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Assumptions on fertility

Does one have to be healthy to opt to have children in Norway today?

Note by Statistics Norway*

Summary

Poor health may constrain women's capacity for active leisure, including family life and childrearing, for earning money in the labor market, but also potentially affect preferences. Still, health remains remarkably understudied as a fertility determinant. We explore the association between health and fertility, using uptake of doctor-certified sickness absences (SA) and long-term health-related benefits (LTB) as proxies for health. We examine whether compositional changes in health distributions and/or changes in the health-fertility association have contributed to the distinct fall in TFR in Norway since 2009. Lastly, we investigate if health-related associations differ across socio-demographic characteristics, and thus influence fertility differently in various groups. We use nationwide registry data on women aged 16-45 from 2004-2018. We analyse first, second and third births separately, and use annual observations with lagged time-varying covariates for education, income, employment, SA and LTB.

LTB uptake is negatively associated with fertility, and the association becomes weaker over time. In addition, such uptake is relatively rare. The use of SA is positively associated with fertility, and the association strengthens over time. SA uptake is common but decreases over time. If this decrease reflects a marked labor market preference and/or attachment among women in fertile ages, it might help explain parts of the observed decline. Overall, the decline in fertility is most pronounced for healthy women. Health as a fertility determinant warrants further research in itself, but also in terms of possible implications for fertility projections.

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I. Introduction

1. Extensively analysed fertility determinants such as income, educational attainment and enrolment are thought to influence fertility because they structure the time and money available to individuals, and to some extent also proxy preferences (Lappegård & Rønsen 2005; Berrington et al. 2015; d'Albis et al. 2017; Jalovaara et al. 2019). Health is, in a comparable way, a resource. Poor or reduced health may constrain the individual's capacity for participating in leisure activities, including family life and childrearing, for earning money in the labor market, but also potentially affect preferences. Still, health remains remarkably understudied as a fertility determinant.
2. The primary aim of this paper is to explore the extent to which women's health is associated with fertility. More specifically, we use nationwide registry data to examine whether suboptimal health matters for whether one chooses to have children or not, and whether it influences the overall number of children. Instead of subjective self-reported health measures, we investigate if uptake of doctor-certified sickness absences (SA) and/or more long-term health-related benefits (LTB) are correlated with childbearing among women in Norway. We also examine whether compositional changes in health distributions and/or changes in the effect of health proxies on fertility may have contributed to the distinct fall in the total fertility rate in Norway since 2009.
3. Second, women's educational attainment has increased further in the past decade, concurrent with declining fertility rates. As there is a strong correlation between education and health, we investigate whether associations between health and fertility differ across educational characteristics and thus influence fertility differently in various groups. As health and education are associated also with income and partnership status, we assess such possible confounding in robustness checks.
4. Poor health may make it more challenging to conceive and carry a pregnancy to term. Older women have, on average, more pregnancy-related health problems than younger women (Bhasin et al. 2019). With a steadily rising birth age, pregnancy and birth-related health problems are expected to continue to increase in the years to come. At the same time, treatment, follow-up care and the prognosis for many medical conditions and disabilities are steadily improving, and more women reach fertile ages in suboptimal health today compared to the situation decades ago (Johnson & Tough 2012). This may imply that an increasing proportion of women in fertile ages must consider their health and that of their offspring, when deciding *whether* they want children, *when* they want children, and how *many* they would like to have, and the extent to which their wishes may be fulfilled. The theoretical framework and factors potentially affecting fertility choices, are outlined in more detail below, along with results from existing studies.

A. Norwegian setting

5. From 2004 to 2009, the total fertility rate (TFR) in Norway increased slightly, from 1,83 to 1,98. Since 2009, the TFR has declined steadily, and reached 1,56 in 2018. This is the lowest TFR ever reported in Norway. At the same time, recent cohorts of Norwegian women have surpassed men in terms of educational attainment and almost as many women as men participate actively in the labor market (Statistics Norway 2019). After the global economic and financial crisis that began in 2008 and hit Norway a bit later and less hard than many neighbouring countries (Comolli et al. 2019), the Norwegian labor market has changed somewhat. Laws have been reformed to facilitate an increasing share of temporary jobs. Since 2011, there has been other minor economic downturns, and there is a general perception that the labor market is becoming increasingly demanding – as young people compete for interesting jobs after having invested heavily in education (Comolli et al. 2019).

6. Norway is a welfare state with several social security measures in place, to promote health and gender equality. Persons are entitled to health-related benefits if poor health limits their ability to participate fully in the labor market. In this study, we use data on doctor-certified sickness absence (SA) and long-term benefits (LTB). SA is compensated fully for a maximum of one year, whereas LTB may be used until one is entitled to old age pension uptake. LTB is commonly only used once the maximum period for SA is reached, as the compensation rate is lower, usually set at 66% of the previous wage.
7. SA has decreased slightly over the past decade for women in fertile ages, although a decreasing number of women report good health (Statistics Norway 2016). On the other hand, there has been a slow but steady increase in the uptake of LTB. Among women in fertile ages, the most common reasons for receiving health benefits relate to mental and/or musculoskeletal problems, which together account for more than half of all the benefit uptake. Other frequent conditions include pregnancy-related problems, respiratory-related problems, problems related to the nervous system (e.g. multiple sclerosis) and digestive problems. For LTB, also certain congenital conditions comprise a marked share, especially among the youngest women.
8. In 2010, major changes were enforced in the Norwegian welfare system concerning health-related benefits (Frøyland et al. 2018). The aim was to reduce the number of younger individuals on long-term benefits, in part to increase work force participation but also based on research that has shown that labor market attachment might be positive for mental and physical health, as well as economic welfare, even for individuals in suboptimal health (see e.g. Nøkleby et al. 2015). Along the same lines, efforts have been made to reduce sickness absence, especially full-time absences over extended time periods. In summary, an increased focus has been directed towards the importance of work and work attachment, both at an individual and a societal level. As a result, relatively strong incentive structures have been established to utilize residual work capacity and avoid reliance on long-term benefits.
9. Even in a robust welfare state such as Norway, slight changes in labor market regulations accompanied by a temporary economic downturn, might increase the perceived economic uncertainty. Previous research indicates, that individuals perceiving insecurity tend to postpone or abolish intentions in different life spheres, including childbearing intentions (Pailhé & Solaz 2012). Individuals in poor health may struggle more to combine work and family under such conditions, and hence be quicker to abandon or postpone fertility intentions. Further, uncertainty in combination with increasing pressure to participate in the labor market, also in temporary jobs, might lead to the emergence of new health problems.

