see Table 6).

Next, analyses focused on weight group differences in rules and routines in the household. An ANCOVA analysis was used to determine weight group difference variables in the number of times per week the family shared a meal were insignificant (see Table 7). A chi-square test was used to investigate weight group differences in whether or not the daughter made all of her own food choice decisions, or if a parent was

involved. There were no weight group differences in dyadic decision making about food, $\chi^2(3, N=177) = 2.14, p = 0.55$ (see Table 8.).

Chi-square tests were also used to investigate the connection between the rules in the house about food and the four weight group categories; there was not a significant difference between the four weight groups in whether or not daughters reported the presence of rules in the house about food, $\chi^2(3, N=168) = 3.95, p = 0.27$. Subsequent analyses only included participants who endorsed rules in the house about eating and food. Chi-square analyses were used to determine no statistically significant difference in weight groups when the specific types of rules were examined, including rules about the eating schedules, $\chi^2(3, N=92) = 1.69, p = 0.64$, and the rules about choice of food $\chi^2(3, N=92) = 4.88, p = 0.18$. The chi-square test used to examine the differences in weight group for the third rule regarding quantity of food indicate no significant difference, $\chi^2(3, N=92) = .72, p = 0.87$ (see Table 8). Overall, rules and routines in the house were not significantly different among the weight groups.

Domain III: Individual Weight Behaviors & Attitudes

Domain three included daughter exercise behavior, daughter weight change intent, mother exercise behavior, mother weight change intent, and mother perception of daughter's weight. A MANCOVA was performed to investigate weight group differences in mother and daughter weight change behaviors. Two dependent variables were included: adolescent exercise behavior and mother exercise behavior. There was no significant difference between the weight groups in this domain, $F(6, 346) = 1.10, p = 0.36$.

Next, several chi-square analyses were used to examine the differences in weight attitudes and behaviors for mothers and daughters among the four weight groups since these variables were measured categorically. Results are presented in Table 10. There was a significant difference in whether the mother said she was trying to lose weight $\chi^2(3, N= 178) = 31.50, p < .001$; whether the daughter said she was trying to lose weight $\chi^2(3, N= 178) = 60.65, p < .001$; and whether the mother reported that she believed her daughter was overweight between the weight groups $\chi^2(3, N=178) = 73.76, p < .001$. Post hoc analyses examined just the contrast of interest (i.e., OM/OD versus OM/NOD). These two groups did not differ in whether mothers said she was trying to lose weight ($\chi^2(1, N= 100) = 0.33, p = 0.57$), but did differ in whether the daughter said she was trying to lose weight, with adolescents who met criteria for overweight/obesity having a higher likelihood of responding that they need to lose weight ($\chi^2(1, N= 100) = 23.55, p < .001$). There were also group differences in whether the mother thought her daughter was overweight, with mothers who had an overweight adolescent being more likely to say their daughter was overweight or obese ($\chi^2(1, N= 100) = 42.65, p < .001$). These significant findings are expected given the actual weight status difference of the NOD and OD adolescents.

The primary goal of analyses was to identify characteristics that distinguish between the OM/OD group and OM/NOD groups. To help summarize these findings, Table 11 presents mean, SD and effect sizes for the OM/OD group to OM/NOD group contrasts on the variables that compose the broad factors that differ in the overall F-tests conducted for the different domains. As shown, the OM/OD group and OM/NOD groups

significantly differed on variables of communication (adolescent report frequency of communication about food, mother encouragement of daughter to lose weight, mother encouragement of daughter to gain weight, positive communication about appearance) and maternal mental health (depressive symptoms, anxiety symptoms, and PTSD symptoms). The communication variables (primarily about daughter's weight and appearance) are not surprising given that daughters actually differed in weight, and these same variables differed among overweight and not overweight daughters in dyads where mothers were not obese.

The difference between OM/OD and OM/NOD may reflect a general difference between OD and NOD, regardless of maternal weight status. However, there was not a significant group difference in maternal mental health between OD and NOD in dyads where the mother was not obese (NOM). In other words, maternal mental health may be associated with increased adolescent obesity in dyads with an obese mother, but not in dyads without an obese mother.

Post-hoc analyses

In the above analyses, mental health variables differed between OM/OD and OM/NOD variables; in other words, among dyads with an obese mother, adolescents were more likely to be overweight if the mother also reported poor mental health. Post hoc tests were done to test for possible mediational factors by which mental health might contribute to adolescent obesity in dyads with maternal obesity. Correlations between maternal mental health, adolescent BMI, and a number of possible factors were computed (Table 12). Only positive mother/daughter communication related to both mental health

and adolescent BMI among these dyad. Conceptually relevant mediating effects were tested; however, none of these were statistically significant.

As a second posthoc analysis, all analyses were calculated with the weight groups redefined to include adolescents whose weight was approaching overweight (75th percentile or above). The pattern of results was the same as when using the 85th percentile as the weight cutoff for adolescents.

Discussion

Overweight adolescents who have an overweight parent have a 78-100% probability of overweight at age 20 years old (Magarey, Daniels, Boulton, & Cockington, 2003). Maternal obesity, in particular, is associated with the highest risk (Huede et al., 2005). The goal of the current study was to better understand individual and family factors that may influence an adolescent female's risk of obesity if they already have a predisposition for the condition as indicated by having an obese mother. Three domains of factors were examined: SES/neighborhood factors, family context, and individual weight behaviors and attitudes.

