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An egalitarian disease? Socioeconomic status and individual survival of the Spanish Influenza pandemic of 1918-19 in the Norwegian capital of Kristiania

Svenn-Erik Mamelund

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Department of Economics
University of Oslo

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An egalitarian disease? Socioeconomic status and individual survival of the Spanish Influenza pandemic of 1918-19 in the Norwegian capital of Kristiania

SVENN-ERIK MAMELUND

Abstract

The Spanish Influenza pandemic of 1918-19 was one of the most devastating diseases in history, killing perhaps as many as 50-100 million people worldwide. In addition to the high death toll and the high general lethality, the disease had a peculiar feature: the largest increase in death rates occurred among those between the age of 20 and 40 as opposed to the very young and the elderly, which is the more typical pattern of influenza epidemics. Furthermore, it appeared that it was the most robust population groups and the previously healthy that had highest mortality rates. Much of the literature favors the view that Spanish Influenza was class neutral with respect to mortality. This paper uses individual level data and applies Cox regressions to test the hypothesis that the blue-collar working class in 1918 suffered higher death rates from Spanish Influenza than the bourgeois and white-collar middle class in two parishes of the Norwegian capital of Kristiania (renamed Oslo in 1924).

Key words: Spanish Influenza mortality 1918-19, individual survival, Norway, event history analysis, Cox proportional hazards

Introduction

The question of whether socioeconomic status played a role in the mortality differentials associated with the Spanish Influenza pandemic of 1918-19, which may have killed an estimated 50-100 million worldwide (Johnson and Mueller 2002), has been under dispute since 1918. On the one hand are those who favor the view that Spanish Influenza was an "egalitarian" disease, that is, a disease that struck blindly and randomly since the pandemic introduced a new virus that few if any had the immunity to fight (Keyser 1918; Stevenson 1921; van Hartesveldt 1992; Tomkins 1992; Winter and Robert 1997; Johnson 2002). A possible reason for supporting this view is the fact that in 1918, the largest increase in the death rates all over the world occurred among those between the age of 20 and 40 as opposed to the very young and the elderly as is normally seen during annual influenza epidemics. Furthermore, a great deal of the literature then and now also refer to contemporary anecdotal reports from doctors and health personnel that the disease seemed to strike the most robust, rigorous and previously healthy members of society, and that even kings and presidents were laid low with influenza. On the other hand are proponents of the view that like tuberculosis and cholera, Spanish Influenza claimed higher death rates amongst the poor and the least well-situated than among the wealthy and privileged (Hersch 1920, 1932; Sydenstricker 1931; Zylberman 2003; McCracken and Curson 2003). Supporters of this view admit that the virus itself may have had certain classless attack properties. However, when the proportion of the sick that were dying of the disease is taken into consideration, it would appear that there were indeed clear differences in social status between those who succumbed to the disease and those who survived it.

Previous studies as to whether social status played a role in Spanish Influenza mortality have utilized individual as well as aggregate level data and applied methods that differ substantially in their degree of statistical sophistication. Several contemporary studies have used individual level data on incidence of illness and case fatality by age, sex, ethnicity, income, and household crowding from “influenza surveys” that were carried out during the course of the pandemic in 1918-19. Though the data from theses studies is based on self-diagnosis by the people who filled out the questionnaires, it is nevertheless the most reliable source for studying incidence and case fatality rates originating from Spanish Influenza. Bivariate cross tables from such studies of a number of cities in the United States and for the city of Bergen, Norway, showed that there was a strong positive relationship between household crowding and case fatality rates on the one hand, but a negative relationship between socioeconomic status as measured by income and status of occupation and case fatality rates on the other hand (Vaughan 1921; Hanssen 1923; Collins 1931; Sydenstricker 1931; Britten 1932). The association between the incidence of the disease and social status was comparable to that between lethality and social status, but was found to be less pronounced. No clear relationship between incidence and/or case fatality rates and occupation/crowding was found in a similar study of four cities in England (Great Britain Ministry of Health 1920).

Rice (1988) collected individual death certificates of Spanish Influenza victims for the whole of New Zealand to study the effect of age, sex, marital status, place of residence, and occupation on the death rates. His aggregate level analysis showed that people whose expected exposure to infection was greater in view of their occupation (such as those in retail and transportation, for example) had a higher than expected percentage of the epidemic death toll, as may be seen by the proportion of these occupation groups in the 1916 census. On the other hand, when occupations were ranked according to social status, no clear relationship to mortality was found. Since Rice (1988) did not do a multivariate analysis, he could not demonstrate whether occupation as a proxy of socioeconomic status had any effect on mortality net of parameters such as age, sex, marital status, or place of residence.

It is only in recent years that attempts have been made to estimate the effects of social status variables on Spanish Influenza mortality and to determine whether they are independent of other variables by using multivariate analysis. However, such studies have used aggregate data as opposed to individual level data. Johnson (2002) did not find any clear effect of social status or occupation and proportion of domestic servants on influenza mortality in 1918 net of the effect of existing health standards (infant mortality), household crowding, and various geographical variables in different regions in England and Wales. However, McCracken and Curson (2003) discovered higher death rates among the blue-collar working class than among professional and commercial groups in the various parishes of the city of Sydney, Australia, net of the effect of crowding and certain other social status variables. In a study of Norway, it has been documented that wealth and income had a negative effect on mortality net of the effect of ethnicity, household crowding, occupational structure, and diffusion of the disease in medical districts (Mamelund 2003b). Nevertheless, these studies do not demonstrate that the estimated aggregate effects of social status on Spanish Influenza mortality also apply at the individual level. Hence, the findings must be interpreted with caution and should be considered provisional. The estimated relationships may be consistent with the hypothesis that there were indeed class differentials with respect to Spanish Influenza mortality, but a causal relationship should not be assumed before the hypothesis is confirmed on an individual level.

This paper makes use of nominal death certificates that are linked to the nominal censuses of 1 February 1918 and 1 February 1919 for two parishes in the Norwegian capital of Kristiania (renamed Oslo in 1924) to test the hypothesis that the blue-collar working class suffered higher death rates from Spanish Influenza than the white-collar middle class and the bourgeois. The analysis is made by applying Cox-regressions and constitutes the first time that death certificates of Spanish Influenza victims have been linked to nominal census data to analyze individual survival of Spanish Influenza. As opposed to Rice (1988) who collected individual level data only for those who died of Spanish Influenza, this paper considers individual level data not only for those who died, but also for those who *did not* die from Spanish Influenza from 1 February 1918 to 1 February 1919 (However, it is not known whether a person ultimately came down with influenza or not). The link between the death certificates and the two censuses also give additional information about those who died other than that given on the death certificates such as marital status, and standard of housing characteristics (rarely available in the censuses of other countries at the time). Furthermore, it may be seen that it was very unusual for other cities or countries to carry out nominal annual censuses in the late 1910s. Hence the Norwegian data allows a very close follow-up of individuals from the start of the pandemic during the early spring of 1918 through to the end of it in the winter of 1919. Finally, registration of deaths and the implementation of the annual censuses were on the whole undisturbed by the First World War, as Norway was a neutral country.

