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Age at First Birth and Long-Term Health in Life Course Perspective: Contextualizing the Health Effects of Fertility Timing

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NON-TECHNICAL SUMMARY

The transition to parenthood is a key moment in a person's development. Children often represent a key source of meaning and stability in parents' lives. The joy of parenthood, however, comes hand in hand with a great many demands on parents' financial, emotional, and temporal resources. It is therefore important that prospective parents are prepared for their new role – a first birth which comes at a time when parents lack the necessary resources to cope can create stress, financial hardship, and impact on subsequent educational and labour market attainment.

This study contributes to understanding the link between age at first birth and subsequent parental health in later life by contextualizing this relationship in terms of the parents' broader socio-economic, partnership, and parenting circumstances. Using the Household, Income and Labour Dynamics in Australia Survey, we analyse the relationship between age at first birth and general physical health and number of chronic diseases.

Consistent with previous research, our results show that older age at first birth is related to significantly better general physical health and fewer chronic diseases for both men and women. However, we also find that the magnitude of this relationship is reduced for more advantaged persons, suggesting that new parents who are more generally 'advantaged' are able to deploy their resources to better juggle the demands of parenthood with the competing priorities of work, partnership, and their health, mitigating the worst health consequences of a poorly timed first birth.

We also show that the strength of the relationship between age at first birth and physical health depends on marital history in a gender-specific fashion. Relationships between age at first birth and general health/chronic disease were notably stronger among women who either never married or were unmarried at the time of the first birth. This likely reflects the importance of husbands' resources and assistance for new mothers' ability to manage competing demands in the family and labour market over a period of their life course when mothering demands may significantly limit their ability to generate resources independently.

Our research emphasizes the need for researchers to address relationships between life course trajectories and health in a more integrated and holistic fashion which incorporates the dynamic relationships between multiple social domains (partnership, fertility, work, etc.) and the way in which statuses in these domains may alter the meaning and consequences of other statuses.

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Abstract

We contribute to understanding the link between age at first birth (AFB) and subsequent parental health in later life by contextualizing this relationship in terms of the parents' broader socio-economic, partnership, and parenting circumstances. Using the Household, Income and Labor Dynamics in Australia (HILDA) survey, we analyse the relationship between AFB and general physical health (N = 5,802 women/4,743 men) and number of chronic diseases (N = 4,438 women/3,519 men). Consistent with previous research, our results show that older AFB is related to significantly better general physical health and fewer chronic diseases for both men and women. However, we also find that a) the magnitude of this relationship is reduced for more advantaged persons, and b) the strength of the relationship between AFB and physical health depends on marital history in a gender-specific fashion. Implications for life course and fundamental cause theories, and for further research, are discussed.

Keywords: age at first birth; health; fertility; socio-economic resources; life course

Introduction

The transition to parenthood is a key moment in a person's development. Children often represent a key source of meaning and stability in parents' lives, and despite increases in the frequency of childlessness, large majorities still have (or if childless, indicate a desire for) children. The joy of parenthood, however, comes hand in hand with a great many demands on parents' financial, emotional, and temporal resources, which are particularly pronounced when children are young. It is therefore important that prospective parents are prepared for their new role – a first birth which comes at a time when parents lack the necessary resources to cope can create stress, financial hardship, and impact on subsequent educational and labour market attainment. In turn, these flow on effects of a poorly timed birth can translate to poorer parental health later in life (Mirowsky 2002; Pudrovska and Carr 2009; Spence and Eberstein 2009).

Empirical support for the importance of first birth timing comes from a large number of studies which find that older age at first birth (henceforth AFB) is associated with better health outcomes and lower mortality for both fathers and mothers[1] (Grundy 2009; Grundy and Kravdal 2008; Grundy and Tomassini 2005; Hardy et al. 2009; Henretta 2007; Mirowsky 2002, 2005; Pudrovska and Carr 2009; Spence and Eberstein 2009). The common rationale for this finding is as Mirowsky (2005: 32) puts it, that "better health and survival come from delaying as long as possible […] in order to lengthen education, establish an employment history and stable marriage, and build household income and wealth". In short, early parenthood places demands on time and resources which the parents often lack the resources to cope with.

While this explanation provides a credible explanation for why earlier AFB is on average associated with poorer health outcomes, it also suggests that the relationship may depend on the broader circumstances in which the birth and subsequent parenting occur. New parents who regardless of their age, possess sufficient resources to manage the additional demands in tandem with competing roles and responsibilities may experience few health consequences. One the other hand for those who lack the resources to cope, or whose wellbeing depends upon heavy commitments to competing social roles, a poorly timed first birth may be especially consequential. However, there has thus far been little research directed at investigating this possibility. This paper contributes to this gap in the literature by documenting the relationship between AFB and later life physical health outcomes in

Australia, and seeking to understand how this relationship may depend on broader socio-economic and family factors in the parent's life.

Age at first birth and health in life course perspective

The widespread associations between AFB and many health outcomes suggest the potential for AFB to be viewed as a 'fundamental cause' of health inequality (Link and Phelan 1995; Lutfey and Freese 2005; Phelan, Link and Tehranifar 2010). In Link and Phelan's (1995) original formulation, social (dis)advantage may be viewed as a 'fundamental cause' of health inequality because it is comprised of flexible resources which allow agents to respond to the health context they are located in. This distinguishes social conditions (as fundamental causes) from more proximal biological causes (such as diet, lead exposure, or sun exposure) in that the fundamental causes are linked to *many* aspects of health and the associations between fundamental cause and health persist across different contexts even though the specific biological mechanisms may change.