Consistent with prevalence rates found in demographically similar samples of adolescents and adult women, the average BMI of participants in this study fell within the overweight range (e.g., Ogden, Carroll, Kit, & Flegal, 2014; Whittemore et al., 2013). Due to the high prevalence of overweight among adult women in this sample, and the direct relationship between high mother BMI and high daughter BMI (Burke et al., 2001), the BMI cutoff for obesity (<30) was used as the best way to determine group differences (i.e., obese women vs. non-obese women). Over 80% of the adult women in the current sample met criteria for overweight and more than half met criteria for obesity. Less than

fifty percent of the adolescent daughters in this sample met criteria for overweight or obesity, although rates were still elevated above national norms.

Four dyad weight groups were created for study purposes: 1. Obese mothers with an overweight/obese daughter (OM/OD), 2. Non-obese mothers with an overweight/obese daughter (NOM/OD), 3. Obese mothers with a non-overweight/obese daughter (OM/NOD), and 4. Non-obese mothers with a non-overweight/obese daughter (NOM/NOD). I hypothesized there would be group differences in the three domains studied (i.e., SES/neighborhood, family context, individual weight related attitudes and behaviors). Of specific interest was the comparison between the OM/OD and OM/NOD groups. By investigating differences in these two groups I was able to better understand the factors that may increase an adolescent's risk for obesity when she has an obese mother. This is a particularly important risk to understand due to the high prevalence of maternal obesity in the United States, particularly in low-income communities. Somewhat surprisingly, only certain factors in the family context (i.e., mother-daughter communication and maternal mental health factors) and individual behaviors/attitudes (i.e., attitudes towards weight) domains were significantly associated with overweight/obesity among adolescent females who had an obese mother. The communication and individual attitudes factors were also associated with overweight/obesity among adolescent females who did not have an obese mother. Consequently, these factors are likely correlates of adolescent weight generally rather than specifically among dyads with an obese mother.

Mother-Daughter Communication and Adolescent Obesity.

Numerous studies have demonstrated the influence of family weight related communication on an individual's weight outcomes (Balantekin, Savage, Marini, & Birch, 2014). Results from the current study indicate that parent-child communication may be a particularly critical area of communication to consider. Among adolescents whose mother was obese, adolescents who experienced more negative food related communication with their mother were also more likely to be overweight/obese. Similarly, adolescents' report of their mother's encouragement for them to lose or gain weight, encouragement of physical activity, and positive communication about appearance, significantly predicted group differences. As expected, adolescents in the OM/OD group reported that their mother encouraged them to lose weight more, and gain weight less, than the adolescents in the OM/NOD group. The same pattern of results was found among non-obese mothers, with mothers of obese daughters being more likely to encourage weight loss. In other words, mothers with an overweight daughter were more likely to encourage their daughter to lose weight than mothers with a daughter who did not meet criteria for overweight/obesity.

It is not surprising that adolescents who are overweight or obese are exposed to more communication about weight and dieting from parents. Although these conversations are likely a result of the adolescent's unhealthy weight status, there is some evidence that communication from parents about dieting or the need to lose weight can actually increase the likelihood of weight gain in the offspring. For example, in a longitudinal study tracking girls from age 9 to 14, Balantekin et al. (2014) found that adolescents who reported maternal encouragement to diet

actually gained weight over time, with an incremental increase in BMI percentage with increases in maternal encouragement to diet. Maternal encouragement to lose weight may also contribute to unhealthy weight loss strategies, which are associated with weight gain rather than loss over time (Benedikt, Wertheim, & Love, 1998). Thus, it is possible that a mother's encouragement to lose weight or negative communication about food actually increases adolescent obesity risk over time. Consequently, mother-daughter communication regarding weight, appearance and dieting could be a point of intervention.

Overall, group differences were found when the adolescent's, but not mother's report, was used in several domains of communication. Daughter's report of family communication may be more important than other reports, which should be taken into consideration when interpreting literature based on studies that only use parent report (e.g. Balantekin et al., 2014). The importance of adolescent report has been documented in studies of mother-daughter communication with sexual risk outcomes, with an adolescent's report of mother-daughter communication, but not her mother's report of communication, being related to her sexual experiences (O'Sullivan, Jaramillo, Moreau, & Meyer-Bahlburg, 1999). The discrepancy between mothers' and daughters' reports may also mean that mothers are unaware of how often they are talking about food with their overweight daughters, or that their daughters are interpreting some parental messages differently than their mothers realize. This discrepancy could contribute to a more conflicted or problematic mother-daughter relationship regarding food or weight. In particular, this conflict

could occur in families with an overweight/obese adolescent who perceives negative communication.

Maternal Mental Health and Adolescent Obesity.

Perhaps the most notable finding from this study was that among mothers who were obese, those who reported more mental health problems were also more likely to have an overweight or obese daughter. These findings are consistent with large-scale studies, such as the Millennium Cohort Study of 10,000 women, in which women with psychological distress were more likely to have obese children (Ramasubramanian, Lane, & Rahman, 2013). This association is true for maternal but not paternal psychological distress (Guxen et al., 2013).