B. Theoretical framework and existing studies

10. There are many ways in which poor health could influence fertility. We apply an economic-demographic framework, in which supply, regulation costs and demand are considered important fertility determinants (Easterlin & Crimmins 1987). Supply is defined as the number of children one would have without regulation and depends on the chance of conceiving and the likelihood of women to bring a pregnancy to term and give birth to a live child (Bongaarts 1983). Regulation costs refers to the availability, affordability and acceptability of contraception and abortion. It is not likely that poor health has operated through this channel in Norway in recent years, although some women might have health issues limiting their contraceptive choices (see e.g. Benagiano et al. 2019). As there are several alternative contraceptive methods available and we have no data on such use, possible implications of changing regulation costs are not discussed further.
11. Demand or fertility desires is defined as the number of children one would ideally like to have. It depends on purchasing power, costs of childbearing, the preferences for spending time and money on raising children rather than on alternatives, and norms.

12. While there is an abundance of studies examining the possible impact of fertility on health, scarce research interest is directed at the reverse relationship. A review of the existing literature on the possible influence of health on fertility suggests that the majority is directed at the *supply* side and centred primarily around specific illnesses and conditions. It appears less well explored in terms of general health issues and/or self-reported health. On the *demand* side, distinctions are made between intended and unintended pregnancies, fertility desires and intentions for women in various states of health or with specific health conditions, as well as counselling processes directed at women with certain specific conditions that might affect conception, pregnancy outcomes or the subsequent health of women and their offspring. Our demand side considerations are thus based on studies that examine the influence of health both directly or indirectly.

13. Poor health may lower supply at a population level in various ways. A decrease in sexual desire among persons with certain specific illness, such as for instance cancer, may be linked to hormonally induced changes, but also to fatigue, chronic weakness, and nausea related to both illness and treatment (Schover 2005; Wenzel et al. 2005). This may influence fecundity negatively. However, of greater concern is subfecundity, either related to difficulties conceiving or carrying a pregnancy to term in patients with serious illness, either due to the illness itself or due to treatment influencing fecundity, such as hormonal therapy, chemotherapy, surgery or ablative therapy, and/or radiation (Meirow & Nugent 2001; Wenzel et al. 2005; Daraï et al. 2017; van den Berg et al. 2018). Studies from the Nordic countries suggest reproductive cancer forms reduce fertility substantially (Syse et al. 2007; Armuand et al. 2017; Weibull et al. 2018), presumably related to subfecundity. However, also cancer forms unrelated to reproductive function are associated with reduced fertility, perhaps suggesting underlying psychological and/or social mechanisms, further supported by the difference in probability between first and subsequent births observed for women with cancer (Syse et al. 2007; Baxter et al. 2013).

14. Other studies examine fertility after disabilities, mental health problems, and nervous system disorders (Bartel & Taubman 1986; Prunty et al. 2008; Houtchens et al. 2018). However, the main focus is on fertility intentions (e.g. Bloom et al. 2017), as well as possible adverse effects on the health of mothers and offspring (e.g. Khajehpour et al. 2013). Whereas earlier studies (see e.g. Nijs et al. 1984; Bartel & Taubman 1986) investigate mental health and psychological stress as a cause for infertility, newer studies and general opinions today suggest that adverse mental health is a consequence rather than a cause of infertility (see e.g. HMHL 2009). Given that musculoskeletal disorders (MSD) account for a large share of health-related benefit uptake in many countries, and particularly among women (Mastekaasa 2000), the attention diverted to this group in terms of fertility appears inadequate, and we were not able to find many studies examining this aspect. An older Norwegian study showed that among otherwise healthy individuals, persons with MSD were more likely to report subfertility (Skomsvoll 2000), whereas a recent study from the UK state that autoimmune rheumatic diseases (e.g. inflammatory arthritis) and many of their treatments can have a detrimental impact on fertility and pregnancy outcomes and warrant further research (Phillips et al. 2018). A recent Swedish study use administrative data on benefit uptake and suggests a health selection into childbirth (Björkenstam et al. 2019). However, in summary, fecundity and fertility appears understudied for common conditions affecting the health of women in fertile ages.

15. Poor health may also influence the chance of finding (and keeping) a partner (Lillard & Panis 1996; Syse & Kravdal 2007; Syse 2008), with links to fertility, although in a causally complex way. On the one hand, a sexual relationship is usually necessary to conceive a child, and those with a partner are typically in better positions economically and have someone to share the joys and distresses of childrearing. On the other hand, pregnancy or birth may trigger consensual unions or lead cohabitants to marry. This is especially true for first births, where the direction of causality is particularly ambiguous.

16. Correspondingly, the demand side can be affected by health in several ways. Poor health often results to a reduced income, which could impact negatively on purchasing power and fertility desires. Poor health in younger ages might also result in a lower education than one would otherwise have, thus also influencing income negatively, with a similar result. Poor health may also influence preferences, either negatively or positively.