Lutfey and Freese (2005) expand on this to suggest that relationships of fundamental causality between *X* and *Y* describe situations where the cause *X* is 'multiply realized' (comprised of interrelated but distinct parts), the outcome *Y* is 'multiply realizable' (the same outcome state can be achieved through multiple pathways), and the relationship is 'holographic' (each component part of *X* is associated in the same way with each component part of *Y*). To illustrate, on the one hand '(dis)advantage' may be thought of as a composite of education, income, social support, familial class, neighbourhood characteristics and so on. 'Health' on the other can reflect the condition of the individual's circulatory system, musculoskeletal system, pain, ability to function physically in day-to-day tasks, and hazard of mortality. Each of the component parts of (dis)advantage are likely to be related to each of the components of health. The fundamental cause perspective therefore generalizes the focus of analysis in two important ways: away from the particular aetiological pathways thought to produce a given health condition towards general health, and away from particular components of advantage (such as education, income, or social support) towards the degree to which agents are *generally* (dis)advantaged (and thereby in a position to exert control over their health through whatever means are relevant to their particular circumstances).

Empirically then, there seems to be a good *prima facie* case to view AFB as one (*X*-side) component of a fundamental cause relationship between (dis)advantage and health. However,

from a conceptual perspective this conclusion is less clear – in particular it is difficult to suggest that AFB *per se* represents a 'resource' which might be flexibly deployed in the pursuit of health by those who have acquired more of it. Rather, it seems more accurate to claim that the first-birth transition imposes a set of demands on the new parent, and that the way in which this impacts on subsequent health-related behaviour and status attainment depends on the age at which the transition occurs. To understand why this may be the case, it is helpful to turn to life course (Elder 1985; Elder and Giele 2009) and cumulative advantage (CA) (DiPrete and Eirich 2006; O'Rand 2002) theories.

An individual's life course may be viewed as an unfolding series of parallel role and resource trajectories (Elder 1985; Elder and Giele 2009; Macmillan and Copher 2005). At any point in time, a person occupies multiple roles (collectively that person's 'role configuration' in Macmillan and Copher's (2005) terminology) and has command over a variety of personal and material resources. A dynamic balance exists between a person's role configuration and their resource set: the behavioural demands associated with the various roles require the application of resources, but equally successful role performance presents one of the primary channels through which resources are created and distributed. Parenthood in this context stands out from other prominent adult roles (notably labour market and partnership roles) in that at least in the short term the associated behavioural demands are likely to outweigh the resources which can be acquired through performance of the role.

The balance between role-performance demands (*D*) and resources (*R*) provides one of the primary rationales for the importance of *timing* (Elder and Giele 2009). In the most basic sense, timing refers to the age at which an event or role-transition takes place, but timing may also be conceived of in a broader sense as relative to the achievement of other relevant milestones or capabilities in an individual's life course trajectory. With regard to a first birth and the (in most cases) accompanying transition to parenthood, particular importance may attach to the new parent's broader socio-economic and partnership circumstances as the principal avenues of access to the resources necessary to handle the new demands of parenthood (Umberson, Pudrovska and Reczek 2010). Viewed from the perspective of a cumulative advantage process, large *D* relative to *R* may restrict the individual's capacity to meet role-performance demands and consequently lead to poorer future *R* (DiPrete and Eirich 2006). Because *R* will tend to increase through the potential childbearing age range as individuals develop their labour market position, acquire housing, and solidify their social ties, it seems likely that the association between AFB and health will be mediated by the

parent's level of subsequent (dis)advantage and family situation. However, since *R* is also partially independent of AFB it is also plausible to suggest that (dis)advantage and family situation may also *modify* the strength of the relationship between AFB and health. Take for example two potential new parents of the same age with resource sets R_1 and R_2, where $R_2 > R_1$. In this circumstance, the same set of new demands arising from a first birth impose a *proportionally* larger demand on the resource set R_1, and consequently may produce a larger impact on the new parent's subsequent status attainment and health. Alternatively, in this situation R_1 may elect to focus their resources on status attainment behaviours at the cost of health-promoting behaviours, while R_2 is capable of arranging their affairs to pursue both.

Although there is only very limited empirical evidence which examines statistical interactions between AFB and the parent's broader circumstances in determining long-term health outcomes (the sole case which we are aware of is Spence (2008), who documents a significantly stronger link between an early first birth and later disability for white than black women in the United States), a considerable body of literature documents that the experience of parenting is dependent on socio-economic and relationship context in ways which may be consequential for long term health. Single parents (in particular mothers) have been found to experience more distress, reduced self-efficacy, and greater stress across a range of life domains (Avison, Ali and Walters 2007; Evenson and Simon 2005; Nomaguchi and Milkie 2003), and women who perceived greater levels of their support from their partners were less likely to experience increased depressive symptomology on entering parenthood (Simpson et al. 2003; Smith and Howard 2008). Low-income families have similarly been found to experience greater levels of work-family conflict (Crouter and Booth 2004). There is consequently strong evidence that the short-term consequences of parenthood depend on the social and socio-economic resources at the parent's disposal.

It is also important to note that the family life course (and by extension the health consequences of the family life course) are strongly structured by gender; men and women typically occupy different role configurations over the life course and command different resource sets (Bianchi, Robinson and Milkie 2006; Chesters, Baxter and Western 2009). For instance, gender role ideologies dominant in mid-20th century western nations, position women as responsible for unpaid 'care' work, in particular childcare and housework, and concomitantly presuppose that women will cease labour market participation upon marriage. Men on the other hand were expected to act in the family as 'breadwinners', employed full-time with little responsibility for the home. Over the latter half of the 20th century this

division has weakened considerably (but not disappeared), with Australian women's labour force participation increasing from 34% in 1961 to 59% in 2011, a change which has been driven by women aged 25-59 (Australian Bureau of Statistics 2011). Part-time employment now represents a large share of women's employment at all ages, particularly for those aged 15-24 and 35-59. For men, overall labour force participation has decreased from 82% to 72% from 1961-2011. Part-time work has also increased for men, but is concentrated at younger and older ages, with less than 10% of men aged 25-59 working part-time. Hours spent on housework has also become more equal due to a large reduction in women's housework time (Baxter 2002), although women's housework time remains strongly tied to partnership and fertility transitions while men's is largely unresponsive (Baxter, Hewitt and Haynes 2008). These patterns suggest that family life course trajectories are likely to have different health consequences depending on sex, and this is borne out empirically in a large body of research on the short and long term health (or health related) consequences of parenthood (Umberson et al. 2010).

