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Abbreviations:
BMI: Body Mass Index
CNLSY: Children of the National Longitudinal Survey of Youth
NLSY79: National Longitudinal Survey of Youth 1979

ABSTRACT

Purpose: Experiencing family instability during adulthood has an immediate impact on adult weight, with adult women gaining weight and adult men losing weight. It is unclear whether experiencing family instability during childhood and adolescence has an accumulating negative impact on weight in young adulthood, specifically, placing females' at-risk for being overweight in young adulthood. We assessed whether female and male young adults differ in overweight status based on the family instability experienced during childhood and adolescence.

Methods: The sample included 5,139 young adults from the Children of the National Longitudinal Survey of Youth 1979. Family instability captured young adults' exposure to family structure transitions from birth to the age of 18 as defined by mother's formation and dissolution of romantic unions. Body mass index was directly assessed in young adulthood.

Results: A series of logistic regression models predicted the odds of young adults being overweight or obese. Results indicate that cumulative family structure transitions during childhood and adolescence increase the odds for young adult females born to married mothers to be overweight by 19%. Family instability, however, does not increase the probability for young adult females nor males born to single mothers to be overweight.

Conclusions: Experiencing family instability during childhood and adolescence has an accumulating detrimental impact on the weight status of young adult females born to married mothers. Interventions during childhood are important to prevent females who experience multiple family transitions from becoming overweight as young adults; therefore helping females successfully transition from adolescence to adulthood.

Keywords: BMI, Family instability, NLSY79, Obesity, Overweight, Young adult

INTRODUCTION

The structure of American families has undergone drastic change over the past several decades. For instance, in 1970 only 37% of marriages ended in divorce, compared to 44% in 1995.[1] During the same time period, cohabitation became a testing ground for romantic relationships. While only 8% of first marriages were preceded by cohabitation in the late 1960's,[2] this number rose to 65% by 1995.[3] Further, at least half of all children will spend some time living in a single parent family, and one-third will live in a household with a biological and non-biological parent.[4] As a result of changes in marriage, divorce, cohabitation, and single parenthood, children today experience greater amounts of family instability than children from earlier birth cohorts.

Previous family research indicates that once a family unit has experienced a transition, they are at a greater risk for experiencing subsequent transitions.[5] According to the cumulative risk hypothesis, the accumulation of risk factors (i.e. cumulative family structure transitions such as marriage, divorce, remarriage), rather than any particular risk (e.g., a single divorce), impacts development negatively.[6,7] The cumulative negative impact of family instability on well-being[8-10] is consistent with the social stress theory which emphasizes how changes in marital and romantic relationships introduce stress into the entire family unit.[11,12] In cases of both relationship entrances (e.g., marriage) and exits (e.g., divorce), parental attention and emotional availability are often turned away from the child. In response, the child may feel emotionally disconnected, creating ambiguity surrounding parental relationships and expectations.

The rising rates of instability among American families have coincided with population level increases in children's and adult's weight status. For instance, five percent of U.S. children between the ages of 2 and 19 were classified as obese between 1971-1974 compared to 17% in

2007-2008.[13] Among adults, the prevalence of obesity has increased from 13% to 32% between 1960 and 2004.[14] Although changes in family structure stability and weight status have occurred concurrently, there is a lack of research investigating whether being overweight (i.e. BMI $\geq$ 25) in young adulthood is influenced by the family instability experienced during childhood. In other words, it is unclear whether the stress that is associated with family instability during childhood could have an accumulating negative impact on weight status in young adulthood. Young adulthood is a critical period to study BMI as this is the life-stage where individuals move out of their parent's house, begin to form their own romantic unions, and begin to create their own path to financial stability either through employment or advancing their education. However, being obese or experiencing the negative health consequences associated with obesity, such as Type 2 diabetes, cardiovascular disease, hypertension, and high cholesterol,[15,16] could impair the successful transition from adolescence into adulthood.

