Maternal Union Status and Changes in BMI during Early Childhood

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Abstract

This study informs current family and health research by using longitudinal Fragile Families data and change models to assess whether maternal union status and transitions are associated with changes in children's BMI between ages three and five. Increasing BMI during early childhood may increase the risk of later obesity in childhood and adulthood. Results indicate that children living with two married parents or whose mothers move into a new union have lower (i.e., healthier) change in BMI than those whose mothers are leaving a union or are in stably single households. When maternal overweight interactions are included, there is evidence that the best scenario for children's BMI in this sample is to have a normal-BMI mother enter a new union. This suggests that relationship or partner qualities, not just number of parents in the household, may be critical to creating family environments that promote healthy BMI growth among children.

Introduction

Obesity is a health epidemic that starts increasingly early in life: globally, over 22 million children under five are now overweight (Deckelbaum & Williams, 2001). The trends are particularly troubling in the U.S., where the number of children who are overweight has doubled since the 1970s, BMI has become exceedingly high among obese children, and there exist important racial and SES disparities in childhood overweight/obesity rates (P. M. Anderson & Butcher, 2006; Kimbro, Brooks-Gunn, & McLanahan, 2007). Obesity problems begin early in life—nationally, 18% of four year olds are already obese (S. E. Anderson & Whitaker, 2010) – and several chronic health problems in adulthood have been linked with BMI growth patterns set early on in the life course (Adair, 2008; P. M. Anderson & Butcher, 2006; Deckelbaum & Williams, 2001).

The family environment (including genetic predisposition) has been recognized as a key factor in the early development of obesity, but we know little about the social aspects of families that may be linked with obesity in children. Children's family structure (parental union status), which is increasingly diverse and dynamic in the U.S., is of particular interest as it has been linked with many child well-being outcomes but has not been adequately explored in connection with children's BMI (Carr & Springer, 2010).

To address this gap in the literature, this study uses prospective, longitudinal data from the Fragile Families Study to consider whether changes in maternal union status are associated with changes in BMI among children in a critical growth period: ages three to five. Healthy BMI growth charts indicate that BMI should be declining from about age one to five. Less BMI decline or increase in BMI before age five or five and a half is known as "early adiposity rebound" and has been linked with later BMI growth patterns and obesity (Adair, 2008; Williams & Goulding, 2009).

This study contributes to existing literature by modeling individual-level changes in family structure and child BMI during this critical stage. This is conceptually appealing because we are better able to test how altering specific aspects of children's family context (in this case whether the mother has a partner in the household or not) is associated with key changes in individual children's BMI. Modeling change also allows for netting out potentially important time-invariant unobserved differences among children and their families. Assessing the links between changing maternal union status and changes in BMI during early childhood may illuminate one way that family social contexts impact BMI growth patterns and set children up for obesity later on in childhood and into adulthood.

Background

Preschool aged children (ages 3-5) are in a critical stage of the life course when becoming overweight or obese can set them on a trajectory of continued obesity and other health problems. The social (and biological) determinants of obesity at this young age center on family factors, since school and neighborhoods are likely to have little direct impact on preschool children. Parents may play a particularly critical role, shaping childhood eating and exercise habits that are difficult to change later in life (Lindsay, Sussner, Kim, & Gortmaker, 2006). At the same time, children's parent environments have become increasingly diverse and dynamic in the U.S., with roughly 40% of children experiencing parental cohabitation before age twelve (Kennedy & Bumpass, 2008), half of all marriages ending in divorce, and a growing number of never-married single parent households. A critical step in child obesity research is to better understand how these distinct parental environments (i.e., marriage, cohabitation, divorced, never married households) may be related to BMI growth during early childhood.

There is little research on family structure, parental marital transitions and BMI among children of any age. Among adults, the research suggests a complicated association, where marriage, although protective of other health problems, may actually increase BMI (Averett, 2008; Kahn & Williamson, 1990; Sobal, 2003). This is thought to occur through diet changes as individuals adopt more social eating behaviors as a couple (the "social obligation hypothesis") (Averett, 2008), increase their time at home and watching TV when living with a partner, or have less incentive to control their weight after getting married (Averett, 2008). Thus, married parent households may be more detrimental to adult BMI, but it is not clear, if any of these arguments hold for children, particularly during early childhood.