Research questions and hypotheses

In light of the preceding discussion, the paper investigates a number of research questions. First, we seek to establish the existence, size, and shape of the relationship between AFB and later life physical health in the Australian population. On the basis of previous research findings (e.g. (Mirowsky 2002, 2005; Pudrovska and Carr 2009; Spence and Eberstein 2009)), we propose:

H1: AFB will be positively related to health for men and women

H1a: The relationship between AFB and health will display an inverted 'U' shape

Second, cumulative advantage theory (DiPrete and Eirich 2006; O'Rand 2002) suggests that although poorly timed transitions early in life will produce 'snowball' effects of compounding advantage, persons who otherwise possess sufficient resources may be (better) able to mitigate any negative consequences. In accordance with fundamental cause theory (Link and Phelan 1995), the particular 'advantage' may not be of central importance, but

rather the overall degree to which they are advantaged across a number of social domains. On this basis:

H2: The strength of the relationship between AFB and later physical health will diminish for people who are otherwise more advantaged across other social domains, including financial situation, education, home ownership, social support, fathers' occupational status, area of residence, and ethnicity.

We also fit a series of additional models which allow us to test whether the interaction between AFB and each advantage considered separately is different from the interaction between AFB and the advantage index as a whole. These models assess hypothesis H2a:

H2a: The statistical interaction between AFB and each of the components of the advantage index in determining physical health will be the same as the interaction between AFB and the overall advantage index.

Fourth, because parenting and partnership are closely intertwined social domains (Macmillan and Copher 2005) the partnership context in which the birth and subsequent parenting occurs is likely to modify how AFB is linked to health (Carr and Springer 2010; Umberson et al. 2010). Good partnerships provide financial, emotional, and instrumental support which may allow new parents to buffer the strains of a poorly timed first birth. Consequently:

H3: The relationship between AFB and physical health will be exacerbated for persons who either (up to age 40) experience a disrupted marital history or who never marry, compared to those who experience a single uninterrupted marriage.

H4: The relationship between AFB and physical health will be stronger for persons who were unmarried at the time of their first birth.

Fifth, subsequent fertility, by placing additional childrearing demands on the parents, may limit their ability to recover from the challenges of an early first birth. This may exacerbate

the cumulative (dis)advantage process and lead to additional negative health consequences. Therefore:

H5: Respondents with more children will exhibit a stronger relationship between AFB and physical health.

Since women tend to be disproportionately responsible for childcare and consequently more reliant on their partners for financial and instrumental support when young children are present, we also propose:

H3a/H4a/H5a: Family life course statuses including marital history, marital status at time of first birth, and parity will interact more strongly with AFB for women than for men.

Data and methods

Sample

Data for the research are drawn from the Household and Labour Dynamics of Australia (HILDA) survey waves 1-13. HILDA is a multi-stage probability sample of Australian households, commencing in 2001 with annual data collection thereafter. All household members over the age of 14 complete an interview and self-complete questionnaire each year. The baseline sample consisted of 7,682 households and 13,969 adult interviewees. A top up sample of 2,153 households and 4,282 adults was added in wave 11. A full description of the sampling design, questionnaire, and interview processes is available in Watson and Wooden (2012).

For the purposes of analysis the sample is restricted in several ways. First, the sample is limited to ever-parents with a first birth from ages 16 to 35 and to person-years when the respondent is aged 41 or older. As the final wave of data was collected in 2013, respondents are born in 1973 at the latest. The data is restricted to parents as the focal variable, AFB, is undefined for non-parents. The decision to exclude respondents with first births outside the 16-35 window was taken as first births outside this range are unusual and may reflect different life course dynamics and have different consequences. Restricting the analysis to

person-years when the respondent is aged 41 or older reflects the focus on longer term health outcomes of first birth timing, which may be distinct from short term health outcomes, and also helps to ensure that there is adequate variation in the health measures under consideration.

Cases with missing values on key variables (health outcomes, AFB, the 'advantages' index, marital history, and parity) were excluded from analysis. Of a potential 79,692 person-years for the 'general health' analysis 12,311 (15.4%) were excluded for this reason, primarily (9,894) due to missing general health. For the analysis of chronic conditions, the corresponding numbers are 637 person-years discarded from a total of 13,244 (4.8%). Missing values for controls including height, number of siblings, childhood general health, whether the respondents' parents smoked, and whether the respondent ever missed a month of school due to poor health were imputed at the sex and birth cohort specific mean (11% of person-years had one or more missing values imputed in this way). This process results in analysis samples of 10,549 respondents (67,381 person-years) for the general health analysis, and 7,972 respondents (12,607 person-years) for the chronic conditions analysis.

Variables

Physical health

Summary statistics for the variables included in analysis are presented in table 1. Two aspects of physical health are analysed in this paper. The first aspect, 'general health', is measured using four subscales of the SF-36 (Ware, Kosinski and Gandek 2000), which is captured each wave in the self-complete section of HILDA (items are listed in table 2). For the purposes of the analyses presented in this paper, the four scales are combined using principal components analysis. Previous work with the SF-36 suggests a single 'physical health' component (Ware et al. 1998), and this was supported for our data. The first principal component (standardized to mean 0 and standard deviation 1 for person-years in our sample) was extracted and is used as the first dependent variable in subsequent analyses.

[Tables 1 and 2 here]

The second measure of physical health we consider is a count of the number of chronic diseases which the respondent is suffering from. In 2009 and 2013, respondents were asked: 'Looking at [show card] have you ever been told by a doctor or nurse that you have any of these conditions? Please only include current conditions that have lasted or are likely to last for six months or more' and could select 'arthritis or osteoporosis', 'asthma', 'chronic bronchitis or emphysema', 'type 2 diabetes', 'heart disease', 'high blood pressure or hypertension', and 'any other serious circulatory condition (e.g., stroke, hardening of the arteries)'. The measure ranges from 0 to 7, with a mean of 0.97. Mental illnesses were excluded in accordance with the papers' focus on physical health. Cancer was also excluded, owing to the established body of research which links later birth to a *higher* incidence of some cancers for women (Kelsey, Gammon and John 1993; Merrill et al. 2005), which is contrary to the direction of the association for most other conditions.