There is some indication that the type of family structure a child experiences influences their risk of being overweight or obese during childhood. For example, research has found that residing in single-mother households compared to two-parent households places children at greater risk for obesity.[17,18] Yet this research focuses on family structure at one point in time and does not consider cumulative changes in family instability throughout childhood and adolescence. Scholarship on family instability during adulthood and its impact on BMI suggest that family instability influences adult women and men's BMI immediately, but in opposite directions. For example, entering or leaving a marriage is associated with adult women gaining weight (i.e. higher BMI levels) and adult men losing weight.[19] If changes in family structure that occur in adulthood have an immediate, yet opposing, influence on adult women and men's weight, changes in family structure that occurred during childhood and adolescence could have

an accumulating, yet opposite, effect on female and males' weight status in young adulthood. In other words, female's weight in young adulthood could differ from male's based on the family instability that occurred during their childhood and adolescence. Experiencing a greater number of family structure transitions could have an accumulating detrimental effect on young adult female's weight, placing them at a disproportionally greater risk for being overweight (i.e. BMI ≥ 25) in young adulthood and affecting their ability to successfully transition from one developmental stage to another.

The current study contributes to the literature that has focused on obesity during young adulthood[20-22] by assessing whether female and male young adults differ in overweight status (i.e. BMI ≥ 25) as a result of family instability experienced during childhood and adolescence, controlling for factors that influence family instability and children's weight. We measure family instability by counting the number of family structure transitions young adults experienced during their entire life-stage of childhood and adolescence, from birth to age 18. We also consider the relationship status young adults was born into, as being born into a single parent household (compared to a two-parent household) increases the likelihood of having experienced more transitions during childhood.[10] Based on the literature cited above, we hypothesized that stress resulting from each family transition during childhood has a linear cumulative effect over time, increasing the risk for females (more so than males) to be overweight in young adulthood. In light of the family instability and obesity trends, along with the negative health consequences associated with obesity, investigating the the association between family instability and young adult overweight status may have important clinical implications. Specifically, the study may help identify which sex is at greatest risk for being overweight in the presence of childhood

family instability, affecting their ability to successfully transition from adolescence to young adulthood.

METHODS

Data for this study come from the National Longitudinal Survey of Youth 1979 (NLSY79) and the linked Children and Young Adults file (CNLSY). NLSY data are sponsored by the U.S. Department of Labor and have been compiled through the Ohio State University Center for Human Resource Research. The original NLSY79 data includes a nationally representative sample of 12,686 men and women followed from 1979-2010. The CNLSY has surveyed the biological children of these women every two years since 1986 and represents over 90 percent of all the children born to this cohort. The study was approved by the Institutional Review Boards at the three universities**.**

Analytic Sample

A total of 8,261 children were born to 3,366 NLSY79 mothers between 1970 and 2005. Women were eligible for inclusion if they did not miss more than 5 total or 3 consecutive waves of data collection. The child sample was further restricted to young adults who were at least 20 years old by 2010 (2,699 children were excluded because they were too young), had valid BMI data (407 cases excluded), and were not pregnant during the BMI assessment (16 cases excluded). Multiple imputation was used to impute missing data for five covariates in our models (2.5% of values). A strength of multiple imputation is that all relevant cases are kept in the analyses for accurate parameter estimates and the standard errors are corrected for the amount of missing information. This is in comparison to listwise deletion, which results in a sample that no longer represents the population.[23] The final analytic sample consisted of 5,139 young adults who were born between 1970-1991, with 75% of the sample being born by 1986 (mean = 1984).

Dependent Variables

Body Mass Index. Direct assessment of young adults' height (feet and inches) and weight (pounds) was collected bi-yearly starting in 1994. BMI was then calculated based on the first valid survey year in which young adults were 20 years of age or older. The continuous BMI measurements was categorized into the reference criteria for adults outlined by the Center for Disease Control [i.e. underweight (BMI < 18.5 kg/m^2), normal weight (BMI = 18.5-24.9 kg/m^2), overweight (BMI = 25.0-29.9 kg/m^2), and obese (BMI >=30.0 kg/m^2)].[24]

Independent Variables

Family Structure Transitions. The cumulative family structure transition variable was created based on the formation or dissolution of the mother's romantic unions (e.g., single to marriage; marriage to separation) experienced by the child from birth to age 18. The variable is a count that increases by 1 for each change in family structure during this time. For example, a child born into a single mother household (0 transitions) who then resided with her newly married mother and stepfather (1 transition), followed by living again with her single mother as a result of a separation (1 transition) and later as a result of a divorce (1 transition), would receive a score of 3 (marriage, separation, divorce). Marital separations to divorce are counted as a transition as not all couples who separate end their relationship in divorce.[25] Thus, not counting this transition underestimates family instability and could bias results. The scale of the cumulative family structure transition variable ranged from 0 to 13 but was top coded at 4 due to the small number of individuals experiencing more than 4 transitions (approximately 10% of children).

