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**Effects of the Spanish Influenza pandemic on fertility and
nuptiality in Norway**

By

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Introduction¹

The Spanish Influenza pandemic of 1918-1920 is one of the worst demographic disasters ever. The global death toll was between 50 and 100 million, five to ten times the death toll of the First World War (Johnson 2000). Apart from influenza, complications of influenza, particularly pneumonia, was an important cause of death during the pandemic. In Norway, 15 000 deaths were recorded in a population of 2.6 million (Mamelund 1998). Two thirds of the deaths occurred in the last quarter of 1918. The first pandemic wave was relatively mild and started during the spring and summer of 1918, either in China or in USA (Shortridge 1999). The second wave was highly virulent, took a great mortality toll, and occurred during the fall of 1918. The third wave broke out during the first months of 1919, and claimed fewer deaths as the first waves left some immunity and the most susceptible individuals was eliminated by death. Spanish Influenza hit people in the most fertile and productive ages (15-40 years), often newly wed or those planning to start a family (Mamelund 1999). This gave a sharp rise in the number of young widowed people and a decline in marital fertility. Nevertheless, the pandemic has been largely forgotten and until recently bypassed by demographers.

The objective

The objective of this paper is to assess the demographic impact of Spanish Influenza morbidity and mortality on fertility and nuptiality in Norway. In the first part, I will present a theoretical framework based on previous studies on the field. In the second part, I analyze short-term (1918-1920) term national reproductive consequences of Spanish influenza. Following questions will be addressed. First, did conceptions fall when morbidity and mortality peaked in 1918? Secondly, did high morbidity among pregnant lead to higher maternal mortality, more abortions and stillbirths, and thus fewer live births in 1918? Thirdly, is “lost” conceptions and pregnancies in 1918 caught up in 1919 and materialized as births in 1920? In the third part of this paper, I analyze whether medical districts with high Spanish Influenza morbidity and mortality in 1918 have low birth rates in 1919 and high birth rates in 1920. I shall use aggregate data for 351 medical districts in Norway in the years 1918-1919, and use least square regression to estimate a number of regression models. I control for possible confounding factors such as wealth, ethnicity, occupational structure and geography. In the fourth and last part of this paper, I analyze the long-term (1918-1963) national reproductive consequences of Spanish influenza. In order to assess the loss of future national reproduction, I will estimate the number of births that the female epidemic

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victims could have expected to achieve during their reproductive periods had they survived. I also give estimates on the immediate impact on nuptiality. Following questions will be addressed. First, how many lost a marriage partner due to Spanish Influenza? And secondly, how many did not marry as a result of Spanish Flu deaths among bachelors and prospective spouses?

Part 1. A theoretical framework

Pools' (1973) analysis of the impact of the flu on fertility and nuptiality among the Maoris on New Zealand was one of the first studies in this field. Höijer (1959) did a study for Sweden earlier than Pools, but Höijer's analysis was less comprehensive and part of a larger descriptive approach to Sweden's population history. Later, Rice (1983), Underwood (1983), Mills (1986), Bartiaux (1994) and Johnson (2000) have analyzed the effect of the Spanish Influenza on fertility and nuptiality for New Zealand, Guam, India, Italy, and England and Wales respectively.

There are at least four possible reasons why we should expect cyclical movements in fertility and nuptiality during Spanish Influenza and the First World War. In this section, I start to discuss the effect of voluntary postponement of conceptions. Thereafter, I discuss the effect of the Spanish Influenza on marriages dissolved by death, death and diseases of pregnant women and biological mechanisms of pregnancy and breast-feeding.

i) Behavioral effects

Coital frequency was probably reduced if one or both of the spouses were struck by the flu (loss of libido). It is also possible that healthy couples avoided sleeping together during the pandemic in order to reduce the chances of being infected (Mills 1986). The postponed conceptions and pregnancies in 1918 would be expected to materialize in 1919 and 1920 as normal sexual relations were taken up in 1919. These short-term effects would only be observed in cases where both spouses survived the flu.

ii) Marriages dissolved by death

This factor has received most attention in previous studies (see Pool 1973, Rice 1983, Underwood 1983, Mills 1986 and Åman 1990). Death among married couples in reproductive ages could reduce both short- and long-term fertility patterns. The opportunity of remarriage and reduced mortality in the years after 1918 can of course, help to reduce the loss in fertility if a widow in her reproductive age and a surviving widower promptly married a man and a younger woman respectively (Mills 1986, Underwood 1983). This, however, assumes a continuing presence of significant numbers of unmarried females and males in the population (Underwood 1983).

