Carla Louise Hughes

The Association Between the 1918 Influenza Pandemic and Suicides in Norway

OSLO METROPOLITAN UNIVERSITY
STORBYUNIVERSITETET

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Faculty of Social Science

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Contents

List of tables and figures

Abbreviations

Norwegian Institute for Public Health (NIPH)

Non-Pharmaceutical Interventions (NPIs)

Pooled Ordinary Least Squares (OLS)

Time-Series Cross-Section Methods (TSCS)

Statistics Norway (SSB)

Norwegian Centre for Research Data (NSD)

Article-based Thesis Introduction: The Association Between the 1918 Influenza Pandemic and Suicides in Norway

This article-based thesis on the association between the 1918 influenza pandemic and suicides in Norway was first proposed in January 2021. This project took influence from several previous works relating to pandemics and mortality, with the overarching incentive of producing pandemic research in light of the current COVID-19 outbreak. Writing an article-based thesis regarding pandemics, social welfare, and health policies during the height of a current pandemic highlighted the need for additional research in this area. Thus, the reflective nature of this article lends itself to contemporary pandemic research. Therefore, through extensive reviewing of literature and statistical analysis, this thesis developed insightful and revealing results that will be discussed herein.

Pandemics and Suicides

Suicide is a still a current issue in Norway and public health organisations have an active role in reducing suicides across the country. In a public health report for *The Norwegian Institute for Public Health* (NIPH) titled *Suicide in Norway* (2018), defines suicide as " the result of a self-inflicted injury with the intent to end life". This definition will also be used in this study. This report by NIPH also states that approximately 600 people commit suicide in modern day Norway; two-thirds of whom are male, often in their mid-to-late 40's (Reneflot et al., 2018). Whilst males commit suicide at a significantly greater rate than females, there is evidence to suggest that suicidal thoughts and behaviours are more common in females (Crosby, 2011). However, there is a lack of robust research on numbers of suicide, including sex differences, at the time of the 1918 influenza pandemic in Norway, and this article-based thesis aims to fill this gap in the literature.

The 1918 Influenza Pandemic is commonly known as The Great Influenza Pandemic, and unfairly also known as the Spanish Flu (Barro, 2020). The name "Spanish flu" began circulating across the globe as a result of the Spanish being so good at spreading the word of the virus that they were consequently blamed with spreading the virus itself. At this time, Spain had a freer press than many other countries, meaning that they could report current news events without the control of government. More specifically on 28th May 1918, the Madrid newspaper *El Sol* (The sun) published that a new virus was wreaking havoc in even the smallest cracks of the community (Rao & Greve, 2017). This newspaper claimed "The

fever of the three days. In Madrid there are 80.000 attacked" and warned the inhabitants of Madrid that a deadly illness was attacking anyone that stood in its way (S. M. EL REY, 1918). Whilst the origin of the virus is unclear, it is somewhat possible to know when the virus first arrived in Norway. According to Statistics Norway (1918b), the first recorded mention of the Spanish influenza in the capital of Kristiania (renamed Oslo in 1924) was on the 29th June 1918, and it has since been suggested that the first cases had travelled from Scotland across the North Sea (Mamelund, 1998). Modern literature has determined several relationships and associations between the 1918 flu and mortality (Garrett, 2008; Mamelund et al., 2016; Rao & Greve, 2017), however, there is an absence of research examining the specific association between deaths by suicide and the 1918 flu in Norway. Therefore, this article-based thesis will be the first to explore this association and will push the front in the state of the art.

Article Submission

This article-based thesis is written for the purpose of publishing in the journal *Suicides and Life-Threatening Behavior*. This journal published a well-established paper titled "The impact of epidemic, war, prohibition and media on suicide: United States, 1910–1920" written by Wasserman (1992), which has strongly influenced much of this study (See Appendix A for Article Submission Guidelines). The article written by Wasserman (1992) used panel data analysis, including fixed effects and between effects, to explore impacts of suicides in the United States between the years 1910 and 1920. Thus, much of this article-based thesis has adapted similar models and methods.

Research question

Existing research reports that after the arrival of the virus in 1918, a total of 14,676 deaths were recorded in Norway throughout the pandemic, which at the time was approximately 0.6% of the total population (Johnson & Mueller, 2002; Mamelund, 1998, 2004). This was an unanticipated shock of mortality, particularly with those who had poor health, or were in lower socioeconomic groups (Karlsson et al., 2014; Mamelund, 2006). Though, most affected during the 1918 influenza pandemic were young people in their 20s and 30s. Reports suggest that although there was high mortality in children and the elderly, mortality peaked between the ages 20 to 34 years (Dahl, 2020). Thus, mortality during the

great influenza pandemic has a characteristic W-shaped mortality curve (Rao & Greve, 2017). Consequently, this paper aims to address to what extent this shock of mortality impacted numbers of suicides in Norway during the 1918 pandemic and the years surrounding it.

In light of the current COVID-19 pandemic, and with reference to social welfare and health policies, this paper will determine to what extent pandemics and mass infection may result in changes in numbers of suicides across Norway and to answer the research question "How is the 1918 influenza pandemic associated with rates of suicide in Norway?" using the following hypotheses:

H^1 There is a negative association between the 1918 influenza cases/deaths and numbers of suicides in Norway.

H^2 Higher populated counties predicts more suicides between 1910-1920 in Norway.