Sex. Young adults' sex was reported by their mothers at time of birth (1=female; 0 = male).

Covariates

A set of child and mother characteristics were incorporated as covariates in the models to reflect selection factors that could influence both mother's union instability as well as overweight status in young adulthood. Child characteristics included the child's age at BMI assessment (in years), race/ethnicity [White (reference), Hispanic, Black], depressive symptoms [1994 Center for Epidemiological Studies Depression Scale (CES-D); 1 = ≥75th percentile; 0 = < 75th percentile],[26] and positive self-esteem [1994 Rosenberg Self-esteem Scale (RSE)].[27] Mother characteristics included the age at child's birth (in years), highest education completed at age 23 (years of schooling), employed at child's birth (1 = employed; 0 = not employed), income below the Federal Poverty Line (FPL) at child's birth (1 = below FPL; 0 = above FPL), and BMI at age 20.

Although not considered a covariate, mother's relationship status at the child's birth was included in the data set as two mutually exclusive variables (married/cohabiting union; single parent household). Separate analyses were conducted for each group because children born to single mothers are more likely to experience greater family structure transitions compared to children born to married or cohabiting mothers.[10] Because only 7% of the mothers reported living in a cohabiting union at the time of the child's birth, young adults born in a cohabiting union were grouped with young adults born in a married union. Thus, the "married mothers" group consist mostly if women who were married at the time of the birth of the child and some women who were in a cohabiting union at the time of the birth.

Analytic Plan

Descriptive analyses and logistic regression models were performed using STATA 11.1 statistical software (StataCorp LP, College Station, Texas). Weighted descriptive analyses were

conducted on non-imputed data, and bivariate associations between gender and each covariate were investigated. Logistic regression models were conducted on imputed data to predict BMI clinical cutoffs for categorizing adults as overweight or obese. To examine whether the overweight status of female and male young adults differs depending on the family instability they experienced during childhood, a term interacting family structure transitions and sex was included in all the models, along with covariates. All multivariate models employed five mirror data sets imputed with STATA's ICE command and used in conjunction with the MICOMBINE and the LOGISTIC commands. The standard errors were adjusted using the Huber-White sandwich estimator to account for the lack of independence of observations based on siblings born to the same mother.[28,29]

RESULTS

The average BMI in our sample during young adulthood was 25 (Table 1). Among young adults who were born to married mothers, young adult females—compared to young adult males–were more likely to have a healthy BMI (59% versus 51%). Young adult males, regardless of their mother's relationship status at birth, were more likely to be overweight compared to their female peers.

On average, young adults experienced approximately 1.5 transitions during childhood and adolescence, with 46% reporting zero transitions and 47% reporting two or more. Young adults born to married mothers experienced fewer transitions than young adults born to single mothers (Table 2). Among children born to married mothers, overweight females (BMI ≥ 25) experienced more family structure transitions than overweight males.

Multivariate Regression Models

Table 3 presents the assessment of whether overweight status (i.e. BMI ≥ 25) for female

and male young adults differ depending on the family instability they experienced during childhood, net of all controls. In Panel A, findings indicate that for young adults born to married mothers, cumulative family structure transitions during childhood increased the odds for females—compared to males-—to be overweight (i.e. BMI ≥ 25) in young adulthood. Specifically, females who experienced multiple family structure transitions during childhood were 14% more likely to be overweight (BMI 25 – 29.9) in young adulthood. Further, cumulative family structure transitions during childhood increased the odds for females to be overweight and obese (BMI ≥ 25) by 19%. As illustrated in Figure 1, females' probability of being overweight (BMI ≥ 25) increased as the number of transitions increased, while males' probability of being overweight stayed fairly constant as the number of transitions increased. In Panel B, findings indicate that for young adults born into single parent households, cumulative family structure transitions during childhood and adolescence do not significantly increase the odds for neither females nor males to be overweight in young adulthood.