This paper first presents the data and discusses issues related to estimation of exposure time and record linkage. It then proceeds with a presentation of the methods used in the descriptive as well as the statistical analysis, prior to presentation of the results. The paper ends with a discussion of possible explanations why socioeconomic status, as measured by occupation and certain other social status indices, might be related to Spanish Influenza mortality.

Data

Parishes

There are two reasons why the analysis is limited to the two parishes of Frogner and Grønland-Wexels, which tally approximately 41,000 individuals or 16 per cent of a total population in Kristiania of 260,000 1 February 1918.[1] First, significant differences in all-cause mortality as well as cause-specific mortality have been demonstrated to be existing between the traditionally poor high mortality parishes to the east of the city and the wealthy low mortality parishes to the west since the 1880s, making Grønland-Wexels (east) and Frogner (west) typical examples worthy of study (e.g. Gjestland and Moen 1988; Barstad 1997; Rognerud and Stensvold 1998). Kristiania of 1918 was a divided city, with large east-west differences with respect to income, wealth, and employment. These differences could also be seen in the stature and weight of individuals as a proxy of disease and nutritional history, standard of housing, sanitation, hygiene, and household crowding (e.g. Geirsvold 1917; Schiøtz 1920; Kristiania Statistiske kontor 1920; Statistisk sentralbyrå 1955). The five per cent that earned the highest incomes had 32.2 per cent of the total income in Kristiania in 1907 (Furre 1996). During the 1914-1918 war, the social differences may even have been more emphatic and reinforced. Most of the wealthy bourgeois and the white-collar and upper middle class in Kristiania lived in the western parishes, while the relatively poor blue-collar working class constituted the majority in the eastern parishes of the city. The selection of Frogner and Grønland-Wexels is thus assumed to give an adequate amount of variance in social status to be able to document social status differences in Spanish Influenza mortality, if these exist.

The second reason why only two parishes are elected for this study is that computerizing the census data for the whole city of Kristiania, which consists of 20 parishes, would have been too costly and time-consuming.

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[1] The parish of Wexels (approximately 5,000 inhabitants) is included in the analysis because it was merged with Grønland (approximately 18,000 inhabitants) in 1919.

Deaths

The nominal data on deaths that is used in this study is from the unpublished report *Anmeldte døde i Oslo 1918-1921*, which gives deaths by surname and first name, age at the time of death, primary and secondary cause of death, occupation, date of death, and *de jure* address (street name, floor and number) for the 20 parishes of Kristiania. The Norwegian Historical Data Center at the University of Tromsø and Bardufoss has computerized the nominal death certificates for the two parishes of Frogner and Grønland-Wexels, from the only available copy of this report in the Oslo City Archive. Deaths in *Anmeldte døde* are organized by parish and by date of death, and are handwritten copies of the original death certificates issued by the physician stating the date and cause of death of the deceased person. Spot tests of the report *Anmeldte døde* confirm that the handwritten copies of the original death certificates (also stored in Oslo City Archive but unfortunately only kept for 1918) were recorded with a high degree of accuracy.

Out of town deaths of persons with de jure address in Kristiania, for example the death of a seaman, are added in a separate section at the end of the report *Anmeldte døde*. Such deaths for individuals with de jure address in Frogner or Grønland-Wexel are of course included in the analysis. Since the age of each person at the time of death recorded in *Anmeldte døde* is reported for whole calendar years at the date of death, exact age at the time of death can only be estimated if the person in question is identified in the 1918 census, where date of birth is given. Then, exact age at the time of death is estimated by subtracting the date of death from date of birth.

Of the 608 all-cause deaths in Frogner and Grønland-Wexels from 1 February 1918 to 31 January 1919 (from *Anmeldte døde*), 41.2 per cent or 250 deaths are here linked with the Spanish Influenza pandemic, of which 81 and 169 deaths occurred in Frogner and Grønland-Wexels respectively. Fatal cases of the disease usually occurred when influenza was followed by bacterial complications such as bronchopneumonia and lobar pneumonia, or by viral or combined viral and bacterial pneumonia. Of the 250 deaths, two-thirds were caused by influenza and pneumonia, while the rest were deaths from other frequently reported complications (stated as secondary cause of death on the death certificates) following influenza (stated as primary cause of death on the death certificates). These might be for example emphysema, pleuritis, lung embolus, acute diarrhea, tetanus, nephritis, and cardiac failures (e.g. myocarditis or pericarditis), or other diseases that were diagnostically hard to separate from influenza and/or pneumonia and that might be labeled “acute catarrhs in the respiratory organs”, acute bronchitis and diphtheria, bronchial asthma, and chronic bronchitis. It should be pointed out that the data used here is not controlled for the fact that some of the 250 deaths considered also would have occurred during a normal epidemic influenza season (see Mamelund 1998).

When the individual deaths from these causes were aggregated by age, sex, and parish for the *calendar year* of 1918 and compared with official statistics on aggregate mortality along the same dimensions from Kristiania sundhetskommision (1919) for the calendar year of 1918, little or no difference was found. Hence, if it is assumed that the official statistics on deaths are complete and were "correctly" aggregated in 1918, it can further be assumed that the process of digitalization of the nominal death certificates 85 years later did not introduce any significant biases.

Population at risk

The data used to estimate the population at risk in Frogner and Grønland-Wexels is taken from the two censuses of Kristiania which were made on the night of 31 January to 1 February 1918 and 1919 (referred to 1 February throughout the paper). The original census data is stored in the Oslo City Archive and was digitalized by the Norwegian Historical Data Center at the University of Tromsø and Bardufoss (Thorvaldsen 1996). In the analysis, the exposure to mortality risks start at 1 February 1918. Right censoring is caused by deaths from other causes than those associated with Spanish Influenza, when moving out of the parishes considered and at the date of the last census. The number of days that each individual *de jure* homeowner including family members and tenants in Frogner and Grønland-Wexels was at risk of dying in the intercensal year of 1918-19 is estimated from the data given in the 1918 and 1919 censuses and in the report *Anmeldte døde i Oslo 1918-1921*. The population at risk also includes individuals who were permanently resident or working in hostels or institutions. Examples of institutions in the two parishes studied in this paper include a prison, a Red Cross nursing home, and a boarding school for deaf pupils, and some old people's homes.

