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Health in early adulthood and fertility: a study based on the 1958 British cohort

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Abstract

Although the relationship between health and fertility in low-income settings has been well explored by demographers, it is surprisingly lacking from equivalent studies in high-income contexts. In this study, we use data from the 1958 National Child Development Study to understand how self-rated health and BMI reported at age 23 relate to achievement of fertility goals by age 46. We found that worse self-reported health and being outside of the healthy weight BMI category at 23 was strongly associated with having fewer children and underachieving fertility goals set at age 23 by 46. These results remained when controlling for socioeconomic controls like education and union history. Our findings suggest that health in early adulthood is an important determinant, whether direct or indirect, for individuals' family life course trajectories. This paper strongly endorses the inclusion of health as an explanatory variable for all studies of fertility in high-income contexts.

Keywords: health; fertility; fertility intentions; BMI; self-rated health; life course; United Kingdom

Introduction

The link between health and fecundity (the biological ability to have children) has been an area of significant interest in the medical, evolutionary and historical literature. Poor health has been shown to affect fertility through several–possibly gender-specific–pathways. For example, certain diseases may lead to infertility issues, be incompatible with pregnancy, limit the individual's ability to participate in leisure activities and family life, including childrearing, or even undermine one's chances to enter a stable union or to find a job (Dow and Kuhn 2004; Fair et al. 2000).

The demographic study of how health affects modern day fertility (actual childbearing outcomes) is typically limited to studies of low-income contexts. This line of enquiry may be motivated by the well-known proximate determinants of fertility framework for 'natural fertility' populations (Bongaarts 1978), which includes sterility because of disease as one component of the model. Demographic research on the determinants of fertility in high-income countries, however, has largely disregarded the role of health in fertility outcomes. Instead, research connecting health and fertility together tends to take the opposite causal argument, looking at how childbearing affects health in later life (e.g., Read et al. 2011; Hank 2010; Yi and Vaupel 2004; Dribe 2004). Socioeconomic factors like family background, educational level, employment career and economic stability are much more common explanations for individual reproductive choices in high-income contexts (Balbo et al. 2013; Brini 2020). This may perhaps be because of the perception that infectious diseases have little influence over people's lives in these countries. However, the COVID-19 pandemic has prompted a renewed interest in comprehending how the direct and indirect consequences of ill health can influence childbearing decision-making and behaviour (Berrington et al. 2022).

This study makes a substantive contribution to the demographic literature by revisiting the pivotal role of health in shaping fertility outcomes, taking the UK as a case study and adopting a life course perspective. Our aim is to assess the relationship between both subjective and objective measures of health, namely self-rated health (SRH) and body mass index (BMI) recorded during early adulthood,

and fertility. Instead of looking at how health influences single fertility transitions – which would make it impossible to account for potential recuperation effects – we focus on completed fertility. In addition, we not only investigate the outcome of fertility, but also delve into the decision-making processes that shape family outcomes, by looking at the relationship between health and the probability of realizing one's 'ideal family size' (declared at age 23). This dual perspective offers a more comprehensive understanding of the dynamic interplay between health, personal aspirations, and fertility choices across the whole life course. It also highlights the instrumental role health plays from an early age on family trajectories.

To this aim, we use longitudinal data from the 1958 National Child Development Study (NCDS) and adopt a gender-perspective by separately investigating the health/fertility link among women and men in the United Kingdom.

Background

Empirical evidence for a link between health and fertility

Generally, the existing medical literature highlights that those with health problems tend to desire (Cvancarova et al. 2009; McGrath et al. 1999) and have fewer children than healthy individuals (Chen et al. 2001; Langeveld et al. 2002). Differing but complementary interdisciplinary perspectives provide explanations for this relationship. On a more ultimate level of explanation, the evolutionary anthropological literature views having children as an energetically costly process. Health problems also require significant energetic resources, and the competing energetic needs between poor health and fertility ultimately result in fewer children (Jasienska et al. 2017). On the more proximate level, the medical literature offers more direct explanations about why poor health is detrimental to childbearing plans and outcomes. Firstly, poor health can affect the ability to conceive a pregnancy for both men and women. Particular health conditions, both physical and mental, are known causes of infertility (Fair et al. 2000; Bhongade et al. 2014). Similarly, markers of poor health like high BMI

and low levels of physical fitness have been associated with inability to conceive among both women and men (Ramlau-Hansen et al. 2007; Chambers and Anderson 2015). For men, issues with fertility appear to stem from an association between high BMI and reduced sperm quality (Cheng and Ng 2007; Hammoud et al. 2008b). Treatment for health conditions, like cancer, can also directly result in issues with infertility (Dow and Kuhn 2004). Beyond the direct impact of health and health behaviours on ability to conceive, health has also been demonstrated as a key decision-making factor for planning children. For example, those with health problems may wish to have fewer or no children because their health problems would make caring for a child difficult (Katz 2006; McDonald 2002), or because they are concerned about passing their health conditions on to their children (Katz 2006). Women with health conditions may also not wish to be pregnant as this may exacerbate their pre-existing conditions or cause complications during pregnancy (Dow and Kuhn 2004; Fair et al. 2000; Drew 2002). Social science studies have also offered more proximate explanations for health's effect on fertility plans and outcomes via indirect routes. For example, health can affect one's ability to be employed or maintain a job, which in turn may make having children too expensive (Currie and Madrian 1991). Health may similarly make finding a partner and maintaining a partnership challenging, which is a strong predictor of having children (Mynarska et al. 2015; Tocchioni 2018; Liu et al. 2023).

However, despite the wealth of evidence suggesting a link between health and fertility, very few demographic studies of fertility in high-income contexts have explicitly tested or controlled for this connection, typically favouring more socioeconomic explanations. This is curious given a comparatively large body of demographic literature which focuses on the opposite direction of association: how fertility affects later life health (e.g., Sironi 2019; Grundy and Tomassini 2005).

