How are children of older mothers doing?: evidence from the U.K.

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Abstract

Childbearing has been increasingly delayed in Western countries. As older mothers are likely to be advantaged, the demographic literature has tended to view this demographic trend as potentially beneficial for child well-being. Conversely, less attention has been given to medical studies showing that giving birth at advanced ages is associated with health risks for children. This paper uses data from the Millennium Cohort Study (U.K.), OLS and logistic regression models to compare cognitive and behavioural outcomes, and obesity at age 5 for first born children by maternal age at first birth. On one side, the findings suggest that giving birth to the first child at ages 30-39, compared to ages 23-29, is positively associated with children's cognitive and behavioural outcomes and not associated with obesity. On the other, delaying first births to ages 40 and above is not associated with children's cognitive and behavioural outcomes and is associated with increased risk of obesity. Although the results are unable to support the argument that this occurs because of the health risks associated with giving birth at advanced maternal ages, they suggest that there is need to more closely investigate the potential trade-offs involved when births are delayed towards older maternal ages.

Introduction

Over the past few decades, important changes have occurred in the timing of demographic behaviours in developed countries (Mills et al. 2011). Across Europe, the mean age at first birth has increased significantly since the 1980s (Sobotka 2004). For example, in the U.K., the mean age at first birth has increased from 24.5 in 1980 to 28.1 in 2012 (ONS 2013). To the extent that older first-time mothers have, on average, relatively advantageous socio-economic profiles and might be better prepared to take on the responsibilities of parenthood (Powell, Steelman, and Carini 2006), the demographic literature has tended to view the rising mean age at first birth as potentially beneficial for children's well-being, such as for their cognitive and social development (Martin 2004, McLanahan 2004). Conversely, the demographic literature has given less attention to the medical literature's argument that childbearing at ages 35 and above may involve health complications for both mother and children during pregnancy and at the time of birth (Bewley, Davies, and Braude 2005). The arguments and evidence presented by the demographic and medical literatures indicate that an increasing maternal age at birth might reflect a social process of resources accumulation and increased maturity as well as a health process due to the increased medical risks associated with giving birth at advanced ages. These perspectives have rarely been considered and discussed together (one exception is the study by Stein and Susser (2000) which briefly discusses the issue), which is unfortunate because both the social and health components of maternal age are relevant for child well-being.[i] In particular, when births are delayed towards advanced ages, the trade-off between the social and health components of maternal might sharpen such that the health disadvantages may dominate the social advantages and an

increase in maternal age at first birth may no longer be positively associated with child well-being.

As first births are being increasingly often delayed towards older ages in developed countries, it is important to more closely investigate the consequences of this demographic trend for the well-being of children. This paper contributes to this aim in two ways. First, it assesses if at age 5 children of older mothers (i.e. 30 and above) have better cognitive and behavioural outcomes and lower risk of obesity than children of younger mothers and whether this association is curvilinear i.e. positive up to a certain age and then levels off or becomes negative when mothers give birth at advanced maternal ages (i.e. 35 or 40 and over). Second, in order to contribute to investigate the potential social vs. health trade-off involved when births are delayed to older ages, the paper aims to unpack the differential that is (possibly) revealed in the unadjusted analyses and to explain it by investigating what is the influence of health, socio-economic and demographic factors. The study is situated in the U.K. context and uses data from the Millennium Cohort Study.

Background

The literature documents that older mothers, in a contemporary developed context like the U.K., tend to have advantageous socio-economic status and beneficial health behaviours. On one side this might occur because mothers who delay childbearing have selected characteristics: they tend to be highly educated, employed in professional occupations (Bray, Gunnell, and Davey Smith 2006, Hawkes, Joshi, and Ward 2004) and with more marked earning trajectories (Hofferth 1984, Martin 2004); they also tend to seek prenatal care earlier and they have healthier life styles

(Aldous and Edmonson 1993, Lampinen, Vehvilainen-Julkunen, and Kankkunen 2009, Tough et al. 2002, Fertig 2010). On the other side, delaying the transition to parenthood to older ages may also influence mothers' socio-economic status. Older mothers may have higher income because an increasing age at first birth might enable them to accumulate resources. Miller (2011), for example, shows that postponing motherhood by one year at the age of 21-34 is associated with a 9 per cent increase in earnings.

Demographers, by building on the evidence that older mothers are likely to be socio-economically advantaged and more mature, have implicitly tended to see an older maternal age at first birth as, potentially, positively associated with children's cognitive and socio-emotional well-being (Mare and Tzeng 1989, Powell, Steelman, and Carini 2006, Martin 2004). For example, Mclanahan (2004 p.209) states that "an increase in maternal age is seen as an increase in parental resources", which are positively associated with parenting quality and with children's cognitive and social development. Sobotka (in the demographic section in Schmidt et al. 2012) argues that "..delayed parenthood..has some positive consequences and implications. It is associated with a more stable family environment, higher socio-economic position, higher income and better living conditions, as well as better parenting practices" (p. 35). These arguments mostly build on evidence revealing that older mothers are likely to have advantageous socio-economic profiles; conversely, less attention has been given to inspect the association between an increasing maternal age at birth and child well-being and/or to discuss existing evidence analysing this link.

