The Shifting Burden of Body Weight for Women's Childbearing Experiences

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Note to organizers:

Dear Dr. Astone and Dr. Hawkes,

I just wanted to let you know that My coauthor (Maggie Weden) and I have done further analysis that show that partnership (marriage/cohab) explain the cohort difference we find in associations between obesity and our fertility outcomes. We're in the process of writing those results up now for an invited revision of this paper but weren't done with that version of the paper in time for the PAA submission. I just thought I would let you both know about these additional analyses that we plan to include in any talk or poster we would present at PAA if our paper is accepted for inclusion on the program.

Best wishes,
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ABSTRACT

Clinical research indicates that a common condition affecting United States' women's health, obesity, biologically impedes conception. Less is understood about population-level links between weight and women's life course childbearing trajectories, the social component of this association, or whether it is malleable over time. This study examines these issues through the lens of life course sociology. Analysis of population representative data from the female sample of the National Longitudinal Study of Youth: 1979 (NLSY) show how weight and childbearing trajectories are linked among two cohorts of women born 5 years apart. The two cohorts experienced similar historical fertility contexts but different normative weight contexts. Cohort 1 entered their peak reproductive years just before the U.S. prevalence of obesity skyrocketed. Cohort 2 entered their peak reproductive years after the obesity prevalence increased. We find that BMI is negatively related to the childbearing trajectories of Cohort 1 but not Cohort 2. More specifically, there are cohort differences in the cross-sectional relationship between BMI and early childbearing and in prospective relationships between early adult BMI and subsequent trajectories of first and higher order childbearing. These cohort differences suggest that the health consequences of BMI do not drive the overall impact of obesity on U.S. women's fertility trends. Rather, the fertility consequences of increasing rates of obesity among U.S. women of childbearing age has been, and may continue to be, malleable over time as the social dimensions of obesity change.

Key Words: childbearing, fertility, BMI, obesity, life course, gender and health, cohort, U.S.

Word count: 7408 (text only); 8224 (including tables)

Introduction

The life course consequences of obesity for health and longevity are well-documented. Obesity leads to an accumulation of risk factors that alter the adult life course and the aging process in enduring ways. It leads to disability, lower health-related quality of life in old age (Ferraro & Kelley-Moore, 2003), and greater hospital admissions and length of stays (Schafer & Ferraro, 2007). This is a primary reason that obesity is classified as one of the most serious public health problems of the 21st century.

Obesity not only stratifies individuals into positions that negatively influence the end of life; it also negatively influences a woman's ability to bring new life into the world. A substantial body of clinical research demonstrates the biological link between obesity and both fecundity and fertility (e.g., Bussen, Sutterlin, & Steck, 1999; Zain & Norman, 2008). Recent social science research also suggests that weight influences U.S. women's life course childbearing trajectories. Obesity is associated with increased childlessness, delayed birth timing, and fewer children born by the end of women's reproductive lives (Frisco, Weden, & Burnett, 2008; Jokela, Elovainio, & Kivimaeki, 2008) The studies just cited both highlight the role that social factors such as sexual partnership play in these associations.

Our understanding of the social nature of the association between obesity and childbearing is still nascent. The current study contributes to this body of research. We use a life course framework to argue that the association between women's weight and childbearing is malleable over historical time because of its social nature (i.e., women's ability to find partners). To test our supposition, we pursue three goals using data from the National Longitudinal Study of Youth (NLSY), a population representative sample of adults followed from 1979-2006. First, we characterize the 'normative weight context' of two U.S. cohorts of women who entered adulthood just prior to and after the rapid increase in the U.S. obesity prevalence. Cohort 1 was born between 1958 and 1960 and Cohort 2 was born between 1963 and 1965. Then, we assess the relationship between early adult body mass index (BMI) and early childbearing among these two female cohorts. Finally, we evaluate whether the prospective relationship between early adult BMI and the subsequent progression of women's childbearing trajectories has remained stable over time, increased, or decreased. Our overarching objective is to provide a broader social, historical and life course population-based context for understanding current and emerging trends in U.S. childbearing that result from women's body weight.

Background

The last two and a half decades have witnessed a dramatic increase in the U.S. obesity prevalence fueled largely by social changes in the way that Americans live, work and eat (French, Story, & Jeffrey, 2001). In 1960, fewer than 15% of the U.S. population was obese. This number remained fairly constant until the mid-1970's and early 1980's. After this time, the obesity prevalence began a steep ascent that has lasted into the 21st century (Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2004). Currently, more than one-third of all Americans are obese according to BMI classifications (BMI ≥ 30) and another one-third are overweight (25 ≥ BMI >30) (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006). Hence, over historical time, the U.S. has reached a point where less than half of population's weight falls in a range that is normal for height.