H^3 Greater access to healthcare predicts fewer suicides between 1910-1920 in Norway.

The key concepts that will be explored in this paper includes rates of suicide and the mental health aspects that coincide with global pandemics. This study is the first to search for explanations of the suicide rates in Norway alongside the 1918 influenza pandemic with co-determinants of total influenza cases, influenza deaths, suicides, and numbers of doctors by using panel data analysis of within 20 municipalities and controlling for gender. Supported by pervious theoretical literature, it is expected in this study that suicides will be negatively associated with numbers of influenza cases in Norway between 1910 – 1920. Furthermore, this article will contribute to the field of social science by explaining how suicides may be impacted by external influences such as access to medical care and recommend suitable preventative interventions.

In order to reduce infection during pandemics, health policies, interventions and preparedness-plans must be in place. For example, Correia (2020) reports that *Non-Pharmaceutical Interventions* (NPIs) flatten the curve of infection and reduce peaks in mortality, and by extension, economic costs associated with morbidity. NPIs witnessed in several countries during the COVID-19 pandemic have included, but are not exclusive to, mandatory face masks, compulsory quarantining for those who are infected, increased levels of personal hygiene, temporary business closures and recommended social distancing. Consequently, these COVID-19 interventions may have increased risks to social

welfare in Norway as a result of job losses and permanent business closures, however, in turn increased numerous health associated benefits.

NPIs such as mask wearing and increased levels of hygiene is not well documented during the 1918 flu in Norway, however, it is reported that in Norway, individuals were requested to quarantine when infected and that popular gathering places (such as cinemas) would be closed during peaks of infection (Borza, 2002). Despite this, the 1918 *State of Health and The Medicinal Conditions Yearbook* (*Sundhetstilstanden of Medicinalforholdene*) for the kingdom of Norway reports that closures and ban of gatherings were impractical and did not last more than 3-4 weeks (Statistics Norway, 1918b). Contrary to this, Hatchett et al. (2007) reports that rapid implementation of several NPIs can significantly reduce the transmission of influenza, and reduces deaths by infection; thus, reducing additional pressure on medical professionals at this time. For instance, amongst several other responsibilities, doctors in 1918 were obligated to report all annual statistics including numbers of patients and their individual diagnoses to central health authorities (Irgens, 2015). Therefore, health professionals played an integral role in maintaining all aspects of health care during the 1918 pandemic, as well as contributing to much of the data explored in this article-based thesis. Subsequently, key takeaways from the 1918 pandemic in this article will inform prospective health policies and interventions during future pandemics.

Theoretical framework

Theories surrounding reasons why one might commit suicide is well established by Emile Durkheim in *The Theories of Suicide (Durkheim, 1897).* Durkheim's book, originally written in French and later translated to English, is recognised as a reliable source of explanation for societal causes of suicide. Durkheim theorises these as Egoistic Suicide, Altruistic Suicide, Anomic Suicide and Fatalistic Suicide (Durkheim, 2005). Egoistic suicide occurs as a consequence of feeling outcast from society and is a result of reduced overall social integration. Conversely, altruistic suicide is the act of committing suicide due to excessive integration within society (Durkheim, 2005). This suggests that although excessive individuation induces suicide, that lack thereof also has the same effect. Anomic suicide occurs when unprecedented events happen within an individual's life, such as financial issues or stresses in personal relationships (Durkheim, 2005). Finally, fatalistic suicide can be

explained as suicide whereby an individual lives under strict and forceful rules, usually witnessed in imprisonment or slavery (Durkheim, 2005).

A common theme throughout these theorised suicide types is the influence of social integration. During 1918, social integration was impacted by several aforementioned consequences of pandemics, including job losses and business closures, but this may also include aspects of fear, bereavement of lost loved ones and reduced trust in government. Amongst the theories mentioned, the most applicable for this article are egoistic and altruistic suicides. This is for the reason that there will have been fluctuations in social integration during the pandemic. Leaning on this theory, it is likely that during years of peak infection, social integration increased due to boosted solidarity and togetherness, which suggests that suicides should decrease during this time. However, this also implies that as solidarity is no longer peaking, levels of social integration will likely rebound, and the excessive integration will increase suicides. This paper aims to address and explain variations in numbers suicide during the years 1910-1920 in Norway using these theories.

Anomic suicides will have explained a number of suicides during this time, most of which were beyond the scope of this study. Whilst they will not be included in data analysis, it is plausible that economic impacts and unprescedented shocks of mortality, including bereavement, during the pandemic will have had societal effects during this time. For example, evidence suggests that 5000 marriages were dissolved due to the deaths of one or both spouses due to the flu (Mamelund, 2004). This may have contributed to change in rates of suicide due to grief or loss of financial aid, however, documented evidence of this was limited and was beyond the reach of this paper.

Methods

This study used quantitative methods using panel data to examine the associations between suicide rates and the intensity of the 1918 flu pandemic, with Norwegian counties as the unit of analysis. Several of the methods and models used by Wasserman (1992) were adopted in this article-based thesis, as well as implementing several supplementary models. An examination of each individual variable was assessed using Pooled Ordinary Least Squares (OLS), Fixed effects (within estimator), Between effects, Time fixed effects, Random effects, and Time-series cross-section methods (TSCS). All data analysis was performed using *StataMP 17.0*.