The association between an older maternal age at birth and child well-being is not a topic that has been neglected in the general social science literature. Different studies have analysed the association between parental age and children's well-being

in developed contexts. Many of these studies reveal that, on average, children of older mothers tend to have better cognitive and behavioural outcomes compared to children of younger mothers (Berryman and Windridge 2000, Fergusson and Woodward 1999, Hawkes and Joshi 2012, Pollock 1996, Sutcliffe et al. 2012). There is also - albeit not extensive - evidence that parental age is positively associated with children's educational attainment (Mare and Tzeng 1989, Kalmijn and Kraaykamp 2005, Pollock 1996). While a smaller fraction of studies question the positive association between increasing maternal age and child/young adult cognitive and psychological well-being (Saha et al. 2009, Weiser et al. 2008), they rely on less contemporary data, where childbearing at older ages predominantly occurred at high parity births in less advantaged families.

The message revealed by this body of the literature is that, on average, an older age at birth is positively associated with children's cognitive and behavioural (and educational) outcomes. However, the extent to which the findings of these studies can be used to support the argument that the current trend of first births postponement is potentially positively associated with child well-being is limited, in particular, for two reasons. First, the majority of these studies analyse the association between childbearing at older ages and children's cognitive and behavioural outcomes by looking at all parity births (e.g. Sutcliffe et al. 2012), but older mothers giving birth to first vs. higher order births are likely to be demographically distinct groups because of the different selection processes involved. Second, and perhaps more importantly, the existing literature has tended to analyse children of mothers who give birth at ages 30 and above as a single group (e.g Hawkes and Joshi, 2012[ii]). This choice has usually been justified by the fact that in the data used by these studies the number of (first)

births occurring after age 30 was too small to analyse mothers who gave birth, for example, after age 30, 35 and 40 separately.

Treating mothers (and their children) who give birth at ages 30 and above as a unique and homogenous group might be problematic. Indeed, part of the medical literature has expressed concerns towards childbearing at advanced maternal ages by claiming that the optimal age for childbearing, in terms of medical outcomes, remains the range 20-35 (Bewley, Davies, and Braude 2005). Evidence shows that with rising maternal age at birth, in particular from age 35 onwards, the risks of antepartum, intra-partum and post-partum complications increase (Aldous and Edmonson 1993, Lampinen, Vehvilainen-Julkunen, and Kankkunen 2009). An advanced maternal age at first birth might negatively affect children's well-being not only in the short term (because of the health risks) but also in the longer term. For example, being born low birth weight and preterm may affect children's development (Reichman 2005), and health outcomes later in life (Hack, Klein, and Taylor 1995). However, it is now an empirical question the extent to which the evidence presented by the medical literature applies to contemporary mothers who delay their first births as some of the studies are based on data which is now 25-30 years old (Carolan and Frankowska 2011). Moreover, contemporary older mothers' selected characteristics might compensate for the initial health disadvantage and their children may not necessarily experience worse (health and social) outcomes later in life (Stein and Susser 2000). In addition, some of the negative consequences of older childbearing may be potentially remediable if women have access to modern obstetric care, which is more likely to occur when they are socio-economically advantaged. Those consequences that are not remediable, like Down's syndrome, have over time become more easily identifiable (Cunningham and Leveno 1995) due to prenatal screening and to the fact that older

mothers utilize prenatal care earlier (Menacker et al. 2004). Indeed, there are grounds to expect that, on average, mothers who today give birth to their first child at advanced maternal ages are at lower risk of adverse health outcomes than twenty years ago (Myrskylä and Fenelon 2012). However, this argument cannot be generalized to births to mothers aged 40 and above, which are still of concern in terms of maternal and child well-being (Carolan and Frankowska 2011, Heffner 2004). Moreover, we have limited and non-conclusive evidence on the longer-term (i.e. after birth and over the life course) association between advanced maternal age and children's health (Savage et al. 2013, Sutcliffe et al. 2012).[iii]

Study contribution

It is challenging to reconcile existing findings and use them to inform about the well-being of children of mothers who nowadays delay first births to older ages. The social scientific literature has analysed the association between an older maternal age at first birth and different markers of children's outcomes, but has often not differentiated by parity and mothers who give birth at ages 30 and above. The medical literature has focused on the health risks associated with giving birth at advanced maternal ages, which might be attenuated and (more than) compensated given the selected profiles of contemporary older mothers and advances in modern obstetric care. We also have limited knowledge about the health of children of older mothers after birth and across childhood. Given the potential social vs. health trade-off involved, analysing the association between an older maternal age at first birth and child well-being in a contemporary context would benefit if both literatures and perspectives, which so far have been developed relatively independently, were

considered. In order to contribute to combine these perspectives, the aim of this paper is to document actual differences in children's cognitive and behavioural outcomes, and obesity based on maternal age at first birth and to assess whether the association might be curvilinear; then, health, socio-economic and demographic factors are considered in order to reveal whether and to what extent the unadjusted maternal age/child well-being association reflects health (as indicated by the medical literature) and social processes (as indicated by the demographic literature).

The focus of this study is on the increasing tendency to delay first births towards older ages. Therefore, the analyses focus on first order births and exclude higher order ones. The selection processes around higher order births at advanced maternal age ages as well as the interaction between the social and health components of maternal age are likely to differ between first and subsequent parities[iv]; although theoretically and empirically relevant, analysing and understanding these differences falls outside the scope of this paper. The geographical focus of this study is the U.K. primarily because it possesses a unique dataset, the Millennium Cohort Study, which enables the consequences of childbearing postponement for child well-being to be analysed in a contemporary setting. The second reason is that in the U.K. birth rates of women aged 35 and over have increased by more than 70 per cent over the period 1990-2010 (ONS 2011) such that first births at older maternal ages may be sufficiently common to be analysed.