Obesity is a multifaceted health status with physiological and social consequences. The U.S. Surgeon General (U.S. Surgeon General, 2007) identifies obesity as a clinical risk factor for obesity-related mortality and morbidity, including conditions that are directly tied to a women's ability to conceive and carry a pregnancy to term. Social scientists also show that weight is an important aspect of women's physical appearance that negatively influences social status and social relationships. Obesity has been recognized as a stigmatized social status for decades (Cahnman, 1968; Carr & Friedman, 2005; DeJong, 1980) and weight stigma is not declining with the increasing prevalence of obesity (Andreyeva, Puhl, & Brownell, 2008). The stigma of obesity is unsurprising given that two of the three types of stigmata identified by Goffman (1963) apply to obesity; it may be seen as a bodily disfigurement, a blemish of individual character, or both (Carr & Friedman, 2005; DeJong, 1980).

Women suffer from the social consequences of obesity to a greater extent than their male counterparts due to strong female appearance norms that favor slenderness (Bartkey, 1990; Benjamin & Kamin-Shaaltiel, 2004; Bordo, 1993). This is evident with respect to outcomes ranging from unhealthy dieting behavior (Rolls, Fedoroff, & Guthrie, 1991) to educational attainment (Crosnoe, 2007) and wages earned (Cawley, 2004; Pagan & Davila, 1997). It is further reflected in romantic and sexual partnership. Obese women have trouble finding romantic and sexual partners (see Sobal, 2006 for a review). They date less frequently and at later ages (Cawley, Joyner, & Sobal, 2006; Pearce, Boergers, & Prinstein, 2002); experience sexual initiation later (Cawley et al., 2006) and are at a greater risk of never marrying (Fu & Goldman, 1996).

The latter findings on weight and sexual partnership combined with clinical understanding of obesity's negative ramifications for conception (Sarwer, Allison, Gibbons, Markowitz, & Nelson, 2006) and pregnancy (Norman & Clark, 1998) led Frisco, Weden and Burnett (2008) to take a demographic approach to understanding how obesity may influence childbearing. They drew from Bongaarts (1978) and others to argue and show that obesity early in the adult life course influences fertility exposure (i.e., women's romantic and sexual partnership) and natural fertility control (i.e., the biological capacity to bear children) in ways that substantially disrupt women's childbearing trajectories. The current study builds upon this previous work by employing cohort comparisons as a lever for better understanding the social consequences of weight for childbearing across women's reproductive lives.

A Life Course Framework for Understanding Relationships between Weight and Fertility

This study is rooted in all five key principals of life course theory (Elder, 1994; Elder, Johnson, & Crosnoe, 2003; Mortimer & Shanahan, 2004) but three are of particular relevance to this study. First, life course theory emphasizes the importance of <u>timing</u> of life events. Timing is a critical consideration in fertility studies because women only have a biological capacity to bear children between first menarche and menopause, with peak fertility in the late teens and early twenties (Menken, 1985). Since birth events involve a non reversible, time-limited sequence of events (Morgan & Rindfuss, 1999), birth timing and spacing allow life course researchers to characterize a trajectory of women's childbearing experiences as they age and progress to higher parity statuses (Wood, Holman, Yashin, Peterson, Weinstein, & Chang, 1994). Studies examining childbearing trajectories from a life course perspective show that delays in first birth increase the likelihood that a woman remains childless across her reproductive life (e.g. Morgan & Rindfuss 1999). They also illustrate that increases in the mean age of childbearing produce a substantial and lasting effect on the reduction of national fertility rates (Bongaarts & Feeney, 1998; Sobotka, 2004).

Life course theory also emphasizes <u>life-span development, or</u> taking a long-term perspective on individual development and how experiences throughout one's life shape it (Elder et al., 2003) This includes the inter-relationship between life events and the role of contemporaneous, lagged, or cumulative advantages and disadvantages as people's life course develops. With respect to childbearing, life course studies describe how the timing and spacing of women's childbearing trajectories are shaped by strong normative expectations about the timing of childbearing with respect to other life events (Hogan, 1978; Marini, 1984; Teachman & Polonko, 1985). The accumulated disadvantages of obesity have been highlighted in studies of health as people age (Ferraro, Farmer, & Wybraniec, 1997; Ferraro & Kelley-Moore, 2003) and in studies of women's childbearing experiences (Frisco et al., 2008).

Life course theory also emphasizes the importance of place and time. Temporally changing social and historical conditions shape and redirect men's and women's life pathways as they age (Elder 1999; Shanahan 2000). Moreover, they highlight the importance of period and cohort differences in behavior that arise from temporal changes in environmental conditions.

Demographers debate the relative advantages of considering childbearing from a period versus cohort perspective, but the cohort approach offers a key advantage. It reflects the actual lived experiences of women responding to historical conditions as they age together through their reproductive lives (e.g., Ryder 1986). The study of cohort differences in fertility elucidate the malleability of childbearing experiences in the context of changing social, economic, cultural and political environments (Frejka & Calot, 2001; Ryder, 1986; Robert Schoen, 2006; Wu, 2008)). For example, life course research indicates that the cohort of women of reproductive age during the great depression had fewer children than the cohorts preceding or following them due in large part to a dire economic climate that led to delayed and fewer births.