Family history

AFB (defined as continuous from 16-35) is the principal predictor, and is constructed retrospectively based on the respondent's children's ages (including deceased children). The mean AFB for the analysis sample is 26.9 years for men (with a standard deviation of 4.1 years) and 24.7 for women (SD = 4.4). For modelling, we center AFB at the grand mean of 25.7 years. This is done in order to improve the interpretability of the estimated coefficients in light of the quadratic relationship between AFB and the outcomes and the presence of interactions between AFB and other covariates in some models. AFB squared was also included in our models to permit the relationship to health to be curved. This decision was made on the basis of both our preliminary analyses and previous research (e.g. (Mirowsky 2002, 2005)) which has found that the relationship is non-linear.

Number of children ever had was defined categorically as '1 or 2', '3 or 4' and '5 or more'. Marital history was measured with two items. The first categorizes respondents into three groups based on their marital history up to age 40: 'single uninterrupted marriage', 'ever divorced, separated or widowed' (excluding separations which ended in reconciliation) and 'never married'. The second measure is a dummy variable which is coded 1 for respondents who were married at the time of their first birth and 0 for those who were not.

Advantage

As one of the paper's key questions concerns the potential for new parents who are more generally advantaged to 'buffer' any negative consequences of a poorly timed first birth, we elected to create an index which combines multiple aspects of 'advantage'. The index includes ten separate items:

- Equivalised household wealth (respondent average over time)
- Equivalised household income (respondent average over time)
- Respondent's highest completed educational qualification
- Respondent's occupational status (current or most recent job)
- Respondent's father's occupational status (when respondent was age 14)
- Whether the respondent owns or is paying a mortgage on their place of residence
- The Socio-Economic Index for Areas (SEIFA) score of the respondent's area of residence
- The degree of remoteness of the respondent's area of residence
- Perceived social support, and
- The respondent's ethnicity

Five of these items (wealth, income, respondent's occupational status, respondent's father's occupational status, and social support) are percentile rank rescaled to range from 0 (most disadvantaged) to 1 (most advantaged). SEIFA is in deciles (due to confidentiality concerns) and is similarly rescaled from 0 to 1. Education is scored 0 'less than complete secondary school', 0.5 'completed secondary school or non-university qualification', and 1 'bachelors' degree or higher'. Home ownership is 1 for respondents who own their home outright or are paying off a mortgage, and 0 otherwise. Remoteness is scored 0 'outer regional and remote', 0.5 'inner regional', and 1 'major city'. Ethnicity is 1 for non-Indigenous respondents born in Australia and for first generation migrants whose first language was English, and 0 for Indigenous Australians and first generation migrants whose first language was not English. Summing these items gives a total 'advantage' score which ranges from 0 to 10 with a mean of 5.7 and standard deviation of 1.7. For modeling the index is centered at the mean. Cronbach's alpha for the index was 0.67.

It is important to note that the advantage index is measured contemporaneously with the health outcomes, and not at the time of the first birth. As AFB may a) depend on; b) contribute to the development of, and; c) be modified by broader (dis)advantage, this limits our ability to disentangle the specific ordering of the pathways involved. Despite this limitation, the study design also offers significant benefits due to the general lack of studies

which investigate interactions between AFB and other parallel life course factors in determining long-term health outcomes.

Controls

We include a number of controls for other background factors, including how many siblings the respondent grew up with, self-reported height in meters, self-reported health in childhood (before age 15), parents' smoking in childhood (yes/no at any stage of childhood), and whether the respondent ever missed a month of school due to poor health in childhood. Age is included as continuous years (centered at the sample-mean) and age-squared is included to capture any curvilinearity in the relationship between age and health. Age is also interacted with AFB to allow the strength of the association between AFB and health to depend on the age of the respondent.

Analysis

The outcomes are modelled using a series of random-intercept growth models (Singer and Willett 2003) with an identity link for the general health models and a poisson link for the chronic disease models. For general health, the models are specified as:

$$y_{it} = \mu_i + \gamma_1 AFB_i + \gamma_2 AFB_i^2 + \boldsymbol{\theta X_{it}} + e_{it} \quad (1)$$

Where y_{it} is the observed value of 'general health' for respondent i at time t, μ_i is the random intercept for respondent i, AFB_i is the respondents' age at first birth (centered at the sample mean), γ_1 is the expected increment in general health associated with delaying the first birth for a year at the sample average first birth age, γ_2 is the yearly change in the slope of the relationship between AFB and health, $\boldsymbol{\theta}$ is a vector of coefficients, $\boldsymbol{X_{it}}$ is a covariate matrix for respondent i at time t (which depending on the model may include all the other covariates described above), and e_{it} is the time/respondent specific residual value. μ_i is presumed normally distributed with a mean of zero.

The chronic disease models are specified as:

$$log\ (E(y_{it})) = \mu_i\ +\ \gamma_1 AFB_i + \gamma_2 AFB_i^2 + \boldsymbol{\theta X_{it}} \quad (2)$$

Where $log\ (E(y_{it}))$ is the natural logarithm of the expected count of chronic conditions for respondent i at time t, γ_1 is the expected increment in chronic disease count associated with delaying the first birth for a year at the sample average first birth age, γ_2 is the yearly change in the slope of the relationship between AFB and chronic disease count, and $\mu_i, \boldsymbol{\theta}$ and $\boldsymbol{X_{it}}$ are the same as the corresponding parameters described above for the general health models.

All models are fitted separately by sex, and a series of models were fitted for each outcome. The first model fitted in each case includes only AFB, age, background controls (number of siblings, childhood health, parents smoking, missed school due to poor health, and height). Subsequent models add in turn interactions between AFB and 1) the 'advantage' index[2], 2) the respondents' marital history up to age 40, 3) whether the respondent was married at the time of the first birth, and 4) parity. A final model is fitted which includes the main effects for all of the aforementioned variables, as well as any interactions which have previously been found to be significant.