Population size was measured by the number of inhabitants in each county, each year, in Norway between 1910 – 1920. This study used annual statistics from Norway's medical records titled *The State of Health and The Medicinal Conditions Yearbook* (*Sundhetstilstanden og medisinal-forholdene*) (Statistics Norway, 1910c, 1911b, 1912b, 1913b, 1914b, 1915b, 1916b, 1917b, 1918b, 1919b, 1920c) including numbers of suicides (with sex differences), influenza cases (with sex differences), influenza deaths (with sex differences), in addition to number of medical doctors living within different counties in Norway. All counties were implemented in this study, which encompasses the 20 counties in Norway at the time of reporting, compared to the 11 today.

All historical mortality statistics and population data were also extracted from comprehensive annual reports in *The Statistical Yearbook for the Kingdom of Norway* (*Statistisk Aarbok for Kongeriket Norge*) at Statistics Norway (SSB) as part of the county and municipal database (Statistics Norway, 1910b, 1911a, 1912a, 1913a, 1914a, 1915a, 1916a, 1917a, 1918a, 1919a, 1920b). Data was cleaned prior to analysis and no missing data was reported. STATA reported strongly balanced data in preparation for analysis. Groups were set as ID (County name 1-20) and time set as year (1910-1920). Internal validity and external validity may be impacted due to the age of the data and method of data collection. However, this is the most reliable source of data regarding suicides between 1910 and 1920 in Norway.

Measures

Dependent variables: Suicides

Statistics for suicides including sex differences were collected from *The State of Health and The Medicinal Conditions Yearbook* (*Sundhetstilstanden og medisinal-forholdene*). Although *The Statistical Yearbook for the Kingdom of Norway* (*Statistisk Aarbok for Kongeriket Norge*) also reports suicide rates for each year, they are categorised less reliably. *The Statistical yearbook* reports suicides under "violent deaths" and does not offer county-specific details. In addition to this, these violent deaths also summarise all suspicious deaths as suicides, including hanging, drowning, shooting, stabbing, or cutting and poisoning as well as "Other or undisclosed means of death". Conversely, *The State of Health and The Medicinal Conditions Yearbook* categorises suicides as "known deaths", which offers a clearer understanding of cause of death.

Independent Variables: Influenza Cases and Deaths

The number of influenza cases including sex differences is registered throughout *The Health and Medicinal Conditions Yearbook*. There was no distinction between those who died of seasonal influenza and the Spanish influenza pandemic.

Confounding Variables: Doctors and Population Size

Population data by age was only available in the census years of 1910, 1920 and 1930 (*Folketællingen i Norge*) (Statistics Norway, 1910a, 1920a, 1930), therefore change in population was calculated using intercensal populations statistics.

Furthermore, Number of doctors was extracted from The State of Health and The Medicinal Conditions Yearbook (*Sundhetstilstanden og medisinal-forholdene*). Though there is no missing data, there were some discrepancies between reports of population between yearbooks and may have impacted estimates made throughout.

Unit of Analysis

The number and borders of counties throughout Norway have changed several times throughout history, due to dynamic and ever-changing rulings; particularly under Danish reign. Between 1910 and 1918, Norway comprised 20 counties (*Amt*): Smaalenene, Akershus, Kristiania, Hedemarken, Kristians, Buskerud, Jarlsberg og Lauvrik, Bratsberg, Nedenes, Lister og Mandal, Stavanger, Søndre Bergenhus, Bergen, Nordre Bergenhus, Romsdal, Søndre Trondhjems, Nordre Trondhjems, Norland, Tromsø and Finmarken. For the purposes of analysis and clarity, these counties will maintain these names throughout this study.

Research Design

Pooled OLS allowed for generalising for modelling both time and space, meaning that the model overlooks panel structure and focuses solely on statistical relationships between individual values (See Appendix B for Pooled OLS Models). All variables in this study were time variant and examined by year, therefore the OLS model assumed homoscedasticity and reported presence of correlation between units. To counter this, a test for serial autocorrelation used with linear panel data, known as the Wooldridge test was applied (Drukker, 2003). Results of the Wooldridge test strongly rejected the null hypothesis of no serial correlation and OLS analysis resumed. Despite this, OLS models can

underestimate standard errors and exaggerate both F-statistics and time, therefore, to further explore the fit of the OLS model, a Breusch-Pagan/Cook-Weisberg test for heteroscedasticity was implemented (Breusch & Pagan, 1979). This test explored the null hypothesis with the assumption that all error variances were equal. All values for the Breusch-Pagan/Cook-Weisberg test reported as significant, which suggested a presence of heteroscedasticity. Due to this presence, robust standard errors, also called heteroscedasticity-consistent standard errors, were applied (See Appendix C for Pooled OLS with Robust Errors Models). The robust errors model did not alter coefficients; however, more accurate p-values were reported. Consequently, clustering for groups in this model also relaxed the assumption that error terms were independent of one another. This option allowed observations to be independent across groups, but not within groups.

Between effects allowed for variation between units to estimate the influence of the unexplored independent variables on the dependent (See Appendix D for Between Effects Models). In other words, this controlled for omitted variables that may vary over time but remained constant between units.