All of the women in our study from both birth cohorts experienced a similar normative context with respect to average family size and childbearing intentions. These cohorts reached their childbearing years after large scale social changes in the 1960's and 1970's gave women more control over total births and total births relative to intentions. In fact, the oldest woman in our study were born after oral contraceptives were approved for use in the U.S., and these women were only 10 years old in 1972, the year in which *Roe vs. Wade* legalized induced abortion. Furthermore, even these oldest members of the sample were still only young girls when legislation such as the 1963 Equal Pay Act and the 1964 Civil Rights Act provided women with more economic opportunities that would produce competing desires to childbearing.

What is dissimilar for the two cohorts (born roughly five years apart from each other in 1958-60 and 1963-65, respectively) is the U.S. weight context during their peak reproductive years. When the first cohort entered adulthood in the early 1980's, the prevalence of obesity was still relatively low and at a level that had been constant for roughly two decades (Flegal et al., 2002). However by the mid-to-late 1980s when the second cohort entered adulthood, the U.S. obesity prevalence had begun a sharp spike upward from under 15% in 1981 to 23% in 1986 (Flegal et al., 2002). In other words, the five year window separating the time points when the cohorts entered early adulthood represent a period when the U.S. obesity epidemic began to skyrocket. Focusing on cohorts with birth dates further apart would allow us to better leverage more dissimilar U.S. weight contexts, but we focus on these two cohorts because they are the two most recent cohorts for whom we have records of (near) complete fertility histories.

Thus, the two cohorts that we study here are well suited for examining how the social ramifications of obesity may change over historical time and thereby impact the development of women's life course childbearing experiences. For this analysis, a cohort perspective is particularly relevant because we are interested in the long-term social and biological consequences of obesity experienced prior to the onset of childbearing. We argue that in light of the absence of any clinical or genetic interventions to ameliorate the biological consequences of obesity for increased infecundity and infertility, any recent change in the relationship between

BMI and women's childbearing trajectories will be driven by changes in the social consequences of early adult BMI for the subsequent likelihood, timing and spacing of births.

Since research is scarce on the changing patterns of weight stigma through the obesity epidemic (see Andreyeva et al., 2008 for an exception) and it remains unclear whether and what direction changes in the population average BMI will have on the childbearing experience of individual women who are heavy, we present three alternative study hypotheses.

Our first hypothesis is that BMI will have stronger negative consequences for childbearing among women entering young adulthood <u>*before*</u> *the rapid increases in U.S. obesity rates (i.e. women born 1958-60) than among women who entered young adulthood five years after*. This hypothesis is substantiated by social homophily. People select partners for social relationships that are similar to themselves (Christakis & Fowler, 2007; McPherson, Smith-Lovin, & Cook, 2001). In the context of increasing obesity among both men and women, sexual and romantic partners may become increasingly available to heavy women as the number of similarly heavy men also increases. Jokela and colleagues (2008) suggest that this is a plausible consequence of increasing rates of obesity in the U.S. for future dynamics between weight and childbearing.

Our second hypothesis is that BMI will have stronger negative consequences for childbearing among women entering young adulthood <u>*after*</u> *the rapid increases in obesity rates (i.e. born 1958-60) than among women who entered young adulthood five years after (i.e. born between 1960-65).* This hypothesis is substantiated by findings from the one known study on historical consistency in weight stigma concurrent with the increasing rates of obesity (Andreyeva et al., 2008), the relevance of weight stigma for sexual and romantic partnership

(Cawley et al., 2006; Pearce et al., 2002; Sobal, 2006), and the particularly gendered nature of weight stigma (Bartkey, 1990; Benjamin & Kamin-Shaaltiel, 2004; Bordo, 1993). It may also be substantiated by biological links between weight and fecundity reviewed above.

Finally in light of the absence of strong substantiating evidence for an increased or decreased relevance of individual BMI in the context of changing population trends in BMI, we consider a third null effect hypothesis. *BMI will have the <u>same</u> negative consequences for childbearing among women regardless of whether they enter young adulthood before or after the rapid increases in obesity rates.*

Methods

Data and Sample

The NLSY79 is a longitudinal, nationally representative sample of 12,686, 14-21 year old young men and women who were first interviewed in 1979. The original sample is comprised of 3 subsamples of youth: a nationally representative sample (N = 6,111), an oversample of Hispanic, Black, and economically disadvantaged Non-Black/Non-Hispanics (N = 5,295), and a military sample (N = 1,280). The 11,406 respondents who participated in the former two subsamples were followed up each year between 1979 and 1994. During this period of the survey, response rates were very high, ranging 91-96 percent (Center for Human Resources Research (CHRR), 2006). Since 1994, follow-up of all respondents in the nationally representative and disadvantaged subsamples has been biennial with one exception. Economically disadvantaged Non-Black/Non-Hispanic respondents were dropped from the study (N =1,643 in 1979) after 1990 due to financial constraints. The most recent wave of NLSY79 data were collected in 2006 and the response rate from the total sample is still quite high (80.5%) (CHRR, 2006).