To test hypothesis H2a we then fit a series of models for general health in which the overall advantage index is included alongside each of its' component items in turn, and both are interacted with AFB. In each case we test whether the coefficient for the interaction between the component item and AFB is significantly different from the coefficient for the interaction between the overall advantage index and AFB. In this case, H2a will be regarded as confirmed if the interactions of the component parts with AFB are *not* significantly different from the interaction of the overall advantage index and AFB.

Results

Modelling results for men are presented in tables 3 (general physical health) and 4 (chronic diseases). Model 1a shows that men's expected general physical health increases with later AFB, and that this relationship flattens out at older ages, peaking in the early thirties. At the sample average AFB, the relationship implies a 3% of a standard deviation increase in general health for an additional year delay in the first birth. Model 1b similarly shows that older AFB is associated with fewer chronic diseases, in this case linearly. Each year older at time of first birth is associated with a decrease of 0.03 (log) chronic diseases. Results for

control variables are as expected and (with few exceptions) significant: older age, having more siblings, poor health in childhood, having parents who smoked, missing school due to poor health, and being shorter are all associated with poorer general health and more chronic disease.

[Tables 3 and 4 here]

For chronic disease, but not general health, we also find that the effect of AFB weakens significantly at older ages. Although the study design does not allow us to determine the processes that generate this phenomenon, it may variously reflect cohort variation in the effect of AFB, selective mortality prior to the study period, or later disease onset among men who experienced a later first birth. This pattern persists through subsequent models, indicating that it is not accounted for by marital history, life-time number of children, or broader (dis)advantage.

Models 2a and 2b add the advantage index and its' interaction with AFB. In both cases, more advantaged men are healthier. Each additional advantage confers an average 0.2 standard deviation increase in general health, and a 0.1 decrease in log chronic diseases. The interaction between advantage and AFB is significantly negative (-0.005, $p < 0.001$) in the general health model (indicating support for H2), but non-significant in the chronic disease model. This indicates that the relationship between AFB and general physical health outcomes is significantly stronger for disadvantaged men and weaker for advantaged men, but is independent of advantage for chronic disease. Hypothesis 2 is therefore partially supported for men.

Turning to marital history (models 3a, 3b, 4a, and 4b) our results show only very limited support for H3 and H4, and with regard to general physical health run in the opposite direction to our predictions. Men who experience a disrupted marital history and those who were not married at the time of the first birth display significantly *weaker* relationships between AFB and general physical health than those who remain continuously married, while there is no significant difference in the relationship for those who never marry. For men's general health, our results therefore show (where significant) precisely the opposite of what our hypotheses predicted. The chronic disease models show again a weaker relationship among men who go on to experience a disrupted marital history than those who remain

continuously married, and no significant interaction between AFB and whether the father was married at the time of the birth. The only support for H3 comes in the marginally significant ($p < 0.1$) negative interaction between AFB and having never married in model 3b, which indicates that for men who never marry, AFB is more strongly related to their subsequent chronic disease.

Models 5a and 5b test whether number of children is consequential for how AFB is related to men's health. Although there is evidence that having 5 or more children is linked to poorer general health for men, there are no significant interactions with AFB. H5 is therefore unsupported for men.

Finally, models 6a and 6b include all main effects for advantage, marital history, marital status at time of first birth, and number of children, in addition to any interactions which have previously been found to be significant. For general health, this includes interactions between AFB, advantage, marital history, and marital status at the time of the first birth. For chronic disease, it includes only marital history. The interactions between AFB, the advantage index, and disrupted marital history persist in the full model for general health, indicating that the relationship between AFB and general health is stronger for disadvantaged men and weaker for those who experienced a disrupted marital history to age 40. The interaction between AFB and being unmarried at the time of the first birth reported in model 4a is however no longer significant in the full model. Model 6b shows that the reduced effect of AFB on chronic disease for men who experience a disrupted marital history and the increased effect among those who never marry persist (in both cases at $p < 0.1$). H3 therefore receives only weak support for men.

Tables 5 and 6 respectively present the general health and chronic disease model results for women. The results (models 1c) indicate that general physical health increases with older AFB, at a diminishing rate, producing an 'upside-down U' shape. The parameter estimates indicate that at the mean AFB, each additional year of delay brings an expected 3% of one standard deviation increase in general physical health. This pattern is mirrored in the results for chronic disease presented in model 1d. H1 and H1a are therefore supported among women for both general health and chronic disease. In both cases, controls performed as expected and were in most cases significant. The chronic disease models for women also show that (the same as for men) the effect of AFB weakens at older ages.

[Tables 5 and 6 here]

Models 2c and 2d test H2 for women. We find in both general health and chronic disease cases that the magnitude of the relationship between AFB and health is reduced for more advantaged women and, conversely, increased for disadvantaged women. Each additional advantage reduces the slope of the general health relationship by 0.005 ($p < 0.001$), and the chronic disease relationship by 0.006 ($p < 0.01$). Advantage also has a positive effect on health in both cases independent of AFB, as expected. H2 is therefore supported for women.

Models 3c, 4c, 3d, and 4d address the relationship between marital history, AFB, and health. For both general health and chronic disease, we find that H3 is partially supported and H4 is supported. This is shown by the significant (positive for general health and negative for chronic disease) interactions between AFB and having never married, which indicates that for women who never marry (compared to those who have a single continuous marriage), the timing of their first birth is much more significant for their later health. The relationships are however, no different for women who marry and subsequently go on to experience a divorce, separation or widowhood. Model 4c/4d show further that the key relationships between AFB and subsequent general health/chronic disease are significantly stronger for women who were not married at the time of the birth (albeit only at $p < 0.1$ in the chronic disease case).

H5 supposes that the relationship between AFB and health will increase with higher numbers of children, and is addressed by model 5c (general health) and model 5d (chronic disease). Our results show no support for H5 in the case of general health. For chronic disease, model 5d shows a significant increase in the magnitude of the effect of AFB for women who had a 3-4 children compared to those who had only 1-2. The effect of AFB on chronic disease was not significantly different for women who had five or more children. There is therefore only partial support for H5 among women, and only with regard to chronic disease.