Most studies of maternal mental health and child weight have focused on depressive symptoms (e.g., Benton, Skouteris, & Hayden, 2015). Maternal depression is associated to child weight overtime, with more significant and chronic symptoms demonstrated to have the strongest association to child weight outcomes (Lampard, Franckle, & Davison, 2014; Wang et al., 2013). A nationally representative study indicated that ten percent of mothers with children under the age of 18 experienced depression in the past year (Ertel, Rich-Edwards, & Koenen, 2011). With this high prevalence rate of both maternal obesity and depression, there is significant reason for concern regarding the association between maternal depression and risk of obesity among adolescents, which has been documented both in the current study and in other published literature. In a systematic review of nine prospective studies, chronic maternal depression, but not episodic depression, was found to be associated with child overweight (Lampard et al., 2014). The current

study used single episode symptom assessments, therefore this study did not assess for chronic mental health problems. Even with a limited symptom assessment, the current study identified a significant association between maternal mental health symptoms and the likelihood of obesity among adolescents at risk for excess weight.

It is important to note that although maternal depressive symptoms were not significantly different in the NOM/OD versus NOM/NOD groups, the magnitude of group difference suggests this may have been due to limited power. Thus, maternal depression may be a risk factor for obesity in adolescent girls regardless of maternal weight status, but this difference may be larger or more impactful in dyads where the mother is obese. In other words, both maternal depression and obesity may incur independent risk for adolescent overweight/obesity, but when both factors are present the likelihood for adolescent overweight/obesity may be particularly magnified.

To date, few studies have investigated the association between other psychiatric conditions in parents and childhood obesity (e.g., anxiety or PTSD). Large-scale surveys indicate that approximately 22% of adult women have experienced an anxiety disorder in the past year and 4% met criteria for PTSD (McLean, Asnaani, Litz, & Hofmann, 2011). Most studies exploring the association between parental anxiety and child weight have been conducted outside the United States, or with younger children (Guxen et al., 2013; Akay, Ozturk, Avcil, Kavurma, & Tufan, 2015). The current study found that among adolescents with a high risk for obesity, as indicated by having an obese mother, there was a significant association

between maternal anxiety and the risk for overweight/obesity among the adolescents.

Although past research has not fully explored anxiety symptoms in relation to child obesity, Gross et al. (2013) argue that because of the clear link between maternal depression and child weight, and high co-morbidity between depression and anxiety, it is possible that similar mechanisms are at work. Functional impairment associated to anxiety disorders can include avoidance and isolation. If a mother is avoiding social situations or other situations that she perceives as dangerous, it is likely that she is encouraging her daughter to do the same, which may limit the adolescent's ability to exercise (e.g., if the mother believes it's dangerous to walk around the neighborhood). Isnard and colleagues (2010) published data indicating obese adolescents who have a mother with anxiety are also more likely to endorse bulimic symptoms. The binge-purge pattern, which is characteristic of bulimia, may be linked to feelings of lack of control typically seen in anxiety. In these types of families, it is plausible that adolescents may get messages of lack of control from their anxious mothers, and engage in binge purge behaviors to regain the perception of control.

No previously published studies have explored maternal PTSD symptoms in relation to child weight. Findings from the current study indicate that among adolescents with a mother who endorses PTSD symptoms, there is an increased risk of adolescent obesity. There are several possible explanations for this association. Maternal PTSD, above and beyond maternal depression and adolescent's own trauma experiences, predicts impaired cortisol reactivity within the adolescent

herself, indicating her HPA axis functioning may be impaired and she may have a hyposecretion of cortisol when she experiences stressors (Danielson, Hankin, & Badanes, 2015). Extreme overweight is associated with activation of the HPA axis (Schorr, Lawson, Dichtel, Klibanski, & Miller, 2015), which may indicate that these adolescents who have activated HPA axis may also be at an increased likelihood for extreme overweight, although the direction of this relationship is not yet clearly understood. Second, as evidenced by studies of offspring of Holocaust survivors, stress can be transmitted intergenerationally (Bowers & Yehuda, 2016) and PTSD is associated with higher odds of weight gain in comparison to people who did not report PTSD symptoms (Leardmann et al., 2015).

Depression, anxiety, and PTSD symptoms can cause functional impairment that impacts the physical well being of a woman and her children. Although not studied in the current project, this functional impairment (e.g., inability to work, care for self/family, grocery shop) could be a mechanism through which adolescents whose mother experiences mental health symptoms may be at high risk for overweight/obesity. Depressed women are more likely to feel fatigued, engage in less activity, and isolate/stay in bed. Understandably, having a sedentary parent likely influences the lifestyle of the children in the family. One study indicates that women who report higher depressive symptoms are also more likely to report that their child watches more TV (Conners, Tripathi, Clubb, & Bradley, 2007), and TV viewing is associated to child BMI (Katzmarzyk et al., 2015). Gross et al. (2013) found that children with depressed mothers had fewer hours of sleep, less playtime outside, and their mothers were less likely to restrict their child's food intake and

set limits. In the large scale Early Childhood Longitudinal Study, depressed women are less likely to have family dinners together, their children are more likely to watch TV, and the family had fewer rules about food (Morrissey, 2014). In a review of the literature on stress and obesity in children, the relationship between parental stress and child obesity is highlighted as a critical area for future research. This review suggests that parental perceived stress is related with childhood obesity related behaviors (e.g., television viewing and fast food consumption) and that a variety of types of parental stressors have been associated with childhood obesity (Wilson & Sato, 2014). Parks et al. (2012) studied over 2,000 parent/child dyads with children ranging in age from 3-17 years old and found that parent perceived stress is related to children's consumption of fast food, which is in turn related to risk for obesity.

