The effects of early-life conditions on later-life health and mortality in a cohort of American women

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Abstract

Adverse early-life social conditions are associated with higher mortality in old-age in American men, but these effects have not been studied to the same extent in American women. We add new evidence on the long-run effects of early-life social conditions and family structure in the United States by studying a large cohort of women. We linked 10,375 subjects from the Iowa Women's Health Study (IWHS) born 1916-1930 to individual early-life census records from the 1930 census. Census records provided objective measures of family structure and social class in early life. The subjects matched to early-life censuses were representative of both girls their age living in Iowa at the 1930 census, and of the IWHS cohort at enlistment. Conditional on survival to IWHS enrolment in 1986 we found the following early-life factors associated with a worse survival experience in later life: growing up in an urban area, having a father employed in manufacturing, lower levels of education, and maternal absence before age 6. There were particularly strong effects of early-life family structure on women's mortality 55-85 years. Subsequent cohorts have experienced higher rates of single parenthood but more generous welfare provision, potentially changing the impact of family structure in future generations.

Keywords: Early life conditions. Family structure. Mortality. Longitudinal studies.

Introduction

A substantial body of research in the social and medical sciences has now established that stress and economic deprivation in early life can have long-lasting effects on individual health and well-being. Thus, the roots of contemporary health conditions in adults, and differences between groups in health status and life expectancy, can be partly traced to adverse experiences in early life. A wide range of inter-related childhood influences can bear on later-life health and mortality, including early-life health itself, and children's social and economic environment (Elo & Preston, 1992; Haas, 2007; Hayward & Gorman, 2004; Kauhanen, Lakka, Lynch, & Kauhanen, 2006). Poor health in childhood has been shown to be associated with poorer health in adulthood in different cohorts in both the United States and Britain (Blackwell, Hayward, & Crimmins, 2001; Haas, 2008; Kuh & Wadsworth, 1993; Wadsworth & Kuh, 1997). In turn health status in both childhood and adulthood is influenced by current and past socioeconomic status (Cohen, Janicki-Deverts, Chen, & Matthews, 2010).

Because children's socioeconomic status is determined by their parents' status, children's access to parents' resources is important to understanding how social and economic conditions in childhood affect health in later life. The ability of children to take advantage of what their parents can provide is influenced by the presence of parents and their decisions to provide flexible resources, such as money and time, for their children. While it is possible for parents who do not live with their children to spend time with them and spend money on their needs, in practice co-residence of parents with young children is important for investing in children's growth and development. The structure of children's families: who lives with them, who does not, and when in the life course

parents are present, is therefore critical to understanding the socioeconomic position of children.

Much of the literature on the effects of early-life circumstances on later-life health and mortality has focused on the experiences of cohorts born since World War II and either followed prospectively or asked retrospectively about their early life circumstances (Brandt, Deindl and Hank 2012; Montez and Hayward 2011). While these cohorts include both men and women, by definition they are relatively young having only reached their 70s at the time of writing. Research on earlier cohorts, born between the 1890s and 1940, has relied on prospective long-term follow-up of pioneering early twentieth century studies (such as the Harvard, Oakland, and Fels growth studies), and linkage between early-life census records and later-life health and mortality outcomes (Aizer et al. 2016; Ferrie and Rolf 2011). Most studies of early twentieth century cohorts have not included women, because women are difficult, though not impossible, to trace over time due to the nearly-universal practice of changing surname upon marriage (Ruggles, Fitch and Roberts 2018). It is clear from the existing literature that the influence of early life conditions on adulty health and mortality differs across time and social context (Currie and Vogl 2013; Galobardes, Lynch and Smith 2008; Galobardes, Lynch and Davey Smith 2004). It is less clear whether the effects differ across the sexes (Power, Hyppönen and Davey Smith 2005).

We address a key gap in the literature in this paper by examining early-life circumstances and late adult mortality in a group of American women born between 1916 and 1930. This is an earlier cohort than has been previously considered in studies of women's early life conditions. Women in this cohort had a significantly different fertility

and labor market profile in their adult lives than surrounding cohorts. This cohort represents the mothers of children born during the baby boom. Yet they also represent a cohort that re-entered the labor force in significant numbers *after* child-bearing, in contrast to earlier generations of American women. Although this cohort's labor force participation was elevated in comparison to their own mothers, it remained lower than the near-universal paid work norm for men. Thus, we are particularly interested to investigate whether the effects of early life conditions differ for women compared to men. We find that, as for men in the same cohort, the impact of early life circumstances on later-life health is important and of similar magnitude. This suggests that social factors common to time (cohort) and place are likely to be relevant for understanding the mechanisms linking early life and mortality. We also expand the literature on the effects of early life family structure on mortality by addressing this question in a cohort of women, finding its effects to be significant and working largely through an impact on family resources.

Background

The normative expectation in many cultures is that children will reside with both parents. This means that family structure is typically measured in relation to that common ideal: which parents are present at particular points in a child's life? The scholarly agreement on childhood parental absence as an important stressor can be seen in its inclusion in two questions in the now widely used Adverse Childhood Experiences questionnaire (World Health Organization, 2011). Beyond the binary measure of presence, the reason for a parent's absence can provide insights into how early childhood experiences affect later-life outcomes (Carr & Springer, 2010). Parental divorce, for

example, has been shown in some studies to be a predictor of earlier mortality (Schwartz et al., 1995), as has parental death during childhood (Mack, 2001). In both cases the childhood environment may be directly impacted through heightened stress and the diversion of resources away from the child (Amato, 2000). However, the long-run effects and causal mechanisms may be quite different. A parent dying in childhood may simply indicate greater frailty within the family, and that the child is at heightened risk for an early death themselves (Garibotti, Smith, Kerber, & Boucher, 2006). Parental separation or divorce may model for children social behaviors that lead to the children's own relationships in adulthood ending in divorce (Dronkers & Härkönen, 2008), with negative consequences for the subject's own adult socioeconomic status and health. The resources available to a childhood following parental death or divorce will also depend on whether parents re-partner, and any welfare provisions available to children and families who have experienced a family disruption. In short, measuring children's family structure is relatively straightforward, making sense of the long pathway to late life outcomes is less so.