Data & Method

The Millennium Cohort Study

The study uses data from the Millennium Cohort Study (MCS), a national cohort study tracking over 18,000 births which occurred in the U.K. around the year 2000, making the survey appropriate to study the association between an older maternal age at first birth and child well-being in a contemporary developed context. Sweeps were collected at intervals of roughly two years (ages 9 months and 3, 5, 7 and 11 years). Some wards were sampled to over-represent areas of high child poverty, areas characterised by concentration of ethnic minorities and the three smaller countries of the UK - Scotland, Wales and Northern Ireland. For this reason, weights are used in the analyses. The analyses focus on those cohort babies for whom the mother is the main interviewee (98% of cases) in order to have a complete record of the mother's characteristics and health behaviours during pregnancy. The analyses focus on first births which correspond to around 40 per cent of the MCS sample. The analyses are based on Sweep 3, which was collected when children were around 5 years old.[v]

Child outcomes

The association between maternal age at first birth and child well-being is investigated looking at three outcome variables, which are markers of children's cognitive and behavioural outcomes, and health. These markers are well placed to capture different dimensions of child well-being which are relevant both for their well-being at age 5, but which are also likely to be associated with well-being later in

life. The child's cognitive development is measured using the British Ability Scale (BAS) Naming Vocabulary (Second Edition) which tests the spoken vocabulary of the child (Hill 2005), is a validated tool to assess children's cognitive development in the British population and is associated with later educational attainment (Feinstein 2003). The child's behavioural and socio-emotional well-being is measured using a summary score obtained from the Strengths and Difficulties Questionnaire (SDQ)[vi] (Goodman and Goodman 2009), a highly validated tool to screen psychiatric disorders for 3-16 years old. Evidence shows that children with a higher SDQ score have greater psychopathology both at the time of the test and later in life (Goodman 2001). For ease of exposition, throughout the paper children's BAS naming vocabulary scores are referred to as "cognitive scores" and the SDQ scores as "behavioural scores". Both are analysed according to standard deviation units and the variables have been rescaled in a way that a higher score corresponds to a better outcome. Finally, children's health is measured looking at obesity, a binary indicator, which is obtained by applying the International Obesity Task Force (IOTF) thresholds for BMI, which are age and sex specific (Cole et al. 2000). Child obesity is an important indicator of current and future health. Obese children are at higher risk of obesity throughout their lives (Guo and Chumlea 1999) a condition that it is associated with higher risks of negative health, economic and social outcomes both in childhood and adulthood (Reilly et al. 2003).

Health, socio-economic and demographic variables

The main variable of interest, mother's age at first birth, is categorized as follows: 14-22, 23-29, 30-34, 35-39 and 40 and over. Differently from previous

studies first births to mothers aged 30 and above are divided into the three groups in a way to reveal whether the association between an older maternal age at first birth and child well-being might be curvilinear. The models include controls for the child's gender, as the developmental process and adiposity level of girls may differ from that of boys (Burman, Bitan, and Booth 2008, Hawkins et al. 2009). Models also control for whether the child is a twin as giving birth at an older age is associated with increased probability of multiple births, which might lead to complications at birth (Corsello and Piro 2010).[vii]

After investigating the unadjusted association between maternal age and the three markers of child well-being, health, socio-economic and demographic factors are considered in order to reveal whether and to what extent the unadjusted maternal age/child well-being association might reflect health and social processes. The analyses investigate the role of child health on the association between child well-being and maternal age at first birth by including, in the regression models, child health variables that the medical literature documents to be a function of maternal age at birth (Tough et al. 2002) and which are also likely to be associated with children's cognitive and behavioural outcomes: whether the child is born low birth weight (LBW) and preterm (Dalton and Bennett 2000, Hack, Klein, and Taylor 1995). The models for obesity only include preterm since evidence suggests a clear and positive association between being born preterm and child obesity (Mathai et al. 2013), but it is less clear for what concerns the association between being born LBW and obesity.

In order to investigate the extent to which the unadjusted coefficients reflect the social process that the demographic literature documents to be associated with an older age at first birth, the regression models include a set of variables that are expected to be associated with the timing of first birth as well as with child outcomes.

In terms of socio-economic/demographic characteristics, models include controls for mothers' education, family structure and for net annual household income at the time of birth of the child. Education is grouped according to ISCED levels (no education, ISCED 1/2, ISCED 3 and ISCED 4/5)[viii] and income at the time of birth is divided into low (less than £10,400), medium (above £10,400 and below £31,200) and high (above £31,200). Family structure at birth categorizes mothers as being married, cohabiting (with the biological father of the cohort child) or not living with a partner (separated, divorced, closely involved with the partner, just friends or not in any relationship). The models control for income at birth rather than at age 5 because it is expected that the former better reflects the (relatively advantaged/disadvantaged) environment in which the child has grown up. Models include controls for family structure at birth rather than age 5 in order to avoid issues of reverse causality as poorer child outcomes could be conducive to relationship problems among parents.[ix] In terms of health behaviours, models control for mothers' smoking behaviours during pregnancy, the number of months after birth the mother has breastfed (never, less than 2 months, between 2 and 4 and more than 4 month) and for whether the pregnancy was intended. Finally, models also control for parenting styles, namely the frequency with which the mother reads to and plays with the child (several times a week, sometimes or rarely).