17. Income may be reduced after serious illness due to changes in both work ability and opportunities (Bartel & Taubman 1986; Chirikos 1993). High costs of treatment and rehabilitation may have the same effect in countries where health care must be bought in the open market, like for instance the US (Mellon & Northouse 2001). In Norway, this may have lesser relevance than in countries with less extensive public welfare systems, as health care is provided virtually free of charge and economic benefits compensate for income losses resulting from poor health.

18. People having stable high incomes do not necessarily want more children than those having stable low incomes, because the former may also feel obliged to spend more on each child and may have developed stronger preferences for their career or other competing activities and investments (Becker 1991). However, income drops are likely to result in fertility declines. Men are the main wage earners in the family even in contemporary Norway (Dommermuth et al. 2019), and a decline in men's income may have a pronounced effect (see e.g. Kravdal 2002; Comolli et al. 2019). Whether this is the case also for women is less clear, as women with poor work possibilities or low earning potentials face low opportunity costs of childbearing and may thus be more likely to display high fertility. Nevertheless, some women may have suffered or foresee a loss of income that will make it difficult to support a family, and thus limit the number of children they choose to have.

19. Educational level, or socio-economic resources more generally, is widely known to have a sharp effect on birth rates (Kravdal 2001). It may also affect women's health, but the causality may well also run in the opposite direction. For example, serious illness in adolescent years is likely to reduce the chances of getting a higher education. On the other hand, women in suboptimal health may have to prioritize their time and resources more carefully than healthier women. If they have invested heavily in education, they may feel that they must choose between raising a family or having a career. Suboptimal health may also have implications for the *type* of work they can do, and the *number of hours* they can work. Career jobs where prospects are tied to full-time effort might thus not be an option for some, irrespective of educational attainment.

20. Women in poor health might perceive that they have less energy to cope with the distresses of childrearing or opt to spend their time and energy otherwise. Depending on the cause and prognosis, women may fear that a pregnancy might impact adversely influence their health (see e.g. Prunty et al. 2008), they may have concerns related to not being able to live to see their children grow up, or not being able to be sufficiently resourceful and present parents (Schmidt et al. 2016). Concerns regarding the health of potential children may also influence desires negatively, especially if there are hereditary factors to consider (Schover 2005). It should be noted, though, that harmful effects of childbearing after serious illnesses are notoriously difficult to identify, as there may be a highly selected group of relatively healthy women with supposedly good prognosis who go on to have children (Kravdal 2003).

21. A US study find that although the attitudes toward motherhood was similar for women with and without disabilities, women with disabilities were less certain whether they would be able to achieve their intentions (Shandra et al. 2014; Bloom et al. 2017). Along the same lines, mothers with disabilities were more likely to want another child, but less likely to intend to have one, than were mothers without disabilities. Research on fertility intentions considering self-reported health status provide ambiguous findings. In Norway, childless individuals reporting poor health are found to express not only longer-term, but also immediate fertility intentions. This might be due to concerns that their health status will make it even more difficult to have children later in life (Dommermuth et al. 2011).

Comparing fertility intentions of couples in Italy and Britain, Fiori et al. (2011) found that poor self-reported health of women is correlated with a lower level of positive fertility intentions in Britain, while in Italy only the partner's health status has a similar impact. Heiland et al. (2008) found no significant correlation between self-reported health status and desired family size in West-Germany.

22. On the other hand, there are also mechanisms contributing to high fertility among women in poor health. If poor health has resulted in an education with fewer prospects for interesting tasks, women might be more likely to prioritize family over work. Furthermore, suboptimal health, and especially poor health, might be hypothesized to increase persons' family orientation and their consciousness of the positive emotional value of having children, thus altering preferences for parenthood in a positive direction. Having experienced and lived through a serious illness may increase the value that is placed on children and family life (Schover 2005; Schmidt et al. 2016). Norms and values concerning childbearing after illness, such as for instance cancer, and disabilities are generally more positive today compared to earlier. This is reflected both in clinical practice of various illnesses and disabilities, as well as in a steadily growing research interest in this topic.
23. In summary, poor health or disability may cause various physical, psychological, social, and financial effects. It may influence the possibility to establish and maintain a family life, to have and raise children, and it may have consequences for employment and earnings. For some health conditions, especially those in reproductive organs, considerations such as these may add to mechanisms operating through fecundity, defined as the ability to conceive and for women to bring a pregnancy to term. For other health conditions, the impact on fertility may be primarily socially mediated. Our primary hypothesis is that poor health would affect fertility negatively, primarily through social mediation. Long-term benefits are indicative of poorer health than sickness absence, and as such we expect the strongest correlations here. Further, as working life has become more difficult and stressful in the aftermath of the economic crisis (Comolli et al. 2019) and since women postpone childbearing decisions to older ages resulting in additional health problems (Bhasin et al. 2019), we hypothesize that the negative influence of health on fertility has increased over time.
24. As we read the literature, most studies focus on aspects related to fecundity and/or infertility in women whose reproductive organs have been directly involved or adversely affected by treatment. The vast majority of studies concern cancer, although some studies also consider other conditions and/or disabilities more generally. While some studies of fertility intentions account for self-reported health, it is commonly not their main focus. Furthermore, persons reporting health problems directly linked to reproductive issues are usually excluded from analyses of fertility intentions. To our knowledge, very few studies have looked at the link between general health and fertility (for an exception, see Björkenstam et al. 2019). As such, this study contributes new knowledge, although we are unable to distinguish characteristics on the supply and demand side.

