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"Associations between maternal perceptions of social support and adolescent weight status: A longitudinal analysis"

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ABSTRACT

Social support is a well-established predictor of improved physical health outcomes among adults. Establishing whether maternal social support may have an inter-generational positive impact on their child's physical health will provide important information for developing potential interventions and policies. Elevated body mass index (BMI) is one indicator of child health that is linked to increased risk for cardiovascular disease and other morbidities later in life. There is some evidence that maternal social support is associated with improved child and adolescent weight status; however, no studies have examined whether specific aspects of social support are more impactful than others or whether support availability is differentially impactful across developmental stages. The present study examined whether maternal perceptions of specific types of social support (i.e., financial support, non-monetary instrumental support, partner emotional support, and having a close supportive contact) were associated with lower adolescent BMI z-scores using longitudinal data collected over a 15-year period from the Future of Families and Child Wellbeing Study (n = 3146), which includes a high proportion of families experiencing socioeconomic disadvantage. Findings from linear regression models using specific types of social support measured across six waves of data collected over a 15-year period indicated that maternal perceptions of greater financial support were associated with lower adolescent BMI z-scores at 15 years (B = −0.05, 95% CI: −0.10, −0.004, $P = 0.04$), while the other types of support were not. Additional timing analyses demonstrated that perceived financial support during late childhood to adolescence was associated with lower adolescent BMI z-scores (B = −0.06, 95% CI: −0.11, −0.01, P = 0.01), whereas associations between support during infancy and early childhood were not detected. Study findings provide important insights for developing interventions and policies that improve maternal social supports to benefit child health.

1. Introduction

An extensive body of literature demonstrates that social support is linked to improved physical and mental health outcomes among adults (Balaji et al., 2007; House et al., 1988; Kawachi & Berkman, 2001; Thoits, 2011; Wang et al., 2003). This support can come in many forms including instrumental support (e.g., helping with daily living tasks), financial support, and emotional support (e.g., demonstrations of love and caring) (Jacobson, 1986; Slatcher & Selcuk, 2017; Thoits, 1995). Less research, however, assesses whether parental perceptions of social support may also benefit their children's health. It is possible that parental perceptions of their own social support might have an inter-generational positive impact on their children's physical well-being through multiple potential pathways.

Pathways by which parental social support may influence their child's health include changing parental mental health, parenting behaviors, and feeding behaviors. For example, greater parental social support soon after a child's birth is related to improved maternal psychological outcomes including decreased emotional distress, decreased postpartum depression, and increased parenting self-efficacy (Cutrona & Troutman, 1986; Leahy-Warren et al., 2012; Racine et al., 2019; Xie et al., 2009). These positive impacts of social support on maternal well-being may then benefit children through physiological pathways, as posited by biopsychosocial models, such as by decreasing stress experienced by the child (Engel, 1980). Maternal social support has also been linked to improved feeding behaviors (e.g., providing healthy foods, enhancing eating behaviors, and providing a pleasant eating environment) (Lusmilasari et al., 2018; Mukuria et al., 2016), higher

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rates of breastfeeding (Isiguzo et al., 2023), as well as improved dietary habits and higher levels of physical activity (Lusmilasari et al., 2018; Mukuria et al., 2016) that may have positive impacts on children's health across the child developmental trajectory via parental role-modeling of healthy behaviors (Russell et al., 2016).

Adolescent weight status is one indicator of health that is associated with poorer health outcomes across the life course. Obesity during adolescence is associated with increased cardiovascular disease risk in adulthood and increased incidence of type 2 diabetes, thereby contributing to a high burden of disease (Hannon et al., 2005; Nadeau et al., 2011; Umer et al., 2017). Importantly, there are large differences in obesity prevalence as youth within some racial/ethnic groups and/or living within families with lower income experience disproportionate risk for overweight and obesity. In 2017–20, the prevalence of obesity among White children and adolescents between ages 2–19 years in the US was 16.6%, compared to 24.8% among non-Hispanic Black youth and 26.2% among Hispanic youth (Bryan et al., 2021). Youth from households with lower incomes are nearly twice as likely to have obesity as are youth from households with high income (Ogden, 2018). These disparities may be caused by a number of influences across socio-ecological spectrum, including genetic predisposition, community factors such as access to healthy foods, and public policies (Institute of Medicine, 2005)