For this study, we employ the sample of female non-Hispanic white, non-Hispanic black, and Hispanic respondents in the nationally representative and disadvantaged samples (n=5827) who were followed by design from 1979 through 2006. We exclude women who were never observed again after 1981 when the first measurement of height and weight was conducted (n=47), who refused to respond to any question about childbearing (n=97), and for whom no information was collected on height and weight (n=112). From this NLSY sample of women born 1958-65 (n=5571), we identify two cohorts born five-years apart. "Cohort 1" was born 1958-60 (n=2029) and "Cohort 2" was born 1963-65 (n=1948)[1].

Our study, employs data from all waves of the NLSY through 2006 to contrast completed childbearing by age 41-43 in both cohorts. Thus, it addresses essentially the entire reproductive life span for the two most recent cohorts of women to have completed or nearly completed childbearing.[2] The opportunity in the NLSY to use both rich childbearing histories as well data on height and weight at a point early in the adult life course of two cohorts of women, make the NLSY79 the best U.S. dataset for considering the dynamics of BMI and fertility over the life course and across historical time. In fact, NLSY has previously been identified as the best source of U.S. data for studying the entirety of women's childbearing experiences from young adulthood through menopause (Quesnel-Vallee & Morgan, 2003).

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[1] Selection of an average five-year difference between the cohorts implies that NLSY women born in 1961 and 1962 must be excluded from the analysis. Sensitivity analyses show that varying the difference in average number of years between the cohorts from 4 to 6 (by including or dropping respondents as appropriate by birth year) does not change the direction of the findings, but that the most statistically robust findings are for a five-year difference.

[2] Vital statistics indicate that only 1-2% of TFR is due to childbearing above age 40 (Quesnel-Vallee and Morgan 2003).

Multiple imputation procedures are used to allow respondents with missing data on one or more of the analytical measures to be included in the analyses. Standard MI methods are employed to address missing data by repeatedly replacing them with predicted values based on random draws from the posterior distributions of the parameters observed in the sample, creating multiple complete data sets (Allison, 2001; Rubin, 1987). Prediction models are based on the rich set of social and economic variables collected in the NLSY79 at each wave, and annual and biennial reports of childbearing and weight at each round. We use a multiple imputation by chained equations (MICE) program called "ICE" for Stata 10.0 (Royston, 2005) and follow standard protocols to account for the random variations across the multiply imputed data sets (Acock, 2005; Royston, 2005).

Measures

Childbearing over the Life Course. Data on the entirety of women's childbearing experiences through age 41-43 (the 2002 wave for Cohort 1 and the 2006 wave for Cohort 2) are abstracted from the childbearing and relationship history file compiled by the Ohio State University Center for Human Resource Research (CHRR). The file is the product of significant editing, recoding and data quality assessment of the fertility histories collected at each survey round (see Mott, 1985; Mott, Baker, Haurin, & Marsiglio, 1983; Mott, Baker, Ball, Keck, & Lenhart, 1998; Nieri, Kulis, Keith, & Hurdle, 2005). We employ data on the total number of children ever born and age of first and second birth. We define <u>completed childbearing</u> as the total number of children born to women by age 41-43. We define <u>ever birth</u> by age 41-43 (1=one or more live births, 0=no children ever born) and <u>higher order birth</u> by age 41-43 (1= two or more live births, 0=one child ever born, missing if no children ever born). We also measure the <u>age of 1^{st} birth</u> among women who have ever experienced a birth by age 41-43. Lastly, we characterize early childbearing as a birth on or before age 21-23. Taken together, ever birth and higher order birth allow us to analyze the life course trajectory of women's childbearing and to assess whether the effects of BMI accumulate by impacting not only the likelihood of first birth, but also the progression to second birth. Due to sample limitations, we are unable to test cohort differences in the progression to higher order births subsequent to the second birth.

Baseline Body Mass Index (BMI). Women's adiposity or level of fatness at the respective baseline for each cohort is measured using the Centers for Disease Control (CDC) body mass index (BMI) calculated from self-reported height and weight in 1981 and 1986 as follows:

$$BMI = weight\ (lb) / [height\ (in)]^2 \times 703.$$

In ideal circumstances, height and weight would be measured at the time of the baseline interview, but the NLSY only includes self-reported data on height and weight. We expect our measures of BMI to be biased downward since adults tend to under-report weight and over-report height (see Gorber, Tremblay, Mohr, & Gorber, 2007 for a review). We expect that this bias in BMI will result in more conservative findings on the associations between obesity and women's life course childbearing experiences. We select women's 1981 and 1986 baseline BMI for practical and theoretical reasons. It ensures appropriate causal ordering between BMI and our childbearing outcomes. Furthermore, since average BMI trajectories increase with age until midlife, women who are obese early life are unlikely to move out of this risk status by the end of their reproductive years. In fact, there is evidence that those who do experience significant weight loss may face negative psychological and social consequences similar to women who remained obese due to a perception of "phantom fat", or a persisting sense of poor body image and weight dissatisfaction (Annis, Cash, & Hrabosky, 2004). Therefore, women who are obese early in the adult life course have the highest risk of obesity impeding life course childbearing experiences.

