# Parental separation and children's Body Mass Index over the life course

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## Abstract

Research has shown that parental separation is associated with worse physical health and unhealthy weight gains during childhood. However, limited empirical attention has been given to the evolution of child health before, upon and following parental union dissolution. Drawing on data from the Child Development Supplement (1997-2007) and the Transition to Adulthood Supplement (2005-2017) of the Panel Study of Income Dynamics, I analyze a cohort of American children aged 0-12 in 1997 to investigate whether parental union dissolution affects children's Body Mass Index (BMI) and overweight/obesity risk in the short and long run (n=2,675). I also investigate whether these associations vary according to parental socio-economic position, measured by parental education and race/ethnicity. The results from 'distributed' fixed-effects linear regression models – which account for observed and unobserved time-constant characteristics – show that parental union dissolution is associated with increases in child BMI and an increased risk of becoming overweight/obese among female but not male children. The negative effect of union dissolution on girls' weight status become significant staring from the year of separation and remains higher than the baseline for at least ten years after the event. Unhealthy weight gains following parental separation are more pronounced among children with lower-educated and non-White parents. The findings suggest that parental union dissolution contributes to increase socioeconomic inequalities in childhood obesity. Consistent with the 'diverging destinies' thesis, the social background differences in the health outcomes of children tend to be amplified when negative life course events, such as parental separation, occur.

**Keywords:** child health, obesity, family instability, parental separation, life-course analysis.

# Introduction

In the United States child obesity has dramatically increased over the last three decades, and approximately 20% of children and adolescents are now overweight or obese (Hales et al. 2017). Obesity is a major problem during childhood and has been linked with adverse health and social outcomes in adulthood (World Health Organization 2006). Families play a crucial role in influencing the health development of children through the promotion of healthy behaviors and the provision of social and economic resources. Disruptive family events, such as union dissolution, may alter these family resources and environment, and previous studies show that parental separation is associated with worse physical health and unhealthy weight gains during childhood (Biehl et al. 2014; Björkenstam et al. 2015; Bzostek and Beck 2011; Chen and Escarce 2010; Gable and Lutz 2000; Garasky et al. 2009; Hohwü et al. 2015; Schmeer 2012a; Yannakoulia et al. 2008). Despite a bulk of studies that have brought to light the association between parental union dissolution and children's overweight/obesity, longitudinal research examining the evolution of child body mass index (BMI) from childhood to young adulthood is still scarce.

The small body of research focusing specifically on the long-term health consequences of family instability relies on follow-up studies conducted many years after parental separation (Gaydosh and Harris 2018; Hernandez et al. 2014). This is a limitation, given that these previous findings provide only limited insight into how child BMI develops before, upon, and after parental union dissolution. In addition, the higher BMI of children from dissolved families may be due to unobserved confounders, such as parental personality and parenting styles, that can influence both the weight status of children and the probability of experiencing parental separation (Arkes 2012). To mitigate the bias introduced by unobserved confounders, some studies adopt a within-child approach and show that young children from recently dissolved families face an increased risk of developing overweight or obesity (Goisis, Özcan and Van Kerm 2020; Schmeer 2012b). Compared to these previous studies, I use a longer observation window (from age 5 to 28) to investigate whether family instability experienced in childhood and adolescence has enduring BMI consequences across the life course. Studying the effects of parental separation in the short and long run is important because a temporary increase in child weight is much less detrimental than a persistent effect that might lead to other obesity-related morbidities. Morevoer, following individuals from childhood to young adulthood allows us to study parental separation as a process (instead of an event) that develops from the pre-separation/ conflictual period to the post-separation/ adaptation period (for a discussion, see Goisis et al. 2020; Sun and Li 2002). This may contribute to our knowledge on whether the association between family instability and child BMI is due to the deterioration of family relationships occurring before the actual separation.

The second contribution of this study is to investigate whether the consequences of parental separation on children's BMI are unevenly distributed across different population subgroups. According to the 'diverging destinies' thesis, the diffusion of union dissolutions, which is more widespread among socioeconomically disadvantaged families, contributes to increase social inequalities across generations (Härkönen, Bernardi & Boertien, 2017; McLanahan 2004). The prevalence of both family instability and childhood obesity is significantly higher among ethnic minority children and those with lower-educated parents (Boardman and Alexander 2011; Isong et al. 2018; Singh et al. 2008a). Because children's health may be positively associated with growing up in intact families, union dissolution may strengthen ethnic and educational disparities in child health. Studies find evidence in support of the 'diverging destinies' thesis, showing that parental separation increases social background differences in educational outcomes of children (Lee and McLanahan 2015; McLanahan 2004; McLanahan and Percheski 2008). However, far less is known on whether the health outcomes of children from disadvantaged social groups are more negatively affected by parental separation compared to those of children from more advantaged families. Herein I examine whether some population groups defined on the basis of parental education and

race/ethnicity are more exposed to the negative consequences of union dissolution on child BMI and overweight/obesity risk.

In this study, I use data from the Panel Study of Income Dynamics (PSID) – the Child Development Supplement (CDS) and the Transition to Adulthood Supplement (TAS) – to analyze the short- and longer-term effects of parental separation on children's weight status. I ask two research questions. First, is parental union dissolution during childhood associated with increases in child BMI and an increased risk of becoming overweight/obese in both the short and long run? Second, is this association more pronounced among ethnic minority children and those with lower-educated parents compared to children of White ethnicity and those with highly-educated parents? To address these questions, gender differences between boys and girls are analyzed to account for gender-specific BMI trajectories during childhood and early adulthood.

# Background

Family instability is associated with lower levels of child and adolescent health (Cherlin et al. 1998; Fomby and Cherlin 2007). This 'divorce effect' has been attributed to changes in the amount and allocation of household resources that parents can invest on children. Divorced, parents, compared to married parents, often face financial constraints that may limit their ability to provide healthy food and access to sports and extracurricular activities (McLanahan and Sandefur 2009). The reduction of social and economic resources may affect food and exercise preferences in the long run, which may influence weight status in young adulthood. Additionally, separated parents may have less time available to focus on nutrition intake, monitoring children's health-related behaviors, and establishing regular routines (Bzostek and Beck 2011; Drewnowski and Specter 2004). Disruptions in eating and sleeping routines can contribute to unhealthy dietary behavior, such as consuming ready meals or processed food, and sedentary lifestyles, which increase the risk of overweight/obesity (Anderson and Whitaker 2010; Goisis et al. 2020). The disruption of family routines is also associated with a decrease in the quality and amount of parental involvement, providing more opportunities for unsupervised behaviors, such as smoking and the consumption of unhealthy food (Westphal, Poortman, and Van der Lippe 2014).