We then present our final models for women (6c, 6d) which include all previously significant interaction terms and all main effects. This includes interactions between AFB and advantage, marital history, and marital status at first birth in both cases, as well as the interaction with number of children in model 6d (chronic disease). The results for H2 are unchanged in both cases, confirming that AFB is more strongly related to health among disadvantaged women. Findings for H3 (supported with regard to women who never marry but not those who experience a disrupted marital history) become non-significant for general

health and marginally significant for chronic disease ($p < 0.1$). H4 (concerning marital status at time of first birth) is rejected with regard to chronic disease cases once other marital history and advantage factors are taken into account, but remains significant for general health.

Finally, table 7 presents the tests of H2a, that the strength of the interaction between AFB and each of the component parts of the advantage index in determining general health will be the same as the strength of the interaction between AFB and the overall advantage index. Note that as the sign of the overall interaction is negative, negative differences in table 7 indicate that the component item has a *larger* interaction with AFB, and *vice versa* for positive differences. For men, H2a is generally supported, as only the AFB by home ownership, and AFB by ethnicity, interactions are significantly distinct (at $p < .05$) from the AFB by overall advantage interaction (being significantly more positive, and therefore weaker). For women however, H2a seems clearly rejected: both wealth and income component interactions are significantly more negative (stronger) than the overall index whereas education and housing interactions are significantly more positive (weaker).

[Table 7 here]

Discussion and conclusion

Consistent with previous research (Grundy 2009; Grundy and Tomassini 2005; Hardy et al. 2009; Henretta 2007; Mirowsky 2002, 2005; Pudrovska and Carr 2009; Spence and Eberstein 2009) one contribution of our results is to show that older AFB is associated later in life with better general physical health and fewer chronic diseases in the Australian population for both men and women. These relationships are (with the exception of men's chronic disease) curvilinear, indicating that the largest potential gains to heath are to be found in the younger range of AFB. We build upon previous research however by demonstrating that the strength of the relationship between AFB and physical health depends upon the parents' broader circumstances, in particular the degree to which they are more broadly (dis)advantaged and the partnership context in which the birth and subsequent parenting occur – a subject which has largely been neglected by previous research (with the exception of (2009))). Broadly, our findings suggest that the primary importance of AFB for health may be limited to some smaller sub-sets of the population, opening the possibility of addressing AFB through targeted interventions.

With regard to general (dis)advantage, we found that for men's general health and for women's general health and chronic disease the strength of the relationship between AFB and health was increased among the most disadvantaged respondents, and correspondingly minimal (but not insignificant) among the most advantaged. Conceptually, this supports our contention that new parents who are more generally 'advantaged' are able to deploy their resources to better juggle the demands of parenthood with the competing priorities of work, partnership, and their health, mitigating the worst health consequences of a poorly timed first birth.

For men, the strength of the relationship between AFB and general physical health seemed to depend on '(dis)advantage' in a general sense, as home ownership was the only component which displayed a significantly different interaction. On the other hand for women it appears that the interaction between advantage and AFB may be primarily driven by the household wealth and income components of the index (both of which displayed much larger interactions with AFB than the index overall) whereas education and home ownership showed more positive (weaker interactions). These findings may partly reflect the admittedly crude measurement of advantage employed in the paper, as the advantage index does not attempt to weight the sub-components by their importance for individual capabilities in either health or social stratification arenas. It is however, noteworthy that the components which interact more weakly with AFB (home ownership and education for women) are those which may be thought of as less 'pure' resources in that they require the application of other resources – ongoing mortgage re-payments or employment in more demanding jobs associated with higher education – in order to reap the benefits associated with the resource. Early AFB may interfere with or complicate these demands. By contrast, income and wealth, the components which most clearly drive the interaction between advantage and AFB for women, are the most flexible and mobile resources and come without any (or minimal) demands for the individual to act in a particular way in order to benefit. This is consistent with the emphasis in fundamental cause theory (Link and Phelan 1995; Lutfey and Freese 2005) on resources as affording individuals the means to respond flexibly to diverse situations.

Partnership history was also found to alter the strength of the relationship between, and the nature of this relationship differed starkly by gender. Consistent with our predictions, the relationships between AFB and general health/chronic disease were notably stronger among women who either never married or were unmarried at the time of the first birth. This likely

reflects the importance of husbands' resources and assistance for new mothers' ability to manage competing demands in the family and labour market over a period of their life course (parenting a young child) when mothering demands may significantly limit their ability to generate resources independently. These relationships were rendered mostly non-significant in the full models which incorporated (dis)advantage alongside marital history, suggesting that the interactions between marital history and AFB may be mediated by the mother's status attainment.

The parallel results for men confirmed our hypothesis that non-standard marital histories would more strongly increase the relationship between AFB and health for women than for men, and in fact indicate that non-standard marital histories tend to *decrease* the strength of the relationship between AFB and health for men – the strongest relationships between AFB and later life health are to be found among men who experience a single uninterrupted marriage to age 40 and/or who were married at the time of the first birth. This finding may be produced by men's greater ability to 'exit' (or in the case of the interactions between AFB and disrupted marital history, the fact of their exit) from what is likely to be a difficult parenting situation, thereby avoiding the corrosive stresses and limitations associated with it – but displacing the consequences onto their erstwhile partners. Our research therefore documents a (to our knowledge) novel and complex link between gender, marital history, and fertility history in producing health outcomes.

Finally, we found some (weak) evidence that the relationship between AFB and chronic disease was increased among women with more children. This finding was partially accounted for in the full model (6d), and if confirmed by subsequent work might reflect limitations imposed by further fertility on women's ability to recover from a poorly timed first birth.

Theoretically, our research emphasizes the need for researchers to address relationships between life course trajectories and health (and arguably other outcome domains) in a more integrated and holistic fashion which incorporates the dynamic relationships between multiple social domains (partnership, fertility, work, etc.) and the way in which statuses in these domains may alter the meaning and consequences of other statuses. As Macmillan and Copher (2005) argue, the life course is an *interlocking* set of trajectories which unfold in tandem over a person's life. Studies should aim to move beyond simply estimating the 'main effects' of the various indicator variables which have been used to summarize life course trajectories.