Given high rates of childhood and adolescent obesity in the US and disparities in risk, it is important to identify potentially modifiable protective factors to inform intervention efforts and, based on a suggestive body of literature, maternal social support may be one such factor. There is some specific evidence that maternal social support is associated with improved child and adolescent weight status (Cohen et al., 2006; Franzini et al., 2009; Gerald et al., 1994; Katzow et al., 2023; Turney, 2013). However, much of this evidence was generated from cross-sectional study designs and outcomes were generally collected earlier in childhood, limiting our understanding of longer-reaching implications. Additionally, these studies treated social support as a single construct (e.g., levels of neighborhood support) without delineating the different components, each of which may have different implications for interventions. Therefore, insights into which types of social support are most impactful will provide additional important information.

In this study, we assess impacts of maternal perceptions of social support on age and sex-standardized adolescent body mass index (BMI) outcomes over a 15-year follow-up period beginning at the time of the child's birth using longitudinal data from the Future of Families and Child Wellbeing Study (FFCWS). FFCWS survey items captured multiple elements of social support. The longitudinal structure of the data allow for an exploration of the time in the child developmental trajectory during which supports may be most beneficial. Specifically, the objectives of the current research were to (1) investigate which specific types of maternal social support are most strongly associated with adolescent BMI z-scores at age 15, and (2) investigate whether maternal social support during different periods of child development is differently associated with adolescent BMI z-scores at age 15. This study will provide important evidence that will be useful for developing or tailoring interventions and policies to improve child and adolescent weight status-related outcomes.

2. Methods

2.1. Data collection

The present study used available data from the FFCWS (originally known as the Fragile Families and Child Wellbeing Study), a 15-year study that was developed out of a joint effort of researchers at Princeton University and Columbia University (Princeton University, 2023). Objectives of the research team who developed the FFCWS included gathering information on the conditions and capabilities of new parents, the determinants and trajectories of parental relationships, and how children born into families in which parents were unmarried at the time of the child's birth fare (McLanahan, 2009; Reichman et al., 2001). To achieve this, the FFCWS enrolled a cohort of children born to parents in 20 large US cities between 1998 and 2000 with an over-sampling of non-marital births through a multistage stratified random sampling process. Baseline interviews took place within the hospital the focal child was delivered at within days of their birth. Parents who planned to place the child for adoption, those for whom the father of the baby was deceased at the time of the birth, and those not fluent in either English or Spanish were excluded from the study. This process is described in greater detail in a paper by Reichman et al. (2001). This sampling strategy means that children in the sample were disproportionately likely to live in households with low-income, to have nonresident fathers, and to have mothers with lower levels of education relative to children in a nationally representative sample (Reichman et al., 2001). The sample also includes a higher representation of non-White families compared to most large-scale US survey samples.

Parents were interviewed at the time of their infant's birth and then completed telephone interviews one, three, five, nine, and fifteen years later (between 1998 and 2016). This study uses data collected from: 1) core mother surveys at baseline, 1-,3-,5-, and 9-year waves, 2) primary caregiver surveys at the 15-year wave, and 3) in-home assessments conducted within a subset of the sample at the 15-year wave, which included collected height and weight measurements. Rather than including both mother and father core interviews during the 15-year wave, the FFCWS conducted only one interview with the focal child's primary caregiver; the majority (88%) of these were conducted with the child's biological mother. At the time of the 15-year wave, 73% of families interviewed at baseline (77% of those still eligible) remained in the study (n = 3580). Reasons for ineligibility included the death of the focal child or the legal adoption of the focal child.

2.2. Outcome Variable

The outcome variable of interest for this study was adolescent BMI z-score at the 15-year wave, calculated using validated growth charts created by the Centers for Disease Control and Prevention (CDC) in 2000 which include age- and sex-specific BMI references for children and adolescents aged 2–19 years to adjust BMI for age and sex as category standards (CDCP, 2022a, b). The BMI z-score was treated as a continuous variable.