As suggested by social stress theories, changes in marital and romantic relationships introduce stress into the entire family unit (Teachman 2003). The end of marriage or cohabitation is a stressful event, accompanied by disputes and conflicts between partners. Additional stress may be related to the events surrounding a separation, such as finding new accommodation, arranging custody for children, and division of goods (Amato 2000). Parents' emotional response to separation may reverberate into a child's psychological stress and unhealthy dietary behaviors through mechanisms such as mood contagion, reduced relationship quality, or less sensitive parenting styles (Augustine and Kimbro 2017; Kim 2011; Strohschein 2005). Studies show that parenting styles and family relationships are particularly relevant for ensuring healthy development in children's BMI (McConley et al. 2012; Patrick and Nicklas 2005; Rhee et al. 2006), and that children's consumption of comfort food is often used as a coping mechanism to handle the stress associated with conflictual family relationships (Tanofsky-Kraff et al. 2008). Children's eating behaviors and sleeping routines may change when family relationships are conflictual. Given that family tensions usually occur before and upon a disruption, the BMI of children from divorced families may deviate from the BMI of children from intact families in anticipation of an upcoming separation. In other areas of research, there is evidence that divorced parents and their children manifest higher levels of psychological distress prior to union dissolution, which suggests that the health consequences of divorce are, in part, due to a selective effect (Amato 2010; Lin, Brown, and Wright 2019; Tosi and van den Broek 2020).

According to a stress-to-adjustment perspective (Amato 2000; 2010), the strain produced by parental separation is short lived. Parental separation is a critical life event that reduces healthy

eating/exercise, sleep routines, and emotional support for children. These practical and emotional changes may be followed by adjustment, through which children's eating behaviors and lifestyles return to previous routines. Sun and Li (2002) show that compared with adolescents from intact families, those from non-intact families have a lower score in socio-psychological indicators before and during marital disruption but recover few years after separation. However, some negative consequences may persist over the life course. Weight gains in early adolescence bring a higher risk of being overweight in young adulthood, and abnormal changes in BMI during the first years of life tend to shape subsequent health trajectories (Centers for Disease Control and Prevention 2011; Singh 2008b; Srinivasan et al. 1996). This may be due to an inability to self-regulate one's energy intake that may persist after a disruptive family event (Hernandez et al. 2014). Additionally, poor relationships and continuing conflicts with divorced parents might affect children's BMI many years after parental separation. Some studies show that adverse childhood experiences and the stress associated with family instability increase children's probability of being overweight/obese in young adulthood (Björkenstam et al. 2015; Gaydosh and Harris 2018; Slopen, Koenen and Kubzansky 2014).

## Parental education and race/ethnicity

Regardless of whether or not the effect of parental union dissolution persists over time, the extent to which a child's physical development is affected by a disruption of a union may depend on parental socioeconomic status. The 'diverging destinies' thesis suggests that the increase in non-intact families over time is leading to greater differences between children from socioeconomically advantaged and disadvantaged backgrounds (McLanahan 2004; McLanahan and Percheski 2008). Studies examining children's educational outcomes provide some evidence in support of the 'diverging destinies' thesis, indicating that socioeconomic inequalities in children's life chances tend to increase when critical life events, such as parental separation, occur (Bernardi and Boertien 2017; Boertien and Bernardi 2022; Sun and Li 2011). With regard to health outcomes, parental education is associated with differential exposure to stressors and the accumulation of material and social resources known to be important for children's health and weight status (Baltrus et al. 2005). While children from higher-educated families have more resources to cope with the stress of parental separation and to ensure healthy food intake, children of lower-educated parents may suffer more from the loss of social and economic resources following parental separation. These resource shortages are likely to contribute to a wide range of problems related to unhealthy food consumption and unsupervised behaviors among children of lower-educated parents (Sun and Li 2002). High-educated parents may be also more aware of the importance of remaining involved and investing in children after separation to foster their healthy development and wellbeing (Mandemakers and Kalmijn 2014). However, it has been also suggested that children whose parents have more cultural and economic resources have more to lose from the absence of a parent in the household (Bernardi and Radl 2014; Boertien and Bernardi 2022). If higher-educated parents are better able to promote healthy behaviors and a normal BMI development during coresidence, then the children of these parents may experience a relatively greater loss of benefits after separation compared to children with lower-educated parents.

In the United States, race and ethnicity are fundamental dimensions of social and health inequalities. Ethnic minority children, on average, have fewer socioeconomic resources such as income, wealth, and quality neighborhoods than White children (Boardman and Alexander 2011; Charles 2006; Singh et al. 2008a). Due to the structure of the housing market and limited residential mobility (apart from their own resources), African Americans are more likely to live in high-poverty neighborhoods characterized by few amenities that support physical activity and health-food consumption (Sharkey 2013); and these neighborhood characteristics increase the risk of being overweight or obese (Zick et al. 2013). Baltrus et al. (2005) find that racial differences in body weight trajectories are largely explained by an accumulation of socioeconomic resources over the life course. Therefore, the effect

of parental union dissolution may be more pronounced among children belonging to racial/ethnic groups that are more socioeconomically disadvantaged. However, given their exposure to socioeconomically stressful environments, ethnic minority children may have more abilities to respond and adapt to family stressors. Some scholars suggest that the stress associated with parental union dissolution is less detrimental for the wellbeing of Black children, given the high number of stressors that they face in their daily lives (Cherlin et al. 1998; Cross 2020; Fomby and Cherlin 2007). In addition, ethnic minority children receive greater support from the extended family network in times of need, which may help them to recover after stressful family events (Cross 2020; Hamilton et al. 2011).

When investigating the health consequences of parental separation, researchers often take into account gender differences, as previous studies indicate varying levels of post-divorce stress experienced by male and female children. Some findings show that post-divorce development problems, including unhealthy BMI gains, are more severe among boys than among girls (Cavanagh, Crissey and Raley 2008; Cavanagh and Huston 2008), whereas others indicate more obesity-related problems among girls than among boys following parental separation (Augustine and Kimbro 2017; Crosnoe 2012; Doherty and Needle 1991; Hernandez et al. 2014). Sun and Li (2001) found no gender differences in terms of psychological and behavioral problems after parental union dissolution; similarly, Goisis et al. (2020) showed that for both girls and boys the risk of being overweight or obese increased after parental separation. It remains unclear whether marital disruption affects boys and girls dissimilarly, and how males' and females' weight status may be differently affected by family instability.

# Data and Methods

## Sample

The analysis is conducted with data from the Child Development Supplement (CDS 1997, 2002, and 2007) and the Transition to Adulthood Supplement (TAS 2005, 2007, 2009, 2011, 2013, 2015 and 2017) of the Panel Study of Income Dynamics (PSID). The PSID collects information on American families since 1968. In 1997, the CDS was introduced to collect detailed information on a nationally representative sample of children aged 0-12 and their primary caregivers who were re-interviewed in 2002 and 2007 (CDS User Guide 2012). As children grew up, children transited from the CDS to TAS, a survey module collecting information on young adults every two years, from age 18 to 28. 3,563 children were eligible for the CDS-1997, corresponding to a total of 17,889 child-year observations, and were followed over time.