A fixed effects model (within estimator) and random effects models were implemented for variables most appropriate. Reports of cov(x1, c1) = 0 suggested that a random effects model was more appropriate (See Appendix E for Fixed Effects Models), whereas where cov(x1, c1) $\neq$ 0, then a fixed effect was implemented (See Appendix F for Random Effects Models). The most accepted method of determining suitability, was to operate a Hausman test (Hausman, 1978). The Hausman test inspected the fixed effects model against the random effects model (consistent vs efficient) and examined whether unique errors correlated with any regressors, with the null hypothesis that they did not. This also allowed for inspecting omitted relationships such as with age structure, socioeconomic status, alcohol consumption or underlying mental health issues (See Appendix G – Causal Estimates Figure). Results of the Hausman test determined that total suicides and female suicides were more appropriate with random effects models, whilst male suicides were best suited for fixed effects.

Fixed effects models were executed similarly to the OLS regression, however, the intercept also included variation between years, rather than simply the variation between units (counties). However, the fixed effect model can produce high variability meaning it is difficult to estimate effects within variables that did not differ within clusters. Furthermore, the random effects models investigated if there was evidence of covariation between the error term and explanatory variables; determining if the dependent variable was correlated with two or more variables. Though, random effects models will only demonstrate cross-sectional heterogeneity and if there is correlation between covariates, this can introduce pooling in results.

Finally, TSCS reported if there were any aspects of non-stationarity. This demonstrates whether parameters of the data changed over time. With time-series data, it is common to use lagged values of the dependent variable as an independent variable; also knows as a vector autoregression (See Appendix H for TSCS Models). The TSCS model also required a test for the presence of a unit root (trend over time) (See Appendix I for Dickey-Fuller Test for Unit Root and Lagged TSCS).

All variables were categorised by sex difference prior to analysis. Therefore, all models for total suicides were explored together with total population, total influenza cases, total influenza deaths and total doctors. All models for male suicides were examined with female suicides, total population, total influenza cases, female influenza deaths, male influenza deaths and total doctors. Finally, all models for female suicides were explored with male suicides, total population, total influenza cases, female influenza deaths, male influenza deaths and total doctors.

Ethics

Data collected in this study were archived by Statistics Norway (SSB). This article-based thesis was written in accordance with rules for statistical results and analyses, including for research purposes relating to official statistics and Statistics Norway. Additionally, much of the digitalised data used in this article-based thesis was previously used by Kotsadam et al. (2021). All of which was shared with approval for research purposes by Jo Thori Lind (*Universitet i Oslo*), and all other co-authors of this paper, in February 2021.

Access to use of municipal data for research purposes was confirmed by Norwegian Centre for Research Data (NSD) in January 2022. Furthermore, privacy of participants can be assumed due to the nature of data collection in this study and all data collection was coordinated in line with Oslo Metropolitan University current ethics policy.

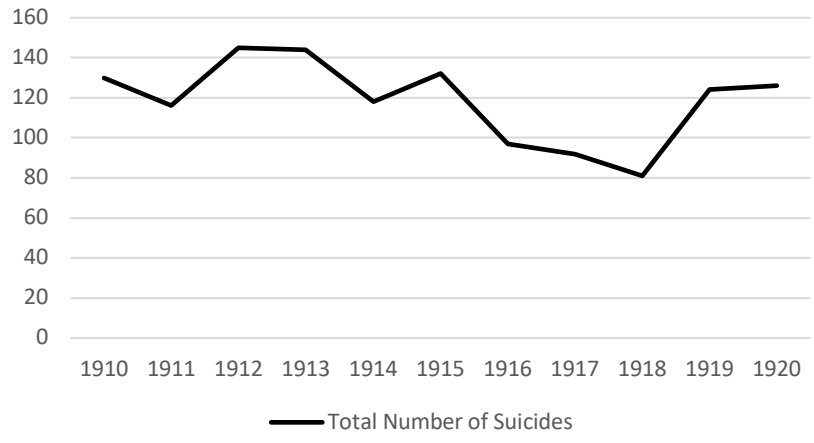
Results

Descriptive Results

In 1918, Norway had an estimated population of 2,572,008 and 7286 deaths were caused by the flu during this year. This implied a death rate of 0.28%. Furthermore, Norway had an average of 1151 doctors each year between 1910 and 1920. During the peak of infection in 1918, most doctors (n = 341, 133.17 per 100,000) were located in Kristiania and the fewest in Finmarkens (n = 14, 32.62 per 100,00). Furthermore, influenza deaths between 1910 – 1917 consisted of 55.46% females, however, in 1918, males accounted for 52% of all total influenza deaths in Norway and continued to be marginally more affected in both 1919 and 1920.

Figure 1.