In the 15-year wave, height and weight were assessed in two ways. First, in the youth survey, interviewers asked all teens (n = 3580) to report their height in feet/inches and their weight in pounds. Second, within the subset of the adolescents that also participated in the in-home visit in the 15-year wave (n = 1090), interviewers took height measurements using a stadiometer and weight measurements using a digital scale. Consequently, there are two sets of constructed BMI variables based on self-report and observation, with some teens having data for both. Sex-specific Pearson correlation coefficients between self-reported and measured BMI among those adolescents with both measures were $r = 0.91$ for males and $r = 0.92$ for females, $P < 0.001$. Adolescent BMI z-score based on self-reported heights and weights was used for all primary analyses since this measure is available for a larger number of adolescents. We also conducted sensitivity analyses that restricted the sample to those youths in which height and weight were measured by interviewers to confirm findings in the self-reported sample.

2.3. Predictor variables

We created indices of perceived maternal social support at each study wave as our predictor variables. For the first research aim, which assessed which specific types of social support are most strongly associated with adolescent obesity, we created scales for each of the four components of social support at each study wave: 1) financial support,

such as being able to count on someone to provide a loan if needed (scale based on 2 sets of questions), 2) non-monetary instrumental support, such as being able to count on someone to help with emergency child care (scale based on 2 questions), 3) partner emotional support, such as feeling that one's romantic partner listens when you need someone to talk to (scale based on 2 questions), and 4) having a close supportive contact, measured by 1 question asking whether respondents have at least one special person to depend on. These are four dimensions of social support that are commonly described in the literature and demonstrated to be associated with maternal and child health outcomes (House et al., 1988; Jacobson, 1986; Thoits, 2011). All questions captured perceived availability of support from others if needed, rather than actual received support. Previous literature posits that measurements of perceived support, which capture general feelings of support emerging from both numerous real instances of help as well as the perception of potential support that may be supplied by social ties if it is needed, are more closely tied to improved health outcomes, compared to received support (Thoits, 2011).

Similar to previous studies using this dataset to examine cumulative associations of early-life exposures with child health outcomes, we created summed scores that included all available responses across all six data waves for each social support type (Doom et al., 2023; Turney, 2013). Z-score transformations for each of the four constructed social support scales were then conducted because the scale ranges varied. By converting a raw scale score to a z-score, scores are expressed on a z-score scale, which has a mean of 0 and a standard deviation of 1. This transformation aligns scales for more effective comparisons.

Table 1
Social support-related variable questions within the Future of Families and Child Wellbeing Study surveys used to construct social support type scales and possible raw score ranges.

Variable	Answer Categories	Years Asked
Financial support (range = 0–21)		
"During the next year, if you needed help, could you count on someone to loan you $200"	Yes (1)/No (0)	Years 0,1,3,5,9,15
IF YES → "… What about $1000?"	Yes (1)/No (0)	Years 1,3,5,9,15
"Is there someone you could count on to co-sign for a bank loan with you for $1000?"	Yes (1)/No (0)	Years 1,3,5,9,15
IF YES → "… What about co-signing for $5000?"	Yes (1)/No (0)	Years 1,3,5,9,15
Instrumental support (range = 0–12)		
"During the next year, if you needed help, could you count on someone to provide you with a place to live?"	Yes (1)/No (0)	Years 0,1,3,5,9,15
"During the next year, if you needed help, could you count on someone to help you with emergency child care?"	Yes (1)/No (0)	Years 0,1,3,5,9,15
Partner emotional support (range = 0–16)		
"(FATHER/CURRENT PARTNER) listens to you when you need someone to talk to …"	Often (2)/ Sometimes (1)/ Never (0)	Years 1,3,5,9
"(FATHER/CURRENT PARTNER) really understands your hurts and joys …"	Often (2)/ Sometimes (1)/ Never (0)	Years 1,3,5,9
Close supportive contact (range = 0–3)		
"The next question is about emotional support you may get from friends and family (but not including FATHER/CURRENT PARTNER). Is there any special person you know that you feel very close with – someone you share confidences and feelings with; someone you can depend on?"	Yes (1)/No (0)	Years 5,9,15

Note: Cumulative scores for each social support type were constructed by adding responses from all questions included within the scale across all the waves in which the scale item was asked. Z-score transformations were conducted for each of the four constructed social support scales in study analyses to allow for more effective comparisons.