For children, family structure and BMI may be linked if two-parent families (of any type) provide healthier environments for their children through more family resources (time and money) and less family stress than single-parent households. Time and money are important parental resources for protecting children's health. Two-parent households may have more time to prepare nutritious food, eat at regular hours, play actively with their children, and ensure that their children stay on regular sleeping routines. These household routines (eating family meals, having adequate sleep, and limiting screen time) have been linked to reduced obesity in a nationally-representative sample of four year olds (S. E. Anderson & Whitaker, 2010).

Two-parent families may also increase household income (Waite, 1995), and higher income is associated with lower BMI in the U.S. (Mujahid, Roux, Borrell, & Nieto, 2005). As households increase their income children may have increased access to better (safer, more walkable) neighborhoods, more extracurricular activities, or healthier foods (Lopez, 2007). If these processes are at work, children with two parents may decrease or prevent increases in their BMI because more economic resources are available to support healthier lifestyles.

Having two parents in the household also may promote healthier BMIs among children if they provide a less stressful, more caring environment. Never married or divorced mothers have been found to be more depressed and less sensitive to their children's needs (RFF), which may contribute to increases in BMI among children. One study found care but not supervisory neglect by mothers was linked with obesity in young children (Knutson, Taber, Murray, Valles, & Koeppl, 2010), and another indicated that less sensitive mothers were more likely to have overweight preschool children (O'Brien, Nader, Houts, Bradley, Friedman, Belsky et al., 2007).

Social selection may be an additional factor to consider, if lower BMI parents select into healthier unions (The & Gordon-Larsen, 2009), or the least healthy parents are more likely to become divorced (Joung, Van de Mheen, Stronks, Van Poppel, & MacKenbach, 1998; Wade & Pevalin, 2004). Stable two-parent households may be associated with healthier child BMI due to parental BMI rather than the social aspects of the family environment. However, it is not clear how much BMI selection plays a role in marriage and divorce – one study finds that adults' baseline BMI does not predict the likelihood of marriage or divorce (Jeffery & Rick, 2002)—nor whether it is a strong factor in the association between family structure and children's BMI.

Empirical research related to family structure and child BMI in the U.S. is limited, relies on cross-sectional data, and provides contradictory results about whether family structure is associated with child BMI. One article based on the data used here from the Fragile Families Study includes family structure as a set of control variables, finding that the mother's relationship status with the biological father at age three (father does not live in the home, married to father, cohabiting with father) does not predict the odds of the child being overweight or obese at age three (Kimbro et al., 2007). On the other hand, a smaller study of children in Michigan found that single parent status was associated with changes in BMI z-scores among low-income Head Start preschoolers net of family income (Lumeng, Kaciroti, & Frisvold, 2010).

This study builds on existing literature by investigating how maternal union status and union transitions are associated with change in BMI for children between the ages of three and five. Maternal union transitions (entering and leaving a union) may be associated with changes in child BMI by changing the number and characteristics of the parents in the household. If two-parent households are beneficial for children, we should see less of an increase (or more of a decline) in BMI among these children who should be experiencing a BMI during this early childhood. Similarly, if having one parent is worse for child health, we should observe an increase in BMI as children move from a two-parent to single-parent household (i.e. the mother dissolves a union) during this time. If characteristics of the mother's partner or the type of union matters, we should observe differences in BMI among children in stable two parent and those whose mother acquires a new partner (i.e., transition into a new union); or, differences between stably cohabiting and stably married parent environments. Thus, we include stable cohabiting, stably married, and stably single-mother households to compare to those children in transitioning environments. It is expected, based on the literature, that single mother households will be worse for children than married parent households. It is not clear how having two cohabiting parents will be associated with child BMI, but if fathers are less involved, provide fewer resources, or the relationships are more stressful these family environments might be worse for children's BMI than having two married parents.

Also considered here is whether maternal BMI moderates the effects of union transitions on changes in child BMI. Specifically, we are interested in whether having an overweight mother enter a union has a similar effect on children's BMI change as when a normal-BMI mother enters a union. If overweight mothers are attracting less healthy partners, as some research suggests, the home environment should be less healthy for child BMI during this time. Thus, if any moderation effect is detected it is expected that children with overweight mothers who enter a union will gain more BMI than children whose normal BMI mothers enter a union.

