FAMILY STRUCTURE AND CHILD OBESITY AMONG U.S. CHILDREN

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Child overweight and obesity in the U.S. is a significant public health issue, with implications for children and their families as well as the future health trajectory of the nation. For example, children who are overweight are more likely to grow up to be overweight or obese[1, 2], to suffer health consequences both as children and well later in life[3, 4], and to experience social and behavioral difficulties[5]. Moreover, in 2009 the estimated annual healthcare costs in the U.S. related to obesity topped $145 billion[6], a figure which is only expected to increase as obese children age and develop other health problems[7]. Thus, although data from recent years shows that the upward trend over the past several decades in overweight and obesity rates for children is now stabilizing, in 2008 nearly one-third (31.7%) of all U.S. children ages 2-17 were still overweight or obese[8]. For young children ages 2-5, fully 21.2% were overweight (at or above the 85th percentile based on the CDC's sex-specific BMI-for-age growth charts), while 10.4% of preschoolers were obese (at or above the 95th percentile)[8]. As such, child obesity continues to be a substantial problem, particularly among younger preschool aged children, and identifying the contributing factors to it an important goal.

By and large, scientists have identified nutrition and physical activity as the primary determinants of weight status for children[9]. Yet social factors have been shown to play an important role too. In examining this side of children's weight development, parents' socioeconomic status has emerged as a primary social predictor. In particular, obesity in the U.S. is more prevalent among children who are racial or ethnic minorities[8, 10], and whose parents have less income and lower levels of education[10]. Differences in parenting styles[11], culture[12], exposure to stressors[13, 14], and neighborhood context[15] have been presented as some of the mechanisms connecting parents' socioeconomic status with children's risk of obesity. Going beyond this well-developed area of research, however, another social factor and indicator of family socioeconomic background that may be associated with children's risk of obesity is family structure. Indeed, increasing family complexity over the past three decades in the United States means that more children are growing up in homes without two biological parents. Yet few studies have considered the role of different family structures in children's weight status, and among those that have, even fewer have constructed categories for family structure that represent the diversity among U.S. families today.

In this study, therefore, we investigate how preschool aged children's risk of obesity varies across eight different family structures—including cohabiting households with and without the presence of the biological father, married step parent families, never married single mother families, and families headed by a divorced mother, relative, or just the child's father—and compare it to risk of obesity when raised in a married two biological parent household. In doing so, we carefully account for a number of demographic, socioeconomic, and health related factors that extant research suggests may be driving these associations. We also test whether the association between family structure and child obesity is stronger among less advantaged segments of the population, namely poor households or those in which the primary caregiver does not have a college degree. This latter step explores the possibility that some family structures, for example households headed by unmarried and unpartnered mothers, may be more problematic—or perhaps even only problematic—when the family is disadvantaged. In this effort, we aim to assess whether children are at greater risk of being obese if they are living outside an intact family, identify the specific family types associated with this increased risk, and set the foundation for future investigations of why these patterns exist and how they can potentially be altered.

Increasing Complexity of Children's Living Environments

U.S. society has experienced significant changes in the family over the past several decades. Often referred to as the "second demographic transition,"[16] these changes include women marrying and having children at later ages, increases in women's labor force participation, and rises in rates of divorce, cohabitation, and nonmarital fertility. As one example of this historic trend, the proportion of births to unmarried women was 18.4% in 1980, increased to 33.2% in 2000, and is now nearly at 40%[17]. As a result of this large-scale transition in women's union formation and fertility behavior, more children are being raised outside of a two-biological-parent, married context in a variety of new family forms.

For example, cohabitation between the biological parents has emerged as an increasingly common family form—a pattern which reflects changes in both fertility behavior (i.e., having children outside marriage) and union formation (delaying marriage). Yet linked to this trend is the rise in other family types, including married or unmarried step parent families, given that cohabiting unions are more likely to dissolve to married unions[18]. Indeed, a recent U.S. cohort study of children born in urban areas found that, among births to unmarried mothers, approximately two-thirds ended their relationship with the child's biological father by the time the child was five year old. At the same time, more than half of these mothers had entered a new partnership.[19] Thus, while this example does not convey the why each of the family structures we explore in this study have grown more common, they illustrate the complex reasons why families have in general become far more diverse than they were in the past.

Connecting these changes in family structure to children's weight status and drawing on literature linking family structure to other sources of child well-being, it is conceivable that family structure is associated with differences in family routines surrounding diet, children's physical activity, mothers' work, and families' time-use—all factors with well-documented implications for children's weight status. For example, in households with children headed by a single parent who must balance work, childcare, meals, and housework, children may spend more time engaged in sedentary behaviors, and eat less nutritious, non-family meals [15, 20-22]. Likewise, step-families with blended children may experience complex routines which are more likely to result in less-healthy meals and exercise patterns. Yet on the other hand, we might expect children in households with two parents, whether married, cohabiting, or step-parents, to have healthier routines simply due to having two adults to manage household routines. In addition, households which can rely upon two incomes, or those which have one working parent and one with a more flexible schedule may have greater resources related to nutrition and physical activity and time to focus on the tasks required of parenthood. Thus, we might also expect to see differences in the likelihood of obesity based on the type of family in which children are living, although it is unclear which family structures present the greatest obesity risks to children.