Table 1 displays individual scale items used to create indices of social support group by construct as well as response choices and study waves in which the question is asked. Financial support questions were asked using a skip logic pattern, so in each of the two sets of questions asking whether mothers felt that there is anyone who can provide them with a loan or co-sign on a loan, two questions were asked. For example, in the question set for loans, all individuals were asked "During the next year, if you needed help, could you count on someone to loan you $200". If individuals answered "yes", they were then asked the question "What about $1000?". We scored the responses so that each of the four questions were coded as yes (1) or no (0); individuals who were not asked the second question due to answering "no" on the first question were coded as a 0 for that second question.

Of note, partner emotional support was measured within a subset of the full sample. Due to skip logic within the FFCWS interviewer guide, the questions about support from fathers/current partners were only asked if individuals reported having a romantic relationship with either the biological father of the focal child or another partner. Therefore, analyses assessing associations between partner emotional support and adolescent obesity were restricted to those mother-child pairs in which the mother reported having a romantic relationship at all four data waves in which this construct was measured (n = 1052). Additionally of note, not all questions were asked at all study waves, as can be seen in Table 1.

Internal reliability calculations demonstrated good internal consistency for each of the four social support type constructs. Cronbach's alpha for financial support at each data wave ranged between 0.79 and 0.82 (average = 0.80). Cronbach's alpha for instrumental support at each data wave ranged between 0.58 and 0.72 (average = 0.67). Cronbach's alpha for partner emotional support for each data wave ranged between 0.71 and 0.85 (average = 0.80). Since Cronbach's alpha is related to the number of items in the scale, the lower Cronbach's alpha for the instrumental support scale could be due to the fact that it consisted of only two items at each data wave.

The second research aim assessed whether social support types significantly associated with adolescent obesity, as determined by findings in the first research question, were most impactful during infancy (ages 0–1), early childhood (ages 3–5), or late childhood to middle adolescence (ages 9–15) by creating summed scores across the two study waves covered within each assessed period (i.e., the ages 9 and 15 data collection for the late childhood to middle adolescence period).

2.4. Control variables

Variables known to be directly associated with the risk of adolescent BMI measured at the time of the focal child's birth were included as control variables, consistent with prior longitudinal research (Jimenez et al., 2016). We included 3 maternal characteristics as control variables: *race/ethnicity* coded categorically as non-Hispanic White, Black, Hispanic/Latino, and other, *education* coded as dichotomously as either obtaining at least a high school degree or not, and *marital status* coded dichotomously as either married or unmarried. Third, we included a household-level variable: *household poverty* calculated as the ratio of total household income relative to the number of members within the household to the official poverty thresholds designated by the U.S. Census Bureau (2023) for the year preceding the interview in which the data were collected coded as a five category variable (0–49%, 50–99% 100–199%, 200–299%, and 300% of the poverty thresholds and higher).

2.5. Data analyses

The analytic sample consisted of families remaining in the 15-year study wave in which the primary caregiver completing the survey was the focal child's biological mother (n = 3146).

2.5.1. Data imputation

Due to the large sample size and collection of data at six separate timepoints over the course of fifteen years, there was a fairly significant amount of missing data across study variables. Of the 3146 mother-child pairs within the sample, 1852 had complete data for all variables (58.9%). Missing values for variables of interest ranged from 0% to 31.1%. Only 11.6% of data on the outcome measure (BMI z-score at age 15) was missing. Little's missing completely at random (MCAR) test was highly statistically significant, indicating that the missing data values were not missing at random: $\chi 2\ (223, N = 3146) = 412.91, P < 0.001$. As such, multiple imputation was used to preserve the analytic sample and to reduce the potential for biased estimates due to missing data (Madley-Dowd et al., 2019). This method fills in each value of missing data from a distribution of values with the assumption that data are not missing completely at random, but are missing conditionally on observed covariates (Graham, 2009).

