The association between socioeconomic status and the risk of miscarriage among two cohorts of British women

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Abstract

Individuals with lower socioeconomic status (SES) tend to have poorer health, including sexual and reproductive health (e.g. pregnancy outcomes and sexually transmitted infections). The SES gradient in reproductive health may have multiple explanations including increased stress, and poorer health behaviours. However, there is a lack of research on the social determinants of miscarriage and the few existing studies show mixed results. We use data from the National Child Development Study (1958 birth cohort) and the British Cohort Study (1970) to investigate whether individual SES is longitudinally associated with subsequent reported miscarriages and whether the association varies by women's age or cohort. Our preliminary analyses apply random-intercept logistic regression to the 1970 cohort data to model the likelihood of reported miscarriage according to SES in previous sweeps. The results suggest a U-shaped relationship between occupational social class and the risk of miscarriage ($OR_{(unskilled\ vs.\ professional)}$=1.10; $OR_{(all\ other\ groups\ vs.\ professional)}$=0.54-0.81 depending on group). Women with low social class (unskilled) might have a higher risk of miscarriage e.g. due to high stress levels resulting from low income or poor working conditions, or risky health behaviours. High social class (professional) might also be associated with high stress levels in high-pressure occupations. Our next analytical steps include (1) building a longitudinal dataset including time-varying outcomes/covariates measured annually; (2) conducting random and fixed effects models with education, income, and partner's SES as covariates; (3) studying whether these associations differ for first versus subsequent miscarriages; and (4) conducting all these analyses also for the 1958 cohort.

Introduction

Many adverse health outcomes are known to be impacted by individuals' low socioeconomic status (SES), which can be measured based on e.g. occupation, income, education or a combination of these. This link may be due to prolonged stress associated with, for instance, low income and low autonomy at workplace; or due to risky health behaviours, such as smoking, being more prevalent among those with low socioeconomic position (Marmot et al. 2010). Socioeconomic status is also associated with many sexual and reproductive health outcomes, such as timing of childbearing (e.g. Imamura et al. 2007) and the likelihood of experiencing an induced abortion (e.g. Väisänen 2015). However, little is known about social determinants of miscarriage (that is foetal death within the first 22 weeks of pregnancy) even though the same factors that link SES with other health outcomes may be risk factors for miscarriage as well.

The few studies that explore the link between SES and the likelihood of spontaneous abortions (i.e. miscarriages) provide mixed results, partly because they were conducted on different samples using a variety of ways of capturing miscarriage. Many of them are outdated or conducted using data that are not nationally representative. For instance, in Italy between the mid-1970s and the mid-1990s, no link between education and the risk of miscarriage was found (Osborn et al. 2000). However, in the early 1990s, low education was associated with a higher risk of miscarriage in Milan (Parazzini et al. 1997) and in the early 2000s, education had an inverted U-shape relationship with the risk of miscarriage in Italy (Caserta et al. 2015). In the turn of the millennium (1996-2002) in Denmark, women with lower education and income had an increased risk of spontaneous abortion probably due to environmental and behavioural factors related to their social position (Norsker et al. 2012). However, another Danish study investigating all pregnancies observed in 2000-2009, found an increased risk of miscarriage among those with high education (Hegelund et al. 2019). In the UK, a population-based study in 2001 found no association between education or unemployment status and miscarriage (Maconochie et al. 2007).

There might be differences in the risk factors for single and multiple miscarriages. In the US, while singular loss history risk was relatively consistent across social and demographic groups, lower socioeconomic status, income below the poverty line, and lower maternal education were associated with a higher risk for multiple pregnancy losses (Price 2006).

Stressful life events (Hamilton Boyles et al. 2000) as well as working night shifts or long hours (Paszkowski et al. 2015; Whelan et al. 2007), which in turn could be linked to lower socioeconomic status, have been associated with a higher risk of miscarriage.

Our aim is to study whether SES (as measured by occupational social class, education, household income, and partner's SES) is associated with the risk of miscarriage and to what extent this varies by cohort and women's age, while controlling for other known risk factors of miscarriage, such as the number and outcome of previous pregnancies and women's health. The British Cohort Studies provide an opportunity to examine this research question using nationally representative longitudinal data from the UK over several cohorts of women.