It is also likely that deaths among unmarried women in reproductive ages resulted in a decrease in marriages, and thus reduced future births. Marriage ceremonies may also have been postponed as a result of the pandemic, either because of illness, or because the death of a near relative made it inappropriate to marry (Mills 1986). Moreover, marriage ceremonies had to be cancelled if one of the prospective spouses died. This could give fewer births in a long-term perspective, but the effect would probably be minimized if the widowed found another marriage partner.

iii) *Death and diseases in connection with pregnancy and birth*

Women in pregnancy, especially those in the last trimester, were extremely vulnerable to spontaneous abortions and stillbirths if they were struck by fatal influenza (Harris 1919, Bourne 1922). Shortage and rationing of food during the First World War probably increased the risk of dying if struck by bacterial complications after Spanish Influenza, for example pneumonia. Being generally vulnerable, a pregnant woman was extremely susceptible if poorly fed. Two investigations report that one fifth to half of pregnant women struck by fatal influenza died (Bland 1919, Harbitz 1919, Harris 1919). The high mortality of the pregnant is not only explained by vulnerability and poor nutrition, but also by the fatal correspondence of reproductive ages 15-49 and Spanish flu victims being mainly 15-40 years. Mortality was also high for mother and child in connection with birth if struck by fatal influenza.

The nutrition of a mother in her early life, in the period before conception, and most importantly, during her pregnancy, will affect birth weight of her children (Rosenberg 1988). Susser and Stein (1994) have shown that exposure to the Dutch Famine 1944-1945 during the last trimester of pregnancy reduced fetal growth including birth weight (see also Ravelli et al. 1976). It is also possible that Spanish Influenza weakened the birth cohort of 1918 (Wilmoth et al. 1990). First, newborns, being extremely vulnerable, may have developed various complications, especially of the respiratory system, which left their after-effects. Second, as with all viral illnesses, the flu must have been the source of numerous congenital diseases and deformations for the children of women struck ill during early pregnancy (*fetal origin hypothesis*). MacKenzie and Houghton (1974) have summarized some reports implicating influenza virus as a cause of maternal morbidity and congenital anomalies, especially those of the central nervous system.

iv) *Biological conditions*

The positive effect of breast-feeding on birth spacing disappears if a stillbirth occur during a crisis or if infants die (Watkins and Menken 1985, Lee 1990). Interruption or a lack of lactation

shortens postpartum amenorrhea, the period in which the mother has a lower risk of another pregnancy. Moreover, women who fail to conceive are not pregnant when the crisis is over. This would leave a larger proportion of the female population of reproductive age at risk of another pregnancy. This means higher risk of another pregnancy in short time, even during the crisis (Juhasz 1971). Temporary sterility in connection with epidemic influenza has been observed, but only for men (Biraben 1973). This effect could reduce the effect of lost breast feeding on the risk of a new pregnancy.

Results

Part 2. Short-term effects of Spanish Influenza on fertility and nuptiality

The effect of the flu on conceptions, pregnancies and births

In a number of European countries at war, total fertility rate (TFR) declined dramatically 1914-1918. In neutral Norway, however, this was not the case. Indeed, TFR fell by 7 per cent from 1914 to 1915, but in the years 1916-1918 TFR was close to the pre-war level (Table 1).

Table 1. Live births, crude birth rates (CBR) and total fertility rate (TFR) in Norway 1912-1923

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Live births	61 409	61 294	62 111	58 975	61 120	63 969	63 468	59 486	69 326	64 610	62 908	61 731
CBR	25.4	25.1	25.1	23.6	24.2	25.1	24.6	22.9	26.3	24.2	23.3	22.8
TFR	3.7	3.6	3.6	3.4	3.4	3.5	3.4	3.2	3.6	3.3	3.2	3.1

Source: Brunborg and Mamelund 1994

The first scattered cases of Spanish Influenza appeared in the first week of April 1918, but are not reported in the official statistics as influenza (Mamelund 1998, Figure 1). The crude death rate during the winter and spring of 1918 is also lower than expected. The increased influenza activity in April may explain why the conception rate did not increase from March to April as was seen in the three previous years (Figure 1). The fall in conceptions from April to May is partly explained by normal seasonal fluctuations, but the fall is larger than expected. Conceptions are normally most frequent during the summer months of June, July and August. In 1918 a continually decline in conceptions was seen from June to October. The expected correspondence between peak morbidity and mortality on the one hand and low conception rates at the other hand were not

striking (r of monthly rates 1918-1920 equals -0.47 and -0.38 respectively).² The decline in conceptions from June to July and the bottom level in October are, however, probably due to the summer and autumn waves of influenza respectively.