Despite this uncertainty in the literature on preschool children's obesity, there is still some preliminary evidence that family structure matters. A small but burgeoning literature on the link between family structure and child obesity has found that children in dual-parent or married households are less likely to be overweight or obese than children in single-parent (usually single-mother) households[10, 21-30]. Moreover, these findings typically persist, even when socioeconomic characteristics are accounted for. Existing research, however, has not made much progress on separating out the effect of marriage from the presence of two parents (biological or step), identifying the prevalence of child overweight in other family types, such as relative headed households, or conceptualizing what the mechanisms connecting family structure to child obesity might be. Rather, due primarily to data constraints, the majority of studies have focused just on two family structure categories (either married vs. single or two parent vs. one). Because children are raised in a number of family contexts, in this study we draw on a large (over 10,000 children) nationally representative sample of children in order to provide a descriptive account of how more complex family structures are associated with child obesity. In doing so, we aim to offer insight as to the mechanisms driving the family structure-child obesity relationship. As one example, if two-parent families to fare better, regardless of whether they are biological parents or step-parent families, we can infer that parental time use is a contributing factor to family structure disparities in child obesity and highlight the importance this linkage for future studies.

At the same time, we also consider an important matter complicating our investigation—the possibility that the association between family structure and child obesity is moderated by the characteristics of the child or the family. Indeed, previous studies have found that only girls raised in single-parent households (compared to two parent households) have an elevated risk of obesity [31-33]. They have also reported that child obesity is only an issue for families with multiple children [24, 25]. Other factors which may moderate the influence of family structure on child obesity are indicators of families' socioeconomic status, including mothers' education and poverty. In the U.S., children in households under the poverty line have more than twice the odds of obesity compared to children in households at 400% of poverty or above; and the family income disparity in child obesity is growing[10]. Children have also been shown to have lower BMIs in single-mother households where the mother has a high school degree[24]. Of course, while mothers' education and family poverty status present well-document risks to children's weight status, it is unknown whether these factors moderate the impact of family structure on child obesity. Guided by previous studies that find parents' socioeconomic characteristics to buffer children's against problematic family structure circumstances disruptive to child learning, there is reason to expect such moderation [35]. Thus, we expect family structure to differentiate children's risk of obesity more when the family is poor or headed by a less educated mother. We expect fewer family structure differences in children's risk of obesity for non-poor families of families with college educated mothers.

Summary of Study

In sum, in the analysis that follows, we first construct more complex categories of family structure than have previously been available for studies of family structure and child obesity, using a large, nationally representative sample of children and prospective data on their health and development. We then test for robust differences between family structure categories with and without controlling for a variety of characteristics which might be related both to family structure and to child obesity. Finally, we assess whether these relationships are similar across different categories of household socioeconomic status.

Methods

Data and Sample

Data come from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B). The ECLS-B is a nationally representative study of U.S. children and their families designed to provide information on children's physical, psychosocial, and cognitive development. Data collection for the study began in 2001 when over 14,000 children were identified based on a clustered list frame sample of births registered in the National Center for Health Statistics vital statistics system. The final study sample included 10,400 children (74 % of families contacted) from diverse socioeconomic and racial and ethnic backgrounds whose primary caregiver (typically the mother) participated in the 9-month in-person interview. Data was subsequently collected when children were 2 years old, in preschool (around age 4 years), and in kindergarten using a variety of collection techniques, including interviews, assessments, and observations.

The analytic sample used in this includes the 8,234 children that completed the preschool assessment. A sampling weight (weight W31C0) created by the National Center for Educational Statistics (NCES) adjusts for differential nonresponse at the preschool wave, over time attrition, and the initial sampling design and nonresponse[37]. Multivariate analyses also apply survey weights to account for the complex survey design in which children were clustered within primary sampling units and Asian, Pacific Islander, Alaska Native children, American Indian, twins, and low birth weight children were over sampled. Missing data estimation techniques allow children with item-level missing data to be retained in this sample.

Measures

Obesity. Children's heights and weights were measured by trained data collectors who received two hours of video instruction and two hours of in-person instruction. This latter session included hands-on training and practice. To measure children's height, data collectors used a stadiometer. A digital bathroom scale was used to measure children's weight. Each height and weight measurement was taken twice. Children's recorded height and weight are the average of these two measurements. This weight-for-height information was then used to calculate children's body mass index (BMI). Finally, using the CDC Growth Charts appropriate for the child's age and gender, children at or above the 95th percentile were classified as obese. Children below the 95th percentile were sorted into a second category for non-obese children. We focus on obesity because it is related more strongly to health problems in adolescence and adulthood than child overweight.

Family structure. At the preschool data collection, the primary caregiver reported on their marital status, relationship to the child, and the other household members that lived in the home. Marital status at the time of the child's birth was ascertained from the child's birth certificate. Together, this information was used to sort families into eight mutually exclusive categories designed to account for both children's current family structure and the one they were born into. The first category captures two biological married parent families. This group includes the small number of families that were unmarried at the time of the child's birth. The second captures families headed by an unpartnered single mother who was unmarried at the time of the child's birth. The third includes cohabiting two biological parent families. The fourth group designates married two parent step families. The fifth category is for unmarried step families. The sixth category captures mothers that were married at the time of the child's birth and have subsequently divorced. The seventh includes households where the child resides with the biological father but not biological mother, referred to here as father headed families. The final category designates families whose primary caregiver is a relative. In addition, a small numbers of children did not fit into these categories, for example, because they were are coresiding with a foster parent, a non-relative caregiver, or adoptive parent. These children are grouped into a final category (n < 100). As explained shortly, this heterogeneous group of children is excluded from the analysis, but retained as part of the analysis sample.

Family characteristics. Information on the sociodemographic characteristics of children and their families comes primarily from the child's birth certificate. This data includes the child's gender (0 = *male*, 1 = *female*), the child's race (sorted into dummy categories for *White*, *Black*, *Hispanic*, and *Other*), the mother's age (measured continuously), and the child's parity (1= *first born*, 0 = *higher order birth*). We also draw on the 9-month parent interview to determine whether the home language was English (coded as "0") or another language (assigned a value of "1") and the families' region of residence (indicated by dummy variables for West, Northeast, Midwest, and South). Lastly, we control for the number of the number of children under age 18 in the household (measured continuously), as reported by the primary caregiver at the preschool data collection.