We imputed sets of values for missing data in adolescent self-reported BMI z-scores, independent variables of interest (maternal perceptions of social support), child gender, and control variables in statistical models among the sample of mother-child pairs remaining in the 15-year follow-up. Imputation models included all control variables, social support variables, and adolescent BMI z-scores as predictors of missingness. We created 20 datasets of 100 imputations using chained equations methods (MICE) to impute missing data in Stata (Royston & White, 2011) and used pooled data for all regression analyses. We analyzed the observed cases dataset using list-wise deletion and imputed dataset separately and compared results as a sensitivity analysis.

2.5.2. Regression analyses

To address research questions of interest, we conducted regression analyses with and without control variables to investigate the association between maternal social support and adolescent obesity among mother-child pairs within the analytical sample. The base model (Model 1) included only the predictor variable of interest, social support z-score, to examine bivariate associations between social support and adolescent obesity outcomes. Model 2 included all control variables in addition to the primary predictor variable of interest (i.e., social support).

Research Objective 1: Investigate which specific types of social support are most strongly associated with adolescent BMI outcomes at age 15. Separate hierarchical linear regression models, which independently tested the effect each of these four types of social support on adolescent BMI z-score, assessed associations between summed scores for each type of support over the 6 waves of study across the 15-year period (partner emotional, instrumental, financial support, and close supportive contact) and adolescent obesity outcomes. Each set regression models included the: (1) base model to examine bivariate associations between social support and adolescent BMI z-score, and (2) model with all control variables added. As a sensitivity analysis, we additionally ran a linear regression model that included all four types of social support in the same model. This approach allows for comparison of the four types of support directly; however, a drawback of this approach is that the analytical sample is limited to the 1052 mothers who responded to partner emotional support questions for the four time periods in which this measure was collected. Hierarchical logistic regression models with adolescent obesity status, defined as having a body mass index (BMI) at or above the 95th percentile for youth of the same age and sex based on validated growth charts created by the CDC (2022), treated dichotomously were run as sensitivity analyses to test whether results could be replicated using a categorical approach to adolescent obesity.

Research Objective 2: Investigate whether maternal social support during distinct periods of child development is differently associated with adolescent BMI outcomes at age 15. Next, we examined timing effects for the types of social support that were statistically associated with adolescent BMI z-score in the first set of analyses at $P < 0.05$. Specifically, the 3 developmental periods assessed were infancy (combining scores from the baseline and 1-year waves), early childhood (combining the 3- and 5-year waves), and late childhood to middle adolescence (combining the 9- and 15-year waves). To do so, we ran three sets of regression models which tested the effect of social support at these three distinct time periods on adolescent BMI z-score independently. We chose to examine these associations in three separate regressions instead of placing support at all three time periods in one regression because they were highly correlated with one another, prompting concerns about multicollinearity.

3. Results

3.1. Sample Description

Table 2 presents distributions of all study variables before and after imputation. Of those mother-child pairs within the analytical sample, 74.7% of mothers were unmarried at baseline. Over half (50.5%) of mothers within the sample identified as Black, 24.7% identified as Hispanic/Latino, and 21.2% identified as non-Hispanic White. A little less than one-third of the sample had not attained a high school degree at baseline (30.8%) and 34.3% of families were defined as having a household poverty ratio between 0 and 99% of the federal poverty threshold. At age 15, 19.1% of adolescents were characterized as having obesity.

3.2. Social support type findings

3.2.1. Main analyses

In separate unadjusted regression models, both greater maternal perceptions of financial support (B = −0.11, 95% CI: −0.15, −0.07, P < 0.001) and instrumental support (B = −0.05, 95% CI: −0.10, −0.01, P = 0.01) were each independently associated with lower adolescent BMI z-score. After adjusting for covariates (i.e., maternal race/ethnicity, maternal education at baseline, maternal marital status at baseline, and household poverty at baseline), the association between financial support and adolescent BMI z-score remained significant (B = −0.05, 95% CI: −0.10, −0.002, P = 0.04). However, the association between instrumental support and adolescent BMI z-score was no longer significant with the inclusion of covariates (B = −0.02, 95% CI: −0.06, 0.03,

Table 2
Characteristics of analytical sample consisting of mother-child dyads remaining in the Future of Families and Child Wellbeing Study (FFCWS) 15-year wave.[a]