There is only a small literature on the long-run effects of family disruptions and different family structures on mortality at older ages (Campbell & Lee, 2009; McEniry, 2013). In the cohort most similar to our own, Hayward and Gorman (2004) examined a cohort of men from the National Longitudinal Survey (NLS) who were born between 1906 and 1921, and survived to enter the NLS in 1966. Early-life family structure and socioeconomic status was ascertained through a question on family circumstances at age 15. Men who grew up with two biological parents and a mother who was not working had lower mortality than those residing with a stepfather and mother. Other childhood

arrangements such as living with extended family also led to higher mortality after age 45. The long-run impact of childhood family structure can be seen also in African Americans during the twentieth century. African American children living with both parents had a 50% greater chance of living to age 85 then children in single parent households (Preston, Hill, & Drevenstedt, 1998). In a follow-up study with the NLS older men's cohort Warner and Hayward (2006) showed that differences in family structure contribute to racial differences in mortality in the United States.

Yet in other settings and populations, measures of childhood family structure exerted only a small influence on older-age mortality. These studies in both Liaoning (China) and Utah are somewhat similar to ours in their focus on people who remain within a state or province over time. In pre-industrial Liaoning, Campbell and Lee found boys who lost a mother during childhood had 15% higher mortality in adulthood (through age 55) than boys who reached 16 with a surviving mother. But in old age (56-75) these effects were nearly entirely attenuated. Similarly, a study from Utah found that while parental death during childhood was associated with higher mortality in childhood, and between the ages of 20 and 50, after age 50 people who lost a parent in childhood had slightly lower mortality (Smith, Mineau, Garibotti, & Kerber, 2009). As in China selective survival to older ages may explain this finding. An important challenge in measuring the changing influence of early life conditions on adult mortality is changing mortality selection. As poor early life circumstances kill fewer people in early life itself, the relationship between early circumstances and adult mortality may be strengthened (Currie and Vogl 2013).

The long sequence of connections between family disruptions in childhood and adult health and well-being necessitates an historical perspective on family structure, and parental absence. Defining children as those aged 0-13 to conform with the ages of the IWHS cohort we examine, and avoid complications arising from the changing age of leaving home (Stranger-Ross, Collins, & Stern, 2005), the proportion of children living with *neither* parent has remained stable since 1850. At any point in time just under 5% of American children have been living apart from both their parents. However, there have been substantial changes in which parents are present in children's households, and substantial differences between the experience of black and white children (Ruggles, 1994a). For white children including the IWHS cohort we study, the first half of the twentieth century saw modest declines in the proportion of children growing up without either parent, or with just one parent. Since the mid-twentieth century children have been more likely to grow up in a single parent household, typically with their mother instead of their father (Figure 1). Black children, similarly, have seen slow and modest declines in the proportion of children living with neither parent, or without their mother, and a significant rise in the proportion of children living in single parent households with their mother. However, the magnitude of parental absence has always been significantly higher among black children (Figure 2).

While the prevalence of parental absence has increased in the past 60 years, the reasons for parents being absent have also changed. Because older Americans today grew up a long time ago, their experience of parental absence will reflect historical patterns in family structure. Again, we focus on white children for comparison to our study population. Until 1930 children living with one parent, whether their mother or their

father, were most likely to be in this situation, because the surviving parent was widowed. Reflecting improvements in adult survival and the increasing prevalence of other reasons for parental absence, since the 1980s less than 5% of children living with one parent have had a parent die (Figure 3). Divorces were legally difficult to obtain for most couples until the mid-twentieth century, so marriages were often dissolved informally before World War II. In the census, couples in this situation were enumerated as married, but with a spouse who was absent. (Ruggles, 1997b). With the liberalization of divorce laws from the 1950s through 1970s (Nakonezny, Shull, & Rodgers, 1995), "separation" as a formal prelude to divorce, and divorce itself became more common reasons that children lived only with their mothers. Since 1980, there has been a significant rise in the proportion of children whose mother has never been married (Andrew J Cherlin, 2010). Different impacts on children can be expected from different transitions into living with a sole parent, or no parent.

While the death of a parent—the modal reason for living with a single parent until the 1940s—is traumatic, widows and their children were more likely to receive support than divorced or separated women. Widows and their children were seen as deserving of sympathy, and when extended family could not provide for them widows' needs were prioritized in the emergence of the American welfare state from the late nineteenth century through World War II (Kleinberg, 2005; Skocpol, 1992). In particular, some widows and their children were given support by mothers pension programs developed by the states after 1911 (Allard, 2004), and expanded to a federal level by the Aid to Families with Dependent Children program after 1935 (Katz, 1997). The scale of mothers' pension programs was limited. In 1930 200,000 children were receiving

support, but in the same year just under 2 million children aged 0-18 lived with a widowed mother. By contrast, the 1.1 million children (0-18) who were living with divorced or separated mothers in the same year were eligible in a small minority of states for support (Lundberg, 1928). Despite recent retrenchment in welfare support for single parents (Lichter & Jayakody, 2002), children growing up for any reason in single-parent households since the late 1930s have access to more government resources than the typical single-parent child in the 1920s and 1930s. Taken as a whole the literature suggests the long-run impact of childhood family structure is likely to be dependent on social context: parents' absence should be less harmful if nearby kin can support a single parent, or if welfare programs are available for a child's family situation. Moreover, as the social acceptance of different family forms has changed over time (Andrew J. Cherlin, 2009) the immediate and long-run impact of living in different family structures is likely to shift over time.

Considerations of social welfare provisions take us more broadly to the question of how income and other measures of family resources affect health in later life. The broad conclusion of the international literature is unsurprising: early wealth begets later health. Ferrie and Rolf (2011) found that boys born between 1895 and 1900 to fathers who were farmers or white collar workers had a better survival experience in later life than boys born to fathers who were laborers. In a more recent cohort drawn from the Health and Retirement Study, Karas-Montez and Hayward found a greater mortality hazard from being born to a father with less education than for recalled economic circumstances (Montez and Hayward 2011). The association between early life circumstance and mortality is not confined to the United States. In the more egalitarian

Scandinavian context, children born to manual workers had higher risks of cancer and cardiovascular disease death in early and mid-adulthood (Elo, Martikainen and Myrskylä 2014; Lawlor et al. 2006).