Among those that have been conducted, most studies focus on the relationship between BMI and childbearing. Three US-based studies find a significant relationship between obesity in early adulthood and likelihood of remaining childless for both men and women (Frisco and Weden 2013; Jokela et al. 2008; Lee et al. 2023). A Swedish study by Barclay and Kolk (2020) analysed the link

between health and fertility among men and found a strong relationship between BMI, physical fitness and height and total fertility, which persisted after controlling for education and income. Another study using Finnish data found a relationship between being outside of healthy weight range in early adulthood and number of children had 21 years later (Jokela et al. 2007).

Studies which do not focus on BMI, have used various different ways to capture health in early adulthood. Holton et al. (2011) found that in among sample of Australian women, childbearing ideals and outcomes were associated with concerns about health conditions and ability to have children. A study in Norway found that sickness absence from work was positively associated with transitions to parenthood, but the long-term receipt of health-related benefits was negatively associated with fertility (Syse et al. 2022). Alderotti and Trappolini (2022) explore this topic among the migrant population in Italy by sex, duration of stay and parity. They found that among migrant men, poor self-rated health negatively affects fertility intentions especially among recent migrants who already have at least one child. The effect is stronger among women, especially among long-term migrants with chronic illnesses and mental health conditions. Finally, a recent study by Liu et al. (2023) based on Swedish and Finnish registers found strong associations between mental-behavioural disorders (especially among men), congenital anomalies, endocrine-nutritional-metabolic disorders (especially among women) and childlessness – but also between inflammatory and autoimmune diseases and childlessness, mediated by singlehood and education.

The first key contribution of this paper is to build upon previous works and investigate, through a life course perspective, the effect of health on fertility by considering: i) multiple health measures (SRH and BMI) recorded at age 23; ii) both completed fertility and the realisation of the ideal family size at age 46; iii) both men and women.

A life course perspective on health and fertility

In this paper, we explore how health in young adulthood affects fertility outcomes and the fulfilment of fertility goals. This approach is informed by frameworks and theories of reproductive decision-

making. Psychosocial theories of reproductive decision-making, like the cognitive-social model (Bachrach and Morgan 2013), outline that expectations about life outcomes (like having children) are formed during early adulthood based on normative ideals about families and childhood experiences. These expectations become revised over the life course in the presence of situational changes, competing preferences and new information. In the context of health, this could be being diagnosed with a particular illness that changes the likelihood of having children, a potential incompatibility between prioritising health/recovery goals and family goals, or simply changing preferences for having children in light of information about one's health. The Traits-Desires-Intentions-Behaviour framework (TDIB, Miller and Pasta 2004) outlines the pathway for how fertility desires and intentions will change over the life course as a result of these changing life circumstances: biologically-based or non-conscious motivations for children are adapted into desires for children in young adulthood (e.g., number of children wanted in the presence of no obstacles). Desires are often highly informed by social norms about having children. In high-income countries like the UK, these social norms in the last half of the 20th century have typically been pro-natal (i.e. parenthood is seen as a desirable goal) with a persistent desired family size of two (Sobotka and Beaujouan 2014). These desires are then translated into more realistic childbearing intentions for children, which are fulfilled through instrumental behaviours to try and achieve or avoid a pregnancy. However, situational factors like health can modify this pathway at each step, making the formation of fertility intentions and likelihood of achieving those intentions malleable across the life course. This paper therefore aims to investigate how reproductive goals formed at an early age, prior to the occurrence of major life milestones, manifest in actual outcomes over a span of 20 years.

Operationalising health in early adulthood

A challenge for this paper is how to operationalise health in the analysis. Health is a multifaceted concept, with multiple intertwining components such as physical, mental and functional health,

disease and emotional well-being. One way to apply some distinction between components of health is to split measures into more objective and subjective measures. Objective measures would include markers of health for clinical purposes, subjective measures are more to do with how the person feels, thus better capturing the component of well-being. In this analysis we are limited to the measures of health included in the NCDS early adulthood wave in 1981, when participants were age 23. For a more "objective" measure, some possibilities included whether an individual had a health condition at 23, when they were diagnosed and how long they had had the condition. However, we decided a binary indicator of whether an individual had a health condition was too general, and introduced too many issues when comparing different types of health conditions. Another possibility was a measure of whether the individual was out of work due to poor health, but this was quite specific to more severe cases of ill health. Mental health scales were also measured at age 23; however, due to insufficient variation in mental health-related variables, we decided not to include them among the main explanatory variables in our analyses. We therefore decided to use body mass index (BMI) at age 23 as our more 'objective measure' as it is measured for the whole sample.

BMI is measured by dividing an individual's weight in kilograms by their height in metres. The scores are divided into underweight, healthy weight, overweight and obese groupings, the cut offs of which vary slightly between ethnic groups to account for a higher risk of developing diabetes (NHS Information Centre 2012). While belonging to one of the BMI groups in and of itself is not indicative of good or poor health, being outside of the healthy weight range has associated risks of developing certain health conditions such as hypertension and diabetes. It is a somewhat crude measure of risk, however, as BMI does not account for other important determinants of health which can also vary with BMI such as gender, ethnicity and muscle mass. For childbearing, being outside of the healthy weight range could affect outcomes both directly and indirectly. Being underweight or overweight may affect male and female physiology in a way that makes the likelihood of experiencing infecundity or negative birth outcomes more likely (e.g., Boutari et al. 2020; Calvacante et al. 2019; Craig et al.

2017; Nguyen et al. 2007). However, being outside of healthy weight range may also have social consequences for childbearing, for example it may affect likelihood of finding a partner (Ajslev et al. 2012; Kallen et al. 1984) or result in discrimination by social institutions which in turn affects partnership and family formation trajectories (Campos-Vazquez et al. 2020; Flint et al. 2016; Puhl and Brownwell 2001).