Table 1. The population at risk in Frogner and Grønland-Wexels from 1 February 1918 to 1 February 1919.

Individuals followed			
From	To	Cases	Per cent
02.01.1918	02.01.1919	34,127	72.7
02.01.1918 or intercensal date of birth	Date of death	608	1.3
02.01.1918	Date of moving out of parish	6,087	13.0
Date of moving into parish	02.01.1919	5,591	11.9
Date of intercensal birth	02.01.1919	559	1.1
Total number of observations		46,972	100.0

Source: Oslo City Archive, Censuses of 1918 and 1919 for the parishes of Frogner and Grønland-Wexels.

A little over 500 individuals are not included in the analysis because they were not resident (*de facto*) in Frogner or Grønland-Wexels, double counted or crossed over by the census enumerators. The total number of observations is close to 47,000 (see Table 1).

Record linkage

Before linking the 1918 census to the 1919 census on the one hand and the 1918 census to death register on the other hand, the surname and first name of each individual in the two censuses were standardized with respect to spelling and phonetics (see Nygård 1992). The linking was carried out in several steps. First, date of birth, surname, first name, full name, an alphabetical reshuffling of full name, and address (street name, number, and floor), in that order, were used to identify whether a person in the 1918 census could be found in the 1919 census. Second, the death register was linked to the 1918 census to identify those that died after 1 February 1918 but before 1 February 1919. Third, individuals in the 1919 census that have birth dates or have reported to have been moving into Frogner or Grønland-Wexels after the time of the 1918 census were identified. The availability of several identification items, especially date of birth, made the links very secure.

This initial round of automatic linkage made it easy to make visual inspections of the death register and the two censuses in order to match more individuals and to detect and revise incorrect matches made automatically, including individuals matched more than once as well as those double counted (errors introduced in the process of enumeration or digitalization). The visual inspection included a comparison of the individuals living in *every* apartment in 1918 to that of 1919. Since a person's name could be entered differently in the two censuses, a semi-manual procedure to match more individuals was the search for candidates who had the same initials, full name, and different combinations of full name alphabetically reshuffled in 1919 as those of persons in 1918. Any matches made using this method could not be considered secure unless some other possible identification criteria also matched, such as day, month, year, place of birth, occupation and marital status, family structure, or address.

Assumptions for the exposure time of movers

Assuming that we had perfect information on the timing of the vital demographic events and no problems of matching, either automatically or manually, the following two "holes" nevertheless became apparent. The first was resident individuals found only in the death register (in principle, people who were born in or moved into Frogner or Grønland-Wexels *after* the 1918 census), and second, resident individuals found only in the 1918 census (in principle, people who had moved out of Frogner or Grønland-Wexels). The exposure time of children born after 1 February 1918 who died before 1 February 1919 and whose parents were residing in Kristiania 1 February 1918 is estimated as the difference between the date of death and the age reported in days or months (given in *Anmeldte døde i Oslo 1918-1921*). The start of exposure of infants born in the time between the two censuses and who moved into Frogner or Grønland-Wexels between the two censuses of course starts at the date that the family moved in (as reported in the 1919 census) and not the date of the baby's birth. For a handful of adults who are only found in the death register for whom it was impossible to find the person's spouse or family in the 1918 census, it is assumed that the individual moved into Frogner or Grønland-Wexels on 1 February 1918 (left censoring).

It was mandatory to fill in and submit change of address forms to Kristiania Population Registration Office within two weeks of moving. Unfortunately, the change of address forms from that period has been discarded and was thus not available for this study. The actual moving date of individuals resident in Frogner and Grønland-Wexels in the 1918 census can therefore not be established. However, since one of the questions in the censuses was "if you have moved in the time since the previous census, when and from where did you move to you present address?", the date of moving out as well as the exposure time of those only found in the 1918 census could nevertheless be estimated using the date that the new residents moved in (to the very same apartment and address) that only appears in the 1919 census. This may be a reasonable assumption in view of the extreme housing shortage and a vacancy rate of only 0.1 per cent of apartments in Kristiania during the 1914-18 war (Statistics Norway, *Statistisk sentralbyrå*, henceforth cited as SSB, 1955).

For 3,141 or 51.6 per cent of the individuals moving *out* of Frogner and Grønland-Wexels, the moving date could not be *estimated* from data given in the 1918 or 1919 census, while for 1,152 or 20.6 per cent of the individuals moving *into* Frogner and Grønland-Wexels, the moving date was not *reported* in the 1919 census or could not be *estimated* from data given in the 1918 census. For these individuals (who constitute 9.1 per cent of 47,000 observations) the date of moving in/out is therefore set at 2 August 1918, which is the date midway between the two censuses. Because the change of address forms sent to Kristiania Population Registration Office in 1918-19 have been discarded, the number of people who may have moved *into* Frogner or Grønland-Wexels after the census of 1 February 1918 but *out* again prior to the census of 1 February 1919 cannot be estimated.

There were three distinct groups of individuals in the 1919 census for which no date of moving into the parishes under consideration during the intercensal year of 1918-19 was given. The largest group was chiefly tenant maid servants followed by tenant students and other tenants. The maids in the cities basically changed jobs on "quarter day" which occurred on the third Tuesday in April and on the third Tuesday in October when the tenancy agreements and contracts of service expired (Søbye 2001). A new maid normally replaced her predecessor on the very same day. It therefore seems reasonable to assume that when the head of the household in the 1919 census does not specify the date in 1918 that a new servant moved in, the new servant moved in on the same date as her predecessor moved in 1917 (April 16 or October 15) adding one year (assuming that contracts of service on average were one year). Likewise, this date is also assumed to be the date when the previous servant moved *out* of the household in question. In cases where the head of household did not answer the question of when a new tenant moved in (whether a maid or some other person), the date of moving in/out is set at 2 August 1918 as described above. For students, this date is only four weeks before the fall semester, which generally starts 1 September, and should therefore be a good approximation for the actual date in which the move occurred. In cases where a whole family/household registered in the 1918-census is not found in the 1919-census, it is assumed that the family had moved out of the parish in question. The date of moving out/selling the flat is set equal to the date that the new family/household (including maids or other tenants) occupying the residence in question has reported to have moved in 1918 according to the 1919 census.

Independent variables

The data for the independent variables used in this paper is from the 1918 and 1919 census in Kristiania (Oslo City Archive). Descriptive statistics for the independent variables appear in Table 2. *Individual level characteristics*. Age for each individual is defined as exact age at last census (1 February 1919), and is estimated as the difference between date of last census and date of birth. In the analysis seven age categories are considered, chosen to reflect the W-age pattern of Spanish Influenza death rates (Table 2). For the individuals who appear in both censuses (73 per cent), the reliability of the date of birth given in each census was checked by comparing the two censuses. When major differences occurred, the date of birth that corresponded best to assumed differences between the age of spouses (3-4 years), between age of parents and first child (25 years) or between the ages of sibling was preferred. The rather skewed distribution between the sexes in the parish of Frogner may be explained by the large number of women who were employed as servants in the homes of the bourgeois (Table 2).