II. Data and method

25. Discrete-time logistic regression models for conceptions leading to live births, hereafter called fertility, were used to estimate possible health effects separately for first, second and third births in nationwide registry data covering the entire population of women aged 16-45 from 2004 through 2018. In analyses of first births, each woman contributed a series of annual observations from age 16 (or earliest age at inclusion in 2004) to age 45, unless conception, emigration, death or end of follow-up occurred earlier. For second and third births the starting point was set to the birth of the previous child. Each observation included variables that referred to the situation at the beginning of the year (e.g. age, time since previous birth, educational activity, level and type, labor market participation, income and partnership status) or the beginning of the previous year for the lagged health variables,

certified sickness absence (SA) and long-term benefits (LTB). Because we have uncertain information on educational and work history of immigrant women, these were excluded from all analyses. Classifications and descriptive statistics for the explanatory variables for the three parity transitions is shown in Table 1.

26. In analyses of first births, we used data on nearly 434,000 childless women, who gave birth to a total of 286,000 children. In analyses of second births, women with one child (N = 295,000) were followed from the birth of their first child. These women had a total of 250,000 children. In analyses of third births, we followed close to 260,000 women with two children from their last birth. In total, these women gave birth to nearly 100,000 children. The data set is described in more detail in Tables 1 and 2.

27. Logistic regression models were estimated using the proc logistic procedure in SAS (Allison 2010). Interaction terms between health characteristics and calendar period were included in additional models to assess possible effect modification. When the interaction term suggested statistical significance, average marginal effects and adjusted predicted probabilities of conceptions leading to live births at different time periods were calculated and plotted to facilitate comparisons across models, using the margins command in Stata (Mood 2010; Williams 2012). The statistical significance level was set at 5%.

28. Health status, and its combination with education, was our primary independent variable of interest. Three main specifications were used: General health (1); Health and educational level (2); and Health and educational type (3). As a robustness check, two additional specifications were set up: Health and income (4); and Health and partnership status (5) (Table A3). Appendix Tables A1-A3 and Figures A1-A5 are not included here due to page limitations but may be requested from sya@ssb.no.

III. Results

29. Table 1 shows that there are pronounced differences in background characteristics between women at risk for a first, second or third birth. This is especially true for educational activity and level of education. Enrolment in education is far less common among mothers than among childless women, while mothers typically also have a higher education. Likewise, the proportion of women with educational types aimed at specific occupations and/or labor market sectors is more common for higher parities. This may be important for our study, because sickness absence is closely related to labor participation. However, it is common in Norway to work some hours while enrolled in education, as is evident in the relatively large share of women with an active labor market participation across parities. As such, most women were entitled to such benefits. We find that first births are more frequent among women who work, as the mean income is much larger among those who have a child compared to those who are childless. For higher-order parities, the differences are minor.

30. The main health variables used in this study are shown in Table 2. In terms of general health, the share receiving long-term benefits (LTB) is relatively stable across parities, whereas the share who uses sickness absence benefits (SA) is almost threefold for mothers as compared to childless women. If we compare women with a low and high education, we see that the use of both SA and LTB is less common among those with a high education. Childless women are almost equally likely to receive SA and LTB, whereas the relative share of mothers with LTB is lower, about half that of SA. One of the most interesting aspects of Table 2 is that the proportion who have received health-related benefits is lower among women at risk of having a third child than a second child. Thus, it is conceivable that there is a health selection among women who want three children. Further descriptive analyses indicate that births are most common among women with a SA the year before conception. This may capture that these women participate more fully in the labor market rather than that they have a poorer health (Table A1).

Table 1. A summary of background characteristics of women included in the analyses of a first, second and third birth, respectively.

	First birth		Second birth		Third birth	
	Pyrs/N/mean	%	Pyrs/N/mean	%	Pyrs/N/mean	%
Total person-years (pyrs)	6.8 million		2.5 million		3.7 million	
Number of women	433854		295224		259802	
Number of births	286482		246847		98400	
Mean age (years)	26.3		35.1		37.8	
Birth=yes	27.7		30.4		32.6	
Birth=no	26.2		35.6		37.9	
Labor market participation[b]	5566056	82.1	2270718	89.6	3412972	92.3
Mean labor market income (NOK)	192 900		332700		370700	
Birth=yes	304800		337400		350700	
Birth=no	188000		332200		371200	
Enrolled in education[c]	2548810	37.6	106991	4.2	65543	1.8
Higher education[d]	1952548	28,8	994430	39.3	1583201	42.8
Educational type						
Female dom., public sector	903600	13.3	657592	26.0	1067115	28.9
Female dom., private sector	432045	6.4	247292	9.8	370767	10.0
Mixed gender, high specificity	993734	14.7	488973	19.3	809646	21.9
Male dom.	340585	5.0	163977	6.5	260223	7.0
Other, general education[e]	4107356	60.6	975309	38.5	1189016	32.2

[a]Not applicable. [b]Includes women with any income from labor market activities. As it is common to work part-time while enrolled in education, the majority of women have some attachment to the labor market. [c]Includes only women for whom enrolment in education comprises their primary activity. [d]Higher education refers to any education beyond high school, i.e. at college or university level. [e]Women with missing education are also included here, but they are relatively few since immigrants have been excluded.

Table 2. A summary of health characteristics of women included in the analyses of a first, second and third birth, respectively.

	First birth		Second birth		Third birth	
	Pyrs	%	Pyrs	%	Pyrs	%
General health[a]						
Healthy	5674939	83.7	1681065	66.4	2517831	68.1
Only sickness absence (SA)	510154	7.5	557231	22.0	794340	21.5
Long-term benefits (LTB)[b]	592227	8.7	294847	11.6	384596	10.4
Health and educational level[c]						
Healthy, low education	3991113	58.9	962571	38.0	1352627	36.6
Healthy, high education	1683826	24.9	718494	28.4	1165204	31.5
SA, low education	331300	4.9	332606	13.1	456218	12.3
SA, high education	178854	2.6	224625	8.9	338122	9.2
LTB, low education	502359	7.4	243536	9.6	304721	8.2
LTB, high education	89868	1.3	51311	2.0	79875	2.2
Health and educational type[d]						
Healthy, general education	3476037	51.3	617435	24.4	758014	20.5
Healthy, female dom.	1049758	15.5	591595	23.4	968468	26.2
Healthy, high-specificity, gender-mixed or male dom.	1149144	17.0	472035	18.6	791349	21.4
SA, general education	206468	3.1	185314	7.3	233292	6.3
SA, female dom.	189460	2.8	238249	9.4	354667	9.6
SA, high-specificity, gender-mixed or male dom.	114226	1.7	133668	5.3	206381	5.6
LTB, general education	424851	6.3	172560	6.8	197710	5.4
LTB, female dom.	96427	1.4	75040	3.0	114747	3.1
LTB, high-specificity, gender-mixed or male dom.	70949	1.1	47247	1.9	72139	2.0