Study Population

We extend the literature on the impact of early-life family structure by examining its impact on mortality after age 55 using a group of women from the Iowa Women's Health Study (IWHS) linked to early-life census records. The IWHS provides an unusual and important opportunity to add objective measures of early-life circumstances to a longitudinal study of aging women. Tracing men forwards or backwards in time is relatively straightforward because men do not change their name at marriage, and there is now an extensive literature linking men between different United States census enumerations, or from the census to mortality records (Aizer, Eli, Ferrie, & Lleras-Muney, 2016; Beach, Ferrie, Saavedra, & Troesken, 2016; Ferrie & Rolf, 2011). Objective measures of early life circumstances are important because the impact of early-life circumstances is attenuated when studies use recalled information (Galobardes, Lynch, & Davey Smith, 2004; Kauhanen et al., 2006).

The IWHS was originally designed to study mid- and late-life influences on health and mortality, not the extended reach of early childhood conditions on mortality after age 55. However, a baseline question on "maiden name" has allowed the study to be re-purposed in its own later life. The question on maiden name was designed to facilitate mortality follow-up, as some states include maiden names on death certificates as an additional attribute to identify individuals and verify the age of death through linkage to

birth certificates. At the 1986 baseline interview 97% of the women provided either a maiden name, or were never married implying their current last name was likely to have been their name in early life.

The IWHS is a long-running epidemiological study that began in 1986 and has followed subjects for mortality through the present. The sampling frame for the study were women aged 55-69 who held a valid Iowa drivers' license in 1985. In January 1986 98,030 women were invited to enter the study, and 41,836 (42.7%) completed the baseline interview. Driver's license information indicated that respondents averaged 3 months older than non-respondents, and had a lower BMI by 0.4. Respondents were more likely to live in rural counties (Folsom et al., 2000). Despite these differences in baseline health and socioeconomic status, the association of body weight with mortality and cancer incidence was similar in respondents and non-respondents (Bisgard, Folsom, Hong, & Sellers, 1994). The baseline questionnaire asked respondents about their health history, lifestyle, diet, and socioeconomic background. Additional follow-up surveys were carried out in 1987, 1989, 1992, 1997 and 2004. Mortality has been ascertained through annual linkages to the National Death Index. In this paper, we follow subjects from the January 1986 baseline to August 2015.

Because IWHS subjects were born between 1916 and 1931 their early-life United States' federal census records are now publicly available (Ruggles, 2014). Complete electronic databases of the 1850-1940 United States' censuses can be obtained for scholarly research through the Minnesota Population Center (Ruggles et al., 2017). Restricted-use versions of the data contain names and low-level geographic information that allow individuals to be identified. We identified IWHS subjects who were alive in

April 1930 (39,621 of the total study population), and matched them to 1930 federal census records from Iowa. Potential matches were identified through comparison of names in the IWHS and census records, adapting procedures used for the construction of the IPUMS Linked Representative Samples (Goeken, Huynh, Lynch, & Vick, 2011). We searched among census records aged plus or minus one year of the age the IWHS subjects would have been in 1930. Two trained research assistants independently reviewed potential matches. The subjects selected for this analysis were cases for which

- Only one potential match was found in the census records
- The census record matched only one IWHS subject
- Both research assistants recorded the match as legitimate

We matched 10,375 women to early life census records, restricting matches to women resident in Iowa in 1930 in order to bring in additional county-level data collected from state government publications. Although state of birth information was not collected in the IWHS, we can assess the effects of this sample restriction in several ways. In the first instance, we can assess whether the linked sample was representative of the populations from which it was drawn. Significantly, the sample matched to early-life records was representative of both populations: the cohort of females aged 0-13 resident in Iowa (Table 1), and the full IWHS sample (Supplemental Table 1). The major substantive difference is that early-life matches are more likely to come from farming households than their similarly aged peers in Iowa in 1930. On the other side of the process, we match a smaller than expected number of never-married women out of the IWHS sample to early life-records.

More broadly, we can assess external validity of the Iowa sample through comparison of the cohort of Iowa-resident women who would later be eligible to participate in the IWHS to other women of the same cohort in the 1980 federal census. Iowa today is not representative of the United States. But in the early twentieth century it was quite representative of the white population (Goldin & Katz, 2000). Three quarters of the eligible cohort had been born in Iowa, and were likely to have resided there for their entire life given migration patterns in this cohort. The cohort resident in Iowa were 98.6% white, compared to the national average of 88.5%. Yet the racial composition of this cohort in Iowa was similar to that seen in other states in the Upper Midwest, New England, the Great Plains and Mountain West. On other important dimensions, women eligible to participate in the IWHS were representative of white American women their age across the country, with nearly identical rates of marriage, fertility, and labor force participation.

The most significant difference in adulthood between the IWHS study population and white American women of the same cohort is that the IWHS cohort was significantly more likely to be rural. At the 1986 baseline interview 19% of the IWHS sample were living on a farm, and an additional 19% of the sample were living in a rural area or a town with fewer than 1,000 people. While the IWHS cohort is distinctive for being rural in later life, growing up in a rural area was common for women born between 1916-1931, and our sample represents reasonably well the distribution of childhood environments for white Americans in the early twentieth century, lacking only a major metropolitan area. At the 1930 census 48% of American women born between 1916 and 1930 lived in a rural area.