For our second measure of health in early adulthood, we use the more subjective and holistic measure of self-rated health (SRH). The question asks *"How is your health in general?"* with and ordered categorical response scale ranging from excellent to poor. It is considered a standard measure of one's general or global health because it encompasses the individual's view on their physical, functional and mental health (de Bruin 1996). It is known to be associated with several 'objective' measures of health (Simmonson and Molarius 2020) and is predictive of subsequent health outcomes, care needs and mortality (Bamia et al., 2017; Luppa et al. 2010). The measure has been included in the NCDS since 1981 (age 23), the starting survey wave of our analysis. While there can be issues comparing self-rated health between countries or over time (different countries or age groups may have different cultural constructions of what being in good health means), comparing within the same country among a cohort born in the same year minimises this issue. Nonetheless other situational factors may affect individual's perceptions of their own health, such as their relative socioeconomic position or gender (Idler and Benyami 1997). Similar, to BMI, self-rated health could be both directly and indirectly related to likelihood of having children. Poor self-rated health is likely to indicate the presence of health conditions, which could affect one's ability to have children, but it may also affect the likelihood of finding and maintaining a partnership, and labour market activity.

Data and methods

Data and sample selection

We used data from the 1958 National Child Development Study. The study is a birth cohort following the lives of 17,415 people born in the UK in a single week of 1958. The study has eleven waves and is still active today.

We selected individuals who participated in the 1981 sweep (i.e., at age 23), who completed the follow-up until 2004 (i.e., until age 46; n=8,219) and who do not have missing information about their health conditions at age 23 and fertility outcomes at age 46 (about 0.3% excluded; n=25). In order to retrieve information about individuals' employment and union histories (which we will use as a control variable), we further restricted our sample to individuals who also participated in the 1991 sweep (i.e., when they were aged 33; n=7,819 included). Since information about health was first collected starting from age 23, we further restricted our analyses to individuals who were childless at that age (23.5% excluded; n=1,839) of individuals were removed. Our final sample consists of 2,815 women and 3,165 men. Descriptive statistics are provided in the supplementary materials (Table A1).

Outcome variables

We focused on two fertility outcomes. The first one is the number of children an individual had at age 46 years, which in this paper we use as a proxy for completed fertility. To analyse the relationship between health and the number of children at age 46, we employed a four-category dependent variable indicating whether the respondent had 0, 1, 2, or 3 or more children at that age.

The second outcome is achieving one's ideal family size at age 46, measured in relation to the self-assessed total number of children desired at age 23 among those that wanted children (hereafter, ideal family size). This information was derived from the question *"How many children would you like altogether?"*. To study this aspect, we generated a categorical variable indicating whether at age 46 the individual had i) exactly or more than the number of children that they stated when they were 23

("ideal size achieved"); ii) one child fewer than the ideal number declared at age 23 ("underachieved by 1"); iii) two or more children fewer than the ideal number declared at age 23 ("underachieved by 2+"). We grouped those who 'overachieve' their intentions together with those who met them. This is because the relationship between poor health and fertility outcomes is hypothesised to be a negative one, so underachieving is the variable of interest. Furthermore, the share of those who exceeded their ideal family size at 23 is relatively small (11.5% of the sample; n=738)–and most of them had only one child more (9.4% of the sample; n=607). Finally, individuals who declared they did not want any (more) children when they were 23 were excluded from this analysis as they have not answered to the question about the total number of children wanted (n=1,353; 17.3% of the sample). Those who answered "don't' know" or did not answer to the question about the total number of children wanted at age 23 were also excluded from this second set of analyses (4.8% of the sample; n=376).

Main explanatory and control variables

We considered two main explanatory variables: self-rated health (SRH) and the body mass index (BMI), both measured when respondents were aged 23. We analysed these two health measures to have a more comprehensive understanding of individuals' health and to capture different health aspects: subjective health and physical health. The former should capture the general perceptions of individuals' health in the short-run, while the latter should capture the objective and long-run health problems. Among the two health outcomes analysed there is poor correlation, about equal to 0.10 both among men and women. This suggests there is room for investigating them separately.

In the NCDS, SRH was derived from the question *"How is your health in general?"*. There were four possible answers: "poor", "fair", "good", "excellent". For our analyses, we collapsed the "poor" and "fair" category due to the small number of cases of the former (n=52). We computed BMI using respondents' height and weight ($BMI = \frac{weight}{height^2}$) and grouped it into four categories following the guidelines provided by the World Health Organisation: "underweight" (BMI<18.5), "healthy weight"

(BMI between 18.5 and 24.9), "overweight" (BMI between 25 and 30) and "obese" (BMI>30). We do not adjust the boundaries for different ethnic groups because of a low proportion in the sample with two foreign-born parents (5%).

In all the analyses, we included a set of socio-demographic control variables. More precisely, the set of variables include the educational level (1 "University Degree", 2 "A level and equivalent (qualification attained at 18)", 3 "O level and equivalent (qualification attained at 16)", 4 "No qualification") and the macro-area of residence (1 "North England", 2 "South England", 3 "Wales", 4 "Scotland", 5 "Unknown") at age 23. We also used the interview when respondents were aged 16 (wave 4 in 1974) to collect information about the respondent's number of siblings (continuous variable) and the migration background (0 "both parents were born in the UK", 1 "at least one parent was born abroad"). Finally, because we are mostly interested in the direct effect of health on fertility, we further control for two variables that may mediate the relationship between health and fertility, namely, employment and union histories. For the former, we used the respondent's employment status at ages 23, 33 and 46 to control for their employment history (0 "Not employed in all waves", 1 "Employed in at least one wave", 2 "Employed in all waves"); for regards the latter, we used the respondent's union status at ages 23, 33 and 46 and control for their union history (0 "Cohabiting or married in all waves", 1 "Cohabiting or married in two out of three waves", 2 "Cohabiting or married in one wave only or in no waves").

Methods

To investigate the health/fertility link, we used multinomial logistic regression models and conducted two separate analyses.

In the first analysis, we examined the relationship between the number of children at age 46 and the two main explanatory variables separately (SRH and BMI). In the second analysis, we modelled the association between the realisation of the ideal family size among those who wanted children at age 23 and the two health measures analysed, while controlling for a set of sociodemographic

characteristics. Additionally, we ran separate models for men and women, considering that existing literature suggests health may influence fertility along sex and gender specific pathways.

First, we estimated the relative risk ratios. Then, to facilitate results interpretation, we presented our findings by computing the average marginal effects (AMEs). AME expresses the effect on the probability of observing the outcome of interest as a categorical covariate change from one category to another, or as a continuous covariate increase by 1 unit averaged across the values of the other covariates included in the model equations. For space reasons, we only report the results about health-related variables. The full models are shown in the supplementary material (Tables A2 and A3).