[a]Health variables coded so that the groups are mutually exclusive. [b]This group comprises women who receive long-term benefits, which is an aggregate measure of work assessment allowance benefits, disability benefits and basic and/or attendance benefits. Some of these women may also receive sickness benefits, but since they also receive long-term benefits they are grouped in this category. [c]This variable is a composite measure of educational level and health, and high education includes all women with education beyond high school, whereas the low education group includes all other women. The categories are mutually exclusive. [d]This variable is a composite measure of educational type and health. The categories are mutually exclusive.

Table 3. Odds ratios with 95% confidence intervals from three models describing the associations between health, education and fertility, for first, second and third births, respectively.

	FIRST BIRTHS, INCL. STUDENTS		FIRST BIRTHS, EXCL. STUDENTS		SECOND BIRTHS		THIRD BIRTHS	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Model 1: General health[a]								
Healthy	1	ref	1	ref	1	ref	1	ref
Only sickness absence (SA)	1.32	1.31-1.34	1.28	1.27-1.30	1.17	1.15-1.18	1.06	1.04-1.07
Long-term benefits (LTB)[b]	0.52	0.51-0.53	0.49	0.48-0.50	0.57	0.56-0.59	0.73	0.71-0.75
Model 2: Health and educational level[c]								
Healthy, low education	1	ref	1	ref	1	ref	1	ref
Healthy, high education	1.36	1.34-1.37	1.42	1.41-1.44	1.98	1.95-2.00	1.88	1.85-1.91
SA, low education	1.40	1.38-1.43	1.35	1.33-1.37	1.28	1.26-1.30	1.16	1.14-1.19
SA, high education	1.67	1.64-1.71	1.72	1.69-1.75	2.12	2.08-2.15	1.82	1.78-1.87
LTB, low education	0.50	0.49-0.51	0.47	0.46-0.48	0.57	0.56-0.59	0.77	0.74-0.80
LTB, high education	0.84	0.81-0.87	0.84	0.81-0.87	1.20	1.15-1.25	1.25	1.18-1.33
Model 3: Health and educational type[d]								
Healthy, general education	1	ref	1	ref	1	ref	1	ref
Healthy, female dom.	1.46	1.44-1.47	1.43	1.41-1.45	1.17	1.16-1.19	0.98	0.96-0.99
Healthy, high-specificity, gender-mixed or male dom.	1.17	1.15-1.18	1.22	1.21-1.24	1.31	1.30-1.33	1.05	1.02-1.07
SA, general education	1.56	1.53-1.59	1.46	1.43-1.49	1.30	1.27-1.32	1.12	1.08-1.15
SA, female dom.	1.69	1.65-1.72	1.67	1.64-1.70	1.31	1.28-1.33	**1.03**	**0.99-1.05**
SA, high-specificity, gender-mixed or male dom.	1.57	1.53-1.61	1.57	1.53-1.61	1.47	1.44-1.51	1.06	1.03-1.10
LTB, general education	0.50	0.49-0.51	0.46	0.45-0.47	0.57	0.55-0.59	0.77	0.74-0.81
LTB, female dom.	0.78	0.75-0.81	0.76	0.73-0.79	0.70	0.68-0.73	0.67	0.64-0.71
LTB, high-specificity, gender-mixed or male dom.	0.74	0.71-0.77	0.74	0.70-0.77	0.74	0.70-0.78	0.74	0.69-0.79
Control variables								
Age group	X		X		X		X	
Period	X		X		X		X	
Time since last birth[e]			X		X		X	
Educational variables	X		X		X		X	

Note: Estimates not in bold, p <0.05. [a]The categories are mutually exclusive. [b]A measure of whether one receives any long-term benefits. Som women may also receive sickness benefits. [c]Education is dichotomized. Low education comprises all women with education limited to high school. The few women with missing education are also included here. High education comprises women with any education beyond high school. [d]Genereal education also include women with only high school or missing education. [e]Only relevant for second and third births.

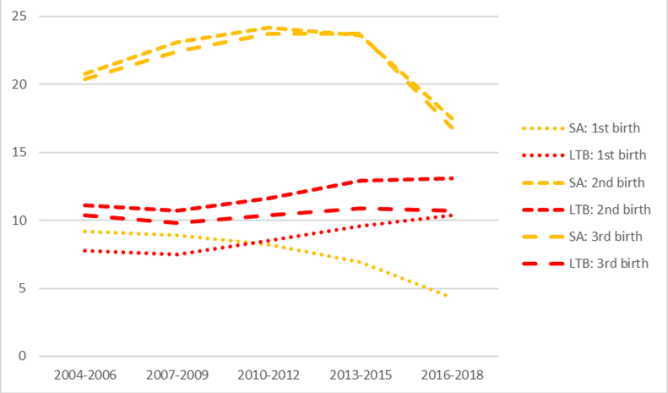
31. Table 3 shows fully adjusted results for the risk of a first, second or third birth by health- and health- and educational-related characteristics. Altogether, three model specifications are shown for each parity, and the respective control variables accounted for are indicated with an 'X'. Model 1 shows that the uptake of any LTB lowers the chance of a birth, across all three parities, although most pronounced for a first or a second birth. On the other hand, SA appears to increase the chance of having a child, especially a first child. For a third birth, the associations are generally weaker, albeit statistically significant. This may imply that there is a health selection for having children at all among childless women on LTB, i.e. in poor health. This is especially true for childless women on disability benefits (not shown), whose fertility is reduced by 75%. The corresponding reduction for one-child mothers is 50%.