Variable	Mean (SD) or % distribution
Dependent variables	
BMI z-score	0.67 (1.08)
Social support variables	
Financial support (range = 0–21)	12.93 (6.03)
Instrumental support (range = 0–12)	10.52 (2.33)
Partner emotional support (range = 0–16)	13.48 (2.56)
Close supportive contact (range = 0–3)	2.73 (0.60)
Covariates	
Maternal race/ethnicity, %	
Non-Hispanic White	21.21
Black	50.48
Hispanic/Latino	24.65
Other	3.66
Maternal education, %	
Less than high school degree	30.78
Marital status, %	
Married	25.30
Poverty category, %	
0–49% poverty threshold	17.45
50–99% poverty threshold	16.82
100–199% poverty threshold	25.81
200–299% poverty threshold	15.89
300+% poverty threshold	24.03

[a] Pooled sample across 20 created datasets and original dataset of n = 3146 mother-child dyads.

P = 0.42). No associations between having a close supportive contact nor partner emotional support and adolescent BMI z-score were detected in analyses. Results from all regression models are displayed in Table 3.

3.2.2. Sensitivity analyses

Complete-case analyses produced identical conclusions as presented models. When using the sub-sample of adolescents with measured heights and weights (n = 978) and in analyses that included all types of support in the same regression model (required mother being partnered at all four time points; n = 1052), greater financial support was associated with lower adolescent BMI z-score in bivariate analyses. However, no significant associations between any types of support and adolescent BMI z-score were detected after adjusting for covariates, though the direction of the associations were the same (Supplementary Materials). In logistic regression models using adolescent obesity status as the outcome of interest that included all covariates, conclusions were identical to presented analyses using continuous BMI z-score outcomes (Supplementary Materials).

3.3. Social support timing findings

3.3.1. Main analyses

Follow-up analyses investigated whether maternal perceptions of financial support during distinct periods of child development, specifically infancy (ages 0–1), early childhood (ages 3–5), and late childhood to middle adolescence (ages 9–15), were differently associated with adolescent obesity at age 15. Only timing for financial support was tested as it was the only cumulative measure of support over the 15-year period that was significantly associated with adolescent BMI z-score after the inclusion of covariates. Results from unadjusted regression models showed that greater financial support was associated with lower adolescent BMI z-score at age 15 during all observed time periods (infancy: B-0.08, 95% CI: −0.12, −0.04; early childhood: B = −0.10, 95% CI: −0.14, −0.06; late childhood to middle adolescence: B = −0.11, 95% CI: −0.15, −0.07. All findings were significant at P < 0.001. After controlling for all covariates in regression models, only the association between support during late childhood to adolescence and adolescent BMI z-score remained statistically significant (B = −0.06, 95% CI: −0.11, −0.01, P = 0.02). The associations between financial support during infancy (B = −0.02, 95% CI: −0.06, 0.02, P = 0.40) and during early childhood (B = −0.04, 95% CI: 0.09, 0.01, P = 0.10) and adolescent BMI z-score became non-significant. Results from linear regression models estimating adolescent BMI z-scores according to financial support during the three assessed time periods are displayed in Table 4.

Table 3
Regression coefficients from separate linear regressions models estimating adolescent BMI z-scores according to four types of perceived social support (n = 3146).

Predictor Variables	B (95% Confidence Interval)	
	Model 1: Unadjusted	Model 2: Adjusted for Covariates
Financial Support	−0.11 (−0.15, −0.07)***	−0.05 (−0.10, −0.002)*
Instrumental Support	−0.05 (−0.10, −0.01)*	−0.02 (−0.06, 0.03)
Partner Emotional Support	−0.04 (−0.10, 0.03)	−0.03 (−0.10, 0.03)
Close Supportive Contact	−0.02 (−0.07, 0.02)	0.00 (−0.04, 0.04)

Note: All social support variables are on standardized z-score scales and partner emotional support is measured among a sub-sample of families in which mothers reported having a romantic partner at all four assessed timepoints (n = 1052). Model 2 includes the following controls: maternal race/ethnicity, maternal education at baseline, maternal marital status at baseline, and household poverty at baseline.
*$P < .05$, **$P < .01$, ***$P < .001$.