Given the persistent correlations between socioeconomic background, family structure, and child obesity, we also include several indicators of families' socioeconomic status. This information was taken from the parent-interview during the preschool data collection. In most cases, the mother was the respondent. In some families, however, a relative caregiver completed the parent-interview. In these cases, the mother data is for the female caregiver. Mother data also applies to female caregivers in father headed families. Socioeconomic variables include the mothers' education (dummy coded *as less than high school*, *high school degree*, *some college*, and *college degree*) and work status (*not working*, *part-time*, *full-time*), whether the father or romantic partner of the mother is college educated (1= *yes*, 0 = *no*) or employed (1 = *yes*, 0 = *no*), and if the family is poor (under 100 percent of the federal poverty line), near poor (100 – 185 percent) or not poor (over 185 percent). Family poverty status is based on an income-to-needs ratio which divided the primary caregiver reports of all sources of household income by the federal poverty threshold for that family size and year. The 185 percent cut-off was chosen because it marks the eligibility criteria for free and reduced lunch in many states.[38]

Health related measures. To account for inherited and endogenous health related factors among both mothers and children that may confound estimates of children's preschool height-for-weight measurement, we include several key measures that are typically absent in other studies. These include the mother's pre-pregnancy BMI (acquired by trained data collectors in the same fashion as children's weight and height), whether the mother reported her child as having fair or poor general health (assigned a value of "1") around the time of birth (versus good, very good, or excellent), a count for the number of mother reported pregnancy complications (e.g., Gestational Diabetes), and dummy variables for whether the child was born low birth weight (below 2500 grams) or high birth weight (about 4500 grams) based on data taken from the child's birth certificate. We also account for whether the pregnancy and delivery were paid for by Medicaid, whether the mother participated in WIC or smoked during her pregnancy, and if the child was ever breast fed.

Other relevant factors. Finally, we consider the two other important factors. The first is the possibility that children with unmarried parents spend time in care arrangement associated with higher rates of obesity (e.g., informal care), while children from more advantaged households experience care arrangements that can lower children's risk of obesity (i.e., center care)[39]. Thus, we account for the child's primary care arrangement using dummy variables for *center, relative*, *group home*, and *exclusive care by the primary caregiver*. We also consider whether the family received food stamps within the past twelve months.

Analysis Plan

Descriptive analyses explore means level differences for all study variables by family structure. Multivariate analysis use binary logistic regression to predict a child's odds of being obese, given his or her family structure. Estimation of the multivariate models processed systematically. First, only family structure was entered into the model, with stably married two biological parent families serving as the reference group. Then, controls for families' sociodemographic characteristics (e.g., gender, child race) were added. Next, we accounted for parents' socioeconomic circumstances. We then added measures tapping different aspects of mother and child health outcomes (e.g., general rating of health at birth) and behaviors (e.g., breast feeding). Finally, we accounted for children's primary care arrangement and food stamp receipt. This step-wise approach provides a more careful look at how the coefficients for family structure change when potentially confounding factors are added to the model. To assess whether the associations between different family structure types and children's odds of obesity vary by families' socioeconomic circumstances, we then interact family structure with a dichotomous measures for poverty (poor, not poor) and maternal education (college degree, no degree). To aid in the interpretation of these interactions, we estimate the predicted probabilities of obesity for different combinations of family structure and our indicators of socioeconomic status (either poverty or maternal education).

Given that the ECLS-B is overrepresents certain groups (e.g., low birth weight babies), the bivariate models apply the sampling weight. The multivariate models employ Stata's *svy* command to handle both the sampling weights and adjust for the complex survey design. This approach provides corrects standard errors, which would otherwise be too low [40]. In addition, we use the *subpop* option to exclude from the analysis the small number of children not assigned to one of our eight family structure categories. This option is preferable to making sample restrictions, which, given the use of survey and sampling weights, could produce incorrect estimates of the standard errors.

To estimate item-level missing values, we use multiple imputation procedures in Stata using the *ice* command[41] .The variables used in the imputation model include family structure, child obesity, and the full set of covariates. This approach produced five fully imputed data sets. Assuming the data is missing-at-random (MAR), this approach provides unbiased estimates that are superior to other conventional approaches to dealing with missing data, such as list-wise deletion[42]. Models estimated without imputation, however, provided results very similar to the imputation results reported here.

Results

Bivariate Models

Bivariate associations between our eight categories of family structure and all of our study variables are presented in Table 1. We also report the weighted frequencies alongside the raw *n*'s for the number of families in each family structure category. The raw *n*'s, however, were rounded to the nearest 50, following NCES licensing agreements. These raw numbers suggest that while the majority of families were headed by two married biological parents, followed by single mothers, there were sufficient numbers of families where an adult relative or father was the primary caregiver or the mother was in step or cohabiting union in order to explore the associations among such family types and child obesity. The ability to do so is an important innovation, given the increasing heterogeneity among families today.

[Insert Table 1 about here]

Such family structures may also have implications for children's weight status. Indeed, children raised by two cohabiting biological parents had the highest rates of obesity (31%) followed by children coresiding with an adult relative (29 %). Not surprisingly, children in married two biological parent households had some of the lowest obesity rates (17 %), but children in father-headed households (15 %) or married step parent households also had lower obesity rates (15 %). Compared to children in married two biological parent households, children in divorced families (21 %), cohabiting step parent families (23 %), and single mother families (23 %) had the highest rates of obese children (23 %).

Importantly, the association between family structure and children's risk of obesity may also be linked to the sociodemographic and socioeconomic characteristics of families that select them into different family structures. For example, mothers married to their child's biological father were typically older, more educated, more likely to be partnered with a college educated father, and less likely to be poor or a racial/ethnic minority. These known demographic and economic risks were most common among women that were unmarried, including single mothers or mothers cohabiting with the child's father or a romantic partner. Such obesity risks may also be confounded with the child's early health outcomes, mothers' health behaviors, or her own health including her pre-pregnancy BMI and whether she experienced complications during the pregnancy. Taken together, this set of health related measures does not immediately suggest a clear pattern by family structure. Still, some important findings emerged. For example, children living in single mother families, father headed families, or relative headed families had the lowest likelihood of being breastfed during infancy. Women married to their child's biological father, on the hand, were the most likely to breastfeed.