Total Number of Suicides in Norway 1910-1920

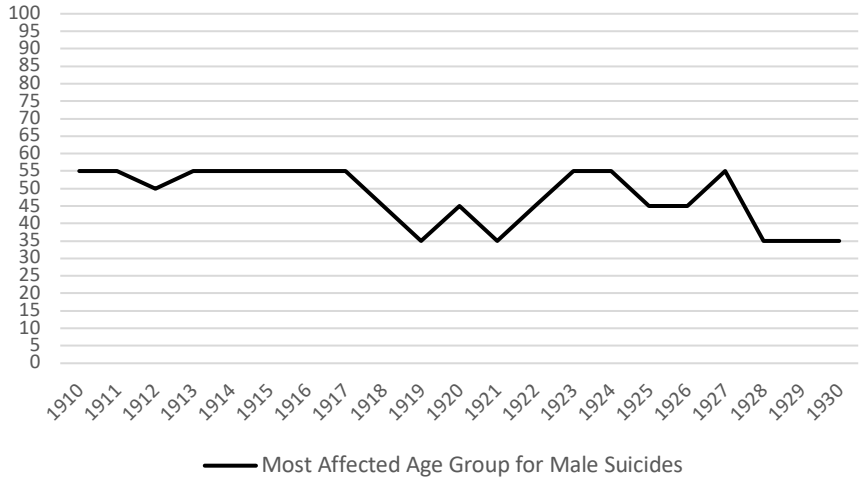


There was an average of 118 suicides per year between 1910 and 1920, ranging from 81 in 1918, to 132 in 1915 during this time (See Figure 1 for Total Number of Suicides in Norway 1910-1920 and See Appendix J for Annual Statistics). Across all counties, the total number of suicides was highest in Kristiania with 176 suicides between 1910-1920, equalling an average of 16 per year (6.39 per 100,000). The fewest number of suicides occurred in

Tromsø, with a total of 15 (1.61 per 100,00) between 1910-1920 (See Appendix K for Overall Statistics).

Figure 2.

Modal Age of Male Suicides in Norway 1910-1930.



Norway had an average of 74.9% male suicides between 1910 and 1920, with the greatest sex difference reported in Akershus county, with 89.03% of its suicides being male. Consistently throughout the years 1910 to 1917, males between the ages 50-60 were the most affected by suicide. In 1918, male suicides peaked between the ages 40-50, in 1919 most affected males were aged 30-40, and then rebounded back to 40–50-year-olds in 1920 (See figure 2. for Modal Age of Male Suicides in Norway 1910-1930). This suggest that there are sex differences between suicides (most suicides are committed by men) and that the 1918 influenza pandemic had an impact on the modal age of suicides (young adults 20-40 years were the prime 1918 flu victims, hence the decrease to most suicides committed among the younger groups in 1918 and 1919) (See appendix L for Absolute Age Distribution of Male Suicides).

Table 1.

Hypothesis Outcomes

	Pooled OLS	Pooled OLS with Robust Errors	Between Effects	Fixed Effects	Time fixed Effects	Random Effects	TSCS
H^1 for total Suicides	Confirmed	Influenced by unmeasured variables	Confirmed	N/A	N/A	Confirmed	Rejected
H^1 for Male Suicides	Rejected	Rejected	Confirmed	Confirmed in several counties	Rejected	N/A	N/A
H^1 for Female Suicides	Rejected	Rejected	Rejected	N/A	N/A	Confirmed	Rejected
H^2 for total Suicides	Confirmed	Influenced by unmeasured variables	Confirmed	N/A	N/A	Confirmed	Confirmed
H^2 for Male Suicides	Confirmed	Influenced by unmeasured variables	Confirmed	Confirmed	Rejected	N/A	N/A
H^2 for Female Suicides	Confirmed	Influenced by unmeasured variables	Confirmed	N/A	N/A	Rejected	Confirmed
H^3 for Total Suicides	Rejected	Rejected	Rejected	N/A	N/A	Rejected	Rejected
H^3 for Male Suicides	Rejected	Rejected	Rejected	Rejected	Rejected	N/A	N/A
H^3 for Female Suicides	Rejected	Rejected	Rejected	N/A	N/A	Rejected	Rejected

Table 1. summarises the outcomes of all analysis models and confirms H^1 and H^2, however rejects H^3. Panel data analyses in this study shows that the 1918 influenza pandemic is associated with fewer suicides. There is some suggestion from results of the robust errors pooled OLS that there may be unexplained variance as a result of unmeasured variables in this study, which may be explained by spurious relationships (See Appendix M for spurious relationships). The between effects model for male suicides identified that influenza cases significantly predicted a decrease in suicides, whilst the fixed effect also identified that strongest correlation for influenza cases and influenza deaths with male suicides was in Nordre Bergenhus. Furthermore, the random effects model further determined that total suicides were negatively predicted by influenza cases, as were female suicides.

Whilst results from the TSCS model presented no pattern for lagged effects within this data, this may also support the concept that the 1918 influenza was an anomaly within regular functions within society and was entirely unprecedented. Therefore, influenza rates in 1917 would not have predicted suicides in 1918.

Overall, H^1 was confirmed for total suicides in all models applied, with the exception of lagged effects. However, sex differences were only confirmed for male suicides using the between effects and fixed effects models, suggesting that there may be other unobserved variables influencing the relationship between male suicides and influenza cases and deaths. Moreover, female suicides were not associated with influenza cases and deaths, with the exception of random effects, suggesting the H^1 must be rejected for females. H^2 was confirmed for all models and sex differences, with the exception of time fixed effects for male suicides and random effects for female suicides, suggesting that with a fixed time period, suicides were not associated with influenza cases. Finally, H^3 was rejected throughout, suggesting that fewer numbers of doctors during 1910 – 1920 was not associated with more suicides.