32. Model 2 compares women in similar health with a high versus a low education. It shows that fertility is higher among the highly educated, across all parities, but that the difference is most pronounced for second births. Further, the results indicate that the negative impact of LTB on birth risks is strongly driven by low educated women, while highly educated women with LTB only differ slightly from healthy low educated women or even have higher third birth risk than this reference group. Model 3 compares individuals with different types of education. The patterns appear different across health status and types of education for first and second births, whereas the differences in general are more modest for third births. The general trend of lowered fertility for women on LTB are however consistent across parities, independent of type of education.

33. Figure 1 shows trends in uptake of health-related benefits over time. SA has declined substantially from 2004 to 2018 among women in fertile ages. The relative decline is most pronounced for first births, where the use is almost halved towards the end of the period. However, SA was substantially lower in this group to begin with. For second and third births, the uptake of such benefits was much higher and increased throughout the first half of the period. The decrease over time is sharp for the latter half, and similar for the two transitions. For LTB we see much more modest changes over time. However, a slight

increase can be observed for all parities across time. Changes over time in educational characteristics and health are shown in Figures A1-A3.

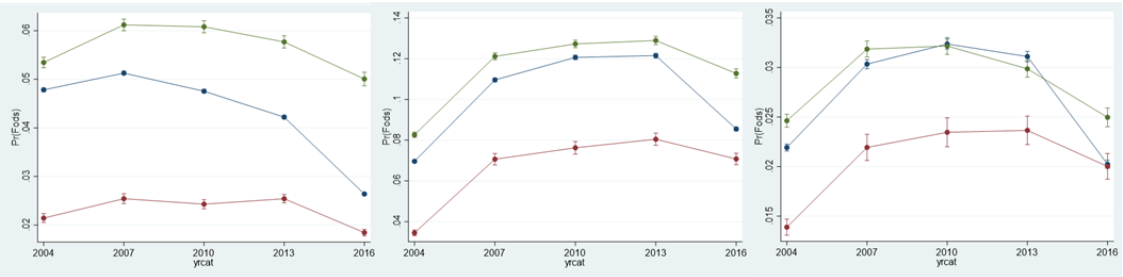
Figure 1. Changes over time in sickness absence (SA) and long-term benefits (LTB) for women at risk for a first, second or third birth.



34. Figure 1 suggests that the incentive structures put in place after 2010 to reduce the uptake of health-related benefits appear to have worked well for the uptake of SA but not LTB. Whether the changes represent actual developments in health or reflects underlying changes in the welfare system, or both, is not clear, and warrants further research.

35. Figure 2 portrays changes over time in fertility, shown as adjusted predicted probabilities, among healthy women (blue lines), women on SA (green lines) and women on LTB (red lines), whereas Figure A4 shows the corresponding average marginal effects for SA and LTB relative to healthy women. The general pattern observed in Table 3 is evident also in these figures. Fertility is higher among women with SA, whereas it is clearly lower among women who receive LTB and thus likely to be in the poorest health. Interestingly, healthy women have experienced the most pronounced decline in birth risks (all parities) after 2013. In absolute terms, the sharpest fall since 2013 is observed for those at risk for a second birth. In relative terms, however, the sharpest fall is observed among those at risk for a third birth. However, the trend is declining after 2013 for *all* women, suggesting that the role played by suboptimal health (SA) and especially poor health (LTB) has diminished in recent years and thus had a greater significance earlier in the 2000s, contrary to our hypothesis. As evident from Figure A4, the difference between healthy women and women with SA, with higher births risks among the latter, has even increased in recent time. These general patterns and observed developments are also contrary to our hypothesis expecting a negative association between suboptimal health and birth risks.

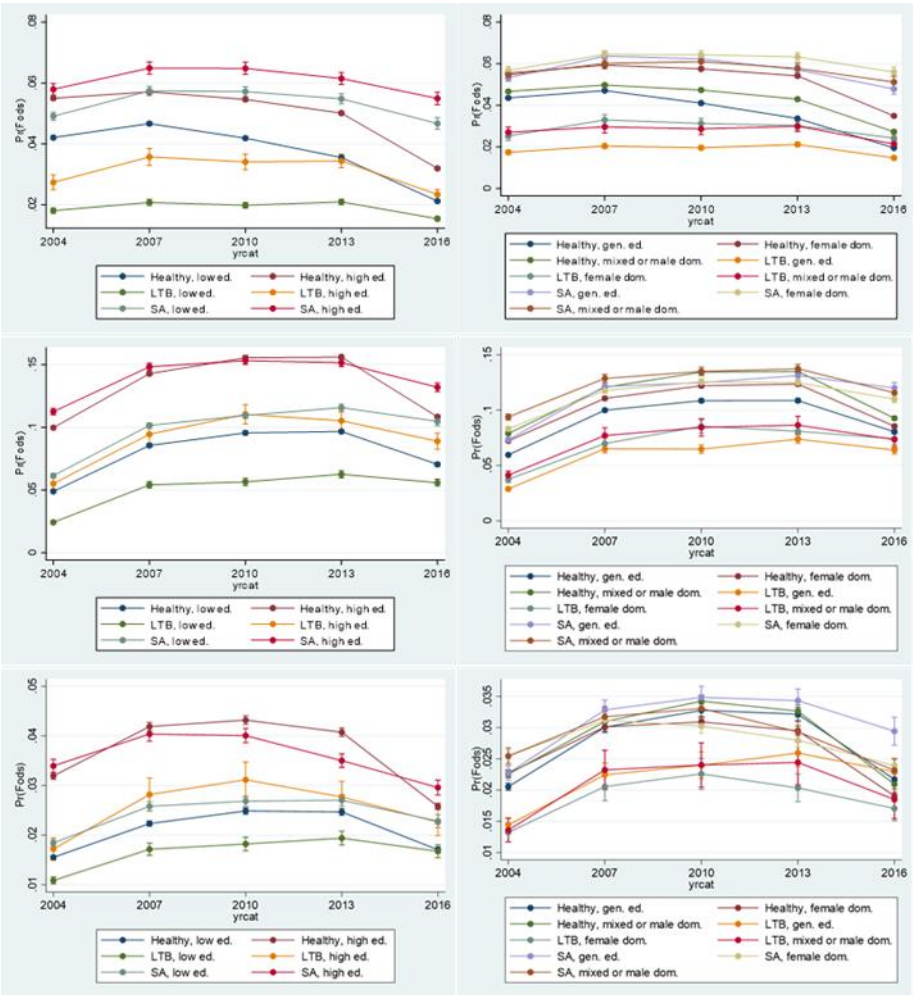
Figure 2. Adjusted predictive probabilities of a first (left panel), second (mid-panel) or third (right panel) child for women by proxies for general health.