Table 4
Regression coefficients from separate regressions estimating adolescent BMI z-scores according to maternal perceptions of financial support during three time periods (n = 3146).

Predictor Variables	B (95% Confidence Interval)	
	Model 1: Unadjusted	Model 2: Adjusted for Covariates
Support during Infancy	−0.08 (−0.12, −0.04)***	−0.02 (−0.06, 0.02)
Support during Early Childhood	−0.10 (−0.14, −0.06)***	−0.04 (−0.09, 0.01)
Support during Late Childhood to Adolescence	−0.11 (−0.15, −0.07)***	−0.06 (−0.11, −0.01)*

Note: All social support variables are on standardized z-score scales. Model 2 includes the following controls: maternal race/ethnicity, maternal education at baseline, maternal marital status at baseline, and household poverty at baseline.
*$P < .05$, **$P < .01$, ***$P < .001$.

3.3.2. Sensitivity analyses

Complete-case analyses produced identical conclusions as presented models. In sensitivity analyses conducted among only the sub-sample of adolescents with measured heights and weights (n = 978), no significant associations between financial support and adolescent BMI z-score were detected during any time periods within models including all covariates, though the direction of the associations were the same (Supplementary Materials). In logistic regression models controlling for all covariates with adolescent obesity status as the outcome of interest, the association between support during early childhood and adolescent obesity was statistically significant (OR = 0.89, 95% CI: 0.80, 0.99, P = .04). Associations between support during infancy and during late childhood to adolescence were not detected (Supplementary Materials).

4. Discussion

The present study sought to answer two research questions regarding the association between maternal perceptions of social support and adolescent BMI outcomes: (1) which types of maternal social support are most strongly associated with adolescent BMI z-scores, and (2) whether timing of maternal social support is differentially associated with adolescent BMI z-scores. Findings demonstrated that only the financial aspect of maternal social support was associated with lower BMI z-scores after controlling for relevant covariates. Subsequent analyses examining timing influences of financial support indicated that support during late childhood to adolescence was associated with decreased adolescent weight status, whereas significant associations between support and BMI z-scores during other time periods were not detected in models—though differences in associations across time periods were small.

The finding that financial support was associated with improved adolescent weight outcomes is consistent with the model of optimal matching support put forth by Cutrona and Russell (1990). This model, which was refined and tested through a review of 42 studies that examined multiple dimensions of social support, posits that tangible social support—including instrumental and financial supports—is more consistently associated with improved outcomes among individuals who were 1) experiencing financial strain, and 2) going through the transition into parenthood (Cutrona & Russell, 1990), both of which were experienced by the majority of families within the present study's sample, compared to other types of support. Knowing that financial assistance is available if needed from social network members may serve as an important source of relief from economic strain among families experiencing high levels of disadvantage that may, in turn, have positive psychological and physiological impacts on mothers and their children (Thoits, 2011). The finding that financial support was associated with lower adolescent BMI z-scores is also consistent with previous research conducted by Kristin Turney (2013), which indicated that a composite

measure of social support including both instrumental and financial support measures was associated with decreased likelihood of child obesity at age nine in unadjusted analyses among mother-child dyads included within the FFCWS at the nine-year wave, although a significant association between these variables was not detected after controlling for covariates.

In unadjusted models examining associations between different types of social support and adolescent BMI z-scores in the present study, instrumental support was also associated with lower BMI z-scores among adolescents. This result is consistent with prior literature that demonstrated associations between increased instrumental social support and improved child weight status (Gerald et al., 1994; Katzow et al., 2023). However, significant associations were no longer detected after controlling for covariates. This finding suggests that these associations may be due to social selection processes, as mothers with high levels of instrumental support may be different from mothers with lower levels of support in some characteristics (e.g., household income, level of education attainment) that also contribute to child's weight status (Turney, 2013). These zero-order correlations may therefore be inflated due the fact that socioeconomic status covariates are associated with both social support as well as adolescent weight status. It is also important to consider that, while maternal social support may positively influence child health, other determinants of child weight status—particularly those related to social determinants of health, such as household nutrition security and community-level access to healthy foods and physical-activity promoting spaces—may have stronger impacts on adolescent weight status and partially explain the lack of significant findings (Institute of Medicine, 2005; Ohri-Vachaspati et al., 2015).