Age of Menarche, Fertility Expectations, and Sociodemographic Controls. The study controls for individual characteristics of the women that may confound associations between baseline BMI and childbearing. *Age of menarche* has been described as both a precursor and consequence of overweight and obesity (Anderson, Dallal, & Must, 2003; Wang, 2002). All women in the sample had reached menarche prior to the baseline assessment of BMI. The study also controls women's fertility expectations, or *expected number of children* assessed at baseline, as well as five years prior, with question "Altogether, how many children do you expect to have?" The sociodemographic controls include *race/ethnicity (i.e. black, Hispanic, non-Hispanic white),* the respondent's *educational attainment* observed at baseline, and the *educational attainment of the respondent's mother* reported in 1979. We also considered the inclusion of controls (assessed prior to baseline) for self-esteem, family poverty status, urbanicity, and region. Since these measures provided no additional explanatory power to the previously noted controls, they are excluded from the final set of findings.

Statistical Analyses

We begin by showing summary statistics for the two cohorts (Table 1) that describe differences between the two cohorts on childbearing before baseline, childbearing after baseline, baseline BMI, and baseline sociodemographic characteristics.

We then assess the cohort differences in the association between early childbearing and BMI controlling for age of menarche and sociodemographics (Table 2). Due to the fact that we are not able to observe BMI prior to 1981, this is a cross-sectional association. It not only provides insight into the relationship between BMI and women's childbearing trajectories, but it also allows us to assess whether there are differences in the characteristics of women who have had children on or prior to the age 21-23 who will be excluded in our next analysis of the prospective relationship between BMI and childbearing. Age 21-23 is the baseline for our prospective analyses because it is the earliest point at which we can observe BMI in both cohorts. Due to the fact that childbearing leads to increases in weight among some women, exclusion of women with births on or prior to this baseline measurement of BMI is required in order to reduce the potential for reverse-causality bias in our prospective analysis.

Our last set of analyses, evaluates the cohort differences in the prospective relationship between BMI and childbearing (Table 3). For each cohort, we employ a logistic regression model to assess the relationship between BMI at age 21-23 and the likelihood of ever birth or childlessness by age 41-43 among women who have not yet had a birth by age 21-23. Then we subset from that sample women those women experiencing at least one birth, and assess, by cohort, the relationship between BMI at age 21-23 and the likelihood of higher order childbearing by age 41-43. Taken together the analysis of BMI and early childbearing, the likelihood of first birth and the likelihood of higher order birth provides a composite understanding of the dynamics between BMI and childbearing across a woman's life course.

In all logistic regression analyses, we test differences in the statistical significance of covariates between the cohorts using pooled models and cohort-interaction variables. The standard errors for the coefficients in all models are estimated using software that combines the multiple imputation samples using Rubin's rules (Rubin 1987). Standard errors are also adjusted for the NLSY79 sampling design and loss-to follow-up over the twenty year prospective period from 1981-2006 by constructing a composite, longitudinal sampling weight for each respondent using the CHRR custom weight tool (CHRR 2010).

Results

Cohort Characteristics

Table 1 provides descriptive statistics for Cohort 1 (ages 21-23 in 1981) and Cohort 2 (ages 21-23 in 1986). There are no significant differences in the childbearing histories of these two groups in terms of total completed childbearing by age 41-43, or early childbearing on or before age 21-23. The sociodemographic characteristics of the two groups are also nearly identical. There are statistically significant cohort differences in fertility expectations at age 21-23, but they are small (1.6 versus 1.8, respectively, for cohorts 1 and 2).

The primary differentiating characteristic between the two cohorts is their BMI; Cohort 2 is heavier. In early adulthood, they have a higher average BMI and a greater prevalence of overweight and obesity. BMI is 0.739 kg/m^2 higher (p=0.000) in Cohort 2 and the prevalence of overweight and obesity are respectively 4.0 percentage points (p=0.002) and 2.0 percentage points higher (p=0.042) in Cohort 2. This difference is unsurprising and reflects the documented spike in obesity that historically began to occur in the early 1980's. These two cohorts represent women who, on the basis of average BMI and rates of overweight and obesity, were exposed to different normative weight contexts as they entered early adulthood.

Cohort Differences in the Association between Early Childbearing and BMI

Table 2 presents the cross-sectional relationship between early childbearing (on or prior to age 21-23) and BMI at age 21-23, adjusting for sociodemographic characteristics. In Model 1, BMI is negatively associated with early childbearing in both cohorts, though not statistically significant in either. Supplementary analyses using a quadratic BMI term produced statistically significant findings in Cohort 1 that are best reflected using weight categories (Model 2). In Cohort 1, obese women are 2.54 times *less likely* than normal weight women to have had a birth before age 21-23 (exp(-0.934), p=0.008). No statistically significant differences in the likelihood of early childbearing are observed in Cohort 2. This difference between the two cohorts is statistically significant (p=0.010).