The study sample includes children aged 0-12 in 1997, whose parents either remained in a partnership or experienced separated during the observed period. Consequently, children whose parents never married or cohabited throughout the observation window are excluded from the sample. An additional selection criterion is based on the measurement of BMI, which is assessed in children aged 5 or older. Children below the age of 5 are included in subsequent waves of the sample as they become eligible for BMI measurement. Therefore, children who undergo parental separation between the ages of 0 and 4 are not observed in the immediate period after the separation, but they do contribute to the estimates regarding the long-term effects of union dissolution. The final sample described in Table 1 includes 2,675 children corresponding to 12,608 child-year observations (on average, 4.7 observations per child).

## Body Mass Index and Overweight/Obesity

CDS data collect information on the weight and height of children through questions answered by the primary caregivers or other caregivers. The primary caregiver reported the weight of the child, while

the children's height was measured by the interviewer asking the children to take off their shoes and stand against a wall (CDS User Guide 2012). In the TAS module information on weight and height was self-reported by young adult respondents. Although self-reported measured may be biased according to respondents' characteristics and preferences (Cole et al. 2005), our model strategy focusing on within-individual changes in BMI over time is less affected by this source of noise. BMI score is derived from the arithmetic calculation of body weight and height ([Weight in pounds / Height in inches$^2$] X 703). The literature suggests that linear BMI (with controls for age and gender) is less biased by initial weight status than z-score measures when analyzing changes in adiposity among children (Cole et al. 2005). Therefore, I use the linear unstandardized BMI score as the first dependent variable. Changes in BMI over time are illustrated in Figure 1A in the Appendix, showing an increase as children grow older that is more pronounced during childhood and adolescence compared to young adulthood. Similarly, Table 1 presents the BMI values across the surveyed waves, indicating an upward trend from 18.6 in 1997 to 27.2 in 2017.

The second dependent variable is the risk of being overweight/obese – like in other studies on the U.S. (e.g. Hernandez et al. 2014). Among children aged below 18, the BMI thresholds to identify the risk of overweight/obesity are based on its distribution according to child sex and age. Children with a BMI exceeding the 95$^{th}$ percentile are defined as overweight or obese. Among young adults aged 18-28, a BMI equal to 25.0 or greater is classified in the category "overweight/obesity" (Centre of Disease Control and Prevention 2011). Table 1 indicates that in the used data approximately 20% of children throughout the observation window are overweight/ obese. This proportion is significantly smaller in 2005 due to the small sample of children aged 0-12 in 1997 interviewed in the TAS module collecting information on young adults (18-28).

Table 1. Sample description according to the year of the interview

| Interview year | Divorce events N. | Child Age mean | BMI mean | Overweight % | Total N. | Survey Module |
|---|---|---|---|---|---|---|
| 1997 | 0 | 8.6 | 18.6 | 17.7 | 1,373 | CDS |
| 2002 | 378 | 10.3 | 21.6 | 20.9 | 2,010 | CDS |
| 2005 | 174 | 18.9 | 24.4 | 12.6 | 580 | TAS |
| 2007 | 113 | 16.2 | 24.2 | 19.9 | 2,016 | CDS/TAS |
| 2009 | 73 | 20.9 | 25.5 | 16.9 | 1,229 | TAS |
| 2011 | 65 | 21.9 | 25.9 | 19.8 | 1,511 | TAS |
| 2013 | 33 | 22.1 | 25.9 | 20.1 | 1,440 | TAS |
| 2015 | 22 | 22.3 | 26.5 | 24.6 | 1,315 | TAS |
| 2017 | 0 | 23.9 | 27.2 | 28.7 | 1,134 | TAS |
| Total | 758 | 17.6 | 24.3 | 20.5 | 12,608 | CDS/TAS |

*Note:* Full-information sample of children aged 0-12 in 1997. CDS on children aged 0-17; TAS on children aged 18-28. In 2005 the sample includes children aged 10-12 in CDS-1997.

## Parental Separation

To identify separated parents, information collected in the regular PSID survey was linked to children's characteristics collected in the CDS and TAS modules, by using mothers' and fathers' identification numbers. Parental separation is measured through two variables, i.e. the marital status of the household heads (for parents classified as heads, i.e. the persons with the most financial responsibility in the household) and marital histories (i.e., number and timing of marriages and separations). Missing values (2.7%; N=432) in parental marital status are concentrated among children living with grandparents only. I create a dummy variable identifying parents who remain in partnership and those who divorce or separate between two consecutive waves. The analysis focuses on parental separation occurring at age 18 or younger, because the effects of family disruption on children's health may differ when they are older and living independently. 758 children (3,922 year-child observations) experienced parental separation throughout the observation window, while 1,917

children (8,686 year-child observations) lived in intact families (see Table 1). In addition, I create a dummy variable regarding remarried parents to control for reverse transitions (i.e. from separation to marriage). Children who experienced multiple parental separations were excluded at the time of the second separation to focus on the separation of biological parents.

I calculate the number of years elapsed between the transition to parental separation and the date of each interview, by using information on the end of the first or last marriage. In case of missing dates, I use the number of years elapsed between interview dates. I then divide the time since/to parental union dissolution into the following categories: more than 3 years before parental separation (baseline); 3/1 years before separation (anticipation effect); the year of separation or the year after (immediate effect); 2/4 years after separation; 5/7 years after separation; 8/10 years after separation; and more than 10 years after separation (long-term effects). Table 2 shows that the number of individual-year observations increase in the post-separation period, given the study's objective of analyzing the effects of parental separation before age 19. Children's BMI tends to increase in the year of separation and remains higher than the baseline in the subsequent time-points. The proportion of overweight/obese children also increases around the time of parental union dissolution and is particularly high eight/ten years after the event.

Table 2. Time elapsed since/to parental separation and BMI

| | Continuously in partnership | | | Transition to divorce/separation | | |
|---|---|---|---|---|---|---|
| | Total N | BMI Mean(SD) | Overweight % | Total N | BMI Mean(SD) | Overweight % |
| Years since/to parental separation | | | | | | |
| Ref. (no separation or >3 y. before) | 8,686 | 20.9 (6.1) | 18.9 | 420 | 20.9 (5.9) | 19.6 |
| 1-3 y. before | | | | 345 | 21.8 (5.9) | 22.8 |
| 0-1 y. after | | | | 354 | 23.4 (6.5) | 23.6 |
| 2-4 y. after | | | | 538 | 24.4 (6.4) | 21.9 |
| 5-7 y. after | | | | 554 | 24.9 (6.5) | 22.9 |
| 8-10 y. after | | | | 630 | 25.9 (6.2) | 26.6 |
| >10 y. after | | | | 1,081 | 26.7 (6.3) | 25.9 |

## Control Variables

The potential confounders included in the analysis refer to economic resources and family climate before age 18 (see Table 3). Economic resources are measured via four variables: mothers' employment status distinguishing between employed, unemployed, and out of the labor market; the total household income (divided in quartiles from the first, i.e. the highest, to the fourth, i.e. the lowest); the amount of money spent on food at the household level (logarithmic transformation); and a dummy variable indicating whether a child usually eats a complete lunch at school or preschool.