Results

Descriptive statistics

A full table of descriptive statistics is available in the supplementary material (Table A1) . Regarding our main explanatory variables, the majority of the sample had either excellent (45% for women, 49% for men) or good (48% and 44%) self-rated health and most had a healthy weight BMI (83% and 79%) at age 23. Men were slightly more likely to have an obese BMI compared to women (16% compared to 9%) and women were more likely to have an underweight BMI (7% vs 3%).

Regarding our main outcomes of interest, the average number of children had by age 46 was 1.6 among women and 1.5 among men, and the mean ideal family size at age 23 for those that wanted children was 2.8 both among men and women. Men were more likely than women to have no children at age 46 (32% vs 24%) and women were more likely to have two children than men (43% vs 37%). There were minimal differences between men and women in whether they achieved or underachieved their ideal family size from age 23. Approximately 40% achieved their goal, 20% underachieved by one child, and another 40% underachieved by 2 children.

Fertility by age 46

Table 1 shows the results of multinomial logistic models examining the association between health measures and the number of children at 46, represented as average marginal effects (AMEs) for the probability of being childless, having two children, and having three or more children (the category 'one child', omitted for space reasons, is shown in the full models in supplementary material, Tables A2 and A3). The results highlight significant associations and large effect sizes between health measures and fertility outcomes, displaying sex-specific patterns.

Among women, BMI exerts the strongest influence on completed fertility. Women who have an obese BMI at 23 exhibit a 20.0 percentage points (p.p.) higher likelihood of remaining childless and a 7 p.p. lower likelihood of having three or more children than women with a normal BMI. Women with an underweight BMI are also more likely to be childless by age 46 than those with a BMI within the healthy range by 5 p.p. (weakly significant), while no significant results are detected for overweight BMI. The effect sizes for SRH are smaller than for BMI, with the only significant effect found being a slightly lower likelihood of having three or more children at age 46 (by 2 p.p.) among women who report good–instead of excellent–SRH.

Conversely, among men, SRH emerges as a strong predictor of fertility. Men reporting good and fair/poor health at age 23 are more likely to remain childless than those reporting excellent health by 5 and 7 p.p., respectively. Additionally, men with good SRH display a 4 p.p. lower likelihood of having two children at age 46. Men with fair/poor health at age 23 are also less likely to have two or three or more children by age 46, but estimates are not significant. Regarding the relationship between BMI and fertility by age 46 among men, no significant results are detected.

Table 1 Multinomial logistic models on the number of children at 46 by sex in the UK. AMEs are reported; p-values in brackets

	Women						Men					
Number of children	0		2		3+		0		2		3+	
SRH (ref. Excellent)												
Good	0.01	(0.390)	0.02	(0.271)	-0.02	(0.099)	0.05	(0.001)	-0.04	(0.020)	-0.01	(0.431)
Fair/Poor	0.03	(0.286)	-0.05	(0.231)	-0.02	(0.487)	0.07	(0.027)	-0.03	(0.381)	-0.04	(0.177)
BMI (ref. Normal)												
Underweight	0.05	(0.100)	-0.01	(0.820)	0.03	(0.367)	0.05	(0.351)	-0.04	(0.481)	-0.02	(0.618)
Overweight	0.03	(0.355)	0.01	(0.650)	-0.03	(0.139)	0.01	(0.560)	-0.01	(0.639)	0.01	(0.685)
Obese	0.20	(0.004)	-0.09	(0.208)	-0.07	(0.089)	0.03	(0.534)	-0.03	(0.614)	0.03	(0.412)

Notes: Models control for level of education, macro-area of residence, employment history, number of siblings, migration background, and union history. Results of the full model are shown in Table A2, supplementary material.
Source: Authors' elaboration based on data from 1958 National Child Development Study (NCDS).

Achievement of the ideal family size

Table 2 presents the results of models examining the achievement of the ideal family size, as reported at age 23 by those who wanted children. Among women, those reporting fair/poor SRH at age 23 demonstrate reduced likelihood of attaining their ideal number of children at age 46, with a 7 p.p. difference compared to women reporting excellent health. Results also suggest that women reporting good or fair/poor SRH at age 23 are also more likely to underachieve the number of children declared, but AMEs have poor statistical precision and estimates are not significant. As regards the role of BMI, the magnitude of effects is especially striking among women with an obese BMI. These women are less likely to achieve their ideal family size by 13 p.p. and more likely to underachieve it by one child or by two or more children by 10 p.p. (albeit not significant) and 23 p.p. respectively, compared to women with BMI in the healthy weight range. Women with an overweight BMI also show significantly lower chances of achieving their ideal family size by 5 p.p. Against our predictions, women with an underweight BMI are less likely than women with normal BMI to underachieve their ideal family size by one child by 5 p.p.

Among men, those reporting good and fair/poor SRH at age 23 also face reduced probabilities of achieving their ideal number of children than those reporting excellent SRH, with difference of 5 and

7 p.p., respectively. Men reporting good (instead of excellent) health are also more likely to underachieve their ideal number of children by two or more children by 7 p.p.. In relation to BMI, the only significant result among men is that those who have an obese BMI at age 23 are more likely to underachieve their ideal number of children by two or more children, exceeding those with a BMI in the healthy weight range by 11 p.p. Men who have an underweight or obese BMI at age 23 are also less likely to achieve their ideal number of children by two or more children, albeit AMEs are not significant.