Five marital status groups, never married, married, widow/widower, separated, and divorced, are included in the analysis to control for the assumed protective and selective effect of marriage on mortality. Three social status categories and eight employment categories are defined.[2] The *bourgeois* include the clergy, high ranked military officers, immaterial employment, large scale retail, whole salesmen, chief executives, chief editors, professors, doctors, dentists, attorneys, Supreme Court Judges, engineers, ambassadors, consuls, high state officials, Member of Parliament, directors in banking/finance/insurance etc.

[2] The paper partly uses the occupation classification system developed by The Norwegian Historical Data Center, where occupation is categorized according to trade and according to hierarchical position in the trade. This system is especially constructed for a Norwegian historical context and is based on Langholm (1984).

Table 2. Distribution for the independent variables. All variables are dummy variables which take the value 0 or 1 (except for average number of persons per room).

	Both parishes		Frogner		Grønland-Wexels	
Variables	Count	Per cent	Count	Per cent	Count	Per cent
Total number of observations	46 972	100.0	21 845	100.0	25 127	100.0
Age						
0-4	3 182	6.8	1 176	5.4	2 006	8.0
5-14	6 266	13.3	2 200	10.1	4 066	16.2
15-19	5 088	10.8	2 365	10.8	2 723	10.8
20-39	18 986	40.5	9 773	44.7	9 213	36.7
40-59	9 209	19.6	4 458	20.4	4 751	18.9
60+	4 241	9.0	1 873	8.6	2 368	9.4
Sex						
Male	20 977	44.7	7 874	36.0	13 103	52.1
Female	25 995	55.3	13 971	64.0	12 024	47.9
Marital status						
Never married	30 221	64.3	14 722	67.4	15 499	61.7
Married	13 495	28.7	5 781	26.5	7 714	30.7
Widow/widower	2 772	5.9	1 158	5.3	1 614	6.4
Separated	336	0.7	54	0.2	282	1.1
Divorced	148	0.3	130	0.6	18	0.1
Employment						
Primary sector	437	0.9	157	0.7	280	1.1
Craft and industry	15 870	33.8	2 296	10.5	13 574	54.0
Sales and service	6 159	13.1	3 362	15.4	2 797	11.1
Transportation incl. seamen	3 813	8.1	979	4.5	2 834	11.3
Civil servants	3 269	7.0	1 808	8.3	1 461	5.8
Clergy, military, health, academic	3 533	7.5	3 220	14.7	313	1.3
Domestic servants	5 587	11.9	4 350	19.9	1 237	4.9
Bank, insurance, real estate, office	5 400	11.5	4 023	18.4	1 377	5.5
Occupation not stated	2 904	6.2	1 650	7.6	1 254	5.0
Social status						
Bourgeois	8 954	19.1	7 952	36.4	1 002	4.0
White-collar middle class	9 952	21.2	5 688	26.0	4 264	17.0
Blue-collar working class	25 949	55.2	7 057	32.3	18 892	75.2
Occupation not stated	2 117	4.5	1 148	5.3	969	3.8
Other social status variables						
Has bathroom	12 859	27.4	12 457	57.0	402	1.6
Has electricity for light	30 752	65.5	16 898	77.4	13 854	55.1
Average number of persons per room	1.7	-	1.1	-	2.3	
Has domestic servants	10 802	23.0	9 222	42.2	1 580	6.3

Source: Oslo City Archive, Censuses of 1918 and 1919 for the parishes of Frogner and Grønland-Wexels.

Examples of employees considered to belong to the *white collar middle class* are teachers, nurses, clerical officers, police inspectors and constables, customs officers, workers in the postal services, telegraph–messenger, port authorities, verger, sorter, porter, poor-relief assistant, cashier, small-scale retailers and the self-employed, and shop assistants. The *blue* *collar working class* includes workers in home crafts, craft factories, industry factories, transportation, quarrying industry, shipbuilding, sawmill, construction work, cleaning, seamen and servants.

The eight employment categories used in the analysis are the primary sector, craft and industry, sales and service, transportation, civil servants (teachers, police, post, telegraph, port authorities etc.), academic training (clergy, military, public health service, professors etc.), domestic servants, and banking/finance/real estate. All individuals are assigned their own scores on social status and occupation except for the following two cases: first, children below 18 years of age who have not yet entered the labor force and who do not have employment are assumed to have the same occupation and social status of occupation as the head of the household, typically their father; and second, housewives, who are given the same social status and employment status as their husbands. A retired person is given former employment if stated.

Household level characteristics. Four covariates on the level of households are defined. Three of these are categorical dummy variables (0/1) which describe whether or not the household members have a bathroom, electric light or domestic servants. The fourth is a continuous variable measuring the average number of persons per room.

Method of analysis

The analysis consists of two parts. The first part is descriptive, and looks into the spatial mortality of Spanish Influenza in the city of Kristiania as a whole. Standardized mortality ratios (SMR) of influenza and pneumonia for each of the 20 parishes are calculated. The correlations between the SMR's on the one hand, and different social status variables on the other hand are then estimated. In the second part of the analysis, the effects of different covariates upon those surviving Spanish Influenza are estimated using Cox proportional hazards models. The Hazard rate for the individual i with n covariates, X = (X_1, X_2,…., X_n), is modeled as

$$h_i(t) = h_0(t)e^{\{\beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n\}}$$

where t is time elapsed to death from Spanish Influenza and where baseline hazard $h_0(t)$ is a hazard function for an individual who scores zero on all n covariates.

Since the correlations between social status and employment are relatively high, in particular between the blue-collar working class and craft-industry employment (r=0.59) on the one hand, and between the bourgeois and academic employment on the other hand (0.44), social status and employment are analyzed in separate models to reduce problems with multicollinearity. Because the correlations between individual social status and employment on the one hand, and having a bathroom, electric light and domestic servants on the other hand, were also relatively high, these variables were not included in the same models.

Results

Descriptive analysis of the whole capital city of Kristiania

The first cases of influenza which are associated with the Spanish Influenza in Norway were reported in the first week of April 1918. However, the first scattered cases of influenza in Kristiania, which later proved to be the smoldering of a pandemic *wave*, occurred on 15 June 1918 (Mamelund 1998). It was not before the first week of July that the number of reported cases and deaths skyrocketed and took the dimensions of a pandemic wave. Figure 1 clearly shows the two outbreaks of Spanish Influenza in the second half of 1918, with peaks in the crude death rate and the influenza death rate in week 29 in mid July and week 44 at the end of October.