Method

The first part of the analyses presents descriptive statistics of mothers' characteristics and three markers of child well-being by maternal age at first birth.

OLS regression models are used to analyse cognitive and behavioural outcomes and logistic models to analyse obesity.

Results & Discussion

Table 1 and 2 present descriptive statistics of the dependent and control variables. Results are presented by mother's age at first birth and for the overall sample. While a relatively large number of first births occur to mothers aged 30-34 (n=1278) and 35-39 (n=445) respectively, a much smaller number (n=53) occurs to mothers aged 40 and above such that the results for the oldest age group need to be interpreted cautiously.

Table 1 shows that the child outcomes analysed vary across maternal age categories. The cognitive score (i.e. BAS naming vocabulary score) increases and then decreases with maternal age at first birth, showing the highest score in the age group 30-34. The behavioural score (i.e. SDQ score) shows a similar pattern, but it is the age group 35-39 showing the highest score. The prevalence of obesity is similar for all age groups, while it is considerably higher (14.5 per cent) for children of mothers aged 40 and above.

Table 2 shows that the prevalence of LBW and preterm tends to increase with maternal age, but the age gradient is not as marked as the one observed for the cognitive and behavioural scores. In terms of socio-economic/demographic characteristics, older mothers tend to have relatively advantageous profiles. Mothers having first births at ages 30 and over are the most likely to hold high qualification levels, to be married and cohabiting at the time of birth and to have high levels of household income.

Older mothers also tend to have better health behaviours compared to younger mothers. Older first time mothers are the group with the lowest propensity to smoke and with the highest proportion of women breastfeeding for a period longer than 4 months. Older mothers are by far the group showing the highest rates of intended pregnancies. In terms of parenting styles, differences by mother's age at first birth appear to be less marked compared to the other variables. Nonetheless, mothers giving birth between ages 30-39 are the most likely to be reading "a lot" to the child and the least likely to be reading "rarely" and mothers having first births at ages 40 and above are considerably more likely to be playing "rarely" to the child compared to younger age groups. A possible interpretation could be that first-time mothers aged 40 and over have less energy than younger mothers and may therefore be less likely to engage into recreational activities (Bray et al., 2006).

Table 1 and 2

Model (1) in Table 3, 4 and 5 shows the unadjusted association between maternal age at first birth and child outcomes, the aim of which is to reveal whether an older maternal age at first birth is positively associated with child well-being but also whether the association is curvilinear. Subsequent models aim to show whether and to what extent the unadjusted association reflects health and social processes, which is done by comparing the magnitude and significance of the age coefficients before and after the progressive inclusion of the control variables in the regression models.

Model (1) in Table 3 reveals that giving birth to the first child at ages 30-34 and 35-39, as opposed to ages 23-29 years (the reference group), is positively and significantly associated with children's cognitive scores at age 5.[x] Conversely, giving

birth to the first child at ages 40 and above is negatively (but not significantly) associated with children's cognitive scores and doing so at ages 22 and below is negatively and significantly (at the 1 per cent level) associated with children's cognitive scores.[xi] A similar pattern is observed when looking at Table 4 as giving birth to the first child between ages 30-39, as opposed to ages 23-29, is positively and significantly (at the 1 per cent level) associated with behavioural scores at age 5. The 40 and over coefficient is positive but not significant and the 22 and below is negative and significant (at the 1 per cent level).[xii] The magnitude of the unadjusted disparities in cognitive and behavioural outcomes by maternal age at first birth is not negligible. Existing evidence suggests that an increase/decrease of about 0.2 of a standard deviation – which is close to the magnitude of the cognitive score coefficients for mothers aged 30 to 39 – in cognitive scores and IQ is relevant for longer term education and well-being (Iacovou and Sevilla 2013, Myrskylä et al. 2013, Feinstein 2003). For the SDQ score there is no evidence of threshold effects at either low or high values and previous studies (Goodman and Goodman 2009) suggests that the odds of disorders increase constantly across the range; in other words, the results suggest that first born children of mothers aged 30-39 experience significantly lower chances of developing, with age, mental health disorders than children of younger mothers.

Finally, Model (1) in Table 5 reveals that children of mothers 40 and over experience significantly higher odds of being obese. However, as the confidence intervals are considerably large, results need to be interpreted with caution as the parameter is not precisely estimated. In summary, the unadjusted analyses suggest the presence of a curvilinear association between an older maternal age at first birth and the considered markers of child well-being. This is also supported by the fact that

when the 35-39 group is set as the reference category, children of mothers aged 40 and above at first birth are significantly worse in terms of cognitive and behavioural outcomes.