All sociodemographic characteristics are correlated with early childbearing, and there are no cohort differences in their respective correlations. Furthermore, we determined that adjustment for race/ethnicity and education is critical. There is a strong positive correlation between having non-Hispanic black or Hispanic race/ethnicity and both BMI and early childbearing. There is also a strong negative correlation between education and both BMI and early childbearing. Inattention to confounding by either of these variables leads to a positive bias in the unadjusted relationship between BMI and early childbearing (findings not shown).

Overall, findings from Table 2 suggest that only in Cohort 1 is there a statistically significant (negative) association between BMI and early childbearing. Aside from this difference, there are no other statistically significant differences in sociodemographic correlates of early childbearing between the two cohorts that may lead to compositional differences among the group of women in each cohort that remained childless by age 21-23. These nulliparous women comprise the study sample for our next analyses.

Cohort Differences in the Relationship between BMI and Adult Childbearing

Analyses in Table 3 examine how weight is related to childbearing among women who had not given birth prior to baseline when the samples in both cohorts were between the ages of 21 and 23. Recall from Table 1, that within both cohorts, the majority of childbearing experiences occur after this baseline. Thus, these analyses describe the role that early adult BMI plays in life course childbearing experiences for the majority of women in both cohorts. They also allow us to better address causal relationships between BMI and childbearing across historical time.

Single birth events are life course staged processes. A first birth must occur in order to enter into a state where a second birth is possible. For each cohort we first show how the odds of ever having a birth are predicted by baseline weight. We then show how weight is related to higher order births among women in each cohort among those that had a first birth. Sample power precludes us from conducting analyses by weight categories; however we found a quadratic BMI term was not statistically significant and did not substantively alter the findings.

In Cohort 1 a one unit increase in early adult BMI reduces the odds of ever having a birth by 5.9% (1-exp(-0.061), p=0.007). Similarly, among Cohort 1 women who had a first birth, the odds of a higher order birth are also reduced by 5.1% as weight increases (1-exp(-0.052), p=0.064). In contrast, there is no relationship between early adult BMI and either the likelihood of the first or second birth in Cohort 2, and these differences between the cohorts are statistically significant (p=0.022 for ever birth and p=0.020 for higher order birth).

To better depict the nature of this relationship, consider how these findings are relevant to two hypothetical women in Cohort 1: a normal weight woman with a BMI of 20 versus an obese woman with a BMI of 33. The obese woman is over twice as likely to be childless as the normal weight woman. Further, even among those who have a first birth, they are again less than twice as likely to have a second. These differences are particularly notable in light of the equivalence of the fertility expectations between normal weight and obese women. The average expected number of children in Cohort 1 is 2.19 with a 0.20 difference in expectations between obese and normal women that is not statistically significant. Thus, in Cohort 1, early adult BMI has an accumulated impact on the trajectory of women's childbearing; it not only shapes whether women are ever able to bear children, but also the subsequent likelihood of any additional childbearing after first birth.

Discussion

This study examines the relationship between weight and life course childbearing among two U.S. cohorts of women. These two cohorts share similar fertility contexts, experiences, and sociodemographic characteristics, but entered adulthood at a time when the normative U.S. weight context was beginning to change. When Cohort 1 entered their early twenties, adults were leaner and in fact, this tendency towards being lean had been the norm for several decades. When Cohort 2 entered their early twenties, the prevalence of obesity was beginning to climb. By comparing the association between early adult weight and life course childbearing among these two cohorts, we broaden knowledge about the social consequences of early adult weight for women's childbearing experiences across their life course.

Our primary contribution is showing that the relationship between weight and childbearing across the life course is malleable across historical time. In our study, the negative relationship between weight and women's childbearing trajectories is only evident in Cohort 1. This finding emerges when we examine early childbearing as an outcome (although these analyses cannot speak to the causal direction of this relationship) and when we examine the relationship between baseline weight and women's progression to both first and higher-order births.

These findings support hypothesis one. Heavier women were less likely to have births prior to but not after the rapid rise in the U.S. obesity prevalence. Thus, the increasing U.S. obesity prevalence may significantly diminish the negative consequences that early adult overweight and obesity has on life course childbearing. We suspect that this is because sexual and romantic partners may become increasingly available to heavy women as the number of similarly heavy men also increases in the context of increasing obesity among both men and women. Future research should investigate this possibility.

A secondary contribution of our research is showing that associations between obesity and childbearing at the population-level are not driven solely by biological determinants of fertility. If biological mechanisms were of primary importance, associations between weight and childbearing trajectories should not decline over historical time. Note that this does not mean that we doubt clinical evidence linking obesity to fecundity. Instead, we suspect that it simply cannot explain population-level trends in associations between obesity and childbearing across biological and historical time among women with recently completed fertility histories. As the prevalence of extreme obesity continues to increase (Ogden et al., 2006), this may change.