Hallmark symptoms of anxiety and PTSD include avoidance and fear. It is possible that mothers who experience anxiety and PTSD symptoms engage in more negative appraisals of their neighborhood and environment, and possibly perceive their community as more dangerous than mothers without these symptoms. The current study explored a broader array of neighborhood factors that may increase an at risk adolescent's likelihood of overweight/obesity. The three neighborhood domains included in the current study were: perceived safety (e.g., safe to walk or jog in neighborhood, other children playing outdoors, crime), availability of opportunities to be physically active (e.g., biking or walking trails in neighborhood), and transportation (e.g., there are places I go within walking distance). Environmental factors, as measured by a self-report of neighborhood factors, were not significantly different among the four dyad

weight groups in this study, indicating the environmental domains included in the current study do not increase an adolescent's risk of obesity when she is predisposed to the condition. Surprisingly, a meta-analysis of 65 published manuscripts examining the association between environmental attributes and physical activity indicates there is only limited support for the positive association between crime and youth physical activity (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011). However, it is possible there is an interaction between mother obesity, PTSD and anxiety symptoms, and negative fear based appraisals of environment which may contribute to messages of lack of safety and the need to avoid outdoor physical activity, or parental deterrence of certain community or afterschool activities. These parental messages or practices could in turn increase the risk of childhood obesity.

Mothers with symptoms of mental illness may also be less emotionally available to their daughters or may be more irritable, which may in turn contribute to their daughter's using food or other unhealthy coping strategies to manage their own emotions. One study indicates that women who have PTSD symptoms are more likely to be disengaged and behave in a hostile manner towards their children (Leen-Feldner et al., 2013). The current study only included a few measures of mother-daughter communication, so it is possible that a closer examination of the overall tone of communication between mothers and daughters may be different among women who are experiencing mental health symptoms versus those who are mentally healthy.

The national prevalence rates of maternal mental health problems are high, with the largest risk documented among socioeconomically disadvantaged women

(Kessler et al., 2005). It is possible that obesity, mental health problems, and socioeconomic factors together contribute to poor outcomes among children. Socioeconomic and environmental factors alone did not appear to increase an obesity-at-risk adolescent's likelihood of overweight/obesity in the current study. While other studies have demonstrated an incremental decrease in child BMI with every \$10,000 increase in family income, this finding was not replicated in the current study (Lane, Bluestone, & Burke, 2012). One explanation for our finding could be the lack of income variability, with nearly our entire sample (87%) being represented by families who receive free and reduced lunch. Therefore, it is possible that limited variability in socioeconomic measures prevented the detection of group differences in socioeconomic status. Although socioeconomic factors alone did not predict group differences in the current study, it is possible that socioeconomic factors could act as mechanisms for the increased risk of child obesity in certain families. For example, past research demonstrates that poor economic resources interfere with a woman's opportunity to access high quality mental health care (Alegria et al., 2008; Neighbors et al., 2007). Thus, women with low resources may suffer from mental illness longer due to an inability to get high quality treatment, and this chronic illness may impact the weight outcomes in the mother and her children.

Clinical Implications

Findings from the current study elucidate the importance of considering mothers when thinking about adolescent's risk for excess weight. Interventions should be targeted towards the individual and the dyad. At the individual level, maternal mental health clearly increases an adolescent's risk of weight problems and the children of women

affected by maternal mental health issues should be targets for weight interventions. Mothers with mental health symptoms are less likely to model healthy eating, set limits on food, and manage their child's food intake (Gross et al., 2013), and interventions could target these specific areas of weight related parenting. Women who are obese and depressed or anxious may have negative appraisals related to body image. These negative attitudes could be targeted during treatment to prevent the transmission of unhealthy appraisals from mother to daughters, which is particularly important for adolescent girls because the teen years are a time of developmental transition during which many adolescent females are sensitive to outside messages about body satisfaction. Maternal mental health interventions that incorporate behavioral activation, scheduling healthy meals, and parenting assertiveness may also be particularly helpful in families with high risk for obesity.

Interventions should also focus on the mother/daughter dyad. While prevention and intervention efforts appropriately focus on adolescent's academic and peer environment, many adolescent females continue to spend considerable time with their mothers. Even if the time spent together as a family is minimal, the mother's weight attitudes and communication towards her daughter can be negative and have a heavy impact. Positive food related parent communication (i.e., warmth, food communication, positive reinforcement) has been associated to decreased risk of excess child weight in young children (Berge et al., 2014). Although this was not true in the current study, results indicate it may be particularly important to decrease negative food related communication. Interventions could include training parents to reflect on their communication style and identify negative communication they are engaging in with

their child, then teach the mother how to reduce these negative comments. This type of intervention could be delivered in a group setting and could even be offered through a school environment. Parent/child communication interventions have been developed, however they have been tested in small sample sizes with little attention to parent/child gender matching (Jelalian et al., 2014). More broadly, there is evidence that how much children benefit from health interventions is affected by maternal mental health (Bartlett et al., 2004). Consequently, it is important for practitioners addressing adolescent overweight/obesity to recognize that maternal mental health may impact the success of these efforts.

Finally, it is important to consider possible challenges related to the implementation of interventions with low-income and minority families like those included in the current sample. Minority groups are difficult to engage in mental health treatment, as evidenced by the disparity in access and receipt of quality care among racial/ethnic groups (Alegria et al., 2008). Low income and minority families may be more receptive to medical, rather than mental, health care. Thus, taking a more “medical health” weight loss approach, with integrative mental health treatment, may be useful in engaging this population.