Model (2) in Table 3 and 4 adds controls for child health at the time of birth (LBW and preterm[xiii]) the aim of which is to inspect whether these health markers mediate the association between maternal age at first birth and child well-being at age 5. If they were mediators, in the models for the cognitive/behavioural scores, I would expect the unadjusted coefficients associated with having the first birth at older ages to either increase in magnitude if the unadjusted coefficient is positive (i.e. further away from the reference category), or become smaller if it is negative (i.e. closer to the reference category). In the case of obesity, I would expect the increased odds of obesity for children of mothers aged 40 and above to attenuate. For all the three considered outcomes, the results fail to support a mediating role of these health markers, which is in line with the descriptive findings showing a very mild age gradient in LBW and preterm. Hence, whilst the unadjusted analyses reveal that there seems to be a trade-off involved when delaying first births to advanced maternal ages, the results do not support the argument that this is due to negative health outcomes associated with giving birth at an advanced age. This could occur because older mothers compensate for the underlying health risks through better lifestyle and nutrition. Alternatively, it could be that the mediation process needs to be investigated looking at other health markers and/or family processes, something discussed in the conclusion section of the paper.

In order to inspect whether and to what extent the age coefficients reflect social processes, the models progressively control for mothers' socio-demographic characteristics. In both Table 3 and 4, the positive association between children's

cognitive and behavioural scores associated with mothers giving birth at ages 30-39 decrease both in magnitude and significance level. The largest changes are observed when the models include controls for socio-economic variables in Models (3). After adjustment for socio-economic variables, the 40+ coefficients for the cognitive score becomes smaller and significant at the 5 per cent level, whilst the one for the behavioural score becomes negative but fails to reach statistical significance. Model (4) in both tables shows that controlling for mothers' health behaviours during pregnancy/close to the time of birth and parenting behaviours produces similar but smaller changes in the age coefficients. When all the control variables are included in Table 3 and 4, differences in cognitive scores between children of mothers giving birth to their first child in the reference groups and at ages 30-34 are reduced, at 35-39 are eliminated and at ages 40+ increased (significantly). Conversely, differences in behavioural scores between children of mothers in the reference group with those aged 30-39 are reduced and differences with those aged 40+ are increased but not significantly. Table 5 shows that progressively controlling for mothers' characteristics increases the odds of obesity for children born to mothers aged 35-39, which become larger and significant at the 10 per cent level, and for children of mothers aged 40 and above. Differently from the cognitive and behavioural outcomes, health behaviours seem to play as much as an important role as socio-economic variables. To conclude, the socio-demographic characteristics and health behaviours of older mothers appear to play an important role in attenuating the (positive or lack of negative) association between giving birth at an older maternal age and children's cognitive and behavioural well-being. These characteristics also appear to be protective against the risk of child obesity.

Although the main focus of the analyses is to document the association between an older age at first birth and child well-being, it is nonetheless of interest to mention the results for the younger maternal ages. In line with existing evidence (Hobcraft and Kiernan 2001, Hoffman, Foster, and Furstenberg 1993), the results show that children of younger mothers have significantly lower cognitive and behavioural scores than children of older mothers (no difference is reported for child obesity); such difference is largely attenuated when the models include adjustment for mothers' socio-economic characteristics.

Table 3 & 4 & 5 about here

Conclusion

Over the past decades there has been a considerable postponement of first births to older childbearing ages, but we still hold quite limited knowledge about its consequences for the well-being of children. The demographic literature (McLanahan 2004, Martin 2004b) has tended to view this process as potentially beneficial for children given that older mothers are likely to have advantageous socio-demographic profiles. In contrast, the medical literature (Bewley, Davies, and Braude 2005) documents that childbearing at advanced ages involves increased health risks for mother and children. This study uses contemporary, high-quality data to analyse the (possibly curvilinear) association between an older maternal age at first birth and child well-being and whether and to what extent it might reflect health and social processes.

The results suggest that giving birth to the first child at an older age is, on average, positively associated with children's cognitive and behavioural scores and not significantly associated with obesity at age 5. The results reveal that this is largely explained by the selected characteristics of mothers who have children at ages 30 and above. But although the descriptive analyses show that mothers giving birth at ages 40+ have similar characteristics to mothers aged 30-39, their children do not experience significantly different levels of cognitive and behavioural outcomes and are at higher risk of obesity compared to children born to mothers in the reference category (aged 25-29). The unadjusted analyses suggest the presence of a curvilinear association between an older age at first birth and the considered markers of child well-being, which is also supported by the fact that when the 35-39 group is set as the reference category, children of mothers who are 40+ at first birth have significantly worse cognitive and behavioural outcomes. However, the analyses haven't been able to reveal that this curvilinear association should be attributed to the increased health risks associated with giving birth at advanced maternal ages. One interpretation could be that the characteristics of older mothers and access to modern obstetric care could compensate for the health risks. It is also important to highlight that only live births were included in the MCS sampling design and, therefore, the analyses do not consider other negative outcomes which the medical literature has found to be associated with increasing maternal age such as increased risk of stillbirths, miscarriages, decreased fecundity and genetic malformations (Bewley, Davies, and Braude 2005). Another interpretation is that the analyses have only considered LBW and preterm as indicators of child health and looking at others (such as very low birth weight[xiv]) might reveal different findings. Ultimately, there could be other social mechanisms involved. For example, having a first child at older ages might reflect

difficulties in finding an appropriate partner to form a family with and it might indicate relationship problems (which could, in turn, be linked with child well-being). But despite the fact that the analyses haven't been able to reveal why the association between an older maternal age at birth and the considered markers of child well-being is curvilinear, the overarching message remains that understanding the consequences of delaying first births towards older ages would benefit by integrating different perspectives on (advanced) maternal age and its interrelated biosocial processes.