A set of indicators of family climate are included in the analysis. First, parental distress is measured through the K-6 Non-Specific Psychological Distress Scale, a 6-item scale that screens for mood and anxiety disorders (Kessler et al. 2002). This is an additive scale of the following items ranging from 0 (none of the time) to 4 (all of the time): primary caregivers were asked if during the last 4 weeks they felt (a) so sad that nothing could cheer them up; (b) nervous; (c) restless or fidgety; (d) hopeless; (e) worthless; (f) that everything was an effort. The total distress score ranges from 0 to 24.

Second, I use the Rosenberg Self-esteem Scale. It was administered to primary caregivers to assess the degree of approval or disapproval toward oneself. The scale is the mean score of 10 items, using response scale of 1 (strongly disagree) – 4 (strongly agree). The 10 items are related to (a) feeling a person of worth; (b) having good qualities; (c) feeling like a failure; (d) doing things well; (e) having

not much to be proud of; (f) having positive attitudes; (g) being satisfied with self; (h) wanting more respect; (i) feeling useless at times; and (j) thinking I am not good.

Table 3. Sample characteristics

| | % or mean | S.D. | Child-year observations |
|---|---|---|---|
| BMI | 24.1 | 6.3 | |
| Overweight/Obesity | 20.4 | | 2,576 |
| Parental separation before age 19 | 23.3 | | 2,934 |
| Parental remarriage | 8.9 | | 1,121 |
| Age | 17.6 | 15.9 | |
| Sex (Boy) | 48.9 | | 6,162 |
| Mother age | 45.4 | 8.9 | |
| Mothers' education | | | |
| Up to lower secondary | 44.6 | | 5,617 |
| High school degree | 22.1 | | 2,786 |
| Post-secondary | 33.3 | | 4,200 |
| Child race/ethnicity | | | |
| White | 54.7 | | 6,893 |
| Black | 31.9 | | 4,028 |
| Other | 13.4 | | 1,687 |
| Mother employment | | | |
| Employed | 71.6 | | 9,028 |
| Unemployed | 6.2 | | 778 |
| Out of the labor market | 22.2 | | 2,797 |
| Household income quartiles | | | |
| 1st (highest) | 22.2 | | 2,798 |
| 2nd | 23.5 | | 2,962 |
| 3rd | 25.5 | | 3,217 |
| 4th (lowest) | 28.8 | | 3,626 |
| Money spent on food (log) | 4.2 | 1.7 | |
| *Family climate before age 19* | | | |
| Parental distress scale (0-24) | 3.9 | 3.5 | |
| Parental self-esteem scale (1-4) | 3.4 | 0.4 | |
| Parental warmth scale (1-5) | 3.9 | 0.7 | |
| Closeness with father (1-4) | 3.3 | 0.9 | |
| Closeness with mother (1-4) | 3.7 | 0.7 | |
| School lunch program | 66.7 | | 8,401 |

Third, parental warmth scale measures affective relationships between the child and his/her parents. The scale is constructed as an average score of six items asking whether in the past month the primary caregiver has (a) shown physical affection to her/his child; (b) said I love you; (c) spent time with his/her child; (d) joked or played with the child; (e) talked about his/her interests; (f) appreciated something. The answer categories range from 1 (not in the past month) to 5 (every day). Additionally, father-child and mother-child closeness are measured through a direct question of whether the child feels extremely close (score equal to 4), quite close, fairly close or not at all close (score equal to 1) to his/her mother and father. Despite these variables reflect the primary caregiver's perception of family climate, previous research indicates that these are validated measures associated with child health (Garasky et al. 2009). In the present analysis, these variables are treated as potential confounders of the effect of parental union dissolution on child BMI. Therefore, these indicators (available in the CDS) are observed before age 19 and are considered as time-constant variables in the subsequent waves.

## Moderators

The study aim is to analyze the moderating effects of parental education and race/ethnicity. These variables are considered as time-invariant indicators and are interacted with parental union dissolution in the following analyses. Regarding parental socioeconomic status, I use information on mothers' education and divide the completed grades of schooling into three categories: up to lower secondary education (from Grade 1 to 11), high school degree (Grade 12), and post-secondary education (from Grade 13 to 17). Given that in standard surveys separated fathers are often difficult to follow after moving out of the household, mothers' educational level is used to avoid missing values in parental socioeconomic status. The choice of considering post-secondary education, which includes some college and Bachelor's degree or more, is driven by the need to have sufficient cell sizes to examine variations of the divorce effect by parental education. The same reasoning is applied when categorizing children's race/ethnicity, distinguishing between White, Black, and the residual category "Others", which primarily includes Hispanic mothers (see Table 4).

Table 4. Number of child-year observations according to the time since/to parental separation, child sex, parental education and race/ethnicity

| | Child sex | | Parental education | | | Race/ ethnicity | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Up to lower secondary | High school | Post-secondary | White | Black | Others | |
| Years since/to parental separation | | | | | | | | | |
| >3 y. before | 203 | 217 | 206 | 108 | 106 | 210 | 174 | 36 | 420 |
| 1-3 y. before | 176 | 169 | 140 | 107 | 98 | 163 | 155 | 27 | 345 |
| 0-1 y. after | 180 | 174 | 112 | 111 | 131 | 168 | 159 | 27 | 354 |
| 2-4 y. after | 259 | 279 | 268 | 141 | 129 | 245 | 248 | 45 | 538 |
| 5-7 y. after | 279 | 275 | 265 | 148 | 141 | 246 | 255 | 53 | 554 |
| 8-10 y. after | 303 | 327 | 299 | 173 | 158 | 283 | 281 | 66 | 630 |
| >10 y. after | 489 | 592 | 566 | 314 | 201 | 458 | 476 | 147 | 1,081 |
| N. of child-year obs. | 1,889 | 2,033 | 1,856 | 1,102 | 964 | 1,773 | 2,149 | 401 | 3,922 |