Sensitivity Results

Three additional sets of multivariate models were conducted to test the robustness of the main results. The first two sets of models changed the analytic sample by (1) conducting analyses on non-imputed data and (2) excluding the 7% of women who were cohabiting at the time of the birth from the married mother sample. The third set of models used a modified version of family structure instability that omitted marital separations from the count. The results from the three sets of sensitivity analyses uphold to our main findings (available upon request).

DISCUSSION

The goal of this study was to investigate whether females—compared with males—were at greater risk for being overweight in young adulthood when faced with multiple family

disruptions during childhood and adolescence. The results give partial support for our hypothesis and suggest that although there is not an effect for males, there is an effect in the expected direction for the majority of females in our sample. Specifically, the results indicate that cumulative family structure transitions place females born into married unions at risk of being overweight as young adults. Surprisingly, family instability does not increase the probability of being overweight for females born to single mothers.

In line with prior research,[10] our findings indicate that young adults born to single mothers experienced a greater amount of family instability throughout childhood compared to their peers born to married mothers. In addition, a large proportion of young adults born to single mothers are overweight compared to their peers born into married unions. Although there are differences between young adults born to single mothers compared to young adults born to married mothers, there is limited variability in both the dependent variable (i.e. overweight status) and the independent variable (i.e. family instability) among young adults born to single mothers. The limited variability in the main constructs could be related to the lack of significant findings in the multivariate results. For example, the proportion of females who were overweight (BMI ≥ 25) and the number of transitions they experienced was *universally high* and *did not differ* from their male counterparts, who are also likely to be overweight and experience a large number of transitions.

The data (CNLSY and NLSY79) are well suited to establish sex differences in the association between family instability and overweight status among young adults born to married unions; yet, the data lacks information on possible behavioral mechanisms that could provide insight into the processes by which family structure transitions matter for females born into married unions. For example, the sex differences observed among young adults born to married

mothers may be related to the allocation of child and household responsibilities. Research on the allocation of household responsibilities indicates that girls spend more time performing housework and caregiving responsibilities than boys do.[30,31] Household responsibilities may further be reallocated when children transition from married, two-parent family structures to single-parent households as a decline in physical activity and an increase in sedentary behaviors have been observed.[32] There is also a lack of supervision that occurs during periods of family disruption.[33] The decrease in supervision, along with the increase in sedentary behaviors, provides opportunities for children and adolescents to turn to comfort foods (i.e. foods high in sugar and fat) as a way to cope with the feelings of ambiguity and parental disconnect that may occur during periods of family instability. The overconsumption of comfort foods under stressful situations contributes to a stress-induced food reward dependence,[34] which is a behavioral response that has been observed more often among females in the past.[35,36] Thus, the behavioral changes that occur during the periods of family instability could be contributing to females born to married mothers to be at risk of being overweight in young adulthood. Data on children's dietary intake, physical activity, and sedentary behaviors, along with measures of parents' supervision and monitoring behaviors, could provide insight into the behavioral mechanisms that contribute to the sex differences in the association between family instability and overweight status in young adulthood.

To gain a better understanding how family instability influences overweight status differently among female and males, future research needs to consider broader measures of weight, such as weight circumference. Previous research has indicated that the association between stress and weight gain is stronger when central adiposity (i.e. waist circumference) is measured rather than BMI,[37] as the stress-induced food reward dependence cycle mentioned

above contributes to an increase in central abdominal fat.[38] The use of BMI (compared to the use of waist circumference) may underestimate how family instability influences weight differently for females and males.