Limitations

This study does have some limitations, including the fact that it is cross-sectional, and may not identify how the three domains influence BMI concordance between mothers and daughters over time. Longitudinal studies are needed to determine maternal influence on the development of child overweight and obesity long term. It is possible that at this point in adolescence girls may not yet be overweight, and their weight may

meet criteria for overweight or obese as young adults as they get older. It is also unclear how long the mothers may have been obese. It is possible that long-term obesity in mothers may have different effects on her daughter in comparison to recent weight gain. Cross-sectional studies do not allow for the exploration of the transactional nature of parent-child relationships and mental health, or the bi-directional transmission of weight related attitudes and behaviors. The present study relied on self-report measures, which may not expose the complete picture of participant's behavior. Weight and height were measured using standardized assessment procedures, which has been demonstrated to be more accurate in comparison to self-report, thus the assessment of height and weight is a strength of this study (Timperio, Salmon, Telford, et al., 2005).

The four dyad weight groups created for this study were developed for the purposes of easy comparison between weight congruent and incongruent pairs, and were based on CDC cutoffs for overweight and obesity. Arguably, other weight groupings and comparisons may be useful for understanding the intergenerational transmission of weight. For example, overweight mothers and their overweight daughters, instead of using only mother's obesity as the grouping criteria. It is also possible that the question proposed in the current study could be investigated without comparing weight groups, but instead by exploring weight as a continuous variable.

Our sample included low-income women, majority of whom identified as Latina or African American, thus our conclusions are limited to low-income, minority samples. Although this limits the generalizability of our findings, low-income minority women and adolescents are a population at particularly high risk for obesity, and attention to this population is necessary (Goodman et al., 2003; Sobal & Stunkard, 1989). The current

study also only considers mother-daughter factors. Father-daughter, or broader socioecological factors, may be at play in increasing an adolescent female's risk of obesity if she is predisposed to the condition. Additionally, due to the racial and ethnic variability in the sample, it would be justified to explore racial/ethnic differences in a number of other variables in future studies.

Is it possible that there was not enough variability in adolescent's family economic situation to elucidate differences in access to healthy foods and exercise opportunities. Adolescents often have access to small amounts of expendable money that they can spend on whatever they choose, such as unhealthy foods (e.g., chips from the gas station, fast food). If most adolescents have a few dollars a day to purchase fast food, regardless of their family's financial situation, it may create a similar food environment across families. All adolescents in this sample have similar food environments (e.g., they all live within walking access to unhealthy and inexpensive food choices and can choose to eat in the school cafeteria) because they attend the same public school, which may contribute to decreased importance of socioeconomic factors (He et al., 2012). While high family income has been demonstrated to be associated to active membership in a sports club among girls, very few families in the community where the current study was conducted meet criteria for a high family income (Kantomaa, Tammelin, Nayha, & Taanila, 2007), so again the current sample may not represent adequate variability to detect group differences.

The current study adds to a growing body of literature supporting the association between maternal depressive symptoms and child weight outcomes, however further clarification of the course and acuity of depression and its association to child weight is

not well understood. Of the studies that have investigated the association longitudinally, symptom checklists are the most widely used assessment of depressive symptoms, which limits our understanding of clinically diagnosable depressive symptoms (e.g., Wang et al., 2013). Validated symptoms measures were used to assess maternal depressive, anxiety, and PTSD symptoms. However, I did not assess for formal mental health diagnoses, and a formal diagnosis may provide a better understanding of the functional impairment the woman is experiencing. Future studies should assess formal diagnoses of major depressive disorder, anxiety disorders, or PTSD as well as functional impairment of these disorders.

Other studies have demonstrated the influence of a mother's concerns about her own weight on adolescents' weight outcomes (van den Berg, Keery, Eisenberg, & Neumark-Sztainer, 2010). Mothers who correctly identify their own weight status are more likely to accurately categorize the weight status of their child (Dowd, Kirwan, Hannigan, Purtill, & O'Gorman, 2016). The current study was not able to assess for accuracy in obesity classification, however the results indicate that obese women and non-obese women correctly identify when their daughter is overweight or obese, even if past studies indicate it may be difficult for women to categorize their own child as overweight or obese (Warschburger & Kroller, 2009).

Future studies

Broadly, there has been a call for contextually focused studies that consider both family and school factors that influence childhood obesity. Davison and Birch (2001) suggest the use of the Ecological Systems Theory (EST) as a conceptual framework, which highlights the importance of considering the contexts within which a child may be

influenced. As mentioned previously, more research that includes measurement of diagnosed mental health disorders is needed. Knowledge of clinical diagnoses may provide us insight into the functional impairment associated with these disorders. This insight may help us develop hypotheses about mechanisms through which the association between maternal mental health concerns increases adolescent obesity risk. Several studies have begun to clarify the paths (e.g., parenting behaviors) through which maternal depression acts and is subsequently associated to child obesity risk factors (e.g., sedentary behavior and diet) (McConley, Mrug, Gilliland et al., 2011). In their review paper, Lampard et al. (2014) suggest that only two past studies have examined sex specific results in parent/child mental health and obesity associations, and no studies investigated the association of maternal depression with child weight beyond children age 12 years old. Although the current study is not prospective, it fills a gap in our understanding of the maternal depression and offspring weight association by investigating maternal depression with older children's weight status, with a sex specific focus. It is clear that attention should be focused on maternal mental health not only for reduction of her health concerns, but the increase in risk for her daughter's lifelong trajectory of health problems. Parent/child communication interventions have been developed, however future work should test these and other interventions on large diverse sample sizes with gender matched parent/child dyads (Jelalian et al., 2014).