## Analytical strategy

I use child fixed-effects linear regression models on child BMI score and the probability of becoming overweight/obese. Linear probability models with individual fixed effects are often preferred over maximum-likelihood specifications to produce more accurate estimates on rare events, such as becoming overweight/obese (Timoneda 2021). The estimates are based on within-child changes in BMI, which has the advantage to account for time-constant characteristics. As part of the fixed-effects analytical strategy, the mean score for a person over all time points for the respective variable has been deducted from a person's score on this variable on a specific time-point. Consequently, all time-invariant characteristics, including those not observed, that may bias the estimate of the association between parental divorce and child health outcomes are accounted for (Allison, 2009). More specifically, child BMI is modelled as indicated in the following equation:

$$BMI_{it} \,/\, OV_{it} = \beta_{1-6} SEP_{it}^{k} + \beta_{7-22} X_{it} + \alpha_i + \varepsilon_{it}$$

*BMI / OV* is the body mass index and overweight/obesity risk of child *i* at time point *t*. *SEP* is a set of dummy variables capturing the time to/since the parental union dissolution of child *i* at time *t*. The superscript *k* refers to the six dummy variables for the group of children with separated parents, and $\beta_{1-6}$ indicates the respective coefficients associated with intervals in the pre- and post-separation periods. X is a vector of control variables, and $\beta_{7-22}$ refers to the respective coefficients. $\alpha$ – which

is an individual-specific constant that varies across individuals but is fixed over time – is not estimated in the models and captures any time-invariant characteristic of the individual *i*. Similar modelling specifications have been used in previous studies to separate the effects of life course events for the pre- and post-event periods (e.g., Dougherty, 2006; Goisis et al. 2020; Tosi and Goisis, 2021).

The analytical strategy consists of two steps. First, I analyze the association between parental separation and children's weight status, by dividing the pre-separation and post-separation periods in a set of dummy variables. The corresponding estimates are interpreted with respect to the baseline level measured three years before marital disruption. The reference category, which includes both children from intact and non-intact families, refers to a child-specific baseline level and is not estimated in the models because it is indistinguishable from the child-specific constant term (Dougherty 2006). The models are performed on the entire sample, as well as on the two distinct subsamples of boys and girls. Second, I analyze the moderating effects of parental education and race/ethnicity – characteristics used as time-constant variables – by including interaction terms in fixed-effects models. To evaluate the effect of parental separation among different population subgroups defined on the basis of parental education and race/ethnicity, Figures 1-4 present the predicted BMI scores and probabilities of becoming overweight/obese according to the time before, upon and following parental union dissolution. These figures also present results separately for boys and girls. Due to the small sample size, there is considerable uncertainty around the estimates. Therefore, point estimates without confidence intervals are reported for illustrative purposes, while the main interpretation of the results is based on the average effects of parental separation on the body weight status of children.

# Results

Tables 5 and 6 present results from fixed-effects linear regression models predicting changes in children's BMI and overweight/obesity risk respectively. The average effect of parental union dissolution is divided in dummy variables for the pre- and post-separation periods to investigate whether the effect of parental separation varies according to the time spell between the family breakdown and the observed weight status. In all models, the coefficients do not reach the significance level until the year of parental union dissolution, indicating that there are no anticipation effects in the process leading up to parental separation. Child BMI increases around the year of parental separation and, despite some fluctuations over time, remains higher than the baseline in the following years (Table 5). Similarly, the risk of becoming overweight/obese increases by seven percentage points in the year of parental separation and remains approximately five percentage points higher than the baseline in the following ten years (Table 6). This long-term effect of family disruption on children's weight status is consistent with a view of parental separation as a chronic strain, but in contrast with the recovering trajectories in health postulated by the stress-to-adjustment perspective.

With regard to gender differences, separate models for boys and girls show that among female children parental separation is associated with an increase in BMI and an increased risk of becoming overweight/obese. Specifically, one year after parental separation, girls experience an average BMI increase of 1.3 points and a 10 percentage point increase in the risk of overweight or obesity. In the following years, the effect size of parental union dissolution on BMI is slightly smaller but significantly higher than the baseline. Conversely, male children who undergo parental union dissolution during childhood do not experience changes in their weight status. Their BMI shows a decrease 8 to 10 years after parental separation; however, this reduction in BMI score does not correspond to a lower risk of becoming overweight or obese.

Table 5 Fixed-effects linear regression models predicting changes in child BMI

| | Overall | | Girls | | Boys | |
|---|---|---|---|---|---|---|
| | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| Time before/after separation (ref. no separation or > 3y. before) | | | | | | |
| 3/1 y. before | 0.22 | (0.28) | 0.45 | (0.41) | -0.12 | (0.37) |
| 0/1 y. after | 0.63* | (0.27) | 1.36** | (0.40) | -0.31 | (0.37) |
| 2/4 y. after | 0.66** | (0.23) | 1.26** | (0.33) | -0.06 | (0.32) |
| 5/7 y. after | 0.33 | (0.24) | 0.92** | (0.35) | -0.42 | (0.33) |
| 8/10 y. after | 0.47† | (0.25) | 1.33** | (0.35) | -0.79* | (0.35) |
| >10 y. after | 0.57* | (0.26) | 1.70** | (0.38) | -0.80* | (0.37) |
| Re-partnered mother | -0.00 | (0.19) | 0.01 | (0.27) | -0.00 | (0.26) |
| Child age | 0.68** | (0.11) | 0.60** | (0.16) | 0.80** | (0.15) |
| Child age^2 | -0.02** | (0.00) | -0.02** | (0.00) | -0.02** | (0.00) |
| Mother age | 0.04* | (0.02) | 0.04† | (0.02) | 0.04† | (0.02) |
| Mother employment (ref. employed) | | | | | | |
| Unemployed | 0.22 | (0.15) | 0.05 | (0.22) | 0.38† | (0.20) |
| Out of the labor market | 0.44** | (0.11) | 0.62** | (0.16) | 0.23† | (0.14) |
| Household income quartiles (Ref. 1st) | | | | | | |
| 2nd | 0.08 | (0.10) | 0.17 | (0.14) | -0.02 | (0.14) |
| 3rd | 0.21* | (0.11) | 0.38* | (0.15) | -0.01 | (0.15) |
| 4th | 0.30* | (0.12) | 0.49** | (0.18) | 0.08 | (0.17) |
| Amount of money spent on food (log) | -0.06** | (0.02) | -0.12** | (0.03) | 0.02 | (0.03) |
| *Family climate before age 19* | | | | | | |
| Parental distress scale | 0.03 | (0.02) | 0.05 | (0.03) | 0.01 | (0.03) |
| Parental self-esteem scale | -0.00 | (0.19) | -0.17 | (0.30) | 0.17 | (0.25) |
| Parental warmth scale | -0.27** | (0.10) | -0.48** | (0.15) | -0.06 | (0.13) |
| Closeness to father | 0.04 | (0.05) | -0.03 | (0.06) | 0.12† | (0.06) |
| Closeness to mother | -0.00 | (0.06) | -0.05 | (0.08) | 0.04 | (0.08) |
| School lunch program | 0.10 | (0.14) | 0.34 | (0.21) | -0.13 | (0.20) |
| Constant | 10.80** | (1.26) | 10.78** | (1.85) | 10.43** | (1.69) |
| N. of children | 2,675 | | 1,313 | | 1,362 | |
| N. of child-year observations | 12,608 | | 6,441 | | 6,167 | |
| R-squared | 0.49 | | 0.49 | | 0.50 | |