This study contributes to the emerging literature on obesity in young adulthood by focusing on family instability during childhood and adolescence as a trigger for poor weight status in young adulthood. A strength of the current study was the ability to capture young adults' experiences with family instability from birth to age 18, as there are limited data sets that have the capability to build a comprehensive picture of family instability during the entire life-stage of childhood and adolescence. However, our measure of family instability is conservative. For instance, the majority of the young adults in the current study were born in the mid-1980s, a time period in which cohabitation was relatively more common than the 1960s;[2,3] however, not as common as it is two decades later.[39] In our sample, the number of mothers who were cohabiting at the time of birth were few, preventing us from examining the effect of family instability on young adult BMI based on cohabitation at birth. It is possible that the effects will be more pronounced among children born to cohabiting mothers in the last decade.

Although findings indicate that family instability during childhood only affects the overweight status of females born into married/cohabiting unions, we also found that a great proportion of young adults born to single mothers were overweight themselves. Thus, the current study underscores the importance of practitioners working with children and their families to learn about all the possible stressors in the family environment in order to lower the risk of children being overweight as young adults. Intervention programs aimed at reducing obesity during childhood need to take into account that *any* change in the family structure changes family dynamics and increases stress. Changes in family structure can be observed immediately.

However, the impact of reoccurring changes in the family structure unit appears to have an accumulating detrimental impact on BMI in young adulthood among females born to married mothers. Excess weight and the negative health consequences associated with obesity[15,16] could impair adolescents from successfully transitioning to adulthood. Increasing support systems for children, especially females, during times of family instability may help to reduce children's risk of being overweight as young adults, helping them to successfully adjust to adulthood.

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Table 1 Weighted Descriptive Characteristics for the Full Analytic Sample and by Maternal Relationship Status at the Child's Birth, Stratified by Child's Sex

| | | Maternal Relationship Status at Birth | | | |
| | | Married/Cohabiting Union | | Single Parent Household | |
Characteristics	Full Analytic Sample	Female	Male	Female	Male
BMI in Young Adulthood					
Continuous, mean (SD)	25.39 (5.33)	24.76 (5.74)**	25.50 (5.00)	26.71 (6.78)	25.97 (5.10)
Obese, No. (%)	423 (17%)	157 (16%)	158 (16%)	60 (25%)	48 (18%)
Overweight, No. (%)	640 (26%)	186 (19%)***	311 (31%)	56 (24%)*	87 (33%)
Healthy BMI, No. (%)	1318 (53%)	570 (59%)**	516 (51%)	107 (46%)	128 (48%)
Underweight, No. (%)	85 (3%)	53 (6%)***	18 (2%)	12 (5%)*	2 (1%)
Family Structure Transitions					
Cumulative, mean (SD)	1.47 (1.57)	1.38 (1.60)	1.27 (1.55)	2.06 (1.43)	2.02 (1.47)
0, No. (%)	1141 (46%)	503 (52%)	545 (54%)	42 (18%)	56 (21%)
1, No. (%)	206 (8%)	41 (4%)*	63 (6%)	51 (22%)	49 (19%)
2, No. (%)	362 (15%)	138 (14%)	119 (12%)	48 (21%)	55 (21%)
3, No. (%)	334 (14%)	124 (13%)	132 (13%)	38 (16%)	39 (14%)
4+, No. (%)	425 (18%)	160 (17%)	143 (14%)	56 (24%)	65 (24%)
Gender					
Female, No. (%)	1200 (49%)	996 (100%)	---	204 (100%)	---
Covariates					
Child Characteristics					
Age at BMI assessment	21.29 (1.37)	21.25 (1.33)	21.25 (1.32)	21.40 (1.43)	21.55 (1.59)
Race/ethnicity, No. (%)					
White	1730 (70%)	786 (81%)	797 (80%)	71 (30%)	83 (31%)
Black	515 (21%)	116 (12%)	99 (10%)	138 (59%)	155 (59%)
Hispanic	222 (9%)	64 (7%)**	106 (11%)	26 (11%)	26 (10%)
Depression, No. (%)	661 (27%)	282 (30%)***	201 (20%)	105 (45%)***	71 (27%)
Positive Self-esteem, mean (SD)	1.81 (0.40)	1.82 (0.41)*	1.78 (0.38)	1.85 (0.46)	1.84 (0.41)
Mother Characteristics					
Age at child's birth, mean (SD),	23.05 (3.90)	23.44 (3.70)*	23.81 (3.64)	20.84 (3.99)	20.86 (3.92)
Education, mean (SD), y	12.08 (2.00)	12.35 (1.84)	12.21 (2.09)	11.33 (1.92)	11.36 (1.91)
Employed at child's birth	896 (40%)	383 (42%)	416 (44%)	52 (28%)	46 (21%)
Income below FPL at child's birth	514 (25%)	142 (17%)	139 (16%)	100 (63%)	130 (66%)
BMI at age 20, mean (SD)	22.58 (3.79)	22.29 (3.70)	22.42 (3.51)	23.64 (4.39)	23.27 (4.25)
Unweighted n	5139	1720	1810	800	809