These questions are addressed using longitudinal data from the Fragile Families study, which allows for a consideration of stability versus change in the mother's union status and child BMI during this key stage (age 3-5) in the BMI life course. The data also provide maternal and paternal BMI measures so that these biological confounders can be controlled for, reducing selectivity bias, and allowing for testing potential moderation effect of maternal overweight status. The outcome of interest (change in BMI between ages three and five) is important conceptually as a critical stage in the BMI life course and empirically by allowing for the estimation of change models (further reducing biases due to observed factors). This study contributes to the growing body of literature on the physical health effects of family structure and aims to provide new evidence about its links with childhood BMI.

Data and Sample

The Fragile Families and Child Wellbeing Study is a longitudinal study that collected family and child-level data at birth, ages one, three and five for a cohort of children born between 1998 and 2000. The sample is representative of children born to unwed parents in cities with populations over 200,000, and there is an additional sample of children born to married parents (see Reichman, Teitler, Garfinkel, & McLanahan, 2001 for a detailed discussion). A sub-sample of data was collected in the children's homes at ages three and five, where anthropometrics were measured by trained personnel. Roughly 50% of the initial birth cohort remained in the study and participated in the in-home portion at age three, yielding 2400 children with valid BMI data at age three. Another 789 of these children attrited between the age three and age five surveys. Since the outcome of interest is change in BMI between ages 3 and 5, the base sample for this study is 1612 children with valid BMI data at both waves. The mean value of children's BMI at age three was slightly higher in those missing to follow up at age five compared with the 1612 sample (17 vs 16.7 BMI).

An additional 32 cases were dropped from the analysis because the mothers reported two or more transitions (leaving a biological father and forming a new partnership) and could not be accurately classified in the categories of interest. Another 22 cases were dropped because the children were not living all or most of the time with their mother at age three or five. The sample means and results did not differ significantly by whether these cases were included or not. The analytical sample size was 1558 children.

Of further concern was losing cases due to missing data on the independent variables. Although most variables had few missing values, fathers' BMI, an important control variable, had over 300 missing values. Multiple imputation of independent variables (but not the dependent variable) using all available data was implemented to avoid dropping these additional cases. The regression models effectively utilize data from five imputed data sets taking into account the uncertainty inherent in the imputed values (Allison 2002). Results were similar with and without the father BMI variable, indicating that imputed values are not driving the results found here.

Methods

Dependent variable

Body mass index (BMI) was calculated as weight in kg/(height in meters)^2 at ages three and five based on trained interviewers' collection of height and weight data in the child's home. Although sex and age-adjusted z-scores are often used when assessing time-invariant BMI, it has been suggested in the literature that when considering change in BMI among children it is better to use linear rather than z-score measures (Cole, Faith, Pietrobelli, & Heo, 2005). Sex and age in months at the age five survey were controlled for in the model to account for biological differences in growth patterns.

Change in BMI during this period may be critical to long term health and BMI tracking obesity (Adair, 2008; Williams & Goulding, 2009). Early childhood contains the "adiposity rebound" when BMI begins to increase after a period of decline. As Figure 1, illustrates based on CDC growth charts (Kuczmarski, Ogden, Guo, Grummer-Strawn, Flegal, Mei et al., 2002), BMI should be declining between the ages studied here (three and five), and increasing BMI before age five indicates children may be at on a trajectory of at risk for overweight/obesity (at or above the 85th percentile).

Insert Figure 1 here.

In the study sample, high BMI is clearly a health concern: 22% of sample children are already overweight or obese by age three. Further, change in BMI is positive in 45% of the sample children, and children in the top 10% of the distribution are gaining over two BMI points between ages three and five. The sample girls are gaining significantly more than the boys during this time, consistent with sex differences in BMI growth charts (see Figure 1). Controlling for sex in the models accounts for this difference.