Measures

Early life family structure: The census records individuals in the households in which they are normally residing, so that people away temporarily (e.g. fathers traveling for work) are enumerated in their usual place of residence. Thus, the presence or absence of a particular family member in the census records can be used to indicate the normal composition of the child's household around the time of the census (Ruggles, 1994b, 1997a). The relationship of individuals within the household is explicitly enumerated in the census, allowing the definite identification of children's parents for nearly every child. For children who are living in secondary families within a household, such as a family boarding with the owners of a dwelling, surnames and ages are used to infer intra-family relationships and parental presence. We derive our measures from the standard IPUMS family relationship codes (Ruggles, 1995). Women's family structure at the time of the 1930 census is classified into four categories: Both parents present, Father only, Mother only, and Neither parent. While these measures were taken contemporaneously, and do not rely on later-life recall of parental absence, the measurement of early-life family structure is limited to a single point in time. A limitation of this measure it that it does not capture every instance of long-term parental absence in the lives of our subjects. However, the objective enumeration of family structure provides significant advantages over retrospective recall of events 55 years prior to interview (Hardt & Rutter, 2004; Kauhanen et al., 2006).

Early life socioeconomic status: The 1930 census collected information on adult occupations, which have been coded by the IPUMS into the U.S. Census Bureau's 1950 occupational categories. We aggregated these occupational categories further into variables denoting whether fathers worked in white collar jobs (professionals, managers, clerical and sales workers), as farmers, skilled or semi-skilled workers in manufacturing, utilities and transport, or as laborers in farming or industry. We measure the economic status of mothers through a binary variable for labor force participation. Distinguishing different occupations for women workers is less important, because labor force participation by married women at this time was very low; nationally less than 10% of white married women worked and in Iowa 7% of married women worked.

Adult health and socio-demographic status: We measure baseline health status at age 55-69 through body mass index (BMI), and smoking status (never smoked, currently smoked, past smoker). Family structure at the baseline interview was measured through a question on current marital status. Because the IWHS cohort was composed of women above and below typical retirement age, a question on current employment would not accurately capture the socioeconomic position of women. Therefore the baseline questionnaire asked about usual work done for "most of your life," classifying response into homemakers, professionals and managers, clerical and sales work, craft and service work (associated with greater physical intensity), and agricultural work. Adult residence was classified into six categories: farm, rural, and four categories of town or city size.

Statistical Analysis

Because of some similarities between our cohort and measures and the National Longitudinal Sample studied by Hayward and Gorman (2004), we show results for models that parallel theirs, and then exploit different features of our data to further explore why family structure has a long-run impact on mortality. Because not all of our sample is deceased, and right censoring is an issue, we use Cox proportional hazard models to estimate hazard ratios of childhood and adult family structure, SES, place of residence, and health. Our first models parallel Hayward and Gorman for comparability. Our final model disaggregates the effect of family structure on mortality into different effects at different ages, and controlling for whether mothers in single parent families are working.

Results

We matched a sample of 10,375 women from the IWHS to 1930 federal census records. We expected that women who survived and remained in Iowa at the time the IWHS began in 1986 to be distinct from the cohort of girls resident in Iowa in childhood, since migration and mortality are not random. However, our sample matched the total cohort of girls in Iowa in 1930 remarkably closely (Table 1). The sample that survived to be in the IWHS was more likely to be living in a rural area or on a farm in 1930, and slightly more likely to be living in a family with both parents present. Similarly, we find the group matched to early-life records has a very similar distribution of social and health characteristics in 1986 to the entire IWHS cohort (Supplemental Table 1).

Most of our sample lived with both parents when enumerated in the 1930 census, and we observed slightly lower levels of parental absence than among contemporary white children nationally or in Iowa. Lower levels of parental absence among our sample that survive to enter the IWHS are consistent with parental absence being associated with higher mortality before age 55, or with parental absence leading to lower levels of social integration. We observe 5% of our sample living either in a single parent family, or with neither parent (Table 2). Three quarters of children living without their parents were living with other relatives. Few lived in institutional or foster care situations. Nationally 64% of white children 0-13 living without their parents in 1930 lived with relatives. 62% of mothers and 80% of fathers were single parents through widowhood, above corresponding national rates.

Family structure has a significant impact on mortality after age 55, though our estimate of its magnitude varies with model specification (Supplemental Table 2). Throughout our different estimations, the hazard ratios for other childhood circumstances do not change substantially indicating that family structure affects mortality independent of childhood SES and residence, and later-life health. We observe important differences in mortality along other dimensions of early life experience, with significantly lower mortality risk for girls growing up in rural areas, and a conventional educational gradient. Women who attended or graduated college had significantly lower mortality risk (10-23%). Somewhat surprisingly we see only small mortality gradients in father's occupation, and not always in the expected direction. To facilitate comparison with other studies, we set the baseline father's occupational category as a laborer (Ferrie and Rolf 2011). Surprisingly, we see that mortality is lowest in this group, and the children of

white collar workers. The daughters of farm laborers and skilled or semi-skilled trades workers fared worst, though the differences were not always significant at conventional levels. We suspect this reflects that social class differentials within Iowa are muted compared to those in the entire United States. Interestingly, we see an inversion of where it was advantageous to live. Growing up in a rural area was better, with significantly lower mortality for women living off-farm but in a rural area in 1930. However in 1986 it was advantageous for subsequent survival to be living in an urban area or on a farm. Remaining in small-town Iowa was hazardous to women's survival.

In models similar to those estimated by Hayward and Gorman, the most significant impact of early life family structure is for girls living in households with a single mother, for whom mortality hazards are 33% higher, the equivalent of being three years older at the start of the IWHS or having a baseline BMI between 35-40 (Grade II obesity). Few of the parents in our sample are observed with new partners, so we cannot examine whether the experience of children with stepparents differs. Girls living with only their father had a moderately higher risk (16%) of mortality. Significantly for our understanding of the mechanisms linking family structure and mortality, we estimate that girls living with neither parent have a lower risk of mortality. This result suggests that for women living to age 55, the environment provided by grandparents and aunts and uncles is sufficient to overcome the stress of family disruption that come from being abandoned or orphaned (the census unfortunately does not ask *why* children lived with other relatives).