Conclusions

Overweight adolescents who have an overweight parent have a 78-100% probability of overweight at age 20 years old (Magarey, Daniels, Boulton, & Cockington, 2003). The current study identified maternal mental health, negative parent/child

communication, and mother/daughter attitudes towards weight to be risk factors for overweight/obesity among adolescents who have an obese mother. Obesity in adolescents is an important topic with implications for public health, medical professionals, and mental health providers, and increased attention should be paid to the family context of adolescent females as health care professionals develop and implement prevention and intervention efforts (Durand, Logan, & Carruth, 2007).

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Tables

Table 1

Demographic Information of Sample

Variable	Overall Sample		Weight Group Category				Sig. Difference				
	n	M (SD)	OM/OD Group	NOM/OD Group	OM/NOD Group	NOM/NOD Group					
	(%)		n	M (SD)	n	M (SD)	n	M (SD)	n	M (SD)	
Sample Size	184		58		30		43		51		
	(100)		(40)		(16)		(24)		(28)		
Mother BMI		31.85(6.97)		36.62(4.54)		25.86(2.82)		37.13(5.42)		25.50(3.17)	
Daughter 85%		25.55(6.22)		30.70(5.53)		30.00(4.78)		21.01(1.95)		20.82(2.25)	
Maternal Age*		41.29(7.47)		41.98(6.32)		41.56(8.06)		43.45(7.84)		38.93(7.03)	OM/OD > OM/NOD; NOM/OD > OM/NOD
Daughter Age		15.44(1.05)		15.24(1.05)		15.56(1.08)		15.50(1.00)		15.53(1.09)	
Free School Lunch	157		48		27		41		41		
	(86)		(83)		(90)		(95)		(80)		
Maternal Education (< high school)	90		27		16		22		25		
	(50)		(47)		(53)		(51)		(49)		
Section 8 Subsidized Housing	51		15		10		13		13		
	(29)		(26)		(35)		(31)		(28)		

Note. *Maternal age is significantly different between weight groups $F(3, 181) = 163.90, p = .03$.

Table 2
Demographic Information of Sample Continued

Variable	Overall Sample	<i>Weight Group Category</i>				Sig. Dif.
		OM/OD Group (n=58)	NOM/OD Group (n= 30)	OM/NOD Group (n=43)	NOM/NOD Group (n=51)	
	n (%)	n (%)	n (%)	n (%)	n (%)	
Mother Black*	40 (22)	15 (26)	5 (17)	15 (35)	5 (10)	OM/OD > NOM/NOD; OM/NOD > NOM/NOD
Mother Latina	105 (58)	31 (53)	19 (63)	20 (47)	35 (69)	
Mother White	36 (20)	12 (33)	6 (17)	8 (22)	10 (28)	
Daughter Black	51 (28)	19 (33)	6 (20)	17 (40)	9 (18)	
Daughter Latina	99 (54)	30 (52)	19 (63)	18 (42)	32 (63)	
Daughter White	32 (17)	9 (28)	5 (16)	8 (25)	10 (31)	

Note. * The number of mothers who identify as Black is significantly different between weight groups $\chi^2(3, N=182) = 9.59, p = 0.02$.

Table 3

SES Domain: Analysis of Covariance (ANCOVA) Between Neighborhood Environment and Food Insecurity by Weight Group

Variable	Overall Sample	<i>Weight Group Category</i>				F value
		OM/OD Group (n= 58)	NOM/OD Group (n=30)	OM/NOD Group (n=43)	NOM/NOD Group (n=51)	
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	
Neighborhood Environment	3.59(0.65)	3.41(0.66)	3.62(0.72)	3.48(.56)	3.54(0.64)	0.43, <i>ns</i>
Food Insecurity	1.63(.55)	1.66(.52)	1.59(.63)	1.66(.54)	1.63(.55)	0.32, <i>ns</i>

Note. All analyses controlled for maternal age and mother identification as Black. The same pattern of results occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese.

* $p < .05$.

Table 4

Multivariate Analysis of Covariance (MANCOVA) Between Communication Variables and Weight Group (Controlling for Maternal Race and Age)

Communication Variable	OM/OD Group (n=58)	NOM/OD Group (n=30)	OM/NOD Group (n=43)	NOM/NOD Group (n=51)	Univariate <i>F</i>	<i>p</i>	Sig. Dif.
Communication Frequency– Adolescent Report	2.54(.91)	2.37(.76)	2.00(.72)	2.10(.94)	3.59	.05**	OM/OD>OM/NOD; OM/OD>NOM/NOD
Communication Frequency – Mother Report	2.84(.76)	2.97(.81)	2.70(.88)	2.69(.82)	.78	.51	
Mother encourage daughter to lose weight	2.77(1.29)	2.83(1.02)	1.85(1.00)	1.51(.87)	16.04	<.001***	OM/OD > OM/NOD; OM/OD > NOM/NOD; NOM/OD > OM/NOD; NOM/OD > NOM/NOD
Mother encourage daughter to gain weight	1.29(.71)	1.23(.63)	1.73(.96)	1.76(1.11)	4.92	.006**	OM/OD < OM/NOD; OM/OD < NOM/NOD; NOM/OD < OM/NOD; NOM/OD < NOM/NOD
Negative communication about appearance	1.64(.88)	1.50(.77)	1.35(.66)	1.33(.67)	1.87	.14	
Positive communication about appearance	3.36(1.29)	3.53(1.22)	3.98(1.12)	3.67(1.07)	2.11	.10	
Mother encourage physical activity	2.28(1.08)	1.81(0.77)	1.91(0.86)	2.09(1.03)	1.99	0.12	

Note. The same pattern overall result occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese. On the univariate level only positive communication about appearance, mother encourage daughter to gain weight, and mother encourage daughter to lose weight significantly differed by weight groups. All analyses controlled for maternal age and mother identification as Black.