Discussion

The purpose of this study was to gain a better understanding and provide new insight into the association between the 1918 influenza pandemic and suicide rates in Norway between the years 1910 and 1920. Suicides in Norway decreased during years of greater social integration and solidarity, which is suggested to occur during pandemic years. Analysis demonstrated that Norway had the fewest number of reported suicides in 1918 compared to any other year between 1910 and 1920. Whilst these findings contradict previous investigation by Wasserman (1992), they are consistent with findings from Gaddy (2021) that higher influenza mortality do not correlate with higher numbers of suicides. Gaddy (2021) re-examined Wasserman's work using a more powerful analysis, investigating NPI data, and reported that not only did the effect of lockdowns between 1918 and 1919 not correlate with increased rates of suicides.

Descriptive data in this study reinforced earlier findings that males commit suicide at a substantially greater rate than females (Reneflot et al., 2018). The analysis suggested that the age group most affected by suicide between 1910 and 1917 was males between the age 55 and 70. However, during the years of the pandemic, this age decreased to males between 40 and 50 and then in 1919 decreased again to males aged 30 to 40. This change suggests that the impacts of the influenza pandemic did more than just reduce the number in suicides, but also affected the age of those most at risk. This confirmed H^1 that suicides had a negative relationship with the influenza pandemic. This further supports the theoretical implications of Emile Durkheim's theories of suicides and reinforces that increased social integration is a predictive factor for fewer egoistic suicides within society. Furthermore, the rebound in numbers of suicide in 1919 and 1920 also emphasised theories that increased social integration, which occurs after pandemics, predicts greater altruistic suicides.

The findings of all models consistently reported larger populations in association with greater numbers of suicides. It is plausible that this a size effect and that greater number of people in one location will simply increase the number of those considered at risk. This association is evidenced by between effects reports that significant relationships were reported for highest populated areas and least populated. This suggests that

population size is relative to rates at which suicides occurred in both directions, even when clustering by county.

Contrary to the hypothesized association, greater access to healthcare did not predict fewer suicides in this research. It appears that access to healthcare, measured as total number of doctors, was greater in more populated counties in the country and therefore correlated more strongly with greater numbers of suicides. Evidence has suggested that access to medical care does not have an impact on survival and recovery from the virus during this pandemic, but that much of the survival was attributed to quality of medical care (Mamelund, 2011). Therefore, it is plausible that doctors were overworked at this time and may have registered suicide deaths as influenza since the person may have also died with the flu when the suicide occurred. Despite this, these results contributed to confounding variables and impacts associated with suicides that were beyond the scope of this paper. Unmeasured confounding variables also include alcohol consumption, mental health issues and ethnic backgrounds.

Conclusion and recommendations

While several previous studies have focused on countries involved in the first world war, these results demonstrate that the Spanish influenza virus impacted rates of suicides during the years that coincided with the war in a neutral context. Results from this study confirmed H^1 and H^2 and rejected H^3, suggesting that there is an association between the 1918 influenza pandemic and suicides in Norway, but that numbers of medical staff were not related to total numbers of suicides, including sex and population differences. Therefore, in line with the hypothesis, outcomes of the current study report that more populated counties and numbers of influenza cases and deaths in Norway predicted greater suicides.

Although the present results support the claim that numbers of suicides were associated with the 1918 influenza pandemic, it is appropriate to recognize several potential limitations. Data issues may affect reliability. For example, the age of the data may influence to what degree data can be trusted for the reason that data in this study have been

collected by hand and archived and scanned in historical documents. Furthermore, the definition of suicide may be different in 1910 as it is now since mental health was not recognised as a common societal issue in the early 20th century, and in many cases individuals with severe mental health issues were registered as insane. An example of discrepancies between the understanding of mental health in the 20th and 21st centuries can be evidenced in mortality reports between 1910 and 1920. In these reports, doctors recorded cause of death as suicide for several children under the age of 10. This study defined suicide as "the result of a self-inflicted injury with the intent to end life", therefore, contemporary reports may contest to what extent children are aware that physically harming themselves will lead to death.

In terms of future research, it would be useful to establish to what extend other unmeasured variables affect rates of suicide during the 1918 flu pandemic. An example of this could be socioeconomic status measured by annual incomes. In light of these contradictory findings, future research may consider examining socioeconomic status in addition to number of medical professionals, including nurses, since this may offer a more revealing aspect of influence on suicides. Another weakness of this study from a health perspective is that pneumonia deaths, which were known to be highly correlated with influenza deaths, were not included, meaning that the impact of the pandemic may be underestimated.

These results build on existing evidence that suicides are related to aspects of the 1918 influenza pandemic. This research also contributes to a growing body of evidence that social integration was not a risk factor for suicide increase during the 1918 influenza pandemic. With this considered, interventions and health policies for COVID-19 and future pandemics should include strengthening awareness surrounding suicides through education in both schools and in the labour market. In particular, current Norwegian labour markets should consider mental health consequences of workers returning to work after the reopening of society. For example, implementation of increased workplace training regarding mental health care upon returning to office spaces after working from home for a prolonged period of time. Overall, this article adds to state in the art and provides new

insights in of the field of pandemic research as well as contributing to perspectives surrounding future social welfare and health policies.

References

Beck, N., & Katz, J. N. (1995). What to do (and not to do) with Time-Series Cross-Section Data. *The American Political Science Review, 89*(3), 634-647. https://doi.org/10.2307/2082979

Borza, T. (2002, 01/01). Spanish flu in Norway 1918-19. *Tidsskrift for den Norske lægeforening : tidsskrift for praktisk medicin, ny række, 121*, 3551-3554.