To better understand the mechanisms linking early-life family structure with later life mortality, we add interactions between children's age at the 1930 census, mother's

labor force participation, and family structure. We expect parental absences may bear more heavily on younger children (Aizer et al., 2016), because parents provide more time caring for them. Older children are in school, and require less parental supervision. Thus we distinguish between girls aged 0-4, and those 5 and older. Moreover, we expect the effects of parental absences at younger ages will be greater for children of single mothers. Labor force participation in 1930 for white mothers was low (9%), and lower (5%) for mothers with a child under age 5. Single mothers of young children faced the triple burden of coping with a stressful family situation, finding paid employment after what was likely a significant labor force break, and continuing to care for young children (Kleinberg, 2005). We expect the stress of parental absence to be similar for fathers in the same situation. But fathers were nearly certainly in the workforce before their spouse left. A significant gender gap in wages meant they would earn more than a widowed mother entering employment. Indeed, because of the prevalent pattern of employed men supporting both wives and children, a widowed father's family may have more money *per-capita* without the mother.

By adding interaction terms we decompose the main effect of a 33% higher mortality hazard into different hazards for the groups most affected (ages 0-4, and 5-15), and identify whether different responses to single parenthood (working) affected mortality risk (Supplemental Table 2, Model 5). We continue to find that family structure by itself is important, with children living in either single parent situation having a 23-27% greater hazard of mortality taken by itself. In order to concisely understand how family structure, age and mother's work combine to influence mortality risk in later life, we present a summary table combining the various interactions (Table 3). The reference

case is a girl aged 5-15 living with both parents, whose mother is not working. Neither age nor mothers' labor force participation have a significant difference on mortality among the group living with both parents.

Among girls living in a single- or neither- parent household, mortality risks differ significantly. Our finding that girls who lived with neither parent did better is concentrated among the older age group, though neither estimate is statistically significant. The most significant impact of early-life family structure is observed for girls who were in a household with only their mother. As expected the effects are concentrated in the younger age-group, with a 83-95% greater hazard of mortality. Mothers' labor force participation did not make a significant difference to mortality hazards. But among older girls—who are likely to be in school—we find that mothers' work matters. It is significant that mortality for older girls whose single mother worked is no greater than for girls in two parent families. Girls whose mother did not work had a 23% greater hazard of mortality, greater than the difference in mortality between college graduates and those who had only finished grade school. These results suggest that single mothers who eventually entered the labor force were able to provide sufficiently for their children to offset the earlier stress of the loss or departure of the father.

Discussion

The demography of childhood family structure has changed significantly in the United States in the past century, with potentially important long run consequences for health and mortality in later life. In the early twentieth century—when the current generation of older Americans were children—living with one parent less common than

today, the modal reason was parental death, and there was substantial public sympathy for widows and their children. But early twentieth century welfare reached less than one in ten children of widows, and very few children of broken marriages. In modern American society, approximately half of all children will live in a single parent household by age 15, parents' choices not mortality determine family structure, and a wider and more generous range of social programs support children in single parent households. In order to understand the long-term consequences of children's family circumstances we must look to the past, when currently aging Americans were children. Our results complement recent work on the long-term effects of mother's pension programs comparing boys whose mothers were accepted and those who were rejected. Boys in a family receiving a pension lived a year longer than rejected applicants (Aizer et al., 2016).

Examining the experience of a sample living in favorable circumstances—Iowa was a state that invested significantly in girls education (Goldin, 1998; Goldin & Katz, 2000), and social capital was high—and surviving to at least age 55, we find significant long-run impacts of parental absences. Girls who grew up with an absent parent had a significantly higher risk of mortality over thirty years, even after controlling for later-life health and socioeconomic status, and additional measures of childhood circumstances. Differences in the mortality risk of girls who grew up with no parents, only their father, or only their mother, suggest possible mechanisms. Significantly, girls observed with neither parent and mostly living with grandparents or aunts and uncles, had a lower mortality risk than girls living with two living parents. This result should not be interpreted as signaling that widespread orphanhood is ideal, since our conclusions

pertain to mortality conditional on surviving to age 55. Evidence from other studies shows parental death during childhood is associated with higher mortality before age 50, even after controlling for family longevity (Campbell & Lee, 2009; Smith et al., 2009). Yet our results suggest extended family can provide an environment in which children can overcome the loss of both parents. In our sample, most girls living with extended family had both an aunt and uncle, or grandmother and grandfather, replicating the socioeconomic structure of a two-parent family.

The mortality risk of living in a single parent household was significant, whether the surviving parent was the mother or the father. However, the risks were greater for children of single mothers, and especially for young children. Mothers abandoned or widowed with young children faced the difficult choice of spending less time with children (if they worked), or having less money. At older ages, when children were more self-sufficient or in school, the trade-off between time or money was less acute. Yet our results show money mattered—when mothers of school age children worked the mortality risk of living with a single parent vanished. Our study extends a small literature on childhood family structure and mortality in old-age to a large cohort of women. Our findings suggest the stress of living in a single parent family is a significant mortality risk. Money ameliorated some of those risks. The implications for future generations of older Americans, who are more likely to have grown up in a single parent household, though for different reasons, are ambiguous. While the population-level impact of family structure may increase, gradual improvements to welfare supports across generations are likely to reduce the risks of growing up without both parents.

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Tables

Table 1. Characteristics of 1930 Iowa cohort and IWHS early-life matches

	Iowa cohort of girls born 1916-1930	IWHS matches
Rural	0.65	0.75
Father's occupation		
Farmer	0.38	0.51
Laborer	0.12	0.11
White collar	0.14	0.11
Trade or craft	0.15	0.13
Owned home	0.41	0.42
Owned radio	0.47	0.48
Both parents present	0.91	0.95
Number of siblings (mean)	2.60	2.66
Father is WW1 veteran	0.14	0.14
Parents nativity		
Both native born	0.87	0.87
One or both foreign-born	0.13	0.13
Mean home rent (if renting)	$8.85	$5.83
Mean home value (if owned)	$2092	$1598
N	344,057	10,375