Our findings should be considered within the bounds of several study limitations. First, we were unable to directly consider the pathways that might link overall population trends in BMI with changes in the characteristics of men and women seeking sexual and romantic partnership, the social dynamics structuring these interactions and their outcomes, and their relevance for individual childbearing experiences. We were also unable to directly assess the relevance of weight-related stigma in the partnership dynamics shaping childbearing experiences of individual men and women, as well as couples. Furthermore, we should note that both historically and currently, the prevalence of obesity has varied by age, race/ethnicity and socioeconomic status (Ogden et al., 2006), as has weight-related stigma (Andreyeva et al., 2008). Furthermore, there are well-established differences in childbearing across the life course by both race/ethnicity and socioeconomic status (Forste & Tienda, 1996; R. Schoen, Landale, Daniels, & Cheng, 2009). Supplementary analyses assessed whether our findings vary by these characteristics. They did not, but these null findings may reflect a lack of statistical power. The last study limitation pertains to measuring body fatness using BMI calculated from self-reported height and weight. BMI is admittedly an imperfect measure; however it correlates well with other body fatness assessments (e.g., dual energy x-ray absorptiometry) and has generally good reliability (CDC, 2009).

Despite limitations, our study shows how one of the most common health problems that U.S. women face is related to historical trends in their childbearing trajectories. On the one hand, our findings are positive. Among women who entered their primary adult childbearing years after the obesity epidemic began, weight played no significant role in their life course childbearing trajectories. Unfortunately, for their predecessors who entered their primary childbearing years before the obesity prevalence skyrocketed, obesity dramatically curtailed childbearing. Future research examining how weight influences the early childbearing trajectories of more recent cohorts of American women will show whether the news continues to be positive or whether obesity plays a new, negative role in the childbearing experiences of American women.

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Table 1. Descriptive Characteristics of Two U.S. Cohorts Age 21-23 in 1981 and 1986, National Longitudinal Survey of Youth (NLSY)

	Cohort 1: Age 21-23 in 1981	Cohort 2: Age 21-23 in 1986	Difference Between Cohorts	
	weighted mean or % (SE)	weighted mean or % (SE)	Contrast C1-C2	p-value
Total Sample Size	2029	1948		
Completed Childbearing				
Total number of children born by age 41-43	1.91	1.81	0.099	0.074
	(0.038)	(0.040)	(0.055)	
Ever birth by age 41-43 (%)	0.817	0.788	0.028	0.077
	(0.011)	(0.012)	(0.016)	
Age 1st birth, if ever birth by age 41-43	23.9	24.0	-0.2	0.507
	(0.172)	(0.176)	(0.246)	
Higher order birth by age 41-43, if ever birth (%)	0.792	0.765	0.028	0.151
	(0.014)	(0.013)	(0.019)	
Early Childbearing				
Birth on or before age 21-23 (%)	0.327	0.313	0.014	0.424
	(0.013)	(0.013)	(0.018)	
Age 1st birth, if early childbirth	18.6	18.7	-0.1	0.309
	(0.086)	(0.086)	(0.122)	
Body Mass Index				
BMI at age 21-23	22.9	22.2	0.7	0.000
	(0.119)	(0.107)	(0.160)	
BMI weight categories at age 21-23				
% under (BMI<18.5)	0.096	0.083	0.013	0.279
	(0.009)	(0.008)	(0.012)	
% normal (18.5≤BMI<25)	0.738	0.693	0.046	0.013
	(0.012)	(0.014)	(0.018)	
% overover (25≤BMI<30)	0.112	0.152	-0.040	0.002
	(0.008)	(0.010)	(0.013)	
% obese (BMI>=30)	0.054	0.072	-0.019	0.042
	(0.006)	(0.007)	(0.009)	

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Table 1. Continued

	Cohort 1: Age 21-23 in 1981	Cohort 2: Age 21-23 in 1986	Difference Between Cohorts	
	weighted mean or %	weighted mean or %	Contrast C1-C2	p-value
Age of 1st Menarche	12.7	12.8	-0.110	0.070
	(0.042)	(0.044)	(0.061)	
Fertility Expectations				
Expected total number of children at age 21-23	1.6	1.8	-0.1	0.021
	(0.035)	(0.034)	(0.049)	
Sociodemographics				
Race/ethnicity				
% non-Hispanic white	0.800	0.795	0.005	0.659
	(0.008)	(0.008)	(0.012)	
% non-Hispanic black	0.139	0.140	-0.001	0.891
	(0.007)	(0.007)	(0.010)	
% Hispanic	0.061	0.065	-0.004	0.499
	(0.004)	(0.004)	(0.006)	
Educational attainment at age 21-23 (years)	12.8	12.8	0.031	0.687
	(0.054)	(0.054)	(0.077)	
Mother's educational attainment (years)	11.5	11.5	0.003	0.980
	(0.076)	(0.072)	(0.105)	

Table 2. Cohort Differences in the Association between Early Childbearing and BMI, NLSY