Table 2 Multinomial logistic models on the achievement of the ideal family size at age 46 by sex in the UK. AMEs are reported; p-values in brackets

	Women						**Men**					
Ideal family size	Ideal size achieved		Underachieved by 1		Underachieved by 2+		Ideal size achieved		Underachieved by 1		Underachieved by 2+	
SRH (ref. Excellent)												
Good	-0.03	(0.148)	0.02	(0.289)	0.01	(0.590)	-0.05	(0.002)	-0.02	(0.256)	0.07	(0.000)
Fair/Poor	-0.07	(0.068)	0.03	(0.407)	0.04	(0.343)	-0.07	(0.054)	0.03	(0.273)	0.03	(0.322)
BMI (ref. Normal)												
Underweight	0.02	(0.684)	-0.05	(0.057)	0.04	(0.285)	-0.02	(0.680)	-0.03	(0.483)	0.05	(0.442)
Overweight	-0.05	(0.097)	0.00	(0.917)	0.05	(0.155)	-0.01	(0.552)	0.02	(0.246)	0.00	(0.873)
Obese	-0.13	(0.055)	-0.10	(0.160)	0.23	(0.001)	-0.08	(0.206)	-0.03	(0.533)	0.11	(0.091)

Notes: Models control for level of education, macro-area of residence, employment history, number of siblings, migration background, and union history. Results of the full model are shown in Table A3, supplementary material.
Source: Authors' elaboration based on data from 1958 National Child Development Study (NCDS).

Potential mediation effects

While exploring mediation within the health and fertility link is beyond the scope of this paper, we conducted additional analyses and repeated the models presented in Tables 1 and 2, but excluding employment and union histories from the set of control variables (results available upon request). When excluding employment from the models, minimal changes in coefficients are observed, suggesting a potentially small mediated effect of employment in the health/fertility relationship, considering limitations of the variable based on three time points. Conversely, excluding union

history from the models resulted in significant changes: several coefficients increased and gained significance, reinforcing the idea that poorer health is strongly related–both directly and indirectly–to reduced fertility outcomes and smaller chances of achieving desired family size. This simplistic analysis does not draw causal conclusions about employment and union histories' mediating roles, as a proper mediation analysis would do. However, it suggests that the total (i.e., direct and indirect) effect of health on fertility outcomes and achieving ideal fertility size might be larger than our analyses imply, highlighting once more the importance of the health/fertility link.

Discussion and conclusion

In the context of high-income settings, limited demographic research has explored the effects of health beyond just BMI on both fertility outcomes and decision-making. Using the longitudinal data from the 1958 National Child Development Study, this study investigates the relationship between health measured in two ways during early adulthood (at age 23) and fertility outcomes at age 46 for both men and women in the UK. The study yields robust findings, revealing a significant association between health and fertility outcomes, while accounting for an extensive set of control variables.

We found that poorer self-rated health and having a BMI outside the healthy weight range in early adulthood is significantly associated with having fewer children and underachieving fertility ideals for both UK men and women. Specifically, we find that poorer self-rated health is associated with having fewer children for men, and underachieving fertility goals for men and women. For BMI, we found that men with underweight BMI were more likely to have fewer children, and men with an obese BMI were less likely to achieve their fertility goals. For women, we found that an obese BMI was associated with having fewer children and underachieving fertility goals.

Our findings suggest that BMI plays a role in determining fertility for both sexes, but it shows a stronger association for women, both in terms of effect size and statistical significance. The obtained results are notable for several reasons. First, the substantial effect sizes persist even after controlling for factors widely acknowledged as strong predictors of fertility, underscoring the enduring and

meaningful impact of early-life health on family trajectories within this cohort. For example, our result of a 20 p.p. higher likelihood of being childless at age 46 for obese women is especially prominent in light of the fact that the average share of childless women in our sample is 24.2%. Similarly, men reporting fair or poor SRH have a 7 p.p. lower likelihood of achieving ideal family size, which translates into a 20% relative change, considering that the share of men achieving ideal family size in the sample is about 37%. Furthermore, given that this analysis does not account for a likely worsening of health over the life course which could impact childbearing, these results are particularly striking. For example, a study using the same birth cohort found that those with a BMI above the healthy weight range increased over time, and that typically individuals with the highest BMI at age 23 had the highest BMI across the whole life course (Bridger Staatz et al. 2023). Both of these factors are not accounted for in our strong statistical association.

The findings in this study suggest differing effects of health on fertility for men and women: while self-rated health at 23 was strongly associated with men's fertility outcomes, BMI was a stronger predictor for women within this sample. This aligns with previous studies (Frisco and Weden 2013; Lee et al. 2023). This could suggest that BMI has a greater physiological effect on women's ability to have children than men: the epidemiological, clinical and genetic literature has extensively described the endocrinological mechanisms through which obesity increases or exacerbates infertility (Craig et al. 2017; Talmor and Dunphy 2015). However, the differences between men and women could also be explained by social factors including partnership behaviour and weight-based stigma, for example in hiring practices. Not having a stable job can also affect likelihood of having children (Alderotti et al. 2021). However, the mechanisms underlying these gender-specific results fall outside the scope of this paper, which aimed to show how different health measures are important for later outcomes. To shed light on the intricate pathways connecting health in early adulthood and fertility outcomes, potential mediators/factors could be examined in future research. For example, investigating to what extent poor health directly affects the ability to have a child or exerts its influence through other important factors, such as the capacity to establish and maintain a partnership,

which, in turn, affects the probability of having children (as we suggested earlier in the manuscript). This would include analysing partnership histories over the life course, and the interactions between socioeconomic status, BMI, self-rated health and childbearing outcomes.

While the longitudinal aspect of this work constitutes an important component of this paper, it also has limitations. In particular, due to the non-annual data collection, this analysis had to be limited to individuals who had not had children by age 23, which correspond to the first wave conducted during the cohort's adult lives. We imposed this exclusion criterion to address the endogeneity between health and fertility, as well as the known influence of parenthood on fertility desires and expectations (Iacovou and Tavares 2011). However, the introduction of this criterion introduces the possibility of selection effects in the final analytical sample, particularly in terms of their health status. Exploring the health explanatory variables among those who had a child before age 23 (1,278 women and 561 men) or were lost to follow up (1,255 women and 1,799 men), these individuals were more likely to have an overweight or obese BMI, and less likely to have a normal BMI than the remaining sample at age 23. They were also less likely to have 'excellent' health and more likely to report their health as fair or poor at 23. As those in the 'lost to follow up' group seem to have poorer health than the remaining sample, this would suggest our estimates for the effect of health on fertility may be an underestimate. However, the finding that those who had a child before age 23 were more likely to have a high BMI may have the opposite implication. Interestingly, this finding was also found by Lee et al. (2023), who noted that women who with an obese BMI in their American sample were not delayed in their transition to first birth, and that overweight women even made a faster transition than those with a healthy weight BMI. However, overweight and obese women were still more likely than those with a healthy weight BMI to remain childless. Another limitation of the sample selection is that we lack information regarding whether individuals with poorer health had already revised their plans for having children downward prior to the age of 23. However, this would mean our findings may potentially underestimate the true effect of health on fertility outcomes.