Independent Variables

The independent variables of interest use prospective data on mothers' union status at ages three and five to categorize mothers as: (1) being in a stable married relationship; (2) being in a stable cohabiting relationship; (3) entering a union (cohabiting or marital); (4) exiting a union (cohabiting or marital); or, (4) never being in union (i.e., stable single mother household) during this two year time period. Figure 2 shows the distribution of the sample children across these categories, with 39% of children living in stable two parent contexts (25% with married parents, 14% with cohabiting parents), 29% living in stable single mother households, and 31% experiencing a maternal union transition (12% had a mother who dissolved a union and 19% had a mother who entered a union) between ages three and five. These data illustrate the benefit of using Fragile Families data, which allow for a large enough categories of single mothers and mothers transitioning into new union to compare with children in stable two parent or union dissolution categories.

Insert Figure 2 here.

Unfortunately, the relatively small sample size of prospective union transitions does not allow for further disaggregation of union transitions by cohabiting versus marital unions, nor a differentiation by whether the transition occurred with the biological or a social father. In looking at the data, roughly 76% of the prospective entrance into unions were mothers entering cohabitations (the other 24% were marriages), and 77% of the union dissolutions were mothers leaving cohabiting unions. This is not surprising, given the relative instability of cohabiting parent relationships in the U.S. (Manning, Smock, & Majumdar, 2004). A mother's entrance into a union was more likely to be with a social father, while exiting a union was more likely to be occurring with the biological father.

Table 1 provides further descriptive information about the sample and lists the control variables used in the analysis. Consistent with the Fragile Families design of gathering a representative sample of urban, non-marital births, the sample consists of children who are relatively disadvantaged: most have overweight mothers (70%) and fathers (67%), low maternal education (65% have mothers with no more than a high school degree), are non-white (80%), and have few economic resources (almost 40% lived below the poverty line at birth).

Insert Table 1 here.

Statistical Methods

To answer my research questions, I utilize the above measures in multivariate regression models with change in BMI as the dependent variable and change in union status measured as the mother entering or leaving a union between ages three and five. The OLS model is a first-difference model, which is equivalent to a two-time period fixed effects model. First difference models reduce biases due to unobserved time-invariant family or individual differences (Wooldridge, 2000). One disadvantage is that the estimation is less efficient, exacerbates measurement error, and limits the sample to only those who experience change. The benefits of the method outweigh the costs when the aim is to reduce biases in the associations, and when there is significant variation in the dependent variable (as in the case of BMI over this two-year time period). In formal fixed effects models, time invariant variables drop from the model, but by using the functionally equivalent two period OLS change model (i.e. first differences) time invariant variables can remain in the model. Thus, stable two married parents, stable two cohabiting parents, and stable single mother categories are also included. The OLS change model is preferred over the fixed effects model to control further for selection (by including maternal and paternal weight status) and to be able to compare union transitions with stable parent households.

The first set of models considers maternal union status and transitions with maternal overweight status as a control variable, and a second set of models includes interactions effects between maternal union status/transition categories and an indicator of whether the mother was overweight at child age three. These later models assess whether the associations between maternal union status/transitions and child changes in BMI differ for those children with overweight mothers and those with normal-BMI mothers.

All models control for the variables listed in Table 1, which include key time invariant measures of the child's sex, survey age, and maternal health, social and economic characteristics. Maternal and paternal overweight status are included to control for that fact that parental weight status may influence both subsequent union transitions and changes in child BMI due biological predispositions. Child BMI at age three is also included in the models to account for the fact that children who are already in the upper distribution of BMI by age three may gain less weight than those who have lower BMI at age three. Several time-varying variables (change between age three and five) are also included: change in number of children in the household, whether the mother was currently working, whether there was a grandparent in the household, and the household income to poverty ratio.

Standard errors are adjusted for heteroskedasticity in the models and statistical significance is assessed at $p<.05$.

Results

The results are provided in Tables 2 and 3, with Table 3 models incorporating maternal overweight interaction effects into the models shown in Table 2. In Model 1, Table 2, two married parent households (stable between age 3 and age 5) are compared with the other union groups. The coefficients on the variables of interest show that change in BMI is higher among children in stable cohabiting households (compared with those in married households), but that the difference is not statistically significant. Having a mother who enters a union has no association with change in BMI (a small and insignificant coefficient) when compared with having stably married parents. However, children living in one parent households (whose mothers dissolved a union or were never in a union during this time) have significantly higher change in BMI levels between ages three and five than do those in two married parent households (Model 1), or those whose mothers entered a union (Model 3). When considering two cohabiting parents as the reference group (Model 2, Table 2), another key difference emerges: children with stable cohabiting parents have more of an increase in BMI than those whose mother enters a new union between ages three and five.