Multivariate Models

Turning to the multivariate models, we begin by estimating the zero-order correlation between our eight categories of family structure and children's odds of obesity. These results appear in Table 2. Compared to children raised by two married biological parents, children in single mother families (*or* = 1.45), cohabiting biological (*or* = 2.17), cohabiting step (*or* = 1.40), and relative headed families (*or* = 1.93) have greater odds of being obese (Model 1). Adding in controls for the sociodemographic characteristics of the family attenuated the association between single mother and child obesity to marginal significance (Model 2). The other significant coefficients remained significant and were roughly the same size as they were in

Model 1. Among the added covariates, Hispanic children were 48 percent more likely to be obese than White children. Alternately, female children were 19 percent less likely to be obese than male children. Children living with more siblings or in the Western region of the U.S. (compared to the North East) also had lower obesity rates (*or* = .92 and .66, respectively).

[Insert Table 2 about here]

Model 3 added in families' socioeconomic characteristics. Accounting for these factors reduced the associations between obesity and living in a single mother or cohabiting step parent household to non-significance. Thus, it appears that much of these children's risk of obesity is driven by the socioeconomic characteristics of their parents. Yet living in a relative headed household or with biological cohabiting parents still remains significantly associated with children's increased risk of obesity. Not surprisingly, children raised by college educated mothers had a lower likelihood of being obese (compared to children whose mothers did not have high school degrees). Other indicators for family socioeconomic background, including father/partner education and employment, mothers' work status, and family poverty status were not significantly associated with child obesity once different family structures and family sociodemographic factors were taken into account.

Model 4 accounts for the possibility that children raised in certain family structures were more likely to be at greater, or perhaps, lesser risk of obesity given their health status at birth, including low or height birth weight status, their mothers' pre- (i.e., WIC recipient, prenatal care paid for by Medicaid, smoking) and postnatal health behaviors (breastfeeding), or their mothers' own health (pre-pregnancy BMI, pregnancy complications.). The inclusion of these variables did not do much to diminish the increased risk of obesity for children raised in two parent cohabiting biological parent households or relative headed households compared to children in two biological parent married households. Adding these variables to the model also revealed that children born low birth weight had a lower odds of obesity (*or* = .67) while children born high birth weight had a higher odds of being obesity during preschool (*or* = 1.78). In addition, children that were breastfed were 19 percent less likely to be obese than children that were not. Lastly, mothers' own BMI was positively associated with her child's obesity risk.

As a last step in building our model, we consider the importance of the child's primary care arrangement and whether the primary caregiver received food stamps. None of these variables reached statistical significance at the minimum probably level of .05. At the same time, the coefficients for two biological parent cohabiting households and relative headed households remained significant. Accounting for the full set of covariates, children raised by two unmarried biological parents had a 65 percent greater likelihood of being obese than children that were raised by married biological parents. Children living with relative caregivers had more than twice the odds of obesity compared to similar children living with their married biological parents.

Testing Interactions between Family Socioeconomic Status and Family Structure

A final analytical step was to test whether we would observe a greater risk of obesity for children raised outside intact families when their primary caregivers were less advantaged. Thus, we included interactions between family poverty and family structure, and as in a separate model, between family structure and maternal education. For these models, we used a simplified dichotomous indicator of poverty and higher maternal education. For our poverty measure, we sort children living below the federal poverty line into one group and children above it into another. For mothers' education, we distinguished families with a college educated mother (or female caregiver) from those with a mother (or female caretaker) without a college degree. Table 3 presents the coefficient for the main effects and interactions. The covariates are not shown. To aid in the overall interpretation of these interactions, Figure 1 presents the predicted probabilities of being obese for poor and non-poor children in our eight family structure categories.

[Insert Table 3 about here]

[Insert Figure 1 about here]

Interacting poverty with family structure reveals an interesting pattern of results. Non-poor children living with married step parents had a 67 percent higher risk of obesity compared to similar non-poor children raised by married biological parents. This is suggested by the significant main effect of married step-parent, in which non-poor and married biological parents serve as the reference category. Thus, married step parent families present some obesity risk to children, but only when their families were not-poor. We also found evidence that poor children raised in married two biological parent families were at a 38 percent increased risk of obesity when their parents are poor, compared to children in similar family structure that were not poor. This is suggested by the significant coefficient for the poverty term. Among other family types, poverty did not seem to increase children's risk of obesity. In fact, poor children living with a father, cohabiting step parent, or married step parent had lower odds of obesity (*or* = .12, .46, and .26 respectively) than children in non-poor married biological households—an unexpected finding which we dicuss below. Each of these patterns are made clearer by Figure 1.

Interacting maternal education with family structure reveals that children in two biological married parent households also had a lower likelihood of being obese if their mother had college degrees (because the findings from this model were generally more straightforward, we do not present predicted probabilities, as we did above).This is suggested by the significant coefficient for mothers' education (*or* = .72, *SE* = .09, $p < .05$), in which no college degree serves as the reference category. This finding mirrors the pattern described above in which poor children from intact households had a greater risk of obesity than non-poor children from intact households. The significant main effect of living with unmarried biological parents (*or* = 1.65, *SE* = .30, p <.01) taken with the nonsignificant coefficient for its interaction with mothers education reveals that the increases risk of obesity associated with this family structure (refer to Model 5, Table 2) was generally concentrated among children of less educated mothers.