Breusch, T. S., & Pagan, A. R. (1979). A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica, 47*(5), 1287-1294. https://doi.org/10.2307/1911963

Chang, S.-S., Stuckler, D., Yip, P., & Gunnell, D. (2013). Impact of 2008 global economic crisis on suicide: time trend study in 54 countries. *BMJ : British Medical Journal, 347*, f5239. https://doi.org/10.1136/bmj.f5239

Correia, S. L., Stephan; Verner, Emil. (2020). Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu. http://dx.doi.org/10.2139/ssrn.3561560

Crosby, A. O., LaVonne;Melanson, Cindi;. (2011). *Self-directed violence surveillance; uniform definitions and recommended data elements*. https://stacks.cdc.gov/view/cdc/11997

Dahl, C. M. H., Casper Worm; Jensen, Peter Sandholt (2020). The 1918 Epidemic and a V-shaped Recession: Evidence from Municipal Income Data. *The Scandinavian Journal of Economics, 124*(1), 139-163. https://doi.org/https://doi.org/10.1111/sjoe.12456

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association, 74*(366), 427-431. https://doi.org/10.2307/2286348

Drukker, D. M. (2003). Testing for Serial Correlation in Linear Panel-data Models. *The Stata Journal, 3*(2), 168-177. https://doi.org/10.1177/1536867x0300300206

Durkheim, E. (2005). *Suicide: A study in sociology*. Routledge.

Durkheim, É. (1897). *Le Suicide: Étude de sociologie* (F. Alcan, Ed.). Ancienne Librairie Germer Bailliere et C.

Gaddy, H. G. (2021, 2021/12/01/). Social distancing and influenza mortality in 1918 did not increase suicide rates in the United States. *SSM - Population Health, 16*, 100944. https://doi.org/https://doi.org/10.1016/j.ssmph.2021.100944

Garrett, T. (2008, 02/01). Pandemic Economics: The 1918 Influenza and Its Modern-Day Implications. *Review, 90*, 74-94. https://doi.org/10.20955/r.90.74-94

Hatchett, R. J., Mecher, C. E., & Lipsitch, M. (2007). Public health interventions and epidemic intensity during the 1918 influenza pandemic. *Proceedings of the National Academy of Sciences, 104*(18), 7582-7587. https://doi.org/doi:10.1073/pnas.0610941104

Hausman, J. A. (1978). Specification Tests in Econometrics. *Econometrica, 46*(6), 1251-1271. https://doi.org/10.2307/1913827

Irgens, L. M. (2015). The roots of Norwegian epidemiology–Norwegian epidemiology in the 19th century. *Norsk Epidemiologi, 25*(1-2).

Johnson, N. P., & Mueller, J. (2002, Spring). Updating the Accounts: Global Mortality of the 1918-1920 "Spanish" Influenza Pandemic. *Bulletin of the History of Medicine, 76*(1), 105-115. https://doi.org/10.1353/bhm.2002.0022

Karlsson, M., Nilsson, T., & Pichler, S. (2014, 03/25). The impact of the 1918 Spanish flu epidemic on economic performance in Sweden. *Journal of health economics, 36C*, 1-19. https://doi.org/10.1016/j.jhealeco.2014.03.005

Laanani, M., Ghosn, W., Jougla, E., & Rey, G. (2015). Impact of unemployment variations on suicide mortality in Western European countries (2000–2010). *J Epidemiol Community Health, 69*(2), 103-109.

Mamelund, S.-E. (1998). Diffusjon av influensa i Norge under spanskesyken 1918-19. *Norsk Epidemiologi, 8*(1).

Mamelund, S.-E. (2004a). Can the Spanish Influenza Pandemic of 1918 Explain the Baby Boom of 1920 in Neutral Norway ? *Population, 59*(2), 229-260. https://www.cairn-int.info/article-E_POPU_402_0269--.htm
https://www.cairn-int.info/load_pdf.php?ID_ARTICLE=E_POPU_402_0269

Mamelund, S.-E. (2004b). *Spanish Influenza and Beyond: The Case of Norway*

Mamelund, S.-E. (2011, 2011/03/01/). Geography May Explain Adult Mortality from the 1918–20 Influenza Pandemic. *Epidemics, 3*(1), 46-60. https://doi.org/https://doi.org/10.1016/j.epidem.2011.02.001

Mamelund, S.-E., Haneberg, B., & Mjaaland, S. (2016). A Missed Summer Wave of the 1918–1919 Influenza Pandemic: Evidence From Household Surveys in the United States and Norway. *Open Forum Infectious Diseases, 3*(1). https://doi.org/10.1093/ofid/ofw040

Rao, H., & Greve, H. R. (2017, 2018/02/01). Disasters and Community Resilience: Spanish Flu and the Formation of Retail Cooperatives in Norway. *Academy of Management Journal, 61*(1), 5-25. https://doi.org/10.5465/amj.2016.0054

Reneflot, A., Øien-Ødegaard, C., Straiton, M. L., Zahl, P. H., Myklestad, I., Stene-Larsen, K., & Hauge, L. J. (2018). *Suicide in Norway*. https://www.fhi.no/en/op/hin/mental-health/suicide/

Rück, C., Mataix-Cols, D., Malki, K., Adler, M., Flygare, O., Runeson, B., & Sidorchuk, A. (2021). Swedish nationwide time series analysis of influenza and suicide deaths from 1910 to 1978. *BMJ Open, 11*(7), e049302. https://doi.org/10.1136/bmjopen-2021-049302