*Note:* Control variables include wave dummies. ** p<0.01, * p<0.05, † p<0.1

In the models presented in Tables 5 and 6, control variables are related to mothers' employment, household economic resources, and family climate. Children's BMI increases when mothers transit out of the labor market or when the total household income decreases over time. By contrast, an increase in the amount of money spent on food is associated with decreases in children's BMI and in their risk of becoming overweight/obese. The used indicators of family climate have no significant associations with child BMI and the risk of becoming overweight/obese. An exception is the parental warmth scale that is associated with changes in BMI, but not with the risk of becoming overweight/obese.

Table 6 Fixed-effects linear regression models on the probability of becoming overweight/obese

| | Overall | | Girls | | Boys | |
|---|---|---|---|---|---|---|
| | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| Time before/after separation | | | | | | |
| (ref. no separation or > 3y. before) | | | | | | |
| 3/1 y. before | 0.01 | (0.02) | 0.05 | (0.03) | -0.04 | (0.04) |
| 0/1 y. after | 0.07** | (0.02) | 0.10** | (0.03) | 0.03 | (0.04) |
| 2/4 y. after | 0.05* | (0.02) | 0.08** | (0.03) | 0.01 | (0.03) |
| 5/7 y. after | 0.04* | (0.02) | 0.07* | (0.03) | 0.01 | (0.03) |
| 8/10 y. after | 0.06** | (0.02) | 0.09** | (0.03) | 0.02 | (0.03) |
| >10 y. after | 0.04† | (0.02) | 0.07* | (0.03) | -0.01 | (0.04) |
| Re-partnered mother | 0.01 | (0.02) | 0.01 | (0.02) | 0.02 | (0.02) |
| Child age | -0.02* | (0.01) | -0.03† | (0.01) | -0.02 | (0.01) |
| Child age^2 | 0.00** | (0.00) | 0.00** | (0.00) | 0.00** | (0.00) |
| Mother age | 0.00* | (0.00) | 0.00* | (0.00) | 0.00 | (0.00) |
| Mother employment (ref. employed) | | | | | | |
| Unemployed | 0.02 | (0.01) | 0.01 | (0.02) | 0.03 | (0.02) |
| Out of the labor market | 0.02* | (0.01) | 0.03* | (0.01) | 0.01 | (0.01) |
| Household income quartiles (Ref. 1st) | | | | | | |
| 2nd | -0.01 | (0.01) | -0.01 | (0.01) | -0.01 | (0.01) |
| 3rd | -0.00 | (0.01) | 0.01 | (0.01) | -0.01 | (0.01) |
| 4th | 0.00 | (0.01) | 0.01 | (0.02) | -0.01 | (0.02) |
| Amount of money spent on food (log) | -0.01** | (0.00) | -0.01** | (0.00) | 0.00 | (0.00) |
| *Family climate before age 19* | | | | | | |
| Parental distress scale | 0.00 | (0.00) | 0.00 | (0.00) | 0.00 | (0.00) |
| Parental self-esteem scale | -0.00 | (0.02) | -0.03 | (0.03) | 0.02 | (0.02) |
| Parental warmth scale | 0.00 | (0.01) | -0.00 | (0.01) | 0.00 | (0.01) |
| Closeness to father | -0.00 | (0.00) | -0.00 | (0.01) | 0.00 | (0.01) |
| Closeness to mother | 0.00 | (0.01) | 0.00 | (0.01) | -0.00 | (0.01) |
| School lunch program | 0.01 | (0.01) | 0.02 | (0.02) | 0.02 | (0.02) |
| Constant | 0.23* | (0.11) | 0.27+ | (0.16) | 0.23 | (0.16) |
| N. of children | 2,675 | | 1,313 | | 1,362 | |
| N. of child-year observations | 12,608 | | 6,441 | | 6,167 | |
| R-squared | 0.02 | | 0.04 | | 0.02 | |

*Note:* Control variables include wave dummies. ** p<0.01, * p<0.05, † p<0.1

## Heterogeneity by parental education and race/ethnicity

Figures 1 and 2 present the findings on the moderating effect of parental education. The predicted BMI score and overweight/obesity risk reported in the two figures are calculated from fixed-effects linear regression models including interaction terms between parental separation and mothers' education (see Tables 1A and 2A in Appendix). Gender-specific BMI trajectories are illustrated by the gray lines. Figures 1 and 2 show that children with lower-educated mothers experience an increase in BMI and an increased risk of becoming overweight/obese during and after parental separation. As noted in the analysis above (Tables 5 and 6), there is no anticipation effect suggesting that the process leading up to parental separation is not correlated with changes in child BMI and the risk of becoming overweight/obese. Among these families, the association between parental separation and children's weight gains is significant starting from the year of separation and remains higher than the pre-separation level for the following ten years. The long-term effect of parental union dissolution on weight status seems to be driven by female children. Following parental separation, girls experience increases in BMI and overweight/obesity risks, which persist above the baseline level for at least ten years. In contrast, boys tend to recover from the negative effects of family disruption after a few years.

Among both boys and girls, higher parental education mitigates the negative effects of union

dissolution on child health. In fact, children with higher-educated mothers do not show significant changes in BMI and overweight/obesity risk during both the pre- and post-separation periods. This result is confirmed by the significant interaction terms presented in Tables 1A and 2A in Appendix. Among male children with higher-educated mothers, there is a decreasing trajectory in BMI and overweight/obesity risk in the post-separation period. Among female children with highly-educated mothers, the BMI score and overweight/obesity risk are only slightly higher than the baseline level.

Children whose mothers have a high school degree exhibit intermediate levels between the other two groups. Their BMI and overweight/obesity risk increase after parental separation and remain only slightly higher the baseline thereafter. This small increase in BMI and overweight/obesity risk is mainly driven by female children, while the weight status of male children is approximately equal to the baseline level.