This study has a number of limitations. The subsample of mothers having a first birth at ages 40 and above is small (n=53), which means that the parameters haven't been precisely measured. Moreover, the findings of this study apply to a specific geographical context. In a context where older mothers are not markedly more advantaged than younger mothers as in the U.K., the consequences of an older age at first birth for child well-being might result to be different from those revealed in this study. Future research should contribute to address these limitations by using different data sources in order to enlarge the sample of mothers giving birth at older ages, look at a larger set of health outcomes (at the time of birth) and different geographical contexts. Finally, the results focus on first order births and therefore are not generalizable to higher order ones; understanding whether and why the association between maternal age and child well-being might differ by parity clearly constitutes an interesting venue for future research. Despite these limitations, this study contributes to the existing literature by revealing how first born children of older mothers are doing in terms of cognitive and behavioural outcomes, and obesity, compared to children of younger mothers; the study also suggests that more research should be conducted to investigate the biosocial interactions and trade-offs that might be potentially involved when births are delayed towards older ages.

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Table 1 Descriptive table of child outcomes by maternal age at first birth

	Maternal age					
Outcomes	<23	23-29	30-34	35-39	40+	Average
BAS Vocabulary (z-scores)	-0.13	0.34	0.53	0.51	0.04	0.27
	(0.03)	(0.03)	(0.03)	(0.05)	(0.20)	(0.02)
SDQ (z-scores)	-0.29	0.09	0.23	0.31	0.00	0.04
	(0.04)	(0.02)	(0.03)	(0.05)	(0.15)	(0.02)
Obesity (%)	5.13	4.36	4.17	5.52	14.51	4.72
% of Births	29.52	36.69	24.31	8.46	1.01	100
Number of births	1,552	1,929	1,278	445	53	5,257

The results are weighted in order to account for the complex survey design

Table 2 Descriptive table of maternal and children's characteristics by maternal age at first birth

	Maternal age					
	<23	23-29	30-34	35-39	40+	Average
Child's characteristics	%	%	%	%	%	%
Twin	0.4	1.6	2.2	2.6	3.3	1.5
Girl	48.3	49.6	48.7	49.3	53.9	49.0
Child health						
Low birth weight	7.6	8.1	7.7	8.1	9.0	7.9
Preterm	8.0	8.7	8.8	7.4	9.4	8.4
Education						
None	17.8	3.8	2.3	2.7	5.9	7.2
Isced 1-2	54.5	32.7	26.9	21.1	21.0	36.1
Isced 3	20.9	21.2	14.5	16.2	19.0	19.0
Isced 4-5	6.8	42.3	56.3	60.0	54.1	37.8
Partnership						
Married	12.4	59.2	74.8	69.9	64.5	51.3
Cohabiting	42.5	31.0	20.1	22.7	24.3	30.6
Single	45.1	9.8	5.1	7.4	11.2	18.1
Income						
High	2.2	24.0	45.6	51.3	58.5	26.2
Medium	38.3	63.5	47.9	42.8	29.8	50.5
Low	59.5	12.5	6.4	5.9	11.7	23.3
Smoke during pregnancy	45.3	15.8	11.5	11.3	8.5	22.4
Breastfeeding						
Never	47.2	20.7	12.9	11.0	7.6	25.0
0-2 months	34.6	38.5	30.4	29.5	21.6	34.4
2-4 months	8.2	14.4	20.6	18.0	28.4	14.7
4 months or more	10.0	26.4	36.2	41.5	42.4	25.9
Unplanned pregnancy	78.8	34.4	21.8	23.7	29.9	42.4
Read to the child						
Several times a week	81.5	88.5	92.0	94.5	87.7	88.0
Sometimes	14.1	9.1	6.2	4.8	9.6	9.3
Rarely	4.4	2.4	1.9	0.8	2.7	2.7
Play with the child						
Several times a week	62.4	62.3	64.7	61.6	58.7	62.8
Sometimes	26.7	28.5	27.6	29.6	19.4	27.8
Rarely	10.9	9.2	7.7	8.7	21.9	9.4