Finally, our study had a number of limitations which should be borne in mind. As noted, the measure of (dis)advantage which we use is crude, and may consequently dilute the strength of the reported results. Future work should attempt to develop and employ measures of general 'advantage' which take better account of the measurement scales, measurement quality, and substantive significance for health and social stratification of each of the sub-components. It may also be important to consider certain aspects of advantage separately (such as education) owing to their nature as less 'pure' resources which carry strong behavioural demands in order to realize their benefits. Ideally, data would also permit us to measure 'advantage' at the time of the first birth transition as well as at the time of the later health observations. Studies which are able to employ such a design would make it possible to better disentangle the pathways which link AFB, (dis)advantage, and later life physical health.

Notes

1. Cancer risk for women is an important exception to this general rule, as the relationship with AFB has been shown to be inconsistent and depends on the site of the cancer (Merrill et al 2005).
2. We also fitted models (not shown) which substitute the main effect of the 'advantage' index for the main effects of each of the components of the index, while retaining the interaction between AFB and the overall index. Although the size of the estimated coefficients for each of the component parts of the advantage index varied considerably, our findings regarding the interaction between AFB and the advantage index as a whole were unchanged. Models in which the advantage index was included as quintiles represented by a series of dummy variables also suggested that both the main effect and interaction with AFB were approximately linear.

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Table 1: Sample summary statistics (at first observation)

	N	Range	n / mean	% / Std. dev.
General physical health	10,480	-3.1/1.3	0.1	1.0
Chronic diseases - count	7,956	0/7	0.9	1.1
Age at first birth	10,712	16/35	25.7	4.5
Advantage index	10,712	0.4/10	5.7	1.7
Marital history to age 40 %	10,712			
Single continuous marriage			7,870	73.5
Ever divorced, separated or widowed			2,335	21.8
Never married			507	4.7
Married at time of first birth	10,712			
No			1,623	15.2
Yes			9,089	84.9
Number of children %	10,712			
1-2 children			5,254	49.1
3-4 children			4,482	41.8
5+ children			976	9.1
Number of siblings	10,712	0/10	3.2	2.3
Childhood health	10,712	1/5	1.7	0.8
Missed school (0 = no, 1 = yes)	10,712	0/1	0.1	0.3
Parents smoked (0 = no, 1 = yes)	10,712	0/1	0.7	0.4
Height (meters)	10,712	1.3/2.3	1.7	0.1
Age	10,712	41/100	54.1	12.3

Table 2: SF-36 scales and items

Scale/Question stub/Item	Response options
General health	
In general, would you say your health is:	'Excellent'; 'Very good'; 'Good'; 'Fair'; 'Poor'
How TRUE or FALSE is each of the following statements for you?	
I seem to get sick a little easier than other people *I am as healthy as anybody I know* *I expect my health to get worse* *My health is excellent*	'Definitely true'; 'Mostly true'; 'Don't know'; 'Mostly false'; 'Definitely false'
Physical functioning	
The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?	
Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports *Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf* *Lifting or carrying groceries* *Climbing several flight of stairs* *Climbing one flight of stairs* *Bending, kneeling, or stooping* *Walking more than one kilometer* *Walking half a kilometer* *Walking 100 metres* *Bathing or dressing yourself*	'Yes, limited a lot'; 'Yes, limited a little'; 'No, not limited at all'
Bodily pain	
How much bodily pain have you had during the past 4 weeks?	'No bodily pain'; 'Very mild'; 'Mild'; 'Moderate'; 'Severe'; 'Very severe'
During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	'Not at all'; 'Slightly'; 'Moderately'; 'Quite a bit'; 'Extremely'
Role physical	
During the past 4 weeks, have you had any of the following problems with your work or other daily activities as a result of your physical health? Cut down the amount of time you spent on work or other activities Accomplished less than you would like Were limited in the kind of work or other activities Had difficulty performing the work or other activities (for example, it took extra effort)	'Yes'; 'No'

Table 3: Men - General physical health

	1a	2a	3a	4a	5a	6a
AFB	0.03***	0.02***	0.04***	0.03***	0.03***	0.02***
AFB^2	-0.003***	-0.001*	-0.003***	-0.002***	-0.002***	-0.001*
Advantage index		0.2***				0.2***
Advantage index * AFB		-0.005***				-0.005***
Marital history						
Single continuous marriage						
Divorced/Separated/Widowed			-0.1***			-0.04
Never married			-0.3***			-0.06
Divorced/Separated/Widowed * AFB			-0.02**			-0.02*
Never married * AFB			-0.006			-0.006
Not married at first birth				-0.2***		-0.04
Not married at first birth * AFB				-0.02*		-0.008
Number of children						
1-2 children						
3-4 children					0.03	0.03
5+ children					-0.2***	-0.06
3-4 children * AFB					-0.003	
5+ children * AFB					0.02	
Controls						
Number of siblings	-0.03***	-0.004	-0.03***	-0.03***	-0.02***	-0.004
Childhood health	-0.08***	-0.04**	-0.07***	-0.08***	-0.07***	-0.04**
Missed school	-0.2***	-0.2***	-0.2***	-0.2***	-0.2***	-0.2***
Parents smoked	-0.06#	-0.03	-0.05	-0.05#	-0.06*	-0.03
Height (meters)	0.4*	0.02	0.4*	0.4*	0.4*	0.03
Age	-0.03***	-0.03***	-0.03***	-0.03***	-0.03***	-0.03***
Age^2	-0.0007***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***
Age * AFB	-0.00002	0.00008	-0.00005	-0.00004	-0.00004	0.00002
Constant	-0.4	0.2	-0.4	-0.4	-0.4	0.2