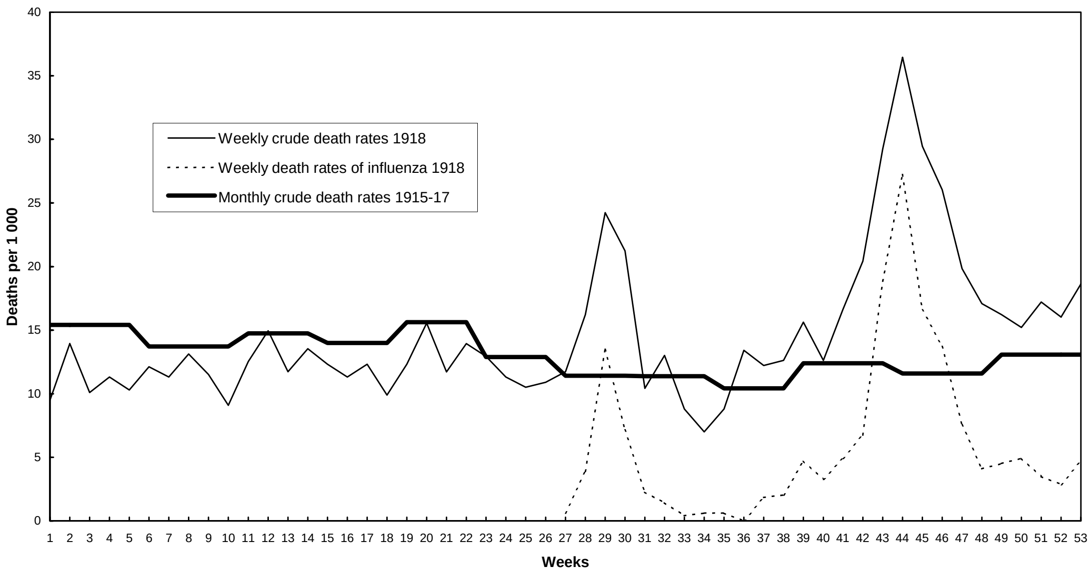

Figure 1. Weekly crude death rates and death rates from influenza in 1918 and monthly average crude death rates for the years 1915-17 in Kristiania.

Sources: Kristiania sundhetskommision 1919; Mamelund 2003a.

Furthermore, when comparing the weekly crude death rates in 1918 with the average monthly crude death rates of the non-pandemic years of 1915-17 which may be considered a norm for mortality levels, it may be seen that the excess in all-cause mortality is explained by an increase in influenza mortality. Unfortunately, weekly mortality figures for 1919 are not available. The mortality from Spanish Influenza for the whole city of Kristiania in the calendar year of 1918 was 20 per cent lower (significant at 0.01 level) than for the nation as a whole (Mamelund 1998).

Table 3. Spanish Influenza mortality and socioeconomic characteristics of 20 parishes in Kristiania 1918-19

Parish	Standardized mortality ratio for influenza and pneumonia		Per cent of pupils aged 7-15 that were underweight[2]	Average number of persons per room[1]	Proportion of households with		
					Maids	Bathroom	Electricity
Vor Frelser	96.6		12.2	1.4	23.2	20.4	72.5
Johannes	92.8		14.8	1.5	14.6	12.5	75.9
Trefoldighet	116.0		12.2	1.5	15.2	9.0	70.9
Jacob	90.1		12.2	2.1	5.4	1.7	80.1
Frogner	74.9	***	2.9	1.0	48.8	67.2	97.0
Uranienborg	81.2	*	7.0	1.1	39.3	42.0	95.0
Fagerborg	82.2	*	7.9	1.5	26.8	30.9	89.7
Gamle Aker	102.3		10.8	1.5	16.4	21.2	92.3
Markus	111.1		10.9	1.5	16.2	22.0	95.8
Sagene	108.5		13.6	3.1	2.3	2.9	78.9
Lilleborg	109.2		15.0	2.8	3.1	0.7	81.0
Paulus	88.4		12.4	2.4	2.5	0.1	76.0
Hauges	88.1		-	2.0	4.6	1.0	76.4
Petrus	132.9	***	13.6	2.9	3.0	0.1	62.0
Mathæus	88.2		-	2.3	3.2	1.9	71.0
Grønland	114.4		12.5	2.5	3.2	1.1	63.4
Wexels	158.6	***	16.3	2.6	2.8	0.2	60.2
Kampen	100.5		14.5	2.8	2.6	1.7	77.6
Oslo	109.2		12.4	1.9	7.3	1.5	75.5
Vaalerengen	116.7		14.0	2.5	3.2	0.8	79.3

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: The parish specific deaths from influenza and pneumonia by age and sex, the parish specific population by age and sex, and the standard population by age and sex for the city as a whole, which are used to calculate the standardized mortality ratios, are from Kristiania sundhetskommision (1919, 1920) and Kristiania statistiske kontor (1920) respectively. The data on crowding, proportion of the households with maids, bathroom and electricity are from Kristiania statistiske kontor (1920), while the data on weight are from Schøitz (1920).
[1] Exclusive kitchen.
[2] The survey was carried out in March 1920, and included 30,000 children in public schools located all over the city as well as private schools which basically were located in the western parishes of Frogner, Uranienborg and Fagerborg. The figures on underweight are corrected for a somewhat different distribution of age and sex across each school (by Schøitz 1920). It should be noted that the schools included in the survey do not recruit pupils exactly according to the parish borders.

Table 3 shows that there were clear east-west differences in Spanish Influenza mortality in Kristiania as measured by the standardized mortality ratio for influenza and pneumonia in 1918-19. On the one hand, in the eastern parishes of Grønland and Vaalerengen, and in particular Wexels and Petrus, mortality was significantly higher than the average for the whole city. On the other hand, mortality in the western parishes of

Uranienborg, Fagerborg, and in particular Frogner, was significantly lower than the average for the whole city.

The east-west differences may also be seen with respect to household crowding and various socioeconomic status variables (see Table 3). The bivariate correlations between the standardized mortality ratios for the 20 parishes on the one hand, and the socioeconomic characteristics of the same parishes on the other hand, are moderately strong but go in the expected direction (average number of persons per rooms (0.52), proportion of households with maids (-0.53), proportion of households with a bathroom (-0.52), proportion of households with electricity (-0.62), percentage of pupils aged 7-15 that were underweight (0.68)).