Data and methods

In this abstract, we used data from the 1970 British Cohort Study (BCS1970) (Elliott and Shepherd 2006) and we will conduct similar analyses using the National Child Development Study (born in 1958) (Power and Elliott 2006) when developing this into a full paper.

Our analytical sample in the preliminary analyses presented in **Results** section includes only those women, who took part in all the six sweeps conducted within the women's reproductive life span (that is sweeps 4-9 conducted at ages 16, 26, 30, 34, 38 and 42) in BCS1970.

In each sweep, women reported pregnancies and miscarriages that had occurred since the last interview, or since age 16 (if interview(s) missed). Our outcome variable is binary, coded as zero, if no miscarriages were reported between two subsequent waves, and as one, if at least one miscarriage was reported. Thus, one woman may experience more than one miscarriage during the study. The explanatory variables include parity; partnership status (in union vs. not in union); self-reported long-term illness; and occupational social class (unskilled, partly skilled, skilled manual, skilled non-manual, managerial and professional). In sweeps 5-9 the occupational social class variable represents that of the woman herself, whereas in sweep 4 (when the woman was aged 16) it represents that of her parents. Characteristics measured at previous sweep predict the likelihood of miscarriage between the sweep in question and the subsequent sweep. In other words, if a woman has a miscarriage between sweeps 5 and 6, her social class (and other characteristics) in sweep 5 would be used to predict the event reported in sweep 6. Thus, our data currently consists of five time points corresponding to the sweeps, when the outcomes were measured (5-9) and the lagged measurements of the explanatory variables in the respective previous sweeps (4-8). We plan to expand the analysis to include a wider range of and more frequent (annual) SES measures based on retrospective reporting as well as conduct the analyses also for the 1958 birth cohort (see **Next Steps** for more details).

We used random-intercept logistic regression models to analyse the odds of miscarriage (a) among all women in our analytic sample and (b) including only those episodes, where a pregnancy (regardless of its outcome: live birth, still birth, induced or spontaneous abortion) took place to control for the changing propensity of pregnancies throughout the life course. The random intercept controls for woman-level time-invariant unobserved characteristics, which may affect the likelihood of miscarriage. We calculated robust standard errors to take into account clustering within individuals, who experienced more than one miscarriage during the study.

Results

Table 1 shows the distribution of the key variables in our analytic sample by sweep. As expected, the average number of miscarriages and live births increased by age, as did the proportion of women being married or cohabiting. Most women in our sample were in skilled non-manual or managerial occupations, and only a few were in non-skilled occupations. The occupational social class measured at wave 4 represents parental social class.

The random intercept models presented in Tables 2a (all women) and 2b (only episodes that include a pregnancy) suggest that social class has a U-shaped association with miscarriage – those in the highest and the lowest groups had a higher risk than those in the middle. However, only one group (partly skilled) was statistically significantly different from the reference group (professional). We also tested an interaction between social class and age, but it was not statistically significant (not shown). The lack of significance may be due to lack of statistical power due to the relatively small sample sizes ($N_{model(a)}$ = 2,450; $N_{model(b)}$ = 1,541), which we plan to address in our future data analyses (see **Next Steps**).

Higher parity was associated with a lower likelihood of miscarriage. The risk of miscarriage was the lowest when the women were in their late 20s and early 30s. The highest risk was observed among those in their late 30s and early 40s.

Discussion

Our results indicate a potential U-shaped relationship with occupational social class and the risk of miscarriage, but the relationship and its underlying mechanisms will be examined in more detail in our future analyses. Women with low social class might have a higher risk of miscarriage for instance due to prolonged stress levels, unfavourable working hours, or risky health behaviours. High social class might also be associated with high stress levels in high-pressure occupations, and women in this social class may postpone their childbearing until their mid- to late-30s, which could explain the higher risk of miscarriage among this group.

As most previous studies have focused on education rather than occupational social class, it is not possible to make direct comparisons between our results and theirs. If we assume that education and occupational social class are both measures of socioeconomic status, our results are in line with some of the Danish and Italian studies, which found either low (Norsker et al. 2012; Parazzini et al. 1997) or high education (Hegelund et al. 2019) associated with an increased risk of miscarriage.

The results varied surprisingly little regardless of whether all episodes (Table 2a) or only episodes where a pregnancy occurred (Table 2b) were included in the model. This may be due to the random intercept taking into account any unobserved time invariant characteristics of the women associated with the propensity to experience a miscarriage.