Note: The probabilities were calculated by including an interaction term between health status and calendar period in the fully adjusted model (Table 3). As such, the portrayed effects are net of covariates. 95% CIs are shown at the predicted values. The axes vary between the parity transitions. Within each parity, women who receive long-term benefits (LTB, red line) may also receive sickness absence benefits (green line). The reference group (blue line) does not receive any health benefits. The groups are thus mutually exclusive, for each parity.

36. The left panel of Figure 3 shows that the most pronounced decline in fertility over time is observed for healthy women with a high education. The right panel, portraying differences across educational types, shows a more mixed pattern, both between the educational types within parities and across parities. As is evident from this panel, we find the most pronounced decline for women with educations relevant for female-dominated public sector, especially for third births. Women with SA and education aimed at female-dominated occupations have the highest fertility rate of all groups, but the importance of SA is less for this group than other groups (i.e. less difference). For long-term benefits (LTB), the trends over time are relatively similar for the different educational types, but also here the differences have become somewhat smaller throughout the period.

Figure 3. Adjusted predictive probabilities of a first (upper panel), second (mid-panel) or third (bottom panel) child for women by uptake of health benefits and education (level to the left and type to the right).



Note: The probabilities were calculated by including an interaction term between health/education status and calendar period in the fully adjusted model (Table 3). As such, the portrayed effects are net of covariates. 95% CIs are shown at the predicted values. The axes vary between the parity transition. The health categories are mutually exclusive. Low education is defined as any education through high school, whereas high education is defined as any education at college or university level. General education includes educational types other than the female, mixed or male dominated ones.

A. Robustness checks

37. We checked to see if the results would be different if we aggregated the health indicator variable two or five years earlier to account for long-standing health problems. The trends

were very similar (not shown). Similarly, we ran analyses of the individual long-term benefits, i.e. work allowance, disability, basic and attendance benefits, but as the trends were similar across the respective benefits we only show overall results.

38. A pronounced share of women at risk for a first birth were students (37%, enrolled in full-time education and with annual work incomes <20 000 Euros in 2018-values). We thus also ran models excluding students, but the results changed very little (Table 3 and Figure A5). Students were thus left in the sample in examinations of changes over time.

39. In Table A3 we show the joints effects of income and health, as well as stratified analyses women with high and low incomes. As income may be viewed as a proxy for purchasing power, we might expect higher fertility among women with higher incomes. At the same time, opportunity costs for childbearing and rearing are higher for this group. We find that the risk of a first birth is clearly lower among healthy women with a low income, as compared to healthy women with a high income. Otherwise, the differences between income groups are generally minor across the various health categories. The smallest influence is observed for third births. When we compare estimates with and without controls for income, we see that the results are very stable, especially for higher-order births. Thus, purchasing power (and to some extent opportunity costs) do not appear to be important for Norwegian women's fertility across various health conditions.

40. Marital or cohabiting status was not included in models for first-births, where the direction of causality is particularly ambiguous. In models for higher-order births, information on partnerships turned out to be an unimportant mediator (Table A2). Table A3 show that being partnered increased the likelihood for a second and a third birth, across all health categories. When we examined the two groups separately, only minor differences could be observed.

IV. Discussion

41. We have examined whether sickness absence or other indicators of poor health are negatively correlated with childbearing among women in Norway, and whether this association has become stronger in recent years and thus might have contributed to the distinct fall in the total fertility rate in Norway since 2009. Our results show that long-term health benefits (LTB) were negatively associated with fertility, whereas the opposite was true for sickness absence (SA), in line with recent Swedish findings (Björkenstam et al. 2019). LTB are indicative of poorer health than SA, and thus might be negatively correlated with finding (and keeping) a partner which many may consider a prerequisite for starting or continuing to build a family. However, our results did not change when we accounted for partnership status. Furthermore, poor health may interfere with the chance of conception, as well as the likelihood of completing a successful pregnancy. It might also affect the desire for a family, or impact on the desired number of children. Our study cannot distinguish between these mechanisms.

42. Women with SA may have a somewhat weaker attachment to the labor market than those without such absences. As such, they may have a stronger preference for family formation than careers. Poor health was also expected to reduce fertility as it may reduce persons' perceived ability to be healthy and caring parents, economically and otherwise. This could not be directly explored by our data. However, there was a strong 'self-selection' into parenthood, as indicated by the difference between women using SA as opposed to LTB, suggesting that primarily the 'healthiest' women in suboptimal health opted to have children, as is also shown by others (Björkenstam et al. 2019).