In the next section, the *individual* and *independent* effects of some of the social status variables listed in Table 2 and Table 3 and on Spanish Influenza mortality in Frogner and Grønland-Wexels will be explored in multivariate models. The analysis may shed more light on which characteristics were independently associated with Spanish Influenza mortality, why there was significantly higher aggregate mortality in Grønland-Wexels compared to Frogner, and ultimately whether the findings in this section using aggregate data also apply on an individual level.

Multivariate analysis of Frogner and Grønland-Wexels

According to model 1, the bourgeois and the white collar middle class had 30 per cent lower mortality from Spanish Influenza compared to the blue collar working class, net of the effect of age, sex, and marital status (Table 4).[3] The effect is highly significant and goes in the expected direction. When a control for residence in Frogner or Grønland-Wexels is included in model 1, much but far from all of the negative effect of the bourgeois and the white collar middle class on Spanish Influenza mortality disappears (results not shown). This finding is hardly surprising given the fact that the two parishes are highly segregated, with 62 per cent of the population in Frogner classified as bourgeois and white collar middle class, while 75 per cent of the population in Grønland-Wexels is assumed to be blue-collar working class (see Table 2). It is estimated that Spanish Influenza mortality was 60 per cent higher in Grønland-Wexels compared to Frogner, net of the effect of age, sex, marital status, and social status (results not shown). The effects of age and sex on mortality are as expected, but most surprisingly, there are no significant effects of marital status on mortality.[4]

[3] The Bourgeois had 6 per cent lower mortality than the white collar middle class, but the difference was far from being statistically significant at 0.10 level.
[4] When estimating model 1 and 2 (see Table 4) for all-cause mortality, it appeared that the married had 25 per cent lower mortality than the reference group of the never married (significant at 0.05 level).

Table 4. Results of Cox proportional hazard models for Spanish Influenza mortality (N=250 deaths) in the parishes of Frogner and Grønland-Wexels combined in 1918

	Model 1		Model 2	
Independent variables	e^{coeff}	t-stat	e^{coeff}	t-stat
Age				
0-4	8.18***	6.17	8.12***	6.15
5-14 (ref)	1.00	-	1.00	-
15-19	1.19	0.38	1.13	0.27
20-39	3.27***	3.63	3.34***	3.66
40-59	2.64***	2.66	2.65***	2.65
60+	8.09***	5.77	7.94***	5.68
Sex				
Male	1.45***	2.85	1.44***	2.69
Female (ref)	1.00	-	1.00	-
Marital status				
Never married (ref)	1.00	-	1.00	-
Married	1.00	0.03	0.99	-0.05
Widow/widower	1.20	0.71	1.16	0.56
Separated	0.52	-0.65	0.51	-0.66
Divorced	1.32	0.27	1.22	0.20
Social status				
Bourgeois	0.66**	-2.29		
White-collar middle class	0.70**	-2.01		
Blue-collar working class (ref)	1.00	-		
Occupation not stated	1.24	0.84		
Employment				
Primary sector			1.35	0.59
Craft and industry (ref)			1.00	-
Sales and service			0.80	-1.07
Transportation incl. seamen			0.61*	-1.76
Civil servants			0.70	-1.24
Clergy, military, health, academic			0.55*	-1.95
Domestic servants			0.76	-0.99
Bank, insurance, real estate, office			0.76	-1.24
Occupation not stated			1.42	1.53

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

In model 2, it may be seen that except for primary sector employees, all other employees have lower mortality than the reference group of craft and industry employees, net of the effects of age, sex and marital status (Table 4). However, only those with academic employment and those in the transport sector have significantly lower mortality than the reference group of craft and industry employees (significant at 0.10 level). The effects of age, sex and marital status in model 2 are not very different from those in model 1. When controlling for place of residence, in model 2 there appears to be no difference in mortality with respect to employment status (results not shown).

Those households that were sufficiently wealthy to have electric light, bathroom or domestic servants, showed a negative effect on the Spanish Influenza mortality of the individuals living in that household (results not shown). However, it was only the convenience of having a bathroom that had a significant effect on lowering the mortality (at 0.05 level). The effect of average number of persons per room was positive on Spanish Influenza mortality as might be expected, but was far from being statistically significant (result not shown).

Is the effect of social status, employment or other socioeconomic status variables on Spanish Influenza mortality independent of place of residence? When estimating model 1 and 2 for each parish separately, controls were made for the interactions of the socio-demographic variables on the one hand and place of residence on the other hand (results not shown). These models showed that there were no significant differences in mortality with respect to social status, employment or the other socioeconomic status variables in Frogner. However, in Grønland-Wexels mortality from Spanish Influenza among the bourgeois and the white collar middle class was lower but not significantly lower than that of the blue-collar working class. There appeared to be no significant differences with respect to employment in Grønland-Wexels. The results in the separate models for Frogner and Grønland-Wexels are not surprising as there may be too little variance with respect to social status, employment, and standard of housing within each of the parishes studied whereby they could affect mortality significantly.

Discussion

The analysis using aggregate data showed that there were clear east-west differences in mortality from Spanish Influenza in the Norwegian capital city of Kristriania in 1918-19 that may reflect socioeconomic status differentials. On the one hand, the relatively affluent western parishes, in particular Frogner, had significantly lower mortality than the city of Kristiania as a whole, while the relatively poor eastern parishes on the other hand, in particular Grønland-Wexels, had significantly higher mortality than the city as a whole. The bivariate correlations between the standardized mortality ratios for influenza and pneumonia for the 20 parishes on the one hand, and the five socioeconomic and anthropometric characteristics of the same parishes on the other hand, were moderately strong but went in the expected directions.

The multivariate analysis showed that the findings on the parish level in the Norwegian capital also applied at the individual level. The regression analysis revealed that the bourgeois and the white collar middle class had 30 per cent lower mortality from Spanish Influenza compared to the blue collar working class, net of the effect of age, sex, and marital status. The finding in this paper is consistent with many other modern and historical studies of general as well as cause-specific mortality in Kristiania by class and geography (e.g. Geirsvold 1917; Gjestland and Moen 1988; Barstad 1997; Rognerud and Stensvold 1998). It is also consistent with the cross sectional and multivariate studies of Spanish Influenza by McCracken and Curson (2003) and Mamelund (2003b) for respectively the city of Sydney, Australia, and for Norway, while being inconsistent with a similar study by Johnson (2002) for England and Wales.