Table 2. Family structure of IWHS cohort matched to 1930 federal census

Family structure	Frequency	Percent
Both parents	9,847	94.91
Father only	103	0.99
Mother only	314	3.03
Neither parent		1.07
Living with aunts/uncles	36	
Living with grandparents	34	
Living with other family	15	
Foster or institutional care	8	
Other living arrangements	18	
Total	10,375	100

Table 3. Summary of mortality hazards combining effects of family structure, age, and mothers' work

	Mother not working or mother absent Hazard ratio (t)		Mother working Hazard ratio (t)	
	Age 0-4	Age 5-15	Age 0-4	Age 5-15
Both parents present	1.02	1.00	0.94	0.99
	(0.37)		(-0.32)	(-0.08)
Father only	0.57	1.27	–	–
	(-1.46)	(1.98)		
Mother only	1.83	1.23	1.95	1.01
	(3.53)	(1.98)	(2.54)	(0.12)
Neither parent	1.21	0.81	–	–
	(0.61)	(-1.70)		

Supplemental Table 1. Characteristics of full IWHS cohort and early-life matches

		Not matched	Matched to 1930	p-value
		N=31461	N=10375	
BMI		26.07 (4.95)	26.30 (4.94)	<0.001
Height (cm)		162.86 (6.35)	162.86 (6.39)	0.92
Age		61.61 (4.28)	62.03 (4.11)	<0.001
Self rated health	Excellent	7572 (24.4%)	2281 (22.3%)	<0.001
	Good	18795 (60.6%)	6386 (62.3%)	
	Fair	4139 (13.3%)	1426 (13.9%)	
	Poor	510 (1.6%)	153 (1.5%)	
Residence in 1986	Farm	5789 (18.6%)	2158 (20.9%)	<0.001
	Rural, non-farm	2330 (7.5%)	764 (7.4%)	
	Town < 1,000	3361 (10.8%)	1238 (12.0%)	
	Town 1,000-2,499	3298 (10.6%)	1191 (11.6%)	
	Town 2,500-10,000	5407 (17.3%)	1787 (17.3%)	
	Town or city, 10,000+	10991 (35.3%)	3172 (30.8%)	
Education	Grade school	2649 (8.4%)	1114 (10.7%)	<0.001
	Attended high school	3313 (10.5%)	1087 (10.5%)	
	Graduated high school	12952 (41.2%)	4445 (42.8%)	
	Vocational education	3158 (10.0%)	1040 (10.0%)	
	Attended college	5195 (16.5%)	1585 (15.3%)	
	College graduate	2899 (9.2%)	795 (7.7%)	
	Graduate school	1200 (3.8%)	290 (2.8%)	
	Missing	95 (0.3%)	19 (0.2%)	

		Not matched	Matched to 1930	p-value
Race	White	30730 (99.1%)	10171 (99.3%)	0.017
	Black	111 (0.4%)	27 (0.3%)	
	Hispanic	97 (0.3%)	20 (0.2%)	
	American Indian	41 (0.1%)	19 (0.2%)	
	Asian or Pacific Islander	31 (0.1%)	3 (<1%)	
Marital status	Never married	1023 (3.3%)	1 (<1%)	<0.001
	Currently married	23655 (75.2%)	8150 (78.6%)	
	Separated/divorced	1435 (4.6%)	428 (4.1%)	
	Widowed	5061 (16.1%)	1735 (16.7%)	
	Missing	287 (0.9%)	61 (0.6%)	
Age at marriage		21.23 (3.88)	21.31 (3.95)	0.057
Live births		3.05 (2.09)	3.16 (2.07)	<0.001
Usual occupation in adulthood				
Homemaker		13042 (41.5%)	4578 (44.1%)	<0.001
Professional, manager		4723 (15.0%)	1311 (12.6%)	<0.001
Clerical, sales, technician		8770 (27.9%)	2836 (27.3%)	0.29
Craft, service, laborer		5476 (17.4%)	1842 (17.8%)	0.42
Farmer, farm worker		1360 (4.3%)	572 (5.5%)	<0.001
Never worked		34 (0.1%)	9 (0.1%)	0.56
Other usual employment		1633 (5.2%)	540 (5.2%)	0.95

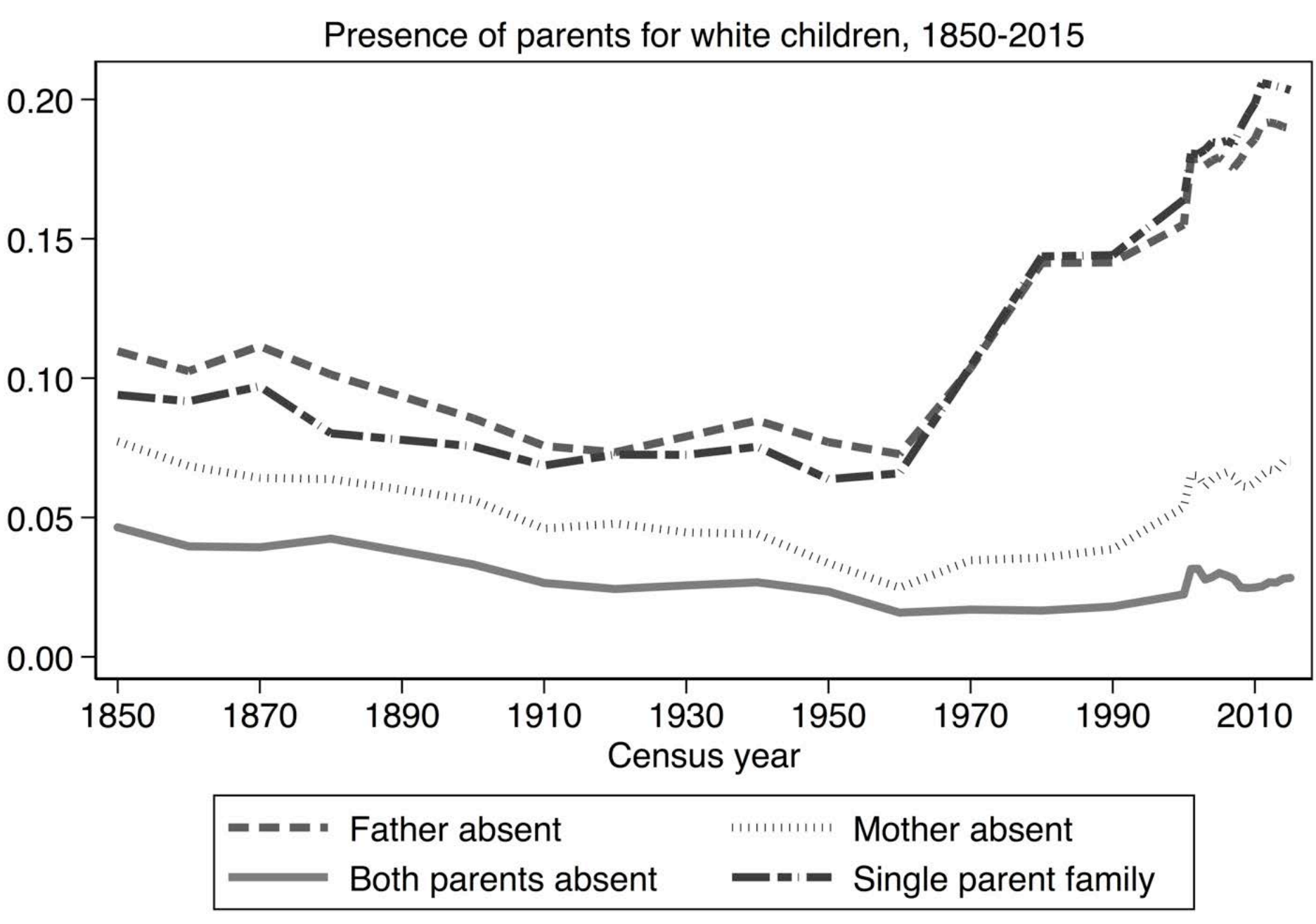
Supplemental Table 2. Cox proportional hazard models for mortality from 1986-2015