Insert Table 2 here.

Table 3 shows results from these models that include interaction effects between these maternal union status categories and whether the mother was overweight when the child was three. A key finding here is in the first model, where a statistically significant interaction effect reveals that having a mother enter a union is associated with significantly less BMI gain than being in a two parent married household if the mother is not overweight. If the mother is overweight, there is no association. This indicates that mothers who are not overweight are likely entering healthier relationships than those who are overweight, and that having a normal-BMI mother who enters a new union is significantly better for child BMI growth than being in a stable two-parent family environment when the mother is not overweight. All other comparisons across union categories hold for both overweight and normal BMI mothers, as evidenced by the lack of statistically significant interaction effects.

Insert Table 3 here.

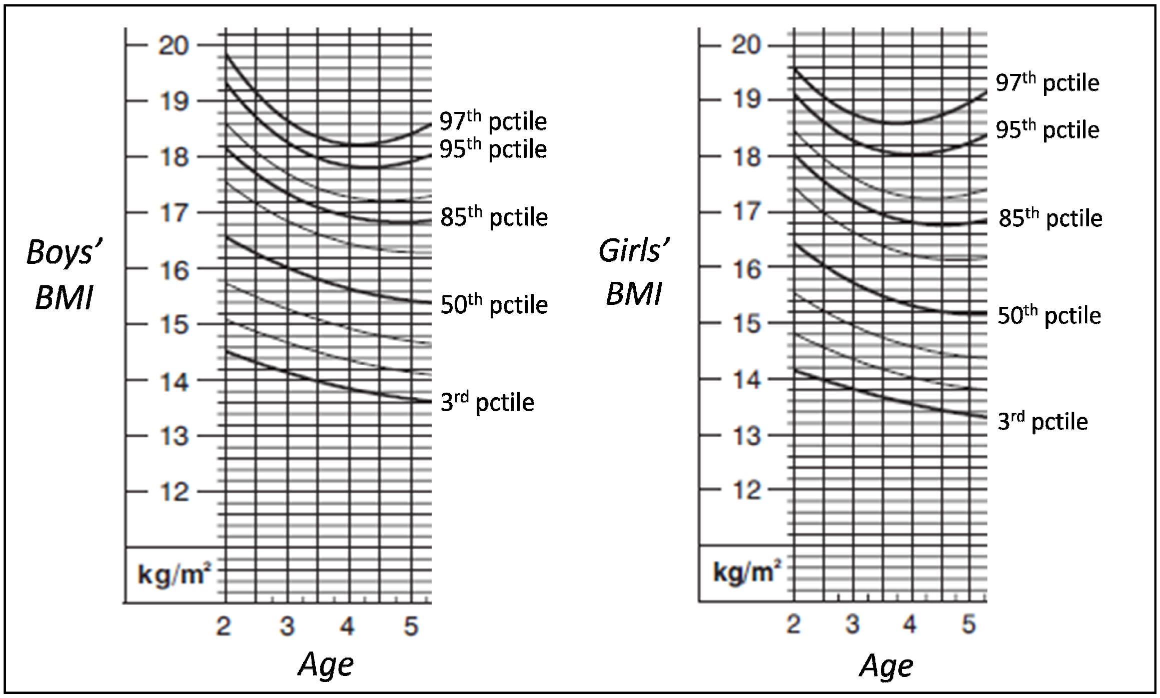
Of further interest in this table is the comparison of the maternal overweight status effect across family structure categories. The main effect of "mom overweight at age 3" in these models represents the effect of having an overweight (or obese) mother compared with normal BMI mother for children in the reference category. Comparing across models, it is evident that maternal overweight status has no significant effect on change in preschool children's BMI when they are living in stable two parent households (married or cohabiting), but does seem to have a relatively large and significant effect when mothers are transitioning into our out of a union or were never in a union during this time.