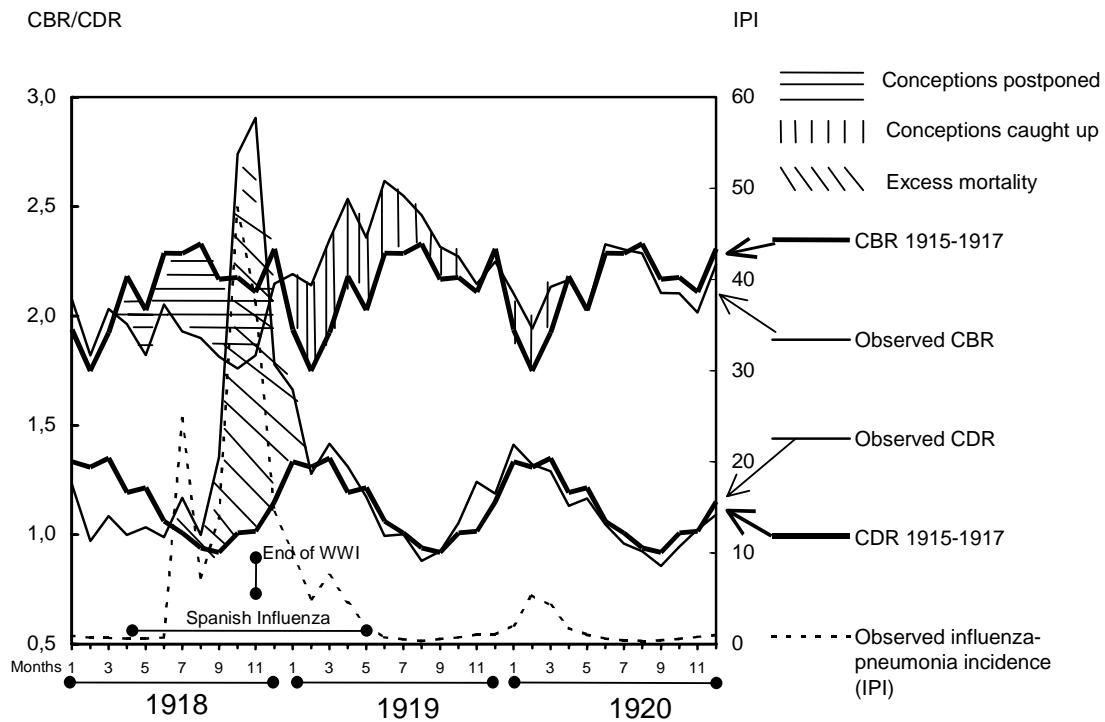


Figure 1. Influenza-pneumonia incidence (IPI), crude death rate (CDR) and crude birth rate (CBR) in Norway 1918-1920*

* Birth dates are moved back 9 months to date of conception (still births included).

Sources: DCM 1922, 1923, 1924, and SSB 1920a, 1920b, 1921a, 1921b, 1923c, 1923d.

In November 1918 mortality peaked and morbidity was still high. Nevertheless, the conception rate in this month increased from October. This is probably due to the celebration of the end of First World War 11 November. The postponements of conceptions and pregnancies and conceptions and pregnancies that never came as marriages were dissolved by death in 1918, were more than compensated by excess conceptions and pregnancies in 1919 and the first three months in 1920 (Figure 1). Spanish Influenza probably postponed the post First World War “baby-boom”. As the war ended in November 1918 one should expect a rise in births in the five last months of 1919. Although conception rates increased in November 1918 to March 1919 (excess rates only in 1919), births declined by 4 000 to 60 000 from 1918 to 1919 (Table 1, Figure 1).

² The correlation coefficient between mortality and conceptions 1915-1917 (average) is -0.76 .

Approximately 9 per cent (350 births) of the decline from 1918 to 1919 are due to fewer women at risk of a pregnancy (excess mortality among women 15-49 years 1918 is multiplied by age specific birth rates 15-49 years 1919). Obviously, conceptions that were supposed to occur during the last nine months of 1918 were postponed to 1919. The effect of postponed conceptions in 1918 and births in 1919, was more than compensated by the high level of conceptions in 1919 and births in 1920. Nearly 70 000 births were recorded in 1920 (Table 1). The 1920 cohort is the second largest birth cohort in the last century, only beaten by the Second World War “baby-boom” cohort of 1946 with 70 747 births.

Spontaneous abortions, stillbirths and health of new-born babies

There was no significant increase in spontaneous abortions from 1917-1918 (Table 2). Stillbirths, however, increased by 100 in 1918 compared to the average 1916-1917 (Table 3, Figure 2). What is striking is the marked fall in both spontaneous abortions and stillbirths from 1918 to 1919. An explanation to this may be a smaller pregnant population at risk than normal at the beginning of 1919 due to deaths of pregnant women in 1918. This is however, probably counteracted by a larger proportion of the female population of reproductive age at risk of another pregnancy in 1919, as a substantial number of women failed to conceive in 1918. The weakest fetuses were probably also eliminated by spontaneous abortions or stillbirths in 1918, leaving fetuses with higher risk of a livebirth in 1919.

Table 2. Spontaneous abortions (5-7 months of pregnancy) in Norway 1915-1925*

	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Total	438	455	491	505	422	443	470	433	488	554	536
Male fetus	236	263	255	272	239	244	263	227	268	312	289
Female fetus	202	192	236	233	183	199	207	206	220	242	247

* Abortions, still births (7-9 months of pregnancy) and deaths during the first 24 hours are combined from 1922 and onwards.
Source: DCM 1918-1929

Table 3. Monthly stillbirths (7-9 months of pregnancy) in Norway 1916-17 (average), 1918 and 1919

	Total	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
1916-17	1 411	126	129	119	132	130	114	120	106	107	110	108	110
1918	1 511	117	119	153	109	111	120	116	125	130	146	152	113
1919	1 387	114	103	126	110	109	92	97	114	124	121	134	143

Source: SSB 1920b, 1921a, 1921b and 1923c.