The individual level "influenza surveys" carried out during the course of the Spanish Influenza pandemic for a number of cities in the United States and for the city of Bergen, Norway, showed that there were clear differentials in lethality with respect to social status of occupation, household crowding and income, but a less pronounced relationship between these indices of social status and incidence (Vaughan 1921; Hanssen 1923; Collins 1931; Sydenstricker 1931; Britten 1932). Socioeconomic status differentials have also been reported for more recent influenza epidemics. Studies from the United States using data from the mid and late 1970s have shown that young children in low-income families are at greater risk of influenza *infection* than are pre-school children of middle-income families (Glezen *et al*. 1980), and that influenza was twice as common among poor adults as among the affluent (Dutton 1988). An individual level study of the white population in the United States in 1960 showed that male mortality from influenza and pneumonia amongst those with less than 8 years of schooling was 1.6 times that of those with one or more years at college; and among comparable women 1.7 times (Kitagawa and Hauser 1968). A later individual level study by Kitagawa and Hauser (1973) could document that influenza and pneumonia mortality of men from low income families in Chicago in 1950 was twice that of men from high-income families. Influenza and pneumonia were in fact the two causes of death that showed the greatest socioeconomic class differences in Chicago, only beaten by tuberculosis.

In a more recent individual level study, for Madrid, Spain, 1996-97, it was found that a reduction of education with one year caused an increase in mortality from influenza and pneumonia by 3.7 per cent for men and by 3.4 per cent for women net of the effects of age, marital status, and employment (Regidor *et al*. 2003). Socioeconomic status, whether measured by income, education or other indices of social class, has also been found to be strongly associated with *mortality* in several recent studies of chronic obstructive pulmonary diseases including bronchial asthma, chronic bronchitis, and emphysema (for an overview, see Prescott and Vestbo 1999).

Much of the current literature favors the view that Spanish Influenza was a "classless" disease. This may be because too little distinction has been made between the risk of being *infected* by influenza on the one hand ("everybody gets it"), which may only be moderately associated with socioeconomic status, and the risk of developing bacterial complications following influenza as well as the risk of *dying* from influenza or pneumonia on the other hand, which in many studies have been shown to be strongly associated with socioeconomic status.

In the following discussion, five possible reasons why the bourgeois and the white collar middle class experienced lower Spanish Influenza mortality than the blue-collar working class in Frogner and Grønland-Wexels are examined. These are the importance of income to obtain an adequate level of nutrition, the role of pre-existing diseases in susceptibility to influenza, standard of housing and household crowding, occupational risks and exposures, and varying awareness and access to public precautionary health care information. All of these may fall into the category of material/structural explanations for socioeconomic mortality differentials as defined by Townsend and Davidson (1982).

Income and nutrition

One possible explanation for the differentials in Spanish Influenza mortality may be that the affluent bourgeois and the white collar middle class could afford a higher nutritional standard compared to the relatively poor blue-collar working class. The income of an average white-collar clerical officer may have been double that of the average income of a blue-collar factory worker, while a principal officer, here considered part of the bourgeois, might earn a salary at least four times that of a factory worker (Furre 1996).

Undernourishment does not increase the risk of viral infections such as influenza (Scrimshaw, Taylor and Gordon 1959). On the other hand, malnutrition associated with low intake of nitrogen results in definite impairment of immune response and a corresponding increase in susceptibility to bacterial diseases (Fox, Hall, and Elveback 1970). Consequently, whether or not its victims were undernourished played no role as to where the Spanish Influenza struck. However, bacterial complications following Spanish influenza, for instance pneumonia, are assumed to have taken a greater toll among those who were poorly fed.

The cost of living in Norway increased by more than 160 per cent during the First World War, while the increase in the average salary was 90 per cent (SSB 1918b). The economic imbalance led to general dissatisfaction, and for most groups, higher wages did not compensate for inflation. The worst affected were those dependent on public assistance – the disabled, widows, abandoned wives with children, the old and the sick – in addition to low paid clerical officers. To compensate for the high inflation, the government introduced price freezes, price ceilings, dear time addition to wages (to low paid clerical officers), and rent control. Discount stamps on food, firewood, coke and coal were also issued, and food exports were prohibited (SSB 1917). At some schools and workplaces, free meals were served to the children of poor families and to the lowest paid employees (SSB 1919). Despite these efforts, neither government salaries nor poor relief could fully compensate the galloping inflation and increasing problems of malnutrition. However, the daily calorie intake of the working class and among low paid clerical officers in Kristiania appeared not to decline during the years 1914-17, for food that was less expensive, more abundant in supply and equally nutritious such as fish, whale oil margarine, whole milk, and whole meal bread, substituted for consumption of expensive food stuffs such as meat, butter, eggs, skimmed milk and white bread of short supply (SSB 1918a, 1919b, 1920). Nevertheless, after a number of food articles were *rationed* in the beginning of 1918, the calorie-intake for craftsmen hard at work (e.g. carpenters, warehousemen) may have been at subsistence level and only marginal for maintaining both body functions and to work.

In a study of height and weight among pupils (12-18 years) in one school located in the parish of Vor Frelser, Kristiania, Schreiner and Schreiner (1922) found that the body-mass index fell during the spring of 1918, and felt that this might be explained by the rationing of food. The physical emaciation suffered by pupils in the city was fully rectified however after stays at summer camps or visits to relatives in the countryside, where the supply of milk and other foodstuff were better than in the cities. Note also that all-cause mortality in Kristiania did not increase during the spring of 1918 which was a period with relatively heavy rationing of food. In fact, all-cause mortality in this period was below the norm of 1915-17 (see Figure 1).

The relatively high bivariate aggregate correlation found between the percentage of the pupils that were underweight in Kristiania in 1920 on the one hand and mortality from Spanish Influenza in 1918-19 on the other hand, may support the nutrition hypothesis. Adult height is another anthropometric measure that is generally accepted as a proxy of malnutrition during childhood and an environment conducive to disease. Height has therefore been used to predict mortality in a number of studies (e.g. Waaler 1984; Fogel 1997). Echeverri (2003) and Mamelund (2003b) have found negative associations between the average height of conscripts and influenza death rates in respectively Spain and Norway in 1918-19 using cross sectional data. These studies give additional evidence that poor nutrition and chronic diseases acquired in childhood may play an important role in explaining Spanish Influenza mortality differentials.

Pre-existing diseases

The assumed higher nutritional standard of the more affluent classes may also have bolstered their immune systems and enabled them to better fight diseases, for instance tuberculosis. The risk of a fatal outcome was greater for Spanish Influenza patients suffering from active lung-tuberculosis or Spanish Influenza patients who had reduced lung-capacity after having suffered a non-tubercular lung disease (e.g. chronic bronchitis, bronchial asthma, emphysema, and cystic fibrosis) (Ramberg 1969; Noymer and Garenne 2000). It was also reported that

Spanish Influenza activated latent tuberculosis (Skajaa 1921), which in turn may have lead to higher mortality immediately in 1918 or many years later. Geirsvold (1917) reported that mortality of tuberculosis was three times higher in Grønland (2.9 deaths per 1 000) than in Frogner (0.8 deaths per 1 000) during the First World War. A second explanation for the socioeconomic differentials in Spanish influenza mortality may therefore be that a higher proportion of the blue-collar working class than the white collar middle class and the bourgeois had active or latent tuberculosis. They may also have had other pre-existing diseases which made them more susceptible to influenza. Generally speaking, those with impaired or damaged cardiovascular (e.g. rheumatic heart disease) and/or respiratory systems are the most prone to succumb to pneumonic complications following influenza.