Conclusion

To be written.

Figures & Tables

Figure 1: Illustrative BMI growth curves for Age 3-5, Adapted from CDC Growth Charts[1]



1(Kuczmarski et al., 2002)

Figure 2: Mother's Union Status Stability and Transitions between Children's Ages 3 & 5 Fragile Families Sample, N=1558.

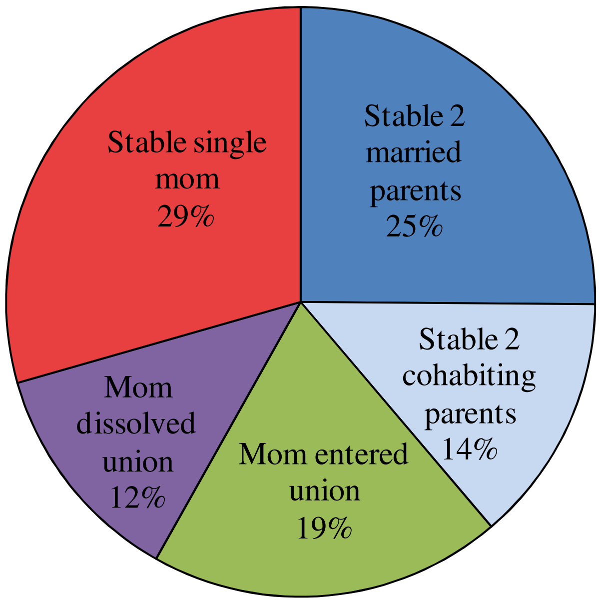


Table 1: Descriptive Statistics of Study Sample
Fragile Families Children with Valid BMI Data, N=1558.

Variable	Mean	Std. Dev.	Min	Max
Dependent Variable				
Change in child's BMI Age 3-5	-0.05	2.03	-9.67	10
Time-Invariant Variables				
Child BMI, age 3	16.67	1.81	12.57	32.26
Mom overweight, age 3	0.70	0.46	0	1
Dad overweight, age 3	0.67	0.47	0	1
Child sex	0.51	0.50	0	1
Child survey age, age 5	60.94	2.36	57	71
Mom very good health, birth	0.65	0.48	0	1
Mom depressed, age 1	0.13	0.34	0	1
Mom smoked, birth	0.32	0.46	0	1
Mom age, birth	24.98	5.96	15	43
Mom <high school educ., birth	0.34	0.48	0	1
Mom religious, birth	0.37	0.48	0	1
Mom White	0.20	0.40	0	1
Mom Black	0.53	0.50	0	1
Mom Hispanic	0.23	0.42	0	1
Mom other race	0.03	0.17	0	1
Income to poverty ratio, birth	2.16	2.39	0	12.3
Violent neighborhood, age 5	0.18	0.38	0	1
Change Variables (Age 3-5)				
Change # kids in HH	0.22	1.01	-7	7
Change mom working	0.03	0.55	-1	1
Change gparent present	-0.03	0.38	-1	1
Change income to poverty ratio	0.40	1.89	-12.1	12.3

Table 2: OLS Models of Change in Child BMI Age 3-5
Fragile Families Children with Valid BMI Data, N=1558

	(1)	(2)	(3)
Maternal Union Status Age 3-5			
2 married parent HH	REF	-0.30	0.086
		(0.18)	(0.17)
2 cohabiting parent HH	0.30	REF	0.39*
	(0.18)		(0.19)
Mom entered union	-0.086	-0.39*	REF
	(0.17)	(0.19)	
Mom dissolved union	0.40*	0.099	0.49**
	(0.18)	(0.21)	(0.17)
Single mom HH	0.42**	0.12	0.51**
	(0.15)	(0.18)	(0.15)
Controls			
Child BMI, age 3	-0.37**	-0.37**	-0.37**
	(0.044)	(0.044)	(0.044)
Mom overweight	0.49**	0.49**	0.49**
	(0.10)	(0.10)	(0.10)
Dad overweight	0.45**	0.45**	0.45**
	(0.12)	(0.12)	(0.12)
Child males	-0.19	-0.19	-0.19
	(0.099)	(0.099)	(0.099)
Child survey age	0.019	0.019	0.019
	(0.023)	(0.023)	(0.023)
Mom very good health	-0.058	-0.058	-0.058
	(0.11)	(0.11)	(0.11)
Mom depressed	-0.066	-0.066	-0.066
	(0.13)	(0.13)	(0.13)
Mom smoked	0.097	0.097	0.097
	(0.12)	(0.12)	(0.12)
Mom age at birth	-0.013	-0.013	-0.013
	(0.010)	(0.010)	(0.010)
Mom < high school educ.	-0.072	-0.072	-0.072
	(0.12)	(0.12)	(0.12)
Mom religious	0.11	0.11	0.11
	(0.11)	(0.11)	(0.11)
Mom Black	-0.059	-0.059	-0.059
	(0.13)	(0.13)	(0.13)
Mom Hispanic	0.082	0.082	0.082
	(0.15)	(0.15)	(0.15)
Mom other race	-0.18	-0.18	-0.18