	Models comparable to Hayward and Gorman (2004)									
	Model 1		Model 2		Model 3		Model 4		Full model	
	HR	t	HR	t	HR	t	HR	t	HR	t
Age at study entry	1.12	37.29	1.12	37.10	1.12	35.42	1.13	38.15	1.13	23.57
Black	1.42	1.50	1.40	1.46	1.31	1.16	1.22	0.87	1.19	0.75
Father's occupation (ref: laborer)										
White collar	0.98	-0.35	1.01	0.12	1.00	-0.02	0.99	-0.28	1.00	0.07
Farmer	1.08	1.35	1.08	1.35	1.08	1.34	1.09	1.58	1.09	1.65
Skilled / semi-skilled	1.10	2.22	1.10	2.16	1.09	1.91	1.09	2.00	1.09	2.02
Farm laborer	1.18	2.41	1.17	2.26	1.16	2.15	1.13	1.72	1.12	1.59
Family structure										
Two parents	1.00	.	1.00	.	1.00	.	1.00	.	1.00	.
Father only	1.17	1.40	1.16	1.28	1.17	1.40	1.16	1.28	1.27	1.98
Mother only	1.33	3.69	1.33	3.68	1.32	3.64	1.27	3.10	1.23	1.98
Neither parent	0.91	-0.87	0.90	-0.96	0.87	-1.20	0.87	-1.25	0.81	-1.70
Mother in labor force	0.90	-1.49	0.90	-1.48	0.89	-1.62	0.92	-1.19	0.99	-0.08
City size in 1930										
City of 100,000 + (Des Moines)	1.00	.	1.00	.	1.00	.	1.00	.		
City of 25-100,000	1.00	0.01	0.99	-0.15	1.00	0.04	1.03	0.35		
Suburb of city	0.96	-0.33	0.94	-0.48	0.95	-0.42	1.03	0.20		
Town of 2,500 to 25,000	1.02	0.29	1.01	0.18	1.02	0.27	1.06	0.71		
Rural non-farm	0.96	-0.60	0.95	-0.67	0.96	-0.56	0.99	-0.09		
Rural farm	0.81	-2.53	0.80	-2.66	0.81	-2.58	0.88	-1.54		
Foreign born	0.90	-0.51	0.91	-0.48	0.89	-0.57	0.80	-1.07	0.79	-1.14
Both parents native born	1.00	.	1.00	.	1.00	.	1.00	.	1.00	.
One parent foreign born	0.98	-0.46	0.97	-0.71	0.98	-0.51	0.99	-0.16	0.99	-0.12
Both parents foreign born	0.95	-0.81	0.93	-1.18	0.93	-1.16	0.94	-1.06	0.93	-1.23

	Models comparable to Hayward and Gorman (2004)									
	Model 1		Model 2		Model 3		Model 4		Full model	
	HR	t	HR	t	HR	t	HR	t	HR	t
Education										
8 years or less			1.00	.	1.00	.	1.00	.		
9-12 years			0.96	-1.08	0.97	-0.87	0.97	-0.81		
13 or more years			0.84	-4.19	0.84	-4.06	0.86	-3.55		
Marital status in 1986										
Currently married					1.00	.	1.00	.	1.00	.
Separated / divorced					1.29	4.21	1.15	2.31	1.13	1.96
Widowed					1.20	5.78	1.15	4.41	1.14	4.04
Residence in 1986										
Rural					1.00	.	1.00	.		
Urban					1.00	-0.13	0.96	-1.56		
BMI (1986)										
15-20							1.00	.	1.00	.
20-25							0.78	-4.61	0.77	-4.73
25-30							0.85	-2.93	0.84	-3.15
30-35							1.09	1.39	1.07	1.06
35-40							1.35	3.99	1.32	3.71
40 +							1.61	4.55	1.58	4.34
Smoking (1986)										
Current							1.00	.	1.00	.
Past							0.58	-13.47	0.57	-13.53
Non-smoker							0.44	-23.93	0.44	-23.49
Mother only X mother working									0.83	-1.10
Aged 0-4 in 1930									1.02	0.37
Father only X Aged 0-4 in 1930									0.45	-2.03
Mother only X Aged 0-4 in 1930									1.47	1.97
Neither parent X Aged 0-4 in 1930									1.46	1.16