# $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, N = 4,743 persons/30,085 person-years.

Table 4: Men - Chronic disease

	1b	2b	3b	4b	5b	6b
AFB	-0.03***	-0.02***	-0.03***	-0.03***	-0.03***	-0.02***
AFB^2	-0.0002	-0.0008	-0.00009	-0.0002	-0.0003	-0.0006
Advantage index		-0.1***				-0.1***
Advantage index * AFB		0.00007				
Marital history						
Single continuous marriage						
Divorced/Separated/Widowed			0.05			0.02
Never married			0.06			-0.04
Divorced/Separated/Widowed * AFB			0.02*			0.02#
Never married * AFB			-0.04#			-0.03#
Not married at first birth				0.03		-0.04
Not married at first birth * AFB				0.01		
Number of children						
1-2 children						
3-4 children					-0.08#	-0.09*
5+ children					-0.003	-0.08
3-4 children * AFB					0.005	
5+ children * AFB					-0.004	
Controls						
Number of siblings	0.02**	0.009	0.02**	0.02**	0.02**	0.01
Childhood health	0.02	-0.003	0.02	0.02	0.02	-0.004
Missed school	0.2**	0.2**	0.2**	0.2**	0.2**	0.2**
Parents smoked	0.1**	0.1**	0.1**	0.1**	0.1**	0.1**
Height (meters)	-0.6*	-0.2	-0.6*	-0.6*	-0.6*	-0.2
Age	0.05***	0.05***	0.05***	0.05***	0.05***	0.05***
Age^2	-0.0009***	-0.001***	-0.0009***	-0.0009***	-0.0009***	-0.001***
Age * AFB	0.0010*	0.0009*	0.0010*	0.001**	0.001*	0.0009*
Constant	0.7	0.1	0.7	0.7	0.7	0.2

# $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, N = 3,519 persons/5,567 person-years

Table 5: Women - General physical health

	1c	2c	3c	4c	5c	6c
AFB	0.03***	0.01***	0.02***	0.02***	0.03***	0.009**
AFB^2	-0.003***	-0.002***	-0.003***	-0.003***	-0.003***	-0.001**
Advantage index		0.1***				0.1***
Advantage index * AFB		-0.005***				-0.005***
Marital history						
Single continuous marriage						
Divorced/Separated/Widowed			-0.1***			-0.1***
Never married			-0.2***			-0.10
Divorced/Separated/Widowed * AFB			0.009			0.008
Never married * AFB			0.04***			0.01
Not married at first birth				-0.1***		-0.03
Not married at first birth * AFB				0.02**		0.02*
Number of children						
1-2 children						
3-4 children					0.1***	0.09***
5+ children					0.2***	0.2***
3-4 children * AFB					0.008	
5+ children * AFB					0.02	
Controls						
Number of siblings	-0.02***	-0.005	-0.02***	-0.02***	-0.02***	-0.008
Childhood health	-0.2***	-0.1***	-0.1***	-0.1***	-0.1***	-0.1***
Missed school	-0.2***	-0.2***	-0.2***	-0.2***	-0.2***	-0.3***
Parents smoked	-0.08**	-0.06*	-0.07**	-0.08**	-0.08**	-0.06*
Height (meters)	0.08	-0.2	0.1	0.1	0.07	-0.2
Age	-0.03***	-0.03***	-0.03***	-0.03***	-0.03***	-0.03***
Age^2	-0.0005***	-0.0004***	-0.0005***	-0.0005***	-0.0005***	-0.0004***
Age * AFB	0.00009	0.0001	0.0002	0.0002	0.00008	0.0003*
Constant	0.4	0.7**	0.3	0.3	0.3	0.6*

# $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, N = 5,802 persons/37,307 person-years

Table 6: Women - Chronic disease

	1d	2d	3d	4d	5d	6d
AFB	-0.03***	-0.02***	-0.03***	-0.03***	-0.03***	-0.01*
AFB^2	0.003***	0.001	0.002**	0.002***	0.002**	0.0005
Advantage index		-0.08***				-0.08***
Advantage index * AFB		0.006**				0.005*
Marital history						
Single continuous marriage						
Divorced/Separated/Widowed			0.06			0.02
Never married			0.08			-0.03
Divorced/Separated/Widowed * AFB			-0.007			-0.008
Never married * AFB			-0.04**			-0.03#
Not married at first birth				0.05		0.01
Not married at first birth * AFB				-0.02#		-0.005
Number of children						
1-2 children						
3-4 children					-0.1**	-0.1**
5+ children					-0.07	-0.05
3-4 children * AFB					-0.02*	-0.01#
5+ children * AFB					-0.02	-0.003
Controls						
Number of siblings	0.005	-0.008	0.004	0.004	0.005	-0.007
Childhood health	0.10***	0.08***	0.09***	0.09***	0.09***	0.07***
Missed school	0.2***	0.2***	0.2***	0.2***	0.2***	0.2***
Parents smoked	0.1**	0.10**	0.10**	0.1**	0.1**	0.09**
Height (meters)	-0.9***	-0.6**	-0.9***	-0.8***	-0.8***	-0.6**
Age	0.05***	0.05***	0.05***	0.05***	0.05***	0.05***
Age^2	-0.0009***	-0.0010***	-0.0009***	-0.0009***	-0.0009***	-0.0010***
Age * AFB	0.001***	0.001***	0.0010***	0.001***	0.001***	0.001***
Constant	1.0**	0.7*	1.0**	1.0**	1.0**	0.8*

# $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, N = 4,438 persons/7,030 person-years

Table 7: Components of advantage index compared to overall index (general health)

	Men		Women	
	β (Component * AFB) - β (Advantage index * AFB)	χ^2 (diff.)	β (Component * AFB) - β (Advantage index * AFB)	χ^2 (diff.)
Household wealth	0.002	0.02	-0.048	12.8***
Household income	-0.021	2.7	-0.037	9.4**
Education	0.005	0.3	0.020	6.5*
Respondent's occupational status	-0.003	0.1	-0.005	0.2
Respondent's father's occupational status	0.001	0.00	0.016	1.7
Owns outright or paying mortgage	0.013	6.6*	0.010	5.2*
SEIFA	-0.008	1.1	0.002	0.1
Remoteness	0.007	1.0	-0.002	0.1
Social support	0.001	0.08	0.006	1.7
Ethnicity	0.018	4.0*	0.010	1.6

$^{\#}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$