Discussion

The goal of our study was to document how children's risk of obesity varied across different types of family structure. As family structures have grown more diverse and children's likelihood of living outside an intact family greater, family structure is now considered an important indicator of socioeconomic background. As such, it has been examined in relation to various child outcomes. Child obesity, however, has rarely been examined in the context of such research. Because family structure also has implications for household processes (e.g., routines, children's physical play) and other proximate factors (e.g., mothers' work, time-use) that could influence children's weight status, the link between family structure and child obesity remains an important topic of research.

The results from our unadjusted models indicated that most family structure groups differed in rates of obesity from married parents. Children in families headed by single mothers, cohabiting biological parents, cohabiting step parents, and those headed by a relative all had higher odds of obesity compared to children with married-parent households, before accounting for covariates. In the fully-adjusted models, however, the only family structure differences in child obesity remaining were for cohabiting biological parents and relative-headed households, relative to married couple households. Thus, after accounting for sociodemographic, socioeconomic, and health factors,only children in these two family types had greater risks of being obese than children living with two married biological parents. These two findings are important as we continue to see a rise in both cohabiting households and children living under the care of a relative, generally a grandparent.

Next we tested whether the relationships between our family structure categories and child obesity changed based on two SES measures – whether the family lives in poverty and whether the mother had a college degree. We had expected that in more socioeconomically advantaged nontraditional family types, children would have similar or only slightly elevated obesity risks compared to similar children in intact families. We expected to observe greater obesity risks associated with family structure when the family was disadvantaged. .In fact, we found just that, but in not in the ways we had anticipated. Based on our findings, poor children living in cohabiting stepfather, married stepfather, and single father households had *lower* odds of obesity compared to non-poor children in married biological parent households. One interpretation is that there is something protective about such family structures for children. Although we believe this interpretation is plausible and should be explored in a future investigation, a more reasonable position to take at this time is that such results underscore how even children in non-poor two biological married parent families are at risk of obesity today. Indeed, the predicted probability that a child in such a context was not zero—it was .17 ($p<.001$). Thus, in improving the health of the nation, children from disadvantaged households deserve special attention, but we should also think more about what is contributing to obesity rates among non-poor children too.

The need for this broader policy emphasis is further emphasized by an additional set of findings—that non-poor children living in step-parent families had a higher risk of obesity compared to married couple households. Thus, in addition to children in cohabiting and relative headed households, step parent families present a risk to children's healthy weight status, but only when the family is not-poor. This finding may reflect the confluence of household dynamics associated with step parent families and access to resources (e.g., computer) that result in sedentary behaviors among children. Again, this finding will need to be explored in the future.

Finally, we find that the benefit of living with married, biological parents is offset by also living in poverty – poor, married, biological parent families' children had a 38% increase in the odds of obesity compared to similar non-poor families. This finding is important reminder that, in the effort to indentify the factors leading to child well-being, we must study them at their intersection. Our measure of poverty was not a significant predictor of children's obesity risk. Yet combined with family structure revealed that children in the "optimal" family structure type can also experience obesity risks when other sources of socioeconomic support are not in place.

These findings suggest several avenues for future research. First, we should explore not only family structure states, but also family structure *changes*. One recent study found that young children whose mothers experienced union dissolutions had worse weight status trajectories compared to children with stably married parents, and that this association was similar in size to the disadvantage faced by children stably living with single mothers[36]. This finding suggests that that the stress associated with varied living circumstances could have an impact on children's weight status. Second, such mechanisms—like stress—and their mediating role in the link between different family structures (or changes in family structure) and children's obesity should be considered. The results of this study highlight the importance of exploring such mechanisms among cohabiting biological parent families and relative headed families, in particular. Potential inquires could include relative caregivers food choices, which could reflected outmoded views on nutrition, or parenting philosophies among cohabiting households', which may be less traditional than more conventional family forms.

They also have implications for policy, practitioners, and interventions aimed at reducing child obesity. Many of these implications have already been laid out above. Taken more broadly, however, they convey how information on children's health and nutrition must reach not only mothers, but the other caregivers (relatives, fathers, step parents) with whom mothers and children regularly interact. While it is difficult to change household dynamics or alter family arrangements (and debatable whether that is the role of policy anyways), schools, pediatricians, child care providers, and other important adults and institutions in the lives of children should recognize that family configurations can contribute to children's obesity risks.

References

1. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine.* 1997;337(13):869-873.

2. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *The American journal of clinical nutrition.* 1999;70(1):145S-148S.

3. Fagot-Campagna A. Emergence of type 2 diabetes mellitus in children: epidemiological evidence. *Journal of pediatric endocrinology & metabolism: JPEM.* 2000;13:1395.

4. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics.* 1998;101(Supplement 2):518-525.

5. Braet C, Mervielde I, Vandereycken W. Psychological aspects of childhood obesity: a controlled study in a clinical and nonclinical sample. *Journal of Pediatric Psychology.* 1997;22(1):59-71.

6. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Affairs.* 2009;28(5):w822-w831.

7. Cawley J. The economics of childhood obesity. *Health Affairs.*29(3):364-371.

8. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA: the journal of the American Medical Association.*303(3):242-249.

9. Anderson PM, Butcher KF. Childhood obesity: trends and potential causes. *The Future of children.* 2006:19-45.

10. Singh GK, Siahpush M, Kogan MD. Rising social inequalities in US childhood obesity, 2003-2007. *Annals of epidemiology.* 2009;20(1):40-52.

11. Rhee K. Childhood overweight and the relationship between parent behaviors, parenting style, and family functioning. *The ANNALS of the American Academy of Political and Social Science.* 2008;615(1):11-37.

12. Contento IR, Basch C, Zybert P. Body image, weight, and food choices of Latina women and their young children. *Journal of nutrition education and behavior.* 2003;35(5):236-248.