Standard of housing and household crowding

As a result of severe shortage of housing during the 1914-18 war (only 0.1 per cent of the apartments were vacant), some families, basically in the eastern parishes of Kristiania, were living in cold and damp basements and draughty attic stories, garden pavilions and hen houses, in conditions not normally permitted for habitation by the city government (SSB 1955). Low-income groups probably also lacked sufficient heating despite access to discount stamps (SSB 1918b). In addition to poor ventilation, hygiene and sanitation, all of the above mentioned conditions may be associated with respiratory symptoms, reduced lung function, and lower socioeconomic status (Prescott and Vestbo 1999). A third explanation of the social profile of Spanish Influenza mortality may therefore be poor housing conditions and household crowding (Skajaa 1921; Hanssen 1923; Mamelund 1998). The findings of this paper indicate that the average number of occupants per room had a positive but not statistically significant effect (at 0.10 level) on Spanish Influenza mortality.[5] However, as McCracken and Curson (2003:275) have noted, density variables might be “more closely associated with morbidity than mortality levels, on the basis that getting the flu was presumably a simpler, more direct spread process than the causal web determining who would go on to die from it”. Of the standard of housing variables, only access to a bathroom had significantly negative effect on mortality of its household members (at 0.05 level). This may not be surprising as it was the most segregated of the variables considered (see Table 2). The result may also reflect that access to a bathroom gives the chance to attain a high level of personal hygiene, which in turn might be associated with a lower risk of spreading the influenza virus.

[5] The effect was linear over the whole intercensal year of 1918-19.

Dangerous occupations?

It may also be reasonable to believe that many years of heavy physical labor, at least ten hours a day combined with possibly also crowded and poor working conditions may have damaged or impaired the general health of the working class relative to that of the bourgeois and the white collar middle class.[6] Specifically, exposure to occupational airborne mineral gas, dust, fumes, asbestos, and sulfate may have impaired the respiratory system of construction, quarrying, mining, painting, paper, iron, and metal workers and consequently made them more susceptible to viral infections like influenza and also more likely to die from lung diseases (for a general reference, see Prescott and Vestbo 1999; for Spanish Influenza, see for example Rice 1988 or Johnson 2002).

Preventive public health advisories

There were no effective vaccines or antiviral drugs in 1918 to combat Spanish Influenza. The doctors and nurses were therefore more or less helpless, and patients that were hospitalized and who received care from professional health practitioners did not seem to have lower mortality than those who were nursed by their families at home. The argument that the affluent could afford better health care and medicine than the poor may thus not be the most relevant for explaining the differences in Spanish Influenza mortality.

The health authorities in Kristiania basically limited their activities to surveillance of the cleanliness and sanitation in the city throughout the pandemic, and to giving precautionary health advice (Kristiania sundhetskommision 1919). In October 1918, estate owners were enjoined to clean and air out stairways and corridors at least twice a week. The owners of cinemas and restaurants were issued similar instructions. The health authorities were initially reluctant to order the closing of schools, theaters, and restaurants, and banning of large public meetings so as to prevent the disease from spreading, as they were concerned that this would give rise to panic. The health authorities in Kristiania also referred to the failure of preventive action in previous epidemics.

However, in mid October 1918 the health authorities issued an advisory urging people not to voluntarily expose themselves to infection, especially those who were not infected during the relatively mild summer wave and who thus had not gained relative immunity. In addition, people were urged to wash their hands and to reduce the bad habit of spitting, to cover their mouth when coughing or sneezing, to go to bed as early as possible after the onset of influenza symptoms, and to stay in bed until they were free of fever. This information was printed in the newspapers and on posters in public spaces, but probably reached fewer of the less well educated and thus more of the Bourgeois and the white-collar middle class than the blue-collar working class. If this assumption is correct, the finding that

[6] The ten-hour day was made statutory in Norway from 1915, the eight-hour day from 1919 (Furre 1996).

there was lower mortality among those in possession of academic training than among the craft and industry workers is not surprising. Moreover, society’s least affluent and the poorest educated classes probably had less possibility of staying away from work to convalesce when ill than the affluent and well educated, as they may have had less saved capital to live on. Even fewer would have had the resources to invest in and benefit from private sickness insurance. The relatively poor working class may therefore have delayed going to bed when ill, would probably not have stayed long enough to avoid pneumonia and other bacterial complications with a higher risk of death than influenza.

Conclusion

There has been a dispute in the literature since 1918 over whether there were socioeconomic status differentials in mortality from the Spanish Influenza pandemic of 1918-19, which may have killed 50-100 million persons worldwide. Individual level data has been used for the very first time in this paper to test the hypothesis that the blue-collar working classes suffered higher death rates from Spanish Influenza than the bourgeois and the white-collar middle class in two parishes in the Norwegian capital of Kristiania (renamed Oslo in 1924) in 1918. The results show a 30 per cent lower mortality from Spanish Influenza among the bourgeois and the white collar middle class compared to the blue collar working class, net of the effect of age, sex, and marital status. This may be because the bourgeois and the white collar middle class were generally better fed and more cushioned by their financial circumstances such that they were less affected by the difficult times, shortage, and rationing of food during the 1914-18 war. Their immune systems were thereby stronger and there is a greater likelihood that they experienced fewer diseases in childhood. Consequently there was probably a lower incidence of chronic diseases among the affluent such that they were less susceptible to influenza infections and had lower risk of dying from influenza and pneumonia. They had better quality housing and experienced less crowding, and they were probably better informed and aware on the importance of following up the health advisories from the health authorities during the Spanish Influenza pandemic.

The finding in this paper is not consistent with the view that Spanish Influenza was an “egalitarian” or classless disease, striking randomly with a new influenza virus few or nobody had immunity to fight. The influenza virus itself may have had certain class neutral infection properties, but the societies it struck were often highly socially segregated. In addition to the three most peculiar and well documented features of the Spanish Influenza, its high death toll, the relatively high overall lethality, and the fact that those between the age of 20 and 40 experienced the highest increase in the death rates, another prominent feature of the disease in the Norwegian capital city of Kristiania was the clear socioeconomic status differentials in mortality.

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