Stillbirths as a percentage of live births and stillbirths increased markedly from 1918 to 1919 (not shown in a table or figure). This is probably explained by the heavy death toll paid by young pregnant women, especially those in the last trimester (SSB 1926a). A higher percentage of total births thus fell on older mothers that have higher risk of stillbirths compared to younger mothers. The number of new marriages increased moderately from 1919 to 1920 (Table 5). As a result, more births fell on young mothers and stillbirths as a percentage of stillbirths and live births declined (SSB 1926a). However, a significant proportion of marriages was probably remarriage of older women. I have not controlled for the average age of first marriages and remarriages in these analyses.

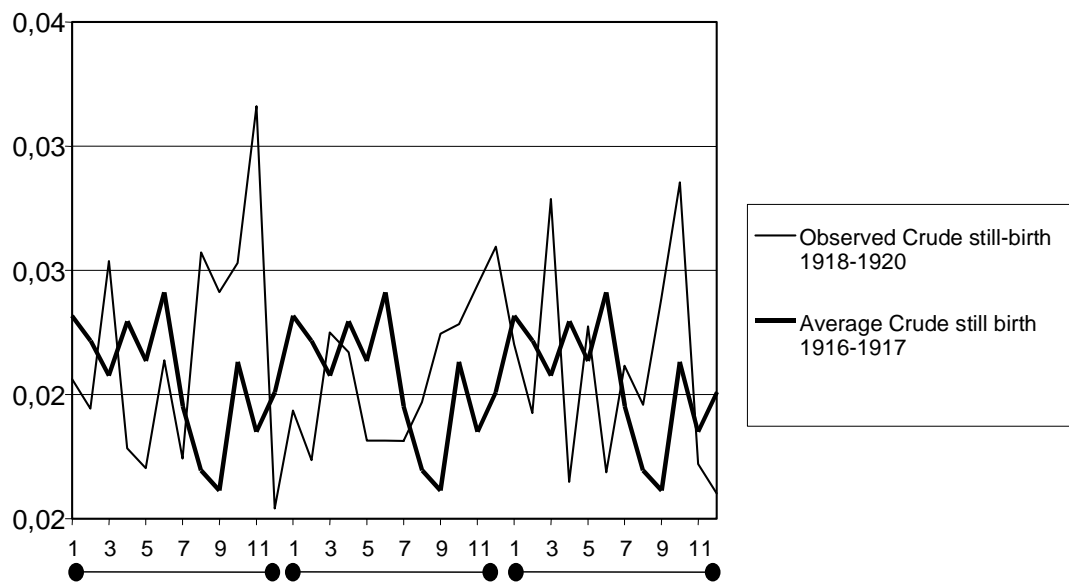


Figure 2. Crude stillbirth rate (7-9 months of pregnancy) in Norway 1916-1917 (average) and 1918-1920 (observed)

Source: SSB 1920b, 1921a, 1921b, 1923c and 1923d.

As reported above, exposure to famines and epidemics during the last trimester of pregnancy can reduce fetal growth including birth weight, and give numerous congenital diseases and deformations of a new-born child (MacKenzie and Houghton 1974, Ravelli et al. 1976, Wilmoth et al. 1990, Susser and Stein 1994). It is beyond the scope of this paper to test the fetal-origin hypothesis and Spanish Influenza. There were no famines in Norway in 1918-1919, but due to rationing and shortage of food during the First World War, the nutrition of pregnant women might have been affected negatively. One study of the city of Bergen indicates that the birth weight of

newborn babies fell during the spring of 1918 due to rationing of food.³ The weight of infants that were breastfed, on the other hand, increased in Bergen 1918 (Looft 1919).⁴

Maternity mortality

It is difficult to estimate deaths in pregnancy and childbirth associated with Spanish influenza and pneumonia. First, there are difficulties of separating the effect of pregnancy and the effect of the peculiar age pattern of Spanish Influenza. This problem, however, can be solved comparing death rates of all women 15-49 years with that of pregnant women. Second, as deaths connected to pregnancy and childbirth in the official statistics are not cause-specific, it is difficult to estimate the effect of Spanish Influenza on deaths of pregnant women. The excess deaths and death rates connected to pregnancy and childbirth may, however, be associated with influenza and pneumonia.