$df = 3$. * $p < .05$. ** $p < .01$. *** $p < .001$. $F(18, 464.35) = 3.77$, $p < 0.001$; Wilk's Lambda = 0.68

Table 5

Multivariate Analysis of Covariance (MANCOVA) Between Mother-Daughter Relationship Factors and Weight Group (Controlling for Maternal Race and Age)

	OM/OD Group (n= 58)	NOM/OD Group (n=30)	OM/NOD Group (n= 43)	NOM/NOD Group (n= 51)	<i>Univariate F</i>	<i>p</i>
Maternal Warmth	3.26(.75)	3.14(.78)	3.21(.56)	3.17(.71)	0.34	0.80
Maternal Hostility	1.64(.54)	1.74(.49)	1.71(.51)	1.67(.47)	0.32	0.81
Adolescent Preoccupation	2.30(.93)	1.98(.77)	2.17(.84)	2.29(.75)	1.34	0.26
Adolescent Dismissiveness	2.37(.80)	2.77(.83)	2.65(.98)	2.57(.85)	2.16	0.09

Note. The same pattern overall result occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese. All analyses controlled for maternal age and mother identification as Black.

$df = 3$. * $p < .05$. ** $p < .01$. *** $p < .001$. * $F(12, 452.72) = 1.16, p = .31$; Wilk's Lambda = 0.92

Table 6

Family Context Domain: Analysis of Covariance (ANCOVA) Between Maternal Mental Health and Weight Group

Variable	Overall Sample	Weight Group Category				F value	Sig. Dif.
		OM/OD Group (n=58)	NOM/OD Group (n=30)	OM/NOD Group (n=43)	NOM/NOD Group (n=51)		
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)		
Maternal Depression	14.42(6.94)	16.60(7.2)	14.66(6.66)	13.20(8.00)	12.83(5.14)	3.35, $p=.02^*$	OM/OD > OM/NOD; OM/OD > NOM/NOD
Maternal Anxiety	1.81(.76)	2.02(.77)	1.71(.74)	1.69(.79)	1.74(.76)	2.35, $p = .08$	
Maternal PTSD	31.56(16.00)	36.58(18.38)	32.27(17.33)	29.20(13.68)	27.38(12.49)	3.52, $p=.02^*$	OM/OD > OM/NOD; OM/OD>NOM/NOD

Note. Weight OM/OD group is significantly different from NOM/NOD group for PTSD. Weight OM/OD group is significantly different from OM/NOD group and NOM/NOD group for Depression. The same pattern overall result occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese. However, the differences in weight groups on the depression variable only approached significance. All analyses controlled for maternal age and mother identification as Black.

* $p < .05$.

Table 7

Family Context Domain: Analysis of Covariance (ANCOVA) for Family Rules and Routines

Variable	Overall Sample	<i>Weight Group Category</i>				F value
		OM/OD Group (n=58)	NOM/OD Group (n=30)	OM/NOD Group (n= 43)	NOM/NOD Group (n=51)	
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	
Shared Family Meal (days per week)	3.98(2.38)	3.88(2.54)	3.57(2.24)	3.98(2.48)	4.33(2.20)	.57, $p=.63$

Note. The same pattern overall result occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese. All analyses controlled for maternal age and mother identification as Black.

Table 8

Family Context Domain: Chi-square Difference Tests for Family Rules and Routines

Variable	Weight Group Category					χ^2 value
	Overall	OM/OD Group (n=58)	NOM/OD Group (n=30)	OM/NOD Group (n=43)	NOM/NOD Group (n=51)	
	n (%)	n (%)	n (%)	n (%)	n (%)	
Rules in the house						
Rules in the house about food	92 (55%)	32 (59%)	17 (61%)	16 (41%)	27 (57%)	$\chi^2 = 3.95$, ns
Rules about schedule	69 (75%)	23(72%)	12(71%)	14(88%)	20(74%)	$\chi^2 = 1.69$, ns
Rules about food choices/ types of food	42 (46%)	16 (50%)	11(65%)	5(31%)	10 (37%)	$\chi^2 =4.88$, ns
Rules about quantity of food	9 (9.8%)	2 (6%)	2 (12%)	2 (13%)	3 (11%)	$\chi^2 = 0.72$, ns
Dyadic decision making about food (daughter decides)	107 (60.7%)	32(56%)	17(58%)	30(70%)	28(58%)	$\chi^2 = 2.14$, ns

Note. Only participants who responded positively to the question about the presence of rules in the house were included in the analyses about rules about schedule, choices, and quantity. The same pattern overall result occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese.