**Figure 1** Predicted BMI score relative to the time before/after parental separation by mothers' education

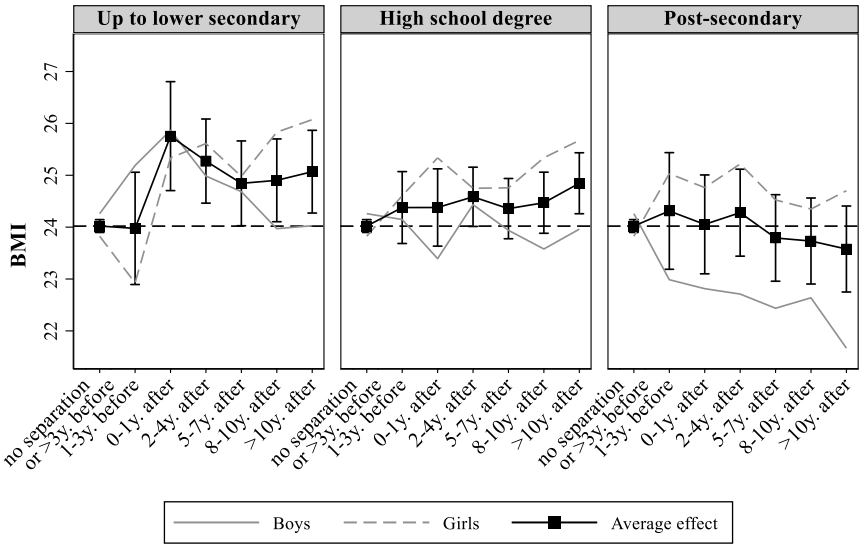
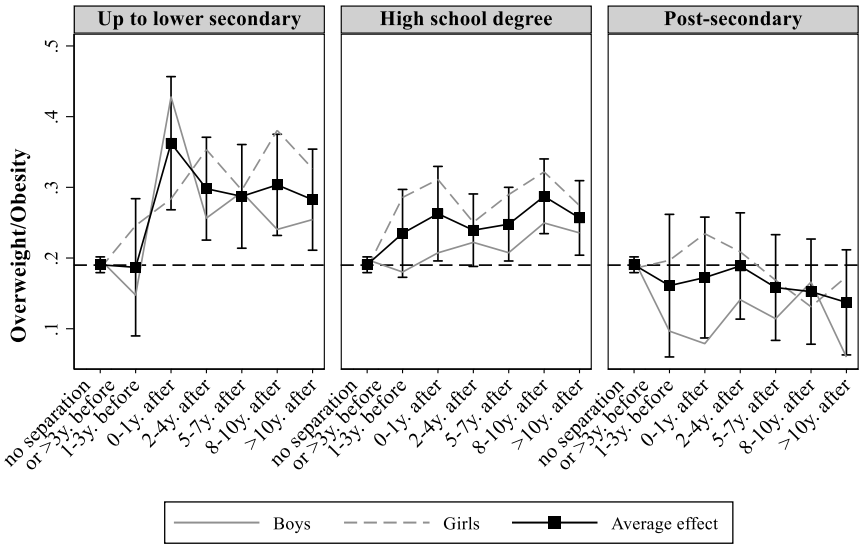



**Figure 2** Predicted probabilities of becoming Overweight/Obese relative to the time before/after parental separation by mothers' education




Figures 3 and 4 report the findings on the association between parental separation and children's weight gains among different racial/ethnic groups (see Tables 3A and 4A in Appendix). The BMI of

White children increases two years after parental separation and rapidly returns to approximately the baseline level (Figure 3). This short-term increase in BMI does not correspond to a higher risk of becoming overweight/obese (Figure 4), which suggests that parental separation is associated with minor changes in BMI score without significant implications for the weight status of their children. On the contrary, among Black children, the BMI score and the risk of becoming overweight/obese increase around the time of parental union dissolution and remain higher than the baseline for the ten years after parental separation. Differences between White and Black children are marked in the analysis on overweight/obesity risk (see also Table 3A and 4A in Appendix). The overweight/obesity trajectories of White and Black children significantly differ from each other in the post-separation period, with Black children being more negatively affected by family disruption than their White counterparts. The long-term negative effect of parental separation on the BMI of Black children seems to be more pronounced for girls than for boys. Among Black girls, the risk of becoming overweight or obese tends to increase after parental separation and remains higher than the baseline in the following years.

Among other non-White ethnic groups, child BMI and the risk of becoming overweight/obese increase before parental union dissolution and remain higher than the baseline level around the time of separation. Although the sample size for this ethnic group is small and the confidence intervals are large, this pattern suggests that these children are more susceptible to developing overweight or obesity following parental separation compared to White children. Overall, there is evidence of long-term increases in BMI score and overweight/obesity risk among non-White children, whereas these increases are not significant among White children.

**Figure 3** Predicted BMI score relative to the time before/after parental separation by race/ethnicity

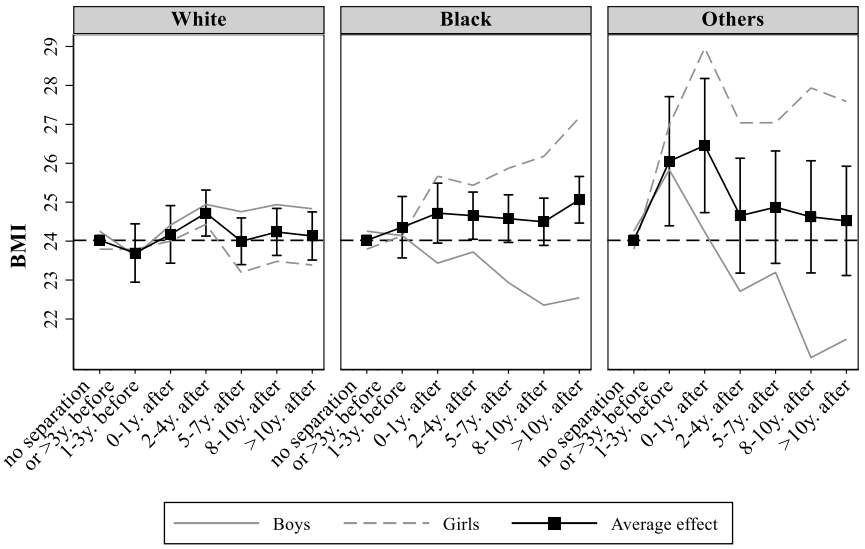
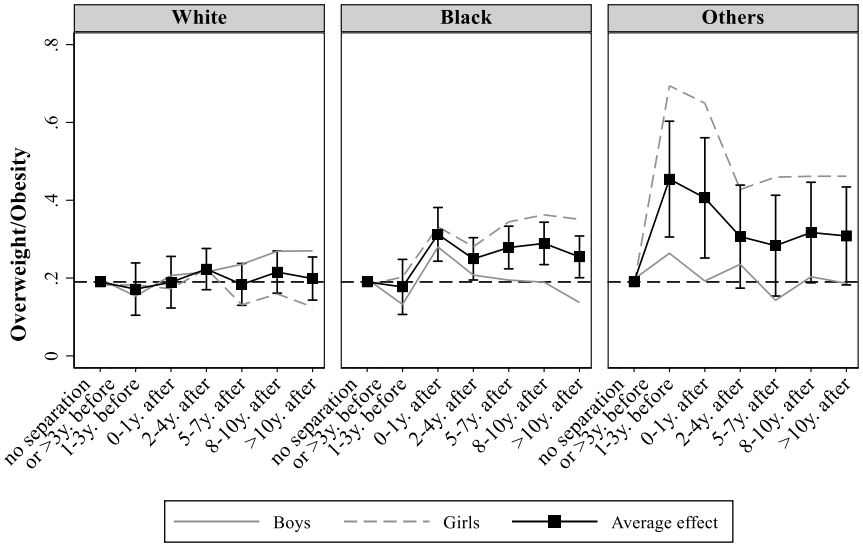