Table 4. Monthly deaths connected to pregnancy and childbirth in Norway 1915-17 (average), 1918 and 1919

	Total	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
1915-17	129	12	13	11	11	13	9	9	10	9	13	8	12
1918	153	3	5	8	11	4	8	4	14	13	31	37	15
1919	125	16	11	10	11	11	11	9	6	13	9	9	9

Source: DCM 1918, 1920, 1921, 1922, 1923

Only October and November 1918 had significantly higher number of deaths from disease of pregnancy and childbirth compared to the average of 1915-1917 (Table 4). Around 50 deaths connected to pregnancy and childbirth may be due to influenza and pneumonia in these months that coincided with the peak in excess morbidity and mortality (Figure 1). The probability that the fetuses of these women also died is high. The excess death rate of pregnancy and childbirth October and November 1918 was 2.5 per 1 000 pregnant women, assuming that all deaths occurred to women in the last trimester.⁵ The excess death rate (1915-1917 normal) of all women 15-49 years, on the other hand was 5.3 per 1 000 in 1918. Can we conclude from this that pregnant women had lower death rates than that of all women 15-49 year? The nutrition status in neutral Norway was not as badly affected as in the countries at war. In addition, the death rate of all women 15-49 was probably higher in October and November 1918 than the average 1918-figure shows, which makes

³ Looft (1919) found that the percentage of babies born in Bergen April-June 1918 (period of heavy rationing) weighting less than 3 000 gram increased from 16.4 to 19.4 per cent compared to the same months in 1917. This may be the effect of both shortage of food in 1917 and rationing in 1918.

⁴ Shortage and rationing of food did not lessen the quality of the mother's milk, and as a reaction to the general shortage and rationing of cow-milk, infants were breastfed longer.

the pregnant mortality even lower compared to all women 15-49 years. On the other hand, there are reasons to believe that deaths of pregnant women, especially those in early pregnancy, are under-registered.

The effect of the flu on nuptiality

1920 represent the top of a marriage boom in the years 1914-1920 (Table 5). The boom in marriages are probably due to the economic boom during the First World War, relatively large birth cohorts reaching typical age of marriage, and low rates of emigration (SSB 1926a).

Table 5. Contracted marriages (CM) and marriages dissolved by death (MDD) in Norway 1915-1925*

	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
CM	15 940	17 312	18 086	20 019	15 379	18 460	18 063	17 185	16 963	16 586	16 214
MDD	10 970	11 072	10 953	14 526	11 663	10 783	10 182	10 968	10 734	10 642	10 454

* Source: Mamelund, Brunborg and Noack (1997).

A new and more restrictive marital legislation imposed from 1. January 1919 (legal age of marriage of women increased from 16 to 18 years, for men minimum age was 20 years) led to unusually high number of marriages in 1918 (Table 5). Approximately 2 000 couples that were supposed to marry in the first half of 1919 married in December 1918. Taking account of this, the decline from 1918 to 1919 is then moderately 640 marriages of which 150 probably due to deaths among bachelors, see below. The hypothesis of a fall in contracted marriages during the period of high morbidity and mortality fall 1918 is not supported (Figure 1, Figure 3). The number of contracted marriages actually increases every month from August to December 1918, as is consistent with the normal seasonal pattern of marriage in Norway (Figure 3). It is, however, possible that without the new marriage law, fewer than normal would have married in this period (i.e. the law probably gave incentives to marry also in these months, not only in December).

⁵ The population at risk is 20 000, estimated by the number of live-births in the period August-November 1918.

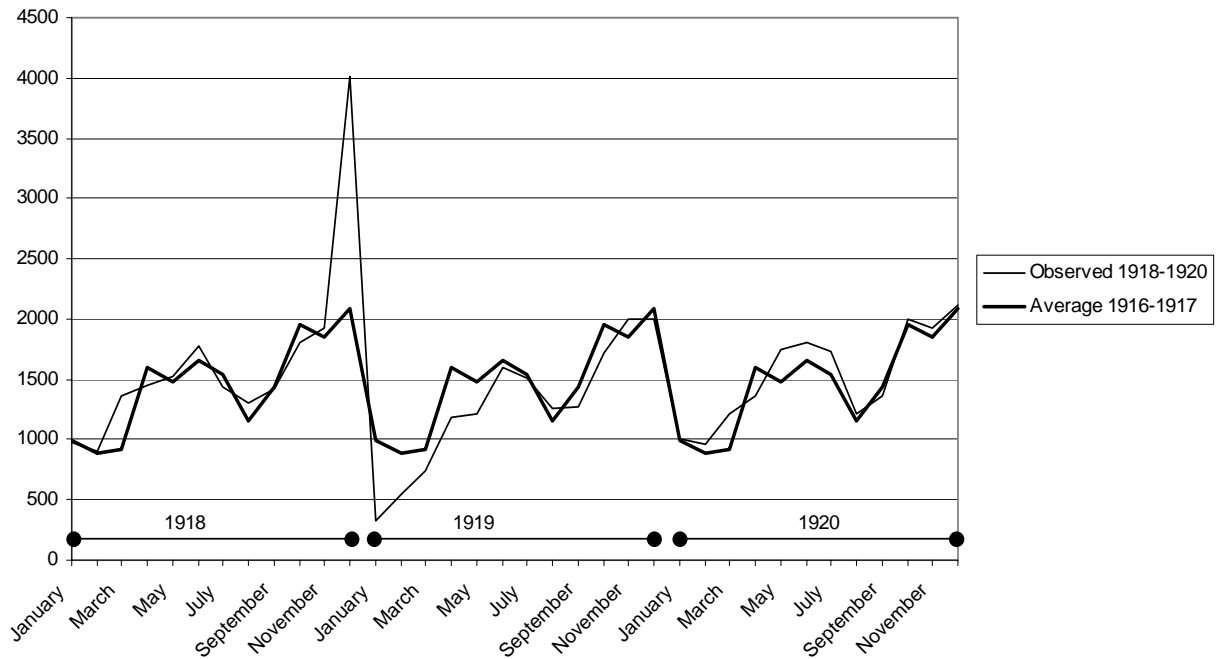


Figure 3. Contracted marriages in Norway 1916-1917 (average) and 1918-1920 (observed)