43. The reductions in fertility in this unselected national material is perhaps less pronounced than what could be expected, based on what is known of poor health and based on what previous medical research has suggested. On the other hand, as age of first, as well as later, births continues to increase, parenthood will remain an issue for many women in suboptimal

health in the years to come. As such, possible social and/or psychological mechanisms influencing fertility warrants further study, possibly also utilizing tools to influence such mechanisms (Prunty et al. 2008).

44. In terms of changes over time, we cannot determine whether the change in the use of health-related benefits over time represents altered health or reflects underlying changes to the welfare system. Most likely, it is a combination of both conditions. In general, the 'work line' has been strengthened somewhat over the period, and relatively strong incentive structures have been established to avoid long-term benefits and to promote the utilization of residual work capacity, especially among younger people. Overall, this should have led to a decline in the use of these benefits, while we find the opposite. However, when we look at the importance of health for subsequent fertility over time, it may seem that the importance of both good and poor health has diminished in recent years and thus had a greater significance earlier in the 2000s, which contrasts with our hypothesis.

45. Our registry-based study contributes interesting but limited information on an entire population of women in fertile ages in different states of health. It is likely that the results may pertain to other countries with similar population structures, illness burdens, health systems, and welfare structures, particularly the other Nordic countries. Research from other countries with equally good population registries on health proxies and fertility is needed to determine to which extent these findings are valid for women in suboptimal health outside Norway. On the other hand, since this is a registry-based study we do not have information on *why* persons act the way they do. We lack exact information on their reason for SA or LTB, but as we lagged both indicators, they are at least not directly linked to the outcome, i.e. the conception and pregnancy resulting in a live birth.

46. Whether our findings show minor or modest associations between fertility and health depends on the perspective one chooses to take. The estimates shown in Table 3 have pronounced magnitudes and appear robust with narrow confidence intervals. However, the use of health-related benefits is fairly uncommon among women in fertile ages, as shown in Table 1. This is especially true for long-term benefits. Thus, on an absolute scale, any health-related impact is likely to be minor.

47. The fact that we use health indicators related to the use of sickness absence benefits or more long-term health-related benefits could be problematic. One concern is that many of the benefits people in poor health are entitled relate closely to labor market participation. Thus, such benefits may be less relevant for subgroups like for instance students. Nevertheless, our health indicators should capture parts of this 'morbidity' as well, as perhaps is indicated by the relatively minor differences observed in the comparison of first birth risks among all women and among women when students were excluded. Along the same lines, also the changes over time were similar with and without students.

48. It is likely that our measures largely capture suboptimal health. There will, however, be substantial variation in *how* sick people are and how *long-lasting* their problems may be. At the same time, there are people in poor health outside the labor market who do not meet the requirements for health-related benefits and thus use alternative benefits, such as financial social assistance. This is a relatively small group that will have little influence on the large group without benefits. It is thus of minor significance for our comparison. Nevertheless, studies using other health measures are clearly needed to validate our findings.

49. Kravdal (2001) has shown that results of parity specific analyses should be interpreted with caution, as they do not account for the selection into motherhood or different parities. However, as we use time-varying covariates, this should reduce the drawbacks associated with the chosen method. Further, the results are still valid, if one keeps in mind that the population under observation is different at each parity, i.e. childless women, mothers with one child, and mothers with two children. However, it will be interesting to see if our analyses could be replicated in a study where parities are modelled jointly.

V. Conclusion

50. Suboptimal health, and especially poor health, might be hypothesized to increase persons' family orientation and their consciousness of the positive emotional value of having children, thus altering preferences for parenthood in a positive direction. In this study, this hypothesis was not explored directly. A next step would be to compare the impact of poor health among men (e.g. Barclay & Kolk 2019) and women, and ideally also within couples. If we find that poor health impacts equally in childless men and women although women are 'burdened' by pregnancies and subsequent nursing periods, this may indicate that women value parenthood more strongly.
51. On the other hand, poor health was expected to reduce fertility as it may reduce persons' perceived ability to be healthy and caring parents, economically and otherwise. This could not be directly explored by our data. However, there was a strong 'self-selection' into parenthood, as indicated by the difference between women using SA as opposed to LTB, and we found that the 'healthiest' women in suboptimal health chose to have children. This may indicate that women take considerations of this kind into account when they decide to opt for parenthood. Furthermore, the association between poor health appears to be particularly strong for firstborns. Whether this might relate to the fact that these women are doing worse in the 'partner market' should be examined further. The association is somewhat weaker for second births, and again weaker for third births, but the trends are similar. In other words, health status appears to matter the least for third births. This might imply that there is a selection of relatively healthy women into motherhood, and subsequently in accordance with the 'two-child' norm – but that this selection has been largely 'taken out' for women at risk for having a third child.
52. We have shown that the use of both short-term benefits, i.e. sickness absence, and longer-term health-related benefits has a bearing on fertility, for all parity transitions. However, there are marked differences between short-term and longer-term benefits: While the use of sickness absence is positively associated with childbirth, the opposite is the case for longer-term benefits. Long-term benefits are likely to indicate a worse health than sickness absence and are normally only granted if health is *really* poor and unlikely to improve. Such benefits are, however, relatively rare, and thus unlikely to explain much of the observed decline in fertility. On the other hand, such uptake is increasing in Norway. The use of sickness absence, positively associated with fertility is, on the contrary, decreasing over time. If this decrease indicates a stronger labor market attachment and a preference for careers over motherhood among women in fertile ages, it might help explain parts of the observed decline. The use of health-related benefits by women in fertile ages deserves more attention, both to ensure that women in various states of health can reach their desired family size, but also to ensure that women with suboptimal health do not have to forgo children due to difficulties with combining family and work life.

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