Finally, the sample analysed comes from a unique cohort (i.e., 1958), which means the findings may not be applicable to other high-income contexts. However, it should be noted that the prevalence of obesity in early adulthood has increased in recent birth-cohorts across many high-income countries: the escalation of obesity rates has been a prominent global concern, with estimates indicating a tripling of global obesity between 1975 and 2016 (Jaacks et al. 2019), while research has consistently shown that being overweight or obese can negatively impact fecundity (Hammoud et al. 2008). Similarly, the incidence and prevalence of mental illness is also spreading among young people in recent birth cohorts (see e.g., McGorry et al. 2013), and poor mental health is well-known to negatively affect SRH (Lachytova et al. 2017). Thus, given such secular shifts in health among the young, we argue that our results shed light on an aspect – i.e., the relationship between health in young adulthood and fertility–which will likely become more and more relevant in the subsequent generations, and that is relatively unlikely to be affected by external validity issues related to the single-cohort composition of our working sample.

To conclude, this analysis constitutes a significant and pioneering contribution to the demographic literature by establishing a novel linkage between health on two dimensions in early adulthood and subsequent fertility outcomes over the life course for both men and women. By elucidating the influential role of early life health in shaping fertility trajectories, this study emphasised the importance of understanding and appropriately accounting for early adulthood health as a potential determinant of future family size and fertility goals in demographic analysis. The gender-specific differences detected underscore the intricate interplay between health and fertility outcomes, advocating for a holistic approach when investigating the factors that influence individuals' reproductive decisions in both women and men. This study's unique longitudinal perspective adds valuable insights to the existing body of knowledge, paving the way for further exploration of the complex mechanisms connecting health and fertility dynamics, and encouraging those analysing fertility in high income contexts to play greater attention to the role of health.

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Supplementary material

Table A1 Sample characteristics and distribution of the outcomes by sex in the UK

	Women	Men
Self-rated health (SRH)		
Excellent	44.76	49.29
Good	48.35	44.01
Fair	6.43	6.13
Poor	0.46	0.57
BMI		
Underweight	6.54	2.53
Normal	82.67	79.33
Overweight	8.92	16.20
Obese	1.87	1.94
Level of education		
Degree	15.06	14.66
"A" level and equivalent	27.28	36.11
"O" level and equivalent	42.10	32.99
No qualification	15.56	16.24
Macro-area of residence		
North England	39.86	41.55
South England	46.36	45.15
Wales	4.40	4.39
Scotland	9.09	8.69
Unknown	0.28	0.22
Employment history		
Not employed in all waves	1.81	1.17
Employed in at least one waves	20.50	17.25
Employed in all waves	77.69	81.58
Mean number of siblings (S. D.)	1.58 (0.03)	1.65 (0.03)
Migration background		
Both parents were born in the UK	92.86	91.75
At least one parent was born abroad	7.14	8.25
Union history		
Cohabiting or married in all waves	41.46	25.82
Cohabiting or married in 2/3 waves	39.75	52.73
Cohabiting or married in only one wave	18.79	21.45
Outcomes		
Number of children at age 46		
0	24.19	31.47
1	16.55	14.82
2	43.09	37.28
3+	16.16	16.43
Realisation of intentions at age 23 by age 46		
Ideal size achieved	37.37	36.90
Underachieved by 1	20.71	17.28
Underachieved by 2+	41.92	45.81
Number of observations (N)	2,815	3,165

Notes: Percentages should be read in columns.
Source: Authors' elaboration based on based on data from 1958 National Child Development Study (NCDS).

Table A2 Multinomial logistic models on the number of children at 46 by sex in the UK. AMEs are reported; p-values in brackets