13. Suglia SF, Duarte CS, Chambers EC, Boynton-Jarrett R. Cumulative social risk and obesity in early childhood. *Pediatrics.* 2012;129(5):e1173-e1179.

14. Gundersen C, Mahatmya D, Garasky S, Lohman B. Linking psychosocial stressors and childhood obesity. *Obesity Reviews.* 2010;12(5):e54-e63.

15. Kimbro RT, Brooks-Gunn J, McLanahan S. Young children in urban areas: Links among neighborhood characteristics, weight status, outdoor play, and television-watching. *Social Science & Medicine.*

16. McLanahan S. Diverging destinies: How children are faring under the second demographic transition. *Demography.* 2004;41(4):607-627.

17. Martin JA, Hamilton BE, Ventura SJ, Osterman MJK, Wilson EC, Mathews TJ. Births: Final Data for 2010. *National Vital Statistics Reports.* 2012;61(1).

18. Wu LL, Wolfe BL. *Out of Wedlock: Causes and Consequences of Nonmarital Fertility*. New York: Russell Sage Foundation; 2001.

19. Bzostek SH, McLanahan S, Carlson MJ. Mothers' Repartnering after a Nonmarital Birth. *Social Forces.* 2012;90(3):817-841.

20. Gable S, Chang Y, Krull JL. Television watching and frequency of family meals are predictive of overweight onset and persistence in a national sample of school-aged children. *Journal of the american dietetic association.* 2007;107(1):53-61.

21. Gable S, Lutz S. Household, Parent, and Child Contributions to Childhood Obesity*. *Family Relations.* 2000;49(3):293-300.

22. Anderson SE, Whitaker RC. Household routines and obesity in US preschool-aged children. *Pediatrics.* 2010;125(3):420-428.

23. Huffman FG, Kanikireddy S, Patel M. Parenthood - a contributing factor to childhood obesity. *International journal of environmental research and public health.* 2010 2010;7(7):2800-2810.

24. Hesketh K, Crawford D, Salmon J, Jackson M, Campbell K. Associations between family circumstance and weight status of Australian children. *International journal of pediatric obesity.* 2007;2(2):86-96.

25. Chen AY, Escarce JJ. Family Structure and Childhood Obesity, Early Childhood Longitudinal Study - Kindergarten Cohort. *Preventing chronic disease.* 2010;7(3).

26. Gibson LY, Byrne SM, Davis EA, Blair E, Jacoby P, Zubrick SR. The role of family and maternal factors in childhood obesity. *Medical journal of Australia.* 2007;186(11):591.

27. Tremblay M, Willms J. Is the Canadian childhood obesity epidemic related to physical inactivity? *International journal of obesity.* 2003;27(9):1100-1105.

28. Sherman JB, Liao YC, Alexander M, Kim M, Kim BD. Family factors related to obesity in Mexican-American and Anglo preschool children. *Family & Community Health.* 1995;18(2):28.

29. Fletcher JM. Accounting for Racial/Ethnic Disparities in Children's Obesity Status at 2 Years of Age. *Current Issues in Health Economics (Contributions to Economic Analysis, Volume 290), Emerald Group Publishing Limited.* 2011;290:163-177.

30. Kitsantas P, Gaffney KF. Risk profiles for overweight/obesity among preschoolers. *Early human development.* 2010;86(9):563-568.

31. Byrne LK, Cook KE, Skouteris H, Do M. Parental status and childhood obesity in Australia. *International journal of pediatric obesity.* 2011;6(5â€•6):415-418.

32. Klein-Platat C, Wagner A, Haan M, Arveiler D, Schlienger J, Simon C. Prevalence and sociodemographic determinants of overweight in young French adolescents. *Diabetes/metabolism research and reviews.* 2003;19(2):153-158.

33. Danielzik S, Czerwinski-Mast M, LangnÃ¤se K, Dilba B, MÃ¼ller M. Parental overweight, socioeconomic status and high birth weight are the major determinants of overweight and obesity in 5â€“7 y-old children: baseline data of the Kiel Obesity Prevention Study (KOPS). *International journal of obesity.* 2004;28(11):1494-1502.

34. Strauss RS, Knight J. Influence of the home environment on the development of obesity in children. *Pediatrics.* 1999;103(6):e85-e85.

35. Cooper CE, McLanahan SS, Meadows SO, Brooksâ€•Gunn J. Family structure transitions and maternal parenting stress. *Journal of Marriage and Family.* 2009;71(3):558-574.

36. Schmeer KK. Family structure and obesity in early childhood. *Social Science Research.* 2012.

37. Snow K, Thalji L, Derecho A, et al. Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), Preschool Year Data File Userâ€™s Manual (2005â€“06)(NCES 2008-024).

Washington, DC: National Center for Education Statistics, Institute of Education Sciences, US Department of Education. 2007.

38. Mistry RS, Biesanz JC, Taylor LC, Burchinal M, Cox MJ. Family income and its relation to preschool children's adjustment for families in the NICHD Study of Early Child Care. *Developmental Psychology.* 2004;40(5):727.

39. Briley M, McAllaster M. Nutrition and the Child-Care Setting. *Journal of the American Dietetic Association.*111(9):1298-1300.