Source: SSB 1920b, 1921a, 1921b, 1923c and 1923d

Part 3. A multivariate analysis of the effect of Spanish Influenza on fertility⁶

In this section, I analyze whether medical districts with high Spanish Influenza morbidity and mortality in 1918 have low birth rates in 1919 and high birth rates in 1920. I use aggregate data for 351 medical districts in Norway in the years 1918 and 1919, and apply least square regression to estimate a number of regression models. The fertility decline in Norway started among the upper classes in the cities in the 1880s (Sogner et al. 1984). The relatively high fertility in rural areas among the fishing and farming population lasted until the 1950s. Of ethnic groups, the indigenous Sami population, which mainly lived in northern Norway, had higher fertility levels than the majority population of Norwegians and another minority population, Finnish immigrants and their descendants (Torgersen 1956, Jonassen 1964). In order to demonstrate any independent effect of Spanish Influenza morbidity and mortality on fertility, I control for the urban/rural effect as well as wealth, ethnicity and occupational structure (see independent variables in Table 6).

⁶ An analysis of the effect of morbidity and mortality on regional *nuptiality* cannot be carried out as data on marriages are only published at the level of the nation as a whole. In addition, the hypothesis of fewer marriages during the period of high morbidity and mortality was not confirmed (see Figure 3).

The dependent variables in the regression models are the standardized fertility ratios (SFR) of 1919 and 1920 (Table 7). They are in logarithmic form, since they cannot attain negative values. Because the SFRs are not observed, but estimated, weighted least squares (WLS) estimation was applied, using the inverse of the estimated variance for each SFR as weights.⁷ The standard set of fertility rates used to calculate SFR, is that of the national age specific fertility rates of women 15-49 years 1919 and 1920 respectively (Brunborg and Mamelund 1994). An SFR above 100 indicates that the medical district in question has higher fertility than the national standard, while ratios below 100 represent lower than average fertility.

Table 6. Independent variables

Variables	Source	Descriptive statistics				
		Count	Min	Max	Mean	St. dev.
<i>Spanish Influenza morbidity and mortality:</i>						
<i>SIR, July-September 1918</i> ¹	Mamelund 1998	118 150	0.0	111.3	14.6	16.7
<i>SIR, October-December 1918</i> ¹	Mamelund 1998	257 980	0.0	515.1	81.4	65.4
<i>SMR 1918</i> ²	Mamelund 1998	12 011	0.0	584.3	100.1	65.1
<i>Ethnicity:</i>						
% Finns	SSB 1923a	7 309	0.0	46.8	0.6	3.7
% Sami	SSB 1923a	19 328	0.0	93.8	1.7	8.0
<i>Socio-economic status:</i>						
Average wealth per person (in 1918 Nok.) ³	SSB 1920	10.2 bill. Nok	399.3	26 271	2 848	2 442
<i>Geography:</i>						
Urban (1), rural (0)	Mamelund 1998	60 (1)	0	1	0.2	0.4
<i>% (15-70+) occupied in:⁴</i>						
Fishing	SSB 1923b	57 719	0.0	43.3	5.6	9.3
Agriculture, forestry, hunting and cattle breeding	SSB 1923b	667 800	0.0	55.0	25.2	14.8

¹ SIR = Standardized incidence rate for influenza-pneumonia. The mean SIR is far from 100 as incidence in the standard rates (the city of Bergen, Hanssen 1923) is based on a census (with incidence close to actual incidence) whereas the incidence in each medical district is based on reported figures (with high degree of underreporting). The underreporting was probably lowest during the highly virulent fall wave of 1918.

² SMR = Standardized mortality rate for influenza-pneumonia. The standard rates are the national age-sex-specific rates of 1918 (DCM 1922)

³ This includes an estimate of cash holdings and the value of among others real estate and furniture (Soltow 1965).

⁴ In those parts of the country where fishing was combined with farming, it was difficult (for the enumerators) to decide which of the two occupational groups an individual belonged. Only 36 per cent of those who reported fishing to be their main occupation had fishing as their only occupation. In addition, 45 per cent reported fishing as their second occupation (SSB 1923b, 1926b).

⁷ The estimated variance of SFR is B/E^2 , where B is the observed number of births and E the expected number (Namboodiri 1991:59). The estimated variance of $\log(\text{SFR})$ is approximately equal to (using the Delta method) $1/(\text{SFR})^2 * (B/E^2) = 1/B$. Thus the weight of $\log(\text{SFR})$ is equal to B. Similarly, the weight of the independent variables $\log(\text{SIR})$ and $\log(\text{SMR})$ equals the observed number of cases and deaths of influenza-pneumonia in 1918.