The results are weighted in order to account for the complex survey design

Table 3 OLS regression results for BAS Naming Vocabulary test (z-scores)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	β/se	**β/se**	**β/se**	**β/se**	**β/se**
Below age 23 (*ref 23-29*)	-0.467***	-0.467***	-0.182***	-0.184***	-0.187***
	(0.036)	(0.036)	(0.042)	(0.043)	(0.043)
Age 30-34	0.199***	0.198***	0.112***	0.103***	0.102***
	(0.041)	(0.041)	(0.038)	(0.038)	(0.038)
Age 35-39	0.174***	0.175***	0.066	0.054	0.051
	(0.053)	(0.053)	(0.051)	(0.051)	(0.050)
Age 40+	-0.292	-0.292	-0.373**	-0.385**	-0.357**
	(0.191)	(0.195)	(0.166)	(0.162)	(0.151)
Twin	-0.215**	-0.151	-0.162*	-0.143	-0.137
	(0.100)	(0.110)	(0.098)	(0.098)	(0.098)
Girl	0.047	0.052	0.046	0.048	0.048
	(0.032)	(0.033)	(0.031)	(0.030)	(0.030)
Preterm		0.111*			
		(0.058)			
Low birth weight		-0.198***			
		(0.071)			
Education: none (*ref Isced 1/2*)			-0.371***	-0.373***	-0.350***
			(0.068)	(0.068)	(0.069)
Education: Isced 3			0.089**	0.086**	0.082**
			(0.037)	(0.037)	(0.037)
Education: Isced 4/5			0.282***	0.267***	0.260***
			(0.036)	(0.035)	(0.035)
Partnership at birth: single (*ref married*)			0.057	0.047	0.053
			(0.061)	(0.063)	(0.062)
Partnership at birth: cohabiting			-0.026	-0.031	-0.027
			(0.041)	(0.043)	(0.043)
Income high (*ref income medium*)			0.151***	0.149***	0.147***
			(0.040)	(0.040)	(0.040)
Income low			-0.248***	-0.260***	-0.261***
			(0.051)	(0.052)	(0.050)
Smoke during pregnancy (*ref not smoke)*				0.095**	0.107***
				(0.038)	(0.039)
Pregnancy planned (*ref unplanned*)				0.006	0.007
				(0.039)	(0.039)
Breastfeeding: 0-2 months (*ref never*)				-0.005	-0.003
				(0.039)	(0.038)
Breastfeeding: 2-4 months (*ref 0-2 months*)				0.024	0.024
				(0.047)	(0.047)
Breastfeeding: 4 months or more				0.106***	0.104***
				(0.040)	(0.039)

Reading to the child: some (*ref a lot*)					-0.024
					(0.049)
Reading to the child: little					-0.221**
					(0.103)
Playing with the child: some (*ref a lot*)					-0.003
					(0.028)
Playing with the child: little					-0.195***
					(0.056)
Constant	0.318***	0.321***	0.191***	0.153***	0.178***
	(0.032)	(0.032)	(0.042)	(0.058)	(0.062)
Number of observations			5257		

note: *** p<0.01, ** p<0.05, * p<0.1

Table 4 OLS regression results for the SDQ test (z-scores)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	β/se	**β/se**	**β/se**	**β/se**	**β/se**
Below age 23 (*ref 23-29*)	-0.386***	-0.386***	-0.091*	-0.060	-0.063
	(0.045)	(0.045)	(0.050)	(0.050)	(0.049)
Age 30-34	0.139***	0.138***	0.061*	0.051	0.046
	(0.040)	(0.040)	(0.035)	(0.036)	(0.036)
Age 35-39	0.218***	0.217***	0.125**	0.113**	0.105**
	(0.053)	(0.053)	(0.050)	(0.051)	(0.051)
Age 40+	-0.097	-0.097	-0.160	-0.186	-0.155
	(0.149)	(0.152)	(0.138)	(0.136)	(0.126)
Twin	-0.096	-0.002	-0.057	-0.050	-0.034
	(0.112)	(0.114)	(0.114)	(0.113)	(0.109)
Girl	0.198***	0.203***	0.199***	0.196***	0.196***
	(0.032)	(0.032)	(0.030)	(0.030)	(0.030)
Preterm		0.052			
		(0.065)			
Low birth weight		-0.199***			
		(0.064)			
Education: none (*ref Isced 1/2*)			-0.391***	-0.385***	-0.348***
			(0.076)	(0.075)	(0.074)
Education: Isced 3			0.166***	0.144***	0.137***
			(0.039)	(0.039)	(0.039)
Education: Isced 4/5			0.259***	0.224***	0.212***
			(0.036)	(0.038)	(0.038)
Partnership at birth: single (*ref married*)			-0.136**	-0.080	-0.073
			(0.065)	(0.068)	(0.066)
Partnership at birth: cohabiting			-0.057	-0.018	-0.013
			(0.038)	(0.039)	(0.038)
Income high (*ref income medium*)			0.120***	0.110***	0.107***
			(0.036)	(0.036)	(0.035)
Income low			-0.143**	-0.118**	-0.114**
			(0.059)	(0.059)	(0.058)
Smoke during pregnancy (*ref not smoke)*				-0.174***	-0.155***
				(0.045)	(0.045)
Pregnancy planned (*ref unplanned*)				0.048	0.047
				(0.035)	(0.034)
Breastfeeding: 0-2 months (*ref never*)				-0.037	-0.036
				(0.039)	(0.039)
Breastfeeding: 2-4 months (*ref 0-2 months*)				0.033	0.028
				(0.050)	(0.050)
Breastfeeding: 4 months or more				0.054	0.043
				(0.044)	(0.044)

Reading to the child: some (*ref a lot*)					-0.157***
					(0.055)
Reading to the child: little					-0.439***
					(0.116)
Playing with the child: some (*ref a lot*)					-0.037
					(0.031)
Playing with the child: little					-0.214***
					(0.059)
Constant	-0.003	0.004	-0.114***	-0.120**	-0.062
	(0.030)	(0.031)	(0.038)	(0.055)	(0.056)
Number of observations			5257		