	(0.20)	(0.20)	(0.20)
Income/pov. ratio at birth	0.024	0.024	0.024
	(0.030)	(0.030)	(0.030)
Violent neighborhood	-0.049	-0.049	-0.049
	(0.13)	(0.13)	(0.13)
Change in # kids in HH	-0.089	-0.089	-0.089
	(0.047)	(0.047)	(0.047)
Change in mom working	-0.013	-0.013	-0.013
	(0.086)	(0.086)	(0.086)
Change in gpar. presence	-0.0090	-0.0090	-0.0090
	(0.13)	(0.13)	(0.13)
Change in income/pov. ratio	-0.045	-0.045	-0.045
	(0.031)	(0.031)	(0.031)
Constant	4.63**	4.93**	4.54**
	(1.66)	(1.67)	(1.68)
R-squared	0.134	0.134	0.134

Robust standard errors in parentheses. ** p<0.01, * p<0.05

Table 2: OLS Models of Change in Child BMI Age 3-5 with Mom Overweight Interactions Fragile Families Children with Valid BMI Data, N=1558

	(1)	(2)	(3)	(4)	(5)
Maternal Union Status Age 3-5					
2 married parent HH	REF	-0.38	0.47*	-0.078	-0.056
		(0.33)	(0.23)	(0.27)	(0.23)
2 cohabiting parent HH	0.38	REF	0.85*	0.30	0.32
	(0.33)		(0.34)	(0.37)	(0.34)
Mom entered union	-0.47*	-0.85*	REF	-0.55*	-0.53*
	(0.23)	(0.34)		(0.28)	(0.23)
Mom dissolved union	0.078	-0.30	0.55*	REF	0.022
	(0.27)	(0.37)	(0.28)		(0.28)
Single mom HH	0.056	-0.32	0.53*	-0.022	REF
	(0.23)	(0.34)	(0.23)	(0.28)	
*Maternal Union Status Age 3-5*Mom Overweight*					
2 married parent HH*Mom OW	REF	0.12	-0.52*	-0.44	-0.49
		(0.38)	(0.26)	(0.33)	(0.26)
2 cohabiting parent HH*Mom OW	-0.12	REF	-0.64	-0.56	-0.61
	(0.38)		(0.41)	(0.45)	(0.41)
Mom entered union*Mom OW	0.52*	0.64	REF	0.083	0.032
	(0.26)	(0.41)		(0.35)	(0.29)
Mom dissolved union*Mom OW	0.44	0.56	-0.083	REF	-0.051
	(0.33)	(0.45)	(0.35)		(0.35)
Single mom HH*Mom OW	0.49	0.61	-0.032	0.051	REF
	(0.26)	(0.41)	(0.29)	(0.35)	
Controls					
Child BMI, age 3	-0.37**	-0.37**	-0.37**	-0.37**	-0.37**
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Mom overweight, age 3	0.20	0.084	0.72**	0.64*	0.69**
	(0.16)	(0.34)	(0.21)	(0.29)	(0.21)
Dad overweight, age 3	0.45**	0.45**	0.45**	0.45**	0.45**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
All other controls included but not reported for brevity.					
R-squared	0.138	0.138	0.138	0.138	0.138

Robust standard errors in parentheses. ** p<0.01, * p<0.05

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