40. Lee ES. *Analyzing Complex Survey Data*. Thousand Oaks, CA: Sage Publications, Inc.; 2005.

41. Royston P. Multiple Imputation of Missing Values. *Stata Journal.* 2004;4:227-241.

42. Allison PD. *Missing Data*. Thousand Oaks, CA: Sage Publications; 2001.

Table 1. Descriptive Statistics for All Study Variables by Family Structure (*n* = 8,234)

	Means (SD) and Percentages							
	Married	**Single**	**Cohabiting Bio**	**Cohabiting Step**	**Married Step**	**Divorced**	**Father**	**Relative**
Child Obesity								
Obese	17 %	23 %	31 %	23 %	15 %	21 %	15 %	29 %
Family Sociodemographic Variables								
Maternal age at birth	29.21	22.46	23.71	26.19	24.10	26.70	24.10	22.93
	(5.57)	(5.03)	(5.37)	(6.34)	(5.58)	(5.86)	(5.58)	(5.21)
Child Female	49 %	47 %	41 %	52 %	54 %	55 %	48 %	53 %
Child first born	33 %	52 %	41 %	33 %	44 %	40 %	25 %	29 %
Black	6 %	49 %	16 %	17 %	11 $	26 %	7 %	13 %
Child Hispanic	14 %	13 %	31 %	13 %	3 %	12 %	8 %	9 %
Child other race/ethnicity	13 %	12 %	27 %	17 %	10 %	14 %	21 %	10 %
Non-English speaking household	20 %	11 %	43 %	14 %	5 %	12 %	8 %	3 %
Number of children in household	1.50	1.02	1.34	1.35	1.38	1.38	.91	.94
	(1.08)	(1.14)	(1.10)	(1.16)	(1.06)	(1.26)	(.99)	(1.10)
Northeast region of residence	18 %	19 %	11 %	17 %	14 %	22 %	9 %	16 %
South region of residence	34 %	40 %	34 %	39 %	57 %	40 %	41 %	45 %
Midwest region of residence	23 %	22 %	21 %	20 %	14 %	17 %	17 %	26 %
West region of residence	25 %	18 %	34 %	24 %	14 %	21 %	33 %	12 %
Family Socioeconomic Variables								
Mother less than high school	10 %	24 %	40 %	19 %	17 %	20 %	15 %	15 %
Mother high school degree	22 %	42 %	36 %	34 %	37 %	35 %	29 %	36 %
Mother some college	32 %	30 %	21 %	36 %	40 %	23 $	35 %	32 %
Mother college degree	36 %	5 %	4 %	11 %	5 %	22 %	13 %	16 %
Father college degree	35 %	4 %	2 %	9 %	4 %	17 %	6 %	5 %
Mother not working [a]	42 %	37 %	49 %	29 %	43 %	48 %	33 %	47 %
Mother part-time work [a]	22 %	17 %	15 %	17 %	13 %	13 %	16 %	13 %
Mother full-time work [a]	36 %	46 %	36 %	54 %	44 %	39 %	51 %	40 %
Father employed full-time [b]	91 %	---	81 %	29 %	88 %	---	70 %	47 %
Poor (below 100 % of poverty line)	13 %	59 %	50 %	40 %	27 %	37 %	32 %	29 %
Near poor (100 – 185 % of poverty line)	20 %	22 %	30 %	29 %	30 %	24 %	28 %	22 %
Not poor (above 185 % of poverty line)	68 %	19 %	20 %	32 %	43 %	38 %	40 %	48 %
Mother and Child Health Characteristics and Behaviors								
Maternal pre-pregnancy BMI	24.84	24.98	25.32	25.23	24.04	25.22	24.05	23.87
	(5.41)	(6.10)	(5.64)	(5.97)	(5.51)	(6.12)	(5.39)	(5.10)
Maternal pregnancy complications	0.36	0.44	0.30	0.42	0.34	0.40	0.37	0.49
	(0.63)	(0.66)	(0.58)	(0.66)	(0.40)	(0.65)	(0.69)	(0.66)

Table 1 Continued. Descriptive Statistics for All Study Variables by Family Structure (n = 8,234)

Child low birth weight	7 %	11 %	9 %	9 %	9 %	11 %	10 %	13 %
Child high birth weight	11 %	6 %	11 %	7 %	5 %	5 %	6 %	5 %
Child poor heath at birth	2 %	4 %	4 %	3 %	1 %	5 %	1 %	3 %
Pregnancy paid for by Medicaid	19 %	70 %	64 %	50 %	53 %	48 %	54 %	73 %
Mother received WIC during pregnancy	27 %	71 %	76 %	58 %	69 %	59 %	56 %	61 %
Mother breastfed for 6 months	77 %	47 %	65 %	60 %	64 %	68 %	43 %	51 %
Mother smoked during pregnancy	2 %	3 %	3 %	7 %	8 %	2 %	6 %	12 %
Other Relevant Factors								
Food stamp receipt	11 %	61 %	40 %	50 %	42 %	44 %	28 %	41 %
Center care	60 %	60 %	49 %	56 %	52 %	56 %	49 %	58 %
Relative care	11 %	20 %	16 %	17 %	18 %	21 %	28 %	16 %
In-home group care	8 %	6 %	7 %	11 %	9 %	9 %	9 %	4 %
No child care	21 %	14 %	28 %	16 %	20 %	13 %	14 %	23 %
Weighted percentage	62 %	12 %	7 %	11 %	2 %	2 %	1 %	1 %
Raw n's [c]	5,250	1,000	500	850	200	200	100	100

Notes: Data are weighted using weight W13C0. Descriptive statistics for children in final family structure group containing adoptive, foster, and other families headed by non-relatives are not shown (n = 50). [a] Refers to mother or female primary caregiver. [b] Refers to father or other male caregiver in household.
[c] Rounded to nearest 50th.