**Figure 4** Predicted probabilities of becoming Overweight/Obese relative to the time before/after parental separation by race/ethnicity




## Discussion

Previous studies have analyzed the cross-sectional association between family instability and children's weight status (e.g., Bzostek and Beck 2011; Chen and Escarce 2010; Yannakoulia et al. 2008), as well as the longitudinal change in child health following parental separation (Arkes 2012; Goisis et al. 2020; Schmeer et al. 2012). However, limited empirical attention has been given to the evolution of child BMI before, upon and after parental union dissolution. By using longitudinal data and distinguishing between anticipation, immediate, and long-term effects, the present study examines whether the impact of parental separation endures throughout the life course, from childhood to young adulthood, and whether this effect varies according to parental education and race/ethnicity.

The first contribution of this study is the investigation of both the short- and long-term effects of parental separation on child BMI. The results presented here indicate that children's BMI and their risks of becoming overweight/obesity increase around the year of parental separation and remain above the baseline ten years after family breakdown. This long-term effect supports a view of parental union dissolution as a chronic strain, from which children and young adults can hardly recover during the life course. As previous studies have indicated, body weight status and unhealthy BMI gains during adolescence are associated higher risks of being overweight in adulthood (Singh 2008b; Srinivasan et al. 1996), partly due to difficulties in self-regulating nutritional intake (Hernandez et al. 2014). Therefore, the physical changes occurring after parental separation tend to have lasting implications for the weight status of young adults, particularly female children.

The analysis presented here captures parental separation as a process (rather than an event) developing from the pre-separation to the post-separation periods. The findings show that there is no significant increase in child BMI in the years leading up to a family disruption. The absence of pre-separation effects is consistent with Goisis et al. (2020), while in contrast with Arkes (2012). This suggests that family conflicts and tensions occurring before the decision to separate have no immediate influence on children's BMI and the risk of being overweight/obese. In line with this result, indicators of family climate are not associated with the risk of becoming overweight/obese. The contribution of parent-child closeness, parental distress, and parental warmth scale seems to be marginal in predicting changes in body weight around parental union dissolution.

The findings on gender differences indicate that parental union dissolution influences the risk of becoming overweight/obese for girls, but not for boys. Consistent with some previous studies (Augustine and Kimbro 2017; Crosnoe 2012; Hernandez et al. 2014), girls may have more difficulties than boys in dealing with the stress associated with parental separation, specifically in relation to body weight outcomes and the consumption of comfort food as a coping mechanism. While male children are more likely to report externalizing disorders after parental separation, the female children of separated parents are at higher risk of internalizing conditions, such as depressive disorders and emotional problems (Liu, Chen and Lewis 2011; Holroyd and Sheppard 1997); symptoms that are associated with unhealthy weight gains (McConley et al. 2011).

Regarding the second contribution of this paper, the findings indicate significant variations in the effects of parental separation on child BMI and overweight/obesity risk based on parental education and race/ethnicity. The health of children with higher-educated and White parents is less affected by parental separation compared to children with lower-educated and Black parents. This finding contradicts theories suggesting that minority groups have greater abilities to respond to family stressors, and that children with higher-educated parents have more to lose in terms of socioeconomic resources (Bernardi and Radl 2014; Cross 2020). Children from Black and lower-educated families generally have fewer resources to deal with stressful family events, such as union dissolution; and low-educated separated mothers usually increase their involvement in the labor market (Özcan and Breen 2012), thus reducing the amount of time available to invest in children and control their eating behaviors. On the other hand, the highly educated have not only more social and economic resources but also stronger attitudes concerning the beneficial effect of parental involvement for the health development of children (Mandemakers and Kalmijn 2014; Spaan et al. 2022). In line with this argument, the health impact of parental union dissolution is found to be more prevalent among social groups that already face socioeconomic disadvantages. This provides evidence in support of the 'diverging destinies' thesis, which suggests that the diffusion of parental union dissolution contributes to increase socioeconomic inequalities across generations (McLanahan 2004; McLanahan and Percheski 2008).

This study has four main limitations. First, the main variable of interest, children's BMI, is measured for children aged at least five. The reported changes in child BMI and the risk of overweight/obesity following parental separation could be underestimated, considering that parental separation may have more substantial impacts on younger children's wellbeing (Amato 2000). Second, the used data collect information on children aged 0-12 in 1997, suggesting a need for future research that examines more recent cohorts to determine if these findings hold true for younger generations. Third, information on children's weight reported by the primary caregiver (in the CDS) or by respondents themselves (in the TAS) may introduce a bias in the between-individual estimates based on the average BMI score; however, the results presented here focus on within-individual changes in child BMI and thus are less affected by individual characteristics and preferences associated with this type of information bias. Four, this study provides limited insight into the underlying mechanisms that explain why a child's weight status is affected by parental separation. More comprehensive and harmonized information on children's diets, activities, and time use is necessary to identify the specific pathways through which family disruption influences a child's health.

Nevertheless, these limitations are largely offset by the advantages of using rich longitudinal data that enable us to look at changes in child BMI before, upon and after parental union dissolution. Our results have two key implications. First, from a methodological standpoint, the use of longitudinal data enables the adjustment for time-constant confounders and the investigation of both short- and long-term consequences associated with parental separation. In fact, changes in child BMI following family disruption do not necessarily indicate significant health issues later in life. The findings presented here provide evidence that parental separation is associated with an increased long-term risk of overweight/obesity among female children and young adults, which may have additional implications for obesity-related morbidities. Second, the results emphasize the differential impact of

family events on various social groups, characterized by parental education and ethnicity. Specifically, children from lower-educated families and minority ethnic groups tend to experience a greater impact on their health outcomes following parental separation. This suggests that family instability may further exacerbate existing socioeconomic disadvantages. Changes in family structures tend to have socioeconomically stratified effects, contributing to diverging destinies in child health outcomes. These disparities observed in child health highlight the importance of addressing the underlying social and economic inequalities that intersect with family dynamics.

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