	Women								Men							
Number of children	0		1		2		3+		0		1		2		3+	
SRH (ref. Excellent)																
Good	0.01	(0.390)	-0.01	(0.416)	0.02	(0.271)	-0.02	(0.099)	0.05	(0.001)	0.00	(0.850)	-0.04	(0.020)	-0.01	(0.431)
Fair/Poor	0.03	(0.286)	0.03	(0.317)	-0.05	(0.231)	-0.02	(0.487)	0.07	(0.027)	0.00	(0.982)	-0.03	(0.381)	-0.04	(0.177)
Level of education (ref. Degree)																
"A" level and equivalent	-0.01	(0.643)	0.07	(0.001)	-0.04	(0.193)	-0.02	(0.476)	0.00	(0.976)	0.04	(0.010)	0.00	(0.989)	-0.04	(0.040)
"O" level and equivalent	-0.03	(0.158)	0.09	(0.000)	-0.01	(0.798)	-0.05	(0.040)	0.05	(0.023)	0.06	(0.001)	-0.02	(0.484)	-0.09	(0.000)
No qualification	-0.01	(0.646)	0.11	(0.000)	-0.03	(0.318)	-0.07	(0.009)	0.03	(0.240)	0.08	(0.001)	-0.02	(0.535)	-0.09	(0.000)
Macro-area of residence (ref. North England)																
South England	-0.02	(0.357)	-0.03	(0.074)	0.00	(0.909)	0.04	(0.003)	-0.01	(0.344)	-0.04	(0.003)	0.01	(0.686)	0.05	(0.001)
Wales	-0.03	(0.498)	0.06	(0.107)	-0.06	(0.201)	0.02	(0.569)	-0.02	(0.567)	0.00	(0.988)	0.00	(0.940)	0.02	(0.497)
Scotland	-0.01	(0.780)	0.03	(0.365)	-0.02	(0.508)	0.01	(0.826)	0.00	(0.928)	0.01	(0.635)	0.03	(0.259)	-0.05	(0.013)
Unknown	-0.12	(0.303)	0.07	(0.638)	-0.04	(0.795)	0.10	(0.511)	0.20	(0.250)	-0.01	(0.939)	-0.05	(0.794)	-0.15	(0.000)
Employment history (ref. Employed in at least one wave)																
Not employed in all waves	0.04	(0.462)	-0.06	(0.168)	-0.16	(0.012)	0.19	(0.011)	0.12	(0.192)	-0.04	(0.611)	-0.14	(0.120)	0.06	(0.575)
Employed in all waves	0.03	(0.074)	-0.03	(0.060)	0.04	(0.123)	-0.03	(0.058)	-0.04	(0.039)	-0.02	(0.352)	0.06	(0.010)	0.00	(0.955)
Number of siblings	0.00	(0.827)	-0.01	(0.039)	0.00	(0.633)	0.01	(0.002)	-0.01	(0.053)	0.00	(0.294)	0.00	(0.396)	0.01	(0.020)
Migration background (ref. Both parents were born in the UK)																
At least one parent was born abroad	-0.05	(0.099)	0.07	(0.024)	-0.04	(0.273)	0.01	(0.625)	-0.03	(0.286)	0.00	(0.940)	0.00	(0.949)	0.02	(0.337)
Union history (ref. Cohabiting or married in all waves)																
Cohabiting or married in 2/3 waves	0.09	(0.000)	0.02	(0.141)	-0.07	(0.002)	-0.05	(0.003)	0.02	(0.153)	0.04	(0.020)	-0.04	(0.045)	-0.02	(0.327)
Cohabiting or married in only one wave	0.38	(0.000)	0.03	(0.106)	-0.30	(0.000)	-0.11	(0.000)	0.59	(0.000)	-0.06	(0.000)	-0.36	(0.000)	-0.18	(0.000)
BMI (ref. Normal)																
Underweight	0.05	(0.100)	-0.071	(0.003)	-0.01	(0.820)	0.03	(0.367)	0.05	(0.351)	0.02	(0.714)	-0.04	(0.481)	-0.02	(0.618)
Overweight	0.03	(0.355)	0.00	(0.810)	0.01	(0.650)	-0.03	(0.139)	0.01	(0.560)	0.00	(0.627)	-0.01	(0.639)	0.01	(0.685)
Obese	0.20	(0.004)	-0.04	(0.448)	-0.09	(0.208)	-0.07	(0.089)	0.03	(0.534)	-0.05	(0.216)	-0.03	(0.614)	0.03	(0.412)
Level of education (ref. Degree)																
"A" level and equivalent	-0.01	(0.712)	0.06	(0.001)	-0.04	(0.182)	-0.01	(0.581)	0.00	(0.907)	0.05	(0.007)	-0.03	(0.909)	-0.05	(0.038)
"O" level and equivalent	-0.03	(0.175)	0.08	(0.000)	-0.01	(0.754)	-0.04	(0.062)	0.06	(0.013)	0.06	(0.001)	-0.02	(0.371)	-0.09	(0.000)

No qualification	-0.01	(0.634)	0.11	(0.000)	-0.04	(0.286)	-0.06	(0.014)	0.03	(0.258)	0.08	(0.001)	-0.02	(0.543)	-0.09	(0.000)
Macro-area of residence (ref. North England)																
South England	-0.01	(0.438)	-0.03	(0.054)	0.00	(0.932)	0.04	(0.004)	-0.02	(0.289)	-0.04	(0.001)	0.01	(0.565)	0.05	(0.001)
Wales	-0.03	(0.398)	0.08	(0.067)	-0.07	(0.147)	0.02	(0.506)	-0.01	(0.678)	0.00	(0.929)	0.00	(0.923)	0.02	(0.516)
Scotland	-0.01	(0.700)	0.03	(0.351)	-0.02	(0.498)	0.01	(0.739)	0.00	(0.895)	0.02	(0.567)	0.04	(0.194)	-0.05	(0.010)
Unknown	-0.14	(0.453)	0.07	(0.652)	-0.04	(0.799)	0.12	(0.453)	0.21	(0.228)	-0.01	(0.923)	-0.05	(0.759)	-0.15	(0.000)
Employment history (ref. Employed in at least one wave)																
Not employed in all waves	0.01	(0.837)	-0.06	(0.253)	-0.16	(0.020)	0.20	(0.007)	0.14	(0.148)	-0.04	(0.616)	-0.15	(0.096)	0.05	(0.622)
Employed in all waves	0.03	(0.088)	-0.04	(0.042)	0.04	(0.085)	-0.03	(0.060)	-0.04	(0.042)	-0.02	(0.349)	0.06	(0.013)	0.00	(0.987)
Number of siblings	0.00	(0.868)	-0.01	(0.047)	0.00	(0.580)	0.01	(0.002)	-0.01	(0.079)	0.00	(0.323)	0.00	(0.356)	0.01	(0.023)
Migration background (ref. Both parents were born in the UK)																
At least one parent was born abroad	-0.04	(0.138)	0.08	(0.019)	-0.05	(0.191)	0.01	(0.624)	-0.03	(0.248)	0.01	(0.740)	0.00	(0.992)	0.02	(0.384)
Union history (ref. Cohabiting or married in all waves)																
Cohabiting or married in 2/3 waves	0.09	(0.000)	0.02	(0.134)	-0.07	(0.002)	-0.05	(0.003)	0.02	(0.164)	0.04	(0.015)	-0.04	(0.038)	-0.02	(0.350)
Cohabiting or married in only one wave	0.37	(0.000)	0.03	(0.103)	-0.30	(0.000)	-0.10	(0.000)	0.59	(0.000)	-0.06	(0.001)	-0.36	(0.000)	-0.18	(0.000)

Source: Authors' elaboration based on data from 1958 National Child Development Study (NCDS).