note: *** p<0.01, ** p<0.05, * p<0.1

Table 5 Logistic regression results for obesity

	(1)	(2)	(3)	(4)	(5)
	OR/se	**OR/se**	**OR/se**	**OR/se**	**OR/se**
Below age 23 (*ref 23-29*)	1.177	1.177	0.704	0.623**	0.624**
	(0.223)	(0.223)	(0.152)	(0.137)	(0.139)
Age 30-34	0.956	0.956	1.090	1.153	1.154
	(0.182)	(0.182)	(0.211)	(0.223)	(0.223)
Age 35-39	1.286	1.285	1.469	1.584*	1.589*
	(0.354)	(0.355)	(0.393)	(0.424)	(0.429)
Age 40+	3.751**	3.751**	4.075**	4.658**	4.646**
	(2.517)	(2.518)	(2.534)	(2.988)	(2.919)
Twin	0.569	0.579	0.534	0.492	0.494
	(0.386)	(0.404)	(0.350)	(0.322)	(0.323)
Girl	0.984	0.984	0.986	0.990	0.991
	(0.136)	(0.135)	(0.135)	(0.135)	(0.136)
Preterm		0.967			
		(0.258)			
Education: none (*ref Isced 1/2*)			1.385	1.354	1.345
			(0.373)	(0.369)	(0.366)
Education: Isced 3			0.938	1.022	1.023
			(0.194)	(0.216)	(0.217)
Education: Isced 4/5			0.680*	0.802	0.804
			(0.148)	(0.187)	(0.188)
Partnership at birth: single (*ref married*)			1.893**	1.497	1.496
			(0.478)	(0.404)	(0.402)
Partnership at birth: cohabiting			1.028	0.875	0.874
			(0.190)	(0.171)	(0.171)
Income high (*ref income medium*)			0.899	0.941	0.940
			(0.176)	(0.189)	(0.190)
Income low			1.131	1.066	1.062
			(0.214)	(0.206)	(0.207)
Smoke during pregnancy (*ref not smoke)*				1.326	1.321
				(0.237)	(0.235)
Pregnancy planned (*ref unplanned*)				0.733*	0.733*
				(0.135)	(0.135)
Breastfeeding: 0-2 months (*ref never*)				0.966	0.966
				(0.169)	(0.168)
Breastfeeding: 2-4 months (*ref 0-2 months*)				0.779	0.779
				(0.178)	(0.178)
Breastfeeding: 4 months or more				0.555**	0.556**
				(0.138)	(0.138)
Reading to the child: some (*ref a lot*)					1.012
					(0.274)

Reading to the child: little					1.131
					(0.567)
Playing with the child: some (*ref a lot*)					0.985
					(0.170)
Playing with the child: little					0.994
					(0.281)
Constant	0.046***	0.046***	0.049***	0.066***	0.066***
	(0.006)	(0.006)	(0.010)	(0.018)	(0.018)
Number of observations			5257		

note: *** p<0.01, ** p<0.05, * p<0.1

Endnotes

[i] Child well-being, when used in general terms throughout the paper, refers to different dimensions of well-being that are associated with development in childhood as well as well-being later in life. These dimensions of well-being would most likely reflect cognitive, socio-emotional and health outcomes.

[ii] The authors, using the MCS, analyse the association between maternal age and children's cognitive and behavioural outcomes. The older age group combines mothers who gave birth at ages 30 and above since the aim of the paper is to establish whether there is an inherent disadvantage to having a young mother. The focus is therefore on young maternal ages at first birth rather than older ones like the present study.

[iii] Using contemporary data, Savage et al. (2013) show that children of mothers who gave birth at ages 30-35 and above were at lower risk of obesity than children of younger mothers, but the sample was small (n=277), whilst Sutcliffe et al. (2012), using data from the MCS, show that children of mothers aged 33 and over were more likely to be overweight. In both studies, first births and mothers aged 40 and over were not analysed separately. Myrskylä and Fenelon (2012) show that children of mothers aged 35 and over have worse health in adulthood than children of younger mothers. Their analyses are based on cohorts born in the 1950s where the selection into childbearing at older maternal ages was different from the one that we observe in contemporary developed contexts.

[iv] For example, having a second or third order birth at an older age does not necessarily reflect the same level of resource accumulation than it does whilst having a first order birth at an older age. The health processes might also differ when looking at higher order births to the extent that the health of the mother might deteriorate after she has a first/higher order birth.

[v] The analyses have been replicated while looking at similar outcomes measured when the cohort children are aged 3 and 7. The results are qualitatively similar to those presented in the paper.

[vi] The SDQ consists of the main respondent's report of 25 items grouped into 5 categories which measure the child's conduct problems, hyperactivity, emotional symptoms and pro-social behaviour.

[vii] In families with twin cohort children, only one child (i.e. the first one reported in the data) per family has been included in the analyses.

[viii] This categorization is based on a derived variable in the dataset which groups respondents according to National Vocational Qualifications (NVQ), which includes both academic and vocational qualifications. To ease interpretation of these categories for a non-U.K. audience, the categories are coded based on the international ISCED qualification levels.

[ix] As a robustness check, models have also been estimated controlling for income and family structure at age 5 and the results are essentially unchanged.

[x] Controlling for whether other languages are spoken at home (in addition to English) does not change the results substantively.

[xi] In line with the descriptive analyses, the 35-39 age coefficient is smaller than the 30-34 one, but the difference between the two coefficients is small and not significant

[xii] In line with the descriptive analyses, in Table 4 the 35-39 coefficient is larger than the 30-34 one but the difference is not significant.

[xiii] The two variables are significantly correlated ($p<0.000$), but controlling for them separately doesn't change the results.

[xiv] It is not possible to look at very low birth weight as an indicator of child health. Its prevalence is too low and the small sample of mothers giving birth in the oldest age groups make the analyses unfeasible.