Table 7. **Dependent variables**

Dependent variables	Source	Descriptive statistics				
		<i>Count</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>St. dev.</i>
SFR 1919	DCM 1923	59 486	39.5	219.5	109.9	25.9
SFR 1920	DCM 1924	69 326	51.9	212.1	116.2	26.3

The results of the regression analyses are presented in Table 8. The hypothesis is that areas with high morbidity and mortality in 1918 have low SFRs in 1919 (low conception rates in 1918) and high SFRs in 1920 (high conception rates in 1919). The postponement-hypothesis is not strongly supported. Only influenza-pneumonia morbidity during the summer of 1918 is negatively associated with SFR. According to model 1b, an increase in incidence by one percentage point gives a decrease in SFR of 2.2 per cent (only significant at 0.10-level), all other factors the same (the coefficient of morbidity summer of 1918 is also in the hypothesized direction, although not significant (model 1a)). The catch-up-hypotheses, however, is to a large degree supported. Both influenza-pneumonia morbidity October-December 1918 and influenza-pneumonia mortality in the whole year of 1918 is positively associated with SFR. An increase in autumn incidence and mortality in 1918 as a whole by one percentage point gives an increase in SFR of 1.6-2.2 and 0.6-0.8 per cent respectively, all other factors the same (only incidence, however, show a significant effect (model 2b)). The effect of the other socio-economic and regional variables is basically in the expected direction (to the extent that they were significant).

Table 8. Results of linear regression analyses for log standardized fertility rates (SFR) 1919 and 1920

Dependent variables →	SFR 1919		SFR 1920	
	Model 1a	Model 1b	Model 2a	Model 2b
LogSIR, July-September 1918	- 0.0165	- 0.0218*	- 0.0056	- 0.0160
LogSIR, October-December 1918	0.0207	0.0242**	0.0163	0.0224**
LogSMR 1918	0.0267	0.0308*	0.0060	0.0080
Wealth per person	- 0.0123***	- 0.0183***	- 0.0119***	- 0.0175***
Percentage of population (15+) employed in fishing ¹	0.0049***	-	0.0052***	
Percentage of population (15+) employed in agriculture, forestry, hunting and cattle breeding ¹	0.0029***	-	0.0034***	
Percentage Sami ²	- 0.0005	0.0012	- 0.0002	0.0015
Percentage Finnish ²	0.0036	0.0046*	0.0029	0.0036*
Urban (1), rural (0) ³	-	- 0.0768***	-	- 0.1005***
Constant	1.8997***	2.0077***	1.9466***	2.0710
N	351	351	351	351
Adjusted R ²	0.4532	0.4064	0.5429	0.4934

* p < 0.10, ** p < 0.05, *** p < 0.01

¹ The reference category is percentage of population (15+) occupied in Industry and service (trade, transportation etc.)

² The reference category is percentage Norwegians.

³ In model 1b and 2b, percentage occupied in agriculture etc. is not included as this variable is highly correlated with the urban-rural variable (r = - 0.73).

Part 4. The loss of future national reproduction and marriages

Averted births

In an assessment of “lost” or “averted” births due to the flu, it is not enough to count spontaneous abortions, stillbirths, and deaths of pregnant women (and fetus) in the years 1918-1919. An unknown number of births never happened since great losses occurred among women who had yet to complete their reproduction. The 5 300 excess female influenza-pneumonia victims of 1918-1919 (1911-1917 as normal period) could have expected to achieve 1 900 births over the remainder of their lives had they survived and experienced the cohort fertility and cohort mortality of the survivors (Table 9).

Table 9. Averted births by age (in parenthesis), period and cohort in Norway ¹

<i>Period</i>	<i>Cohort</i>								<i>Sum</i>
	<i>1914-1918</i>	<i>1909-1913</i>	<i>1904-1908</i>	<i>1899-1903</i>	<i>1894-1898</i>	<i>1889-1893</i>	<i>1879-1888</i>	<i>1869-1878</i>	
<i>1918</i>	(0-4)	(5-9)	(10-14)	(15-19)	(20-24)	(25-29)	(30-39)	(40-49)	
<i>1923</i>	(5-9)	(10-14)	(15-19)	(20-24)	(25-29)	(30-34)			
<i>1928</i>	(10-14)	(15-19)	(20-24)	(25-29)	(30-34)	(35-39)	(40-49)		
<i>1933</i>	(15-19)	(20-24)	(25-29)	(30-34)	(35-39)	(40-44)			
<i>1938</i>	(20-24)	(25-29)	(30-34)	(35-39)	(40-44)	(45-49)			
<i>1943</i>	(25-29)	(30-34)	(35-39)	(40-44)	(45-49)				
<i>1948</i>	(30-34)	(35-39)	(40-44)	(45-49)					
<i>1953</i>	(35-39)	(40-44)	(45-49)						
<i>1958</i>	(40-44)	(45-49)							
<i>1963</i>	(45-49)								
<i>Sum</i>	<i>262</i>	<i>88</i>	<i>123</i>	<i>291</i>	<i>482</i>	<i>444</i>	<i>194</i>	<i>19</i>	<i>1902</i>

¹ Averted births are estimated by exposing the Spanish Influenza victims to both cohort mortality (Brunborg and Mamelund 1994) and cohort fertility (Mamelund and Borgan 1996). Net-migration is assumed to be zero.