Table A3 Multinomial logistic models on the achievement of the ideal family size at age 46 by sex in the UK. AMEs are reported; p-values in brackets

	Women						Men					
Ideal family size	Ideal size achieved		Underachieved by 1		Underachieved by 2+		Ideal size achieved		Underachieved by 1		Underachieved by 2+	
SRH (ref. Excellent)												
Good	-0.03	(0.148)	0.02	(0.289)	0.01	(0.590)	-0.05	(0.002)	-0.02	(0.256)	0.07	(0.000)
Fair/Poor	-0.07	(0.068)	0.03	(0.407)	0.04	(0.343)	-0.07	(0.054)	0.03	(0.273)	0.03	(0.322)
Level of education (ref. Degree)												
"A" level and equivalent	0.03	(0.278)	-0.03	(0.289)	-0.01	(0.847)	0.03	(0.312)	0.03	(0.187)	-0.05	(0.041)
"O" level and equivalent	0.03	(0.310)	0.03	(0.215)	-0.06	(0.041)	-0.02	(0.361)	0.03	(0.100)	-0.01	(0.697)
No qualification	0.03	(0.360)	0.04	(0.216)	-0.07	(0.048)	0.00	(0.977)	0.04	(0.134)	-0.04	(0.238)
Macro-area of residence (ref. North England)												
South England	0.01	(0.531)	0.00	(0.871)	-0.01	(0.629)	0.02	(0.337)	-0.02	(0.131)	0.00	(0.785)
Wales	-0.05	(0.207)	0.01	(0.729)	0.04	(0.372)	0.03	(0.414)	-0.03	(0.357)	0.00	(0.917)
Scotland	0.02	(0.556)	-0.01	(0.764)	-0.01	(0.737)	-0.08	(0.009)	0.01	(0.636)	0.06	(0.038)
Unknown	0.01	(0.936)	-0.21	(0.000)	0.20	(0.234)	-0.05	(0.755)	0.12	(0.502)	-0.06	(0.713)
Employment history (ref. Employed in at least one wave)												
Not employed in all waves	-0.05	(0.454)	-0.02	(0.736)	0.07	(0.322)	-0.08	(0.416)	-0.06	(0.349)	0.14	(0.167)
Employed in all waves	-0.01	(0.543)	0.04	(0.045)	-0.02	(0.307)	0.06	(0.011)	0.03	(0.114)	-0.08	(0.000)
Number of siblings	-0.01	(0.237)	0.01	(0.302)	0.00	(0.745)	-0.01	(0.134)	0.01	(0.188)	0.00	(0.637)
Migration background (ref. Both parents were born in the UK)												
At least one parent was born abroad	-0.04	(0.216)	-0.01	(0.670)	0.06	(0.120)	-0.04	(0.169)	0.05	(0.049)	-0.01	(0.695)
Union history (ref. Cohabiting or married in all waves)												
Cohabiting or married in 2/3 waves	-0.13	(0.000)	0.01	(0.693)	0.13	(0.000)	-0.06	(0.004)	0.01	(0.653)	0.05	(0.009)
Cohabiting or married in only one wave	-0.29	(0.000)	-0.06	(0.004)	0.35	(0.000)	-0.38	(0.000)	-0.11	(0.000)	0.49	(0.000)
BMI (ref. Normal)												
Underweight	0.02	(0.684)	-0.05	(0.057)	0.04	(0.285)	-0.02	(0.680)	-0.03	(0.483)	0.05	(0.442)
Overweight	-0.05	(0.097)	0.00	(0.917)	0.05	(0.155)	-0.01	(0.552)	0.02	(0.246)	0.00	(0.873)
Obese	-0.13	(0.055)	-0.10	(0.160)	0.23	(0.001)	-0.08	(0.206)	-0.03	(0.533)	0.11	(0.091)
Level of education (ref. Degree)												

"A" level and equivalent	0.03	(0.232)	-0.03	(0.223)	-0.01	(0.859)	0.02	(0.379)	0.02	(0.260)	-0.05	(0.076)
"O" level and equivalent	0.03	(0.280)	0.03	(0.228)	-0.06	(0.038)	-0.03	(0.273)	0.03	(0.142)	0.00	(0.941)
No qualification	0.03	(0.369)	0.04	(0.186)	-0.07	(0.041)	0.00	(0.979)	0.03	(0.225)	-0.03	(0.341)
Macro-area of residence (ref. North England)												
South England	0.01	(0.652)	0.00	(0.803)	0.00	(0.814)	0.01	(0.292)	-0.02	(0.123)	0.00	(0.842)
Wales	-0.06	(0.209)	0.02	(0.600)	0.03	(0.462)	0.04	(0.412)	-0.03	(0.398)	-0.01	(0.865)
Scotland	0.03	(0.463)	-0.01	(0.705)	-0.01	(0.674)	-0.07	(0.015)	0.01	(0.578)	0.06	(0.064)
Unknown	0.04	(0.836)	-0.21	(0.000)	0.18	(0.302)	-0.06	(0.729)	0.11	(0.525)	-0.05	(0.778)
Employment history (ref. Employed in at least one wave)												
Not employed in all waves	-0.04	(0.565)	0.00	(0.942)	0.05	(0.529)	-0.09	(0.343)	-0.06	(0.342)	0.15	(0.130)
Employed in all waves	-0.01	(0.587)	0.03	(0.083)	-0.02	(0.380)	0.06	(0.012)	0.02	(0.189)	-0.08	(0.001)
Number of siblings	-0.01	(0.195)	0.01	(0.282)	0.00	(0.682)	-0.01	(0.095)	0.01	(0.183)	0.00	(0.524)
Migration background (ref. Both parents were born in the UK)												
At least one parent was born abroad	-0.04	(0.207)	-0.01	(0.653)	0.06	(0.111)	-0.04	(0.244)	0.05	(0.054)	-0.02	(0.571)
Union history (ref. Cohabiting or married in all waves)												
Cohabiting or married in 2/3 waves	-0.13	(0.000)	0.01	(0.676)	0.13	(0.000)	-0.06	(0.003)	0.01	(0.470)	0.05	(0.012)
Cohabiting or married in only one wave	-0.29	(0.000)	-0.06	(0.004)	0.34	(0.000)	-0.39	(0.000)	-0.10	(0.000)	0.49	(0.000)

Source: Authors' elaboration based on data from 1958 National Child Development Study (NCDS).