Follow-up timing analyses indicated that only financial support during late childhood to adolescence was associated with lower adolescent BMI z-scores with all covariates included in the model. It is possible that maternal factors in late childhood to middle adolescence may be particularly strongly associated with adolescent BMI z-scores. Another possibility is that the most recent exposures to maternal factors may be most strongly associated with adolescent BMI z-scores. Notably, regression coefficients between support and adolescent BMI z-scores across time periods were not substantively different from one another (infancy: $B = -0.02$; early childhood: $B = -0.04$; adolescence: $B = -0.06$) and financial support across time periods were highly correlated with one another (Pearson correlations between financial support during each time period ranged between 0.60 and 0.71). In sensitivity analyses with adolescent obesity as the outcome of interest, maternal financial support during the early childhood period was most strongly associated with increased odds of experiencing obesity in adolescence. This is consistent with some epidemiology literature demonstrating that a variety of exposures during the sensitive early childhood period (ages 2–5) may have lasting effects on risk for later disease, sometimes referred to as the "long arm of early childhood" (Ben-Shlomo & Kuh, 2002; Shanahan, 2000; Wadsworth, 1997). Life course frameworks posit that risk factors, protective factors, and health behaviors interact over long periods of time to shape individual health. Given the inconsistency in timing findings for financial stress, weight status during adolescence may be a result of cumulative risk and protective factor exposures, rather than exposures during one time period being particularly impactful over another (Katz et al., 2012; Power et al., 1999), suggesting that it may be important to consider cumulative accumulation of factors that mitigate risk, such as maternal perceptions of financial social support, occurring across the child developmental trajectory (McEwen, 2000).

4.1. Strengths and limitations

This study is strengthened by its 1) use of rich, longitudinal data collected over a 15-year period and 2) inclusive set of sensitivity analyses that add confidence to conclusions. However, there are several important limitations to this study that should be noted. First, sample attrition and missing data may introduce bias. We minimize some of this bias by imputing values for all variables of interest among mother-adolescent dyads remaining in the sample in the 15-year follow-up using a multiple imputation model. Second, there exist gaps in questions that are asked about social support at each study wave in the dataset. Some questions measuring social support were not asked until later waves in the study or were not asked in the final wave, as evident in Table 1. For example, questions about partner emotional support were not asked during the 15-year follow-up study wave. As a result, differences in social support measurement across type and time could have influenced results. Third, primary analyses relied upon self-reported adolescent BMI as the assessed outcome of interest. To address this limitation, we completed sensitivity analyses among only those with measured BMI, and patterns of results were similar. BMI is just one marker of health and is an imperfect measurement. We did not have information on other indicators of child adiposity, such as levels of lean and fat mass or body fat distribution, or other cardiovascular health measures such as blood pressure or lipid profiles. Future work should explore whether maternal social support is associated with these more precise adiposity measures, as well as with other indicators of child physical health. Finally, both social support and adolescent BMI/obesity are complex variables. We consequently cannot rule out the possibility that associations found may be caused by factors not included in the dataset or models.

5. Conclusions

Study findings collectively indicate that greater maternal perceptions of financial support across childhood—and potentially financial support during the late childhood to middle adolescence period—are associated with lower BMI among their adolescent children. These findings suggest that it is important to take a multi-generation approach to improving child health. This study is novel in its exploration of impacts of specific types of support and exploration of the timing during which that support was most impactful, thereby filling in important gaps in the existing literature. Study findings suggest that increasing maternal perceptions that financial support could improve child weight-related outcomes. Importantly, private sources of financial support (i.e., individuals with available financial support) are often not consistently available when needed. Thus, improvements in the availability, awareness, and accessibility of public safety nets may be valuable for supporting families experiencing financial strain and other stressors in the US (Edin & Lein, 1997; Ryan et al., 2009). As childhood obesity continues to increase in the US, avenues that bolster maternal sources of financial support may be beneficial to improve child health.

CRediT authorship contribution statement

Emily M. Melnick: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Jenalee R. Doom:** Writing – review & editing, Supervision.

Declaration of competing interest

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

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2024.101647.

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