The main limitations in the current study include potential bias introduced in the sample by only including women, who participated in all sweeps of interest, as attrition patterns in longitudinal studies tend to be associated with socioeconomic status. In addition, because the sweeps of the study have not been conducted at regular intervals, in some cases the explanatory variables were measured many years before the outcome event. The most problematic stretch of time is the ten years between sweeps 4 (age 16) and 5 (age 26). We plan to tackle both of these issues in our future analyses (see **Next Steps**).

Next Steps

Our next steps include further developing the analytical strategy. First, we will build a longitudinal annual dataset including time-varying information about pregnancy outcomes, partnership, work and education histories for each year between ages 16 and 42. This dataset will allow for more accurate predictions of the odds of miscarriage, as the measure of socioeconomic status is measured closer to the event. This improved data structure also allows us to include women, who missed some of the sweeps of interest rather than relying on complete case analysis only, thus reducing bias due to attrition. In addition, we will use multiple imputation or full information maximum likelihood methods to account for missing data and attrition bias. Second, we will explore other measures of SES (woman's education, partner's SES, and household income) in addition to the occupational social class used here. We will also conduct fixed effects models exploring whether changes in individual's socioeconomic circumstances are associated with the likelihood of miscarriage. Third, we will explore, whether these associations differ for first versus subsequent miscarriages. Finally, we will conduct all these analyses also using the 1958 British Birth Cohort Study, and discuss the causes and consequences of any cohort differences and whether these may be related to macro-level societal changes around support for families and those in poorer socioeconomic position between the two cohorts.

Table 1. Distribution of key variables by sweep (N=2,484).

	Mean total number of…		**Proportion….**							
	Miscarriages	*Live births*	*In partnership*	*Long-term illness*	*Unskilled*	*Partly skilled*	*Skilled manual*	*Skilled non-manual*	*Managerial*	*Professional*
Sweep 4 (age 16)	na	na	0.246	0.107	0.029	0.086	0.375	0.125	0.309	0.076
Sweep 5 (age 26)	0.074	0.396	0.629	0.151	0.014	0.110	0.071	0.384	0.369	0.052
Sweep 6 (age 30)	0.125	0.652	0.713	0.210	0.016	0.091	0.059	0.379	0.395	0.059
Sweep 7 (age 34)	0.198	1.071	0.761	0.255	0.008	0.111	0.053	0.320	0.447	0.060
Sweep 8 (age 38)	0.289	1.414	0.844	0.108	0.010	0.127	0.059	0.291	0.452	0.062
Sweep 9 (age 42)	0.366	1.569	na	na	na	na	na	na	na	na

Notes: SES in sweep 4 is parental SES, own SES in sweeps 5-8. Partnership is marriage or cohabiting union, except in sweep 4 dating. Number of miscarriages and births is measured between the sweep in question and subsequent sweep. Na = not applicable. Source: BCS1970, authors' calculations.

Table 2. Random intercept logistic regression: odds of miscarriage (a) among all women and (b) only for episodes with a pregnancy.

	(a) *OR*	*p-value*	**(b)** *OR*	*p-value*
Occupational social class				
Unskilled	0.96	0.937	1.10	0.866
Partly skilled	0.55	0.043	0.54	0.072
Skilled manual	0.69	0.191	0.72	0.316
Skilled non-manual	0.69	0.123	0.72	0.238
Managerial	0.88	0.571	0.81	0.440
Professional (ref.)	1.00		1.00	
Parity				
No children (ref.)	1.00		1.00	
1 child	0.33	<0.001	0.21	<0.001
2 children	0.52	<0.001	0.35	<0.001
3+ children	0.44	<0.001	0.27	<0.001
Age at the time of pregnancy				
16-26 (ref.)	1.00		1.00	
27-30	0.53	0.002	0.56	0.011
31-34	0.58	0.007	0.62	0.032
35-38	1.06	0.782	1.10	0.691
39-42	4.83	<0.001	11.60	<0.001
Level-2 variance	1.19	<0.001	0.96	<0.001

Notes: Controlling for long-term illness, partnership status, government region of residence and pregnancy status between sweeps (**latter only in** model A). Source: BCS1970, authors' calculations. $N_{model(a)}$ = 2,450; $N_{model(b)}$ = 1,541.

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