Table 9

Multivariate Analysis of Covariance (MANCOVA) Between Individual Weight Related Behaviors and Weight Group (Controlling for Maternal Race and Age)

Communication Variable	OM/OD Group (n=58)	NOM/OD Group (n=30)	OM/NOD Group (n=43)	NOM/NOD Group (n=51)	Univariate F	p
Mean Standardized Daughter Exercise Behavior Composite	-0.01(.63)	-0.23(.64)	0.12(.59)	0.04(.65)	2.11	.10
Mother Exercise Behavior	3.07(2.13)	2.69(1.89)	3.07(2.18)	3.04(2.01)	.21	.89

Note. The same pattern overall result occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese. All analyses controlled for maternal age and mother identification as Black.

$df = 3$. * $p < .05$. ** $p < .01$. *** $p < .001$. * $F(6, 340) = 1.10, p = .36$

Table 10

Individual Weight Related Attitudes: Chi-square difference test for the mother trying to lose weight, daughter trying to lose weight, and mother's perception of daughter as overweight across weight groups

Weight Group	Mother trying to lose weight n (%)	Daughter trying to lose weight n (%)	Mother perception that daughter is overweight n (%)
OM/OD Group (n=58)	50 (87.7%)	49 (86%)	38 (67%)
NOM/OD Group (n=30)	12 (40%)	24 (83%)	13 (45%)
OM/NOD Group (n=43)	36 (83.7%)	17 (39%)	1 (2.3%)
NOM/NOD Group (n=51)	26 (51%)	15 (31%)	1 (2.0%)
χ^2	$\chi^2 (3, N= 178) = 31.50, p < .001$	$\chi^2 (3, N= 178) = 46.96, p < .001$	$\chi^2 (3, N=178) = 73.76, p < .001$

Note. The same pattern overall result occurred when analyses were run on groups conducted with daughters over the 75th percentile considered as overweight/obese.

Table 11

Effect Sizes for OM/OD group vs. OM/NOD group comparisons

Variable	OM/OD Group (N = 58)	OM/NOD Group (N=43)	Effect Size Cohen's d	T test
Communication Variables				
Communication – Adolescent Report	2.54(.91)	2.00(.72)	0.66	2.77**
Communication – Mother Report	2.84(.76)	2.70(.88)	0.17	0.74
Mother encourage daughter to lose weight	2.77(1.29)	1.85(1.00)	0.80	3.53**
Mother encourage daughter to gain weight	1.29(.71)	1.73(.96)	0.52	-2.62*
Negative communication about appearance	1.64(.88)	1.35(.66)	0.37	1.79
Positive communication about appearance	3.36(1.29)	3.98(1.12)	0.51	-2.42*
Mother encourage daughter physical activity	2.28(1.08)	1.91(0.86)	0.38	1.58*
Mental Health Variables				
Maternal Depression	16.60(7.20)	13.20(8.00)	0.45	2.22*
Maternal Anxiety	2.02(.77)	1.69(.79)	0.42	2.06*
Maternal PTSD	36.58(18.38)	29.20(13.68)	0.46	2.17*

Note. All analyses controlled for maternal age and mother identification as Black.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 12

Correlations between variables for adolescents based on the full sample and for adolescents with obesity risk

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Adolescent BMI Percentile	---	0.16*	0.17*	0.49**	-0.29**	0.19*	-0.24**	0.20**	0.17*	0.22**	0.06	0.64**	0.56**
2. Communication frequency about food (Adolescent Report)	0.06	---	0.20**	0.45**	0.06	0.17*	0.02	0.15	0.09	0.15*	0.11	0.02	0.27**
3. Communication frequency about food (Mother Report)	0.04	0.15	---	0.13	0.13	-0.06	-0.02	0.02	0.04	0.10	-0.04	0.09	0.10
4. Mother encourage daughter to lose weight	0.12	0.58**	0.06	---	-0.11	0.41**	-0.13	0.14	0.04	0.13	0.05	0.44**	0.43**
5. Mother encourage daughter to gain weight	-0.20	0.16	0.19	0.01	---	-0.01	0.02	-0.03	-0.03	0.03	-0.05	-0.29**	-0.23**
6. Negative mother/daughter communication about weight	0.22	0.27*	-0.14	0.29*	-0.03	---	-0.30**	0.11	0.02	0.03	0.08	0.25**	0.15
7. Positive mother/daughter communication about weight	0.09	0.02	0.08	0.01	0.13	-0.48**	---	-0.19*	-0.07	-0.17*	-0.01	-0.23	-0.15
8. Mother Depressive Symptoms	0.01	0.07	0.05	-0.14	0.05	0.03	-0.27*	---	0.61**	0.60**	0.09	0.13	0.14
9. Mother Anxiety Symptoms	-0.08	0.05	0.16	-0.11	0.12	-0.08	-0.18	0.72**	---	0.48**	0.12	0.07	0.08
10. Mother PTSD Symptoms	0.02	0.06	-0.01	-0.14	0.09	-0.05	-0.14	0.67**	0.64**	---	0.03	0.13	0.13
11. Mother reports trying to lose weight	0.25	0.10	-0.01	0.06	-0.46**	0.03	0.11	0.08	-0.04	0.09	---	0.05	0.12
12. Daughter reports trying to lose weight	0.28*	-0.04	-0.09	0.25	-0.49**	0.12	-0.13	0.04	-0.03	0.05	0.46**	---	0.47**
13. Mother perceives daughter as overweight	0.63**	0.17	0.05	0.17	-0.20	0.04	0.08	-0.06	0.03	-0.04	0.30*	0.36**	---

Note. In the upper quadrant reflect correlations for full sample; values in the lower quadrant reflect correlations for adolescents in groups OM/OD & OM/NOD. * $p < .05$. ** $p < .01$. *** $p < .001$.