In the calculations, I have only, however, estimated the direct loss of births. I have not included births of the grandchildren of the epidemic victims (indirect effect). I have also assumed that there are no selection effects of Spanish Influenza. I do not include any assumptions that the epidemic survivors have higher mortality in later life than the average of the cohorts considered.

Averted marriages

In 1918-1919, approximately 4 900, many young and newly wed, lost their spouse due to the Spanish Influenza (Mamelund 1999, Table 5).⁸ In 1918 alone, there was 1 900 more influenza-pneumonia deaths among bachelors and 2 000 more influenza-pneumonia deaths among married men above the age of 20 compared to 1917 (SSB 1926a). If the bachelors had survived and followed the observed age specific marriage rates (average of the period 1919-1922), an estimated 150 of them would have married in 1919 (SSB 1926a). This calculation assumes no

⁸ The estimate is calculated subtracting the number of marriages dissolved by death in 1918 (14 526) and 1919 (11 663) by the annual average in the period 1911-1917 (10 656).

distortions in the marriage market. If we had followed each cohort of victim bachelors some 30-40 years ahead from 1918, several more would of course have married. It is beyond the scope of this paper to pursue this question.

Discussion and conclusions

The demographic impacts of Spanish Influenza morbidity and mortality (10 000 deaths in the last quarter of 1918 alone) on fertility and nuptiality were considerable. More than 4 000 conceptions were probably postponed from 1918 to 1919 (some of them never catch up) due to a loss of libido, marriages dissolved by death, and deaths in connection with pregnancy and birth. The hypothesis that areas with high morbidity and mortality in 1918 had low fertility in 1919 was not strongly supported in the regression models. Approximately 9 per cent (350 births) of the decline from 1918 to 1919 are due to fewer women at risk of a pregnancy. Spontaneous abortions, stillbirths (100) and deaths of pregnant women (probably also the fetus) (50) gave fewer than expected live births in 1918 (maximum 500, which is the fall from 1917). The most striking, however, was not the high number of abortions and stillbirths in 1918, but the low number in 1919. This is probably explained by a selection effect. Spanish Influenza probably eliminated “weak” fetuses in 1918 and left fetuses with higher risk of surviving to a livebirth in 1919. The positive effect of breast-feeding on birth spacing declined among women that gave a still birth or lost their infants to the flu. In 1920, the 4 000 or more postponed “Influenza births” and another 6 000 postponed “war births” were catch up. The results of the regression analysis show that those areas with high Spanish Influenza morbidity in the last quarter of 1918 and high Spanish influenza mortality in the whole year of 1918 were associated with high fertility in 1920. The women who failed to conceive during the fall of 1918 had a high risk of another pregnancy in 1919 and later. This probably partly explains the high number of births in 1920 and 1921.

Women in pregnancy, especially those in the last trimester, were extremely vulnerable to spontaneous abortions and stillbirths if they were struck by fatal influenza, especially those poorly fed. In neutral Norway, however, pregnant women probably had lower mortality than in other countries at war with stronger effects of shortage and rationing of food.

Due to Spanish Influenza, a significant number of births never happened. The 5 300 excess female influenza-pneumonia victims of 1918-1919 could have expected to achieve 1 900 births over the remainder of their lives had they survived. In addition, 150 fetuses did not survive to a livebirth in 1918 as the mother aborted because of - or died of - Spanish Influenza. Thus, more than 2 000 births was averted due to Spanish Influenza. These calculations do not, however, include estimates on lost births of the grandchildren of the epidemic victims (indirect effects).

Spanish Influenza also had an effect on nuptiality. Due to a new and more restrictive marital legislation imposed from 1. January 1919, it is difficult to estimate the effect of high morbidity and mortality on the number of contracted marriages. When we look at the monthly figures for the second half of 1918, however, there are no departures from the normal seasonal pattern of marriages (except for the 2 000 extra marriages in December due to the new law). The Spanish Influenza did not affect the influx of marriages to the total married population. It did, however, contribute to heavy losses in the married population. Approximately 4 900, many young and newly wed, lost their spouse due to Spanish Influenza. This must have affected both short- and long-term fertility patterns. Spanish Influenza also took a great toll among bachelors. Due to a smaller bachelor population at risk, 150 marriages did not happen in 1919.

The effects of the Spanish influenza morbidity and mortality on fertility were considerable, both in 1918-1920 and later. The long-term effects are not only averted births. The large fluctuations in the cohort sizes in 1918-1920 have been visible in the age-structure of Norway in the whole twentieth century and still are.

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