Abbreviation: BMI, body mass index; FPL, federal poverty line.
Descriptives based on non-imputed data. Significant differences between female and males: *** $p < .001$; **$p < .01$; *$p < .05$.

Table 2 Average Number of Transitions and (Standard Deviations) by Relationship Status at Birth Stratified by BMI Category and Sex

	Panel A: Married/Cohabiting Union Average Number of Transitions = 1.32 (1.57)			
	Normal BMI (BMI 18.5 – 24.9)	Overweight (BMI 25 – 29.9)	Obese (BMI ≥30)	Obese/Overweight (BMI ≥ 25)
Gender				
Female	1.37 (1.56)	1.51 (1.60)	1.74 (1.63)[b]	1.61 (1.60)[a]
Male	1.44 (1.58)	1.35 (1.57)	1.29 (1.48)	1.33 (1.54)
	Panel B: Single Parent Household Average Number of Transitions = 2.04 (1.45)[c]			
	Normal BMI (BMI 18.5 – 24.9)	Overweight (BMI 25 – 29.9)	Obese (BMI ≥30)	Obese/Overweight (BMI ≥ 25)
Gender				
Female	1.92 (1.45)	1.93 (1.44)	1.74 (1.47)	1.84 (1.46)
Male	1.81 (1.47)	1.82 (1.52)	1.82 (1.46)	1.82 (1.50)

Descriptives based on non-imputed, weighted data.
[a] Significantly different from males at $p < .05$.
[b] Significantly different from males at $p < .01$.
[c] Significantly different from married/cohabiting union at $p < .001$.

Table 3 Adjusted Odds Ratios (95% CI) Predicting the Association between Family Structure Transitions and Overweight based on Relationship Status at Birth[a]

	Panel A: Married/Cohabiting Union		
	Obese vs. Overweight (n = 1565)	Overweight vs. Healthy BMI (n = 2803)	Obese/Overweight vs. Healthy BMI (n = 3411)
Family Structure Transitions			
Cumulative	0.97 (0.88, 1.07)	0.95 (0.89, 1.29)	0.94 (0.87, 1.01)
Child Gender			
Female	1.08 (0.79, 1.46)	0.50 (0.40, 0.63)***	0.52 (0.43, 0.64)***
Transitions x Gender			
Cumulative x Female	1.12 (0.97, 1.29)	1.14 (1.02, 1.26)*	1.19 (1.08, 1.30)***
	Panel B: Single Parent Household		
	Obese vs. Overweight (n = 838)	Overweight vs. Healthy BMI (n = 1210)	Obese/Overweight vs. Healthy BMI (n = 1566)
Family Structure Transitions			
Cumulative	1.06 (0.92, 1.22)	1.01 (0.90, 1.12)	1.31 (0.93, 1.13)
Child Gender			
Female	1.96 (1.25, 3.06)**	0.86 (0.59, 1.26)	1.11 (0.80, 1.54)
Transitions x Gender			
Cumulative x Female	0.89 (0.74, 1.08)	0.99 (0.84, 1.16)	0.95 (0.83, 1.09)

[a] Models were conducted on imputed data and child and mother covariates listed in Table 1 were included in all models.
***$p < .001$; ** $p < .01$; *$p < .05$.

Figure 1. Probability of Overweight (BMI >= 25) Based on Cumulative Family Structure Transitions According to Sex

Mothers were Married/Cohabiting at the Time of the Child's Birth