	Models comparable to Hayward and Gorman (2004)									
	Model 1		Model 2		Model 3		Model 4		Full model	
	HR	t	HR	t	HR	t	HR	t	HR	t
Mother working X Aged 0-4 in 1930									0.93	-0.34
Mother working X Aged 0-4 in 1930 X Mother only									1.38	0.82
Residence in 1930										
Urban									1.00	.
Rural farm									0.95	-1.34
Rural non-farm									0.85	-3.08
Education										
Grade school									1.00	.
High school attended									1.07	1.22
High school graduate									0.96	-0.92
Vocational education									0.93	-1.26
Some college									0.90	-2.07
College graduate									0.83	-2.78
Graduate school									0.77	-2.71
Residence in 1986										
Farm									0.99	-0.30
Rural non-farm									1.10	1.89
Town < 1,000									1.11	2.43
Town 1,000-2,499									1.03	0.74
Town 2,500 - 10,000									1.02	0.56
Town or city, 10,000 +									1.00	.
Usual occupation as adult										
Homemaker										
Professional									0.97	-0.76
Clerical, sales, technician									0.95	-1.58
Craft, service									1.06	1.72
Agricultural									0.98	-0.38
N	10375		10375		10375		10375		10375	

	Models comparable to Hayward and Gorman (2004)									
	Model 1		Model 2		Model 3		Model 4		Full model	
	HR	t	HR	t	HR	t	HR	t	HR	t
Log likelihood	-59507		-59357		-59332		-58998		-59102	
LR chi2	1484		1515		1564		2233		2295	


Presence of parents for white children, 1850-2015
0.20
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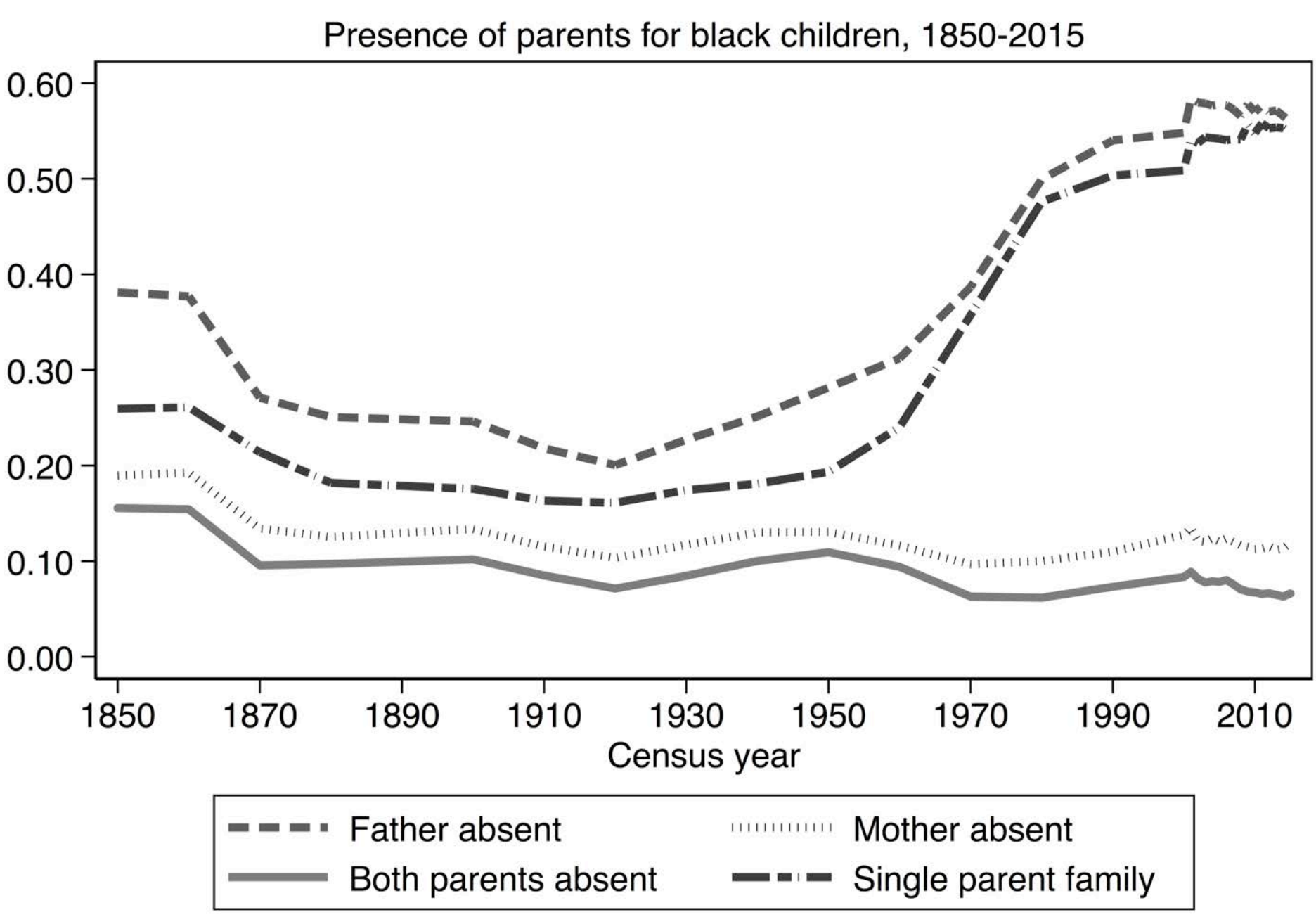
Census year
Father absent
Mother absent
Both parents absent
Single parent family
Data from IPUMS USA 1850-2015


Presence of parents for black children, 1850-2015
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0.40
0.30
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1850
1870
1890
1910
1930
1950
1970
1990
2010
Census year
Father absent
Mother absent
Both parents absent
Single parent family
Data from IPUMS USA 1850-2015

Marital status of white children's mothers when father is absent, 1880-2010