	Log-Odds of Birth Before Age 21-23 vs No Birth Before Age 21-23								
	Adjusted Model 1[a]					Adjusted Model 2[b]				
	Cohort 1[c] (n=2029) Beta Coeff. (SE)		Cohort 2[d] (n=1948) Beta Coeff. (SE)		Contrast C1-C2 p-value	Cohort 1 (n=2029) Beta Coeff. (SE)		Cohort 2 (n=1948) Beta Coeff. (SE)		Contrast C1-C2 p-value
BMI at age 21-23	-0.028		-0.005		0.327	-		-		
	(0.018)		(0.015)							
BMI weight category at age 21-23										
under (BMI<18.5)	-		-			0.025		0.373		0.349
						(0.250)		(0.275)		
normal (18.5≤BMI<25)	-		-			-		-		-
over (25≤BMI<30)	-		-			0.382		-0.022		0.145
						(0.209)		(0.183)		
obese (BMI>=30)	-		-			-0.934	**	0.191		0.010
						(0.352)		(0.255)		
Age of 1st menarche	-0.060		-0.041		0.769	-0.051		-0.043		0.888
	(0.048)		(0.041)			(0.048)		(0.041)		
Race/ethnicity										
non-Hispanic white					-					-
non-Hispanic black	1.272	***	1.009	***	0.181	1.277	***	0.998	***	0.156
	(0.138)		(0.139)			(0.140)		(0.138)		
Hispanic	0.122		-0.016		0.618	0.084		-0.017		0.717
	(0.201)		(0.188)			(0.202)		(0.189)		

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Table 2. Continued

	Log-Odds of Birth Before Age 21-23 vs No Birth Before Age 21-23								
	Adjusted Model 1[a]					Adjusted Model 2[b]			
	Cohort 1[c] (n=2029) Beta Coeff. (SE)		Cohort 2[d] (n=1948) Beta Coeff. (SE)		Contrast C1-C2 p-value	Cohort 1 (n=2029) Beta Coeff. (SE)		Cohort 2 (n=1948) Beta Coeff. (SE)		Contrast C1-C2 p-value
Education at age 21-23	-0.656	***	-0.601	***	0.516	-0.662	***	-0.600	***	0.457
	(0.060)		(0.059)			(0.059)		(0.058)		
Mother's education	-0.016		-0.060		0.266	-0.015		-0.060	*	0.276
	(0.029)		(0.027)			(0.030)		(0.028)		
Constant	8.835	***	7.872	***	0.513	8.182	***	7.715	***	0.718
	(1.072)		(1.012)			(0.978)		(0.848)		

*p<0.05; **p<0.01; ***p<0.001.
[a]Adjusted Model 1 employs the continuous measure of BMI.
[b]Adjusted Model 2 employs weight categories for BMI on the basis of CDC thresholds for adults.
[c]Cohort 1 is observed at age 21-23 in 1981.
[d]Cohort 2 is observed at age 21-23 in 1986.

Table 3. Cohort Differences in the Childbearing Trajectory of Women with No Children at Baseline, Observed Age 21-23 through 41-43, NLSY

	Log-Odds of 1+ Children vs No Children			Log-Odds of 2+ Children vs. No Children		
	Cohort 1[a] (n=1021) Beta Coeff. (SE)	Cohort 2[b] (n=1148) Beta Coeff. (SE)	Contrast C1-C2 p-value	Cohort 1 (n=693) Beta Coeff. (SE)	Cohort 2 (n=768) Beta Coeff. (SE)	Contrast C1-C2 p-value
BMI at age 21-23[c]	-0.061 **	0.007	0.022	-0.052 †	0.039	0.020
	(0.023)	(0.019)		(0.028)	(0.027)	
Age of 1st menarche	0.064	0.076	0.889	0.034	0.142 †	0.322
	(0.064)	(0.056)		(0.076)	(0.079)	
Fertility expectations at age 21-23	0.323 ***	0.316 ***	0.959	0.131	0.276 *	0.380
	(0.093)	(0.081)		(0.093)	(0.137)	
Race/ethnicity						
Non-Hispanic white	-	-	-	-	-	-
non-Hispanic black	-0.111	-0.189	0.774	-0.332	-0.182	0.673
	(0.204)	(0.180)		(0.253)	(0.247)	
Hispanic	0.525 †	0.169	0.339	0.098	0.144	0.930
	(0.281)	(0.245)		(0.402)	(0.327)	
Education at age 21-23	-0.143 **	0.048	0.007	0.070	0.140 *	0.515
	(0.049)	(0.051)		(0.084)	(0.067)	
Mother's education	0.035	-0.055	0.076	-0.062	0.043	0.127
	(0.037)	(0.035)		(0.053)	(0.044)	
Intercept	2.284 †	-0.879	0.075	1.224	-4.649 ***	0.013
	(1.276)	(1.235)		(1.629)	(1.702)	

†p<0.10; *p<0.05; **p<0.01; ***p<0.001.
[a]Cohort 1 is observed at age 21-23 in 1981.
[b]Cohort 2 is observed at age 21-23 in 1986.
[c] Sample size limitations preclude the analysis of BMI weight categories; however a quadratic BMI term was found to not be statistically significant in any of the models.