Table 2. Logistic Regression Models Predicting Children's Obesity Odds (n = 8,234)

	Odds Ratios (Standard Errors)				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Family Structure (*intact*)					
Never married single mother	1.45 **	1.39+	1.26	1.28	1.31
	(.18)	(.23)	(.23)	(.25)	(.26)
Cohabiting with bio father	2.17***	1.94***	1.70**	1.64**	1.65**
	(.34)	(.35)	(.31)	(.30)	(.30)
Cohabiting with step father	1.40*	1.41*	1.24	1.27	1.30
	(.20)	(.22)	(.24)	(.24)	(.24)
Married step father	.89	.96	.82	.88	.89
	(.24)	(.27)	(.24)	(.24)	(.24)
Single divorced mother, married at birth	1.30	1.29	1.23	1.26	1.27
	(.35)	(.36)	(.35)	(.37)	(.37)
Biological father headed household	.86	.90	.79	.83	.82
	(.36)	(.40)	(.36)	(.38)	(.38)
Relative headed household	1.93**	2.00**	1.84*	1.99*	2.02*
	(.45)	(.47)	(.47)	(.56)	(.58)
Family Sociodemographic Characteristics					
Maternal age at birth	---	1.01	1.02**	1.02	1.02*
		(.01)	(.01)	(.01)	(.01)
Child Gender (male)	---	.81*	.82*	.84	.84*
		(.07)	(.07)	(.07)	(.07)
Child black (White)	---	1.13	1.06	1.04	1.06
		(.14)	(.13)	(.04)	(.14)
Child Hispanic	---	1.48*	1.34+	1.30	1.30
		(.23)	(.21)	(.21)	(.21)
Child other race/ethnicity	---	1.25+	1.17	1.19	1.19
		(.16)	(.15)	(.16)	(.16)
Non-English speaking household	---	1.22	1.09	1.20	1.19
		(.16)	(.15)	(.17)	(.16)
Number of children in household	---	.92*	.88**	.87	.87**
		(.04)	(.04)	(.04)	(.04)
Southwest region (Northeast)	---	.93	.86	.89	.88
		(.11)	(.11)	(.11)	(.11)
Midwest region	---	.88	.86	.84	.82
		(.10)	(.10)	(.11)	(.11)
West region	---	.66***	.62***	.65***	.64***
		(.08)	(.07)	(.08)	(.08)
Focal child is mother's first birth	---	1.07	1.09	1.10	1.10
		(.11)	(.13)	(.12)	(.11)
Family Socioeconomic Characteristics					
Mother high school degree (drop-out)	---	---	.81+	.84	.85
			(.09)	(.09)	(.09)
Mother some college	---	---	.79+	.80	.82
			(.11)	(.12)	(.12)
Mother college degree	---	---	.57***	.63**	.65*
			(.09)	(.11)	(.11)
Father college degree (no college)	---	---	.86	1.07	.97
			(.13)	(.16)	(.15)
Mother part-time work (not working)	---	---	.90	.90	.91
			(.11)	(.11)	(.12)
Mother full-time work	---	---	1.10	1.05	.91
			(.11)	(.11)	(.12)

Table 2 Continued. Logistic Regression Models Predicting Children's Obesity Odds (n = 8,234)

	Odds Ratios (Standard Errors)				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Father employed full-time	---	---	1.06 (.15)	1.07 (.16)	1.07 (.16)
Near poor (not poor)	---	---	1.22 (.16)	1.16 (.15)	1.16 (.16)
Poor	---	---	1.10 (.16)	1.02 (.16)	1.05 (.18)
Mother and Child Health Characteristics and Behaviors					
Maternal pre-pregnancy BMI	---	---	---	1.05*** (.01)	1.05*** (.01)
Maternal pregnancy complications	---	---	---	.98 (.07)	.98 (.07)
Child low birth weight	---	---	---	.67*** (.07)	.67*** (.06)
Child high birth weight	---	---	---	1.78*** (.22)	1.77*** (.22)
Child heath at birth (poor health)	---	---	---	1.22 (.35)	1.22 (.35)
Pregnancy paid for by Medicaid	---	---	---	1.01 (.13)	1.02 (.13)
Mother received WIC during pregnancy	---	---	---	1.12 (.12)	1.13 (.12)
Mother breastfed for 6 months	---	---	---	.81* (.08)	.81* (.08)
Mother smoked during pregnancy	---	---	---	1.12 (.30)	1.12 (.30)
Other Relevant Factors					
Food stamp receipt	---	---	---	---	.90 (.12)
Relative care (center care)	---	---	---	---	1.04 (.17)
In-home group care	---	---	---	---	1.15 (.13)
No child care	---	---	---	---	1.19+ (.10)

Notes: *** p<.001, ** p<.01, *p<.05, +p<.10

Table 3. Logistic Regression Models Predicting Children's Obesity Odds with Family Structure x Family Socioeconomic Characteristics Interactions (*n* = 8,234)

	Odds Ratios (Standard Errors)	
	Family Structure x Family Poor	**Family Structure x Mother College**
Family Structure (*intact*)		
Never married single mother	1.35	1.28
	(.40)	(.26)
Cohabiting with bio father	1.47	1.65**
	(.53)	(.30)
Cohabiting with step father	2.11	1.25
	(.57)	(.24)
Married step father	1.67**	.82
	(.67)	(.23)
Single divorced mother, married at birth	1.72	1.10
	(.72)	(.37)
Biological father headed household	2.32	.86
	(1.46)	(.41)
Relative headed household	1.89	1.64
	(.94)	(.59)
Family Socioeconomic Characteristics		
Family Poor (not poor)	1.38*	---
	(.20)	
College (less than college)	---	.72*
		(.09)
Interactions (*intact*)		
Never married single mother x SES	.87	1.26
	(.26)	(.66)
Cohabiting with bio father x SES	1.05	1.02
	(.39)	(.79)
Cohabiting with step father x SES	.45**	1.39
	(.13)	(.55)
Married step father x SES	.26*	2.83
	(.16)	(2.57)
Single divorced mother, married at birth x SES	.59	2.05
	(.31)	(1.36)
Biological father headed household x SES	.12**	.02
	(.09)	(.13)
Relative headed household x SES	1.08	3.18
	(.93)	(3.29)

Notes: *** *p*<.001, ** *p*<.01, **p*<.05, +*p*<.10. SES = Socioeconomic status indicator for either poverty or mothers' education.

Figure 1. Predicted Probability of Obesity by Family Structure and Poverty Status