S. M. EL REY, E. (1918, 177). LA FIEBRE DE LOS TRES DIAS; EN MADRID HAY 80.00 ATACODOS. *El Sol,* 1. http://hemerotecadigital.bne.es/issue.vm?id=0000188376&page=2&search=&lang=es

Statistics Norway, S. (1910a). *Folketællingen i Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/nos/nos_vi_077.pdf

Statistics Norway, S. (1910b). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1910.pdf

Statistics Norway, S. (1910c). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_v_181.pdf

Statistics Norway, S. (1911a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1911.pdf

Statistics Norway, S. (1911b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_v_216.pdf

Statistics Norway, S. (1912a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1912.pdf

Statistics Norway, S. (1912b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_019.pdf

Statistics Norway, S. (1913a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1913.pdf

Statistics Norway, S. (1913b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_056.pdf

Statistics Norway, S. (1914a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1914.pdf

Statistics Norway, S. (1914b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_094.pdf

Statistics Norway, S. (1915a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1915.pdf

Statistics Norway, S. (1915b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_133.pdf

Statistics Norway, S. (1916a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1916.pdf

Statistics Norway, S. (1916b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_186.pdf

Statistics Norway, S. (1917a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1917.pdf

Statistics Norway, S. (1917b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_003.pdf

Statistics Norway, S. (1918a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1918.pdf

Statistics Norway, S. (1918b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_058.pdf

Statistics Norway, S. (1919a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1919.pdf

Statistics Norway, S. (1919b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_108.pdf

Statistics Norway, S. (1920a). *Folketællingen i Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/nos/nos_vii_161.pdf

Statistics Norway, S. (1920b). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1920.pdf

Statistics Norway, S. (1920c). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_138.pdf

Statistics Norway, S. (1930). *Folketællingen i Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/nos/nos_viii_182.pdf

Wasserman, I. M. (1992). The impact of epidemic, war, prohibition and media on suicide: United States, 1910–1920. *Suicide and Life-Threatening Behavior, 22*(2), 240-254.

Appendix A- Submission guidelines for Journal on *Suicides and Life-Threatening Behavior*

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Sections

1. Submission and Peer Review Process
2. Article Types
3. After Acceptance

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Appendix B – Pooled OLS Models

$$y_{it} = \beta_0 + x_{1it}\beta_1 + x_{2it}\beta_2 + x_{3it}\beta_3 + x_{4it}\beta_4 + x_{5it}\beta_5 + \varepsilon_{it}$$

Table 3.

Pooled OLS for Total Suicides

Total suicides	β	Std. err.	t	[95% conf. interval]	
Total population	.000046***	6.50e-06	7.07	.0000332	.0000588
Total influenza cases	-.0001151***	.0000345	-3.34	-.0001831	-.0000471
Total influenza deaths	.0082527	.0096143	0.86	-.0106976	.0272031
Total Doctors	.0184746***	.0048963	3.77	.0088238	.0281254
_cons	-.7641909	.6504246	-1.17	-2.046216	.5178345

*p < .05; ** p < .01; *** p < .001.

OLS was also performed for sex differences and examined males suicide rates, categorised by year and unit (y_{it}) and assumed by the coefficients of female suicide rates, total population, total influenza cases, male influenza deaths, female influenza deaths and total doctors

$$y_{it} = \beta_0 + x_{1it}\beta_1 + x_{2it}\beta_2 + x_{3it}\beta_3 + x_{4it}\beta_4 + x_{5it}\beta_5 + x_{6it}\beta_6 + x_{7it}\beta_7 + \varepsilon_{it}$$

Table 4.

Pooled OLS for Male Suicides

Male suicides	β	Std. err.	t	[95% conf. interval]	
Female Suicides	.0388622	.1592088	0.24	-.2749644	.3526889
Total population	.0000347***	6.11e-06	5.69	.0000227	.0000468
Total influenza cases	.00003	.0000638	0.47	-.0000957	-.0001558
Female influenza deaths	.0093154	.0186657	0.50	-.0274777	.0297428
Male influenza deaths	-.0216384	.0171957	-1.26	-.0555339	.012257

Male suicides	β	Std. err.	t	[95% conf. interval]	
Total Doctors	.0205826***	.0046471	4.43	.0114224	.0297428
_cons	-.5528424	.5752986	-0.96	-1.68685	.5811653

*$p < .05$; ** $p < .01$; *** $p < .001$.

OLS was performed for sex differences and examined females suicide rates, categorised by year and unit (y_{it}) and assumed by the coefficients of male suicide rates, total population, total influenza cases, male influenza deaths, female influenza deaths and total doctors.

$$y_{it} = \beta_0 + x_{1it}\beta_1 + x_{2it}\beta_2 + x_{3it}\beta_3 + x_{4it}\beta_4 + x_{5it}\beta_5 + x_{6it}\beta_6 + x_{7it}\beta_7 + \varepsilon_{it}$$

Table 5.

Pooled OLS for Female Suicides

Female suicides	β	Std. err.	t	[95% conf. interval]	
Male Suicides	.007196	.0294803	0.24	-.0509145	.0653065
Total population	9.84e-06***	2.74e-06	3.59	4.45e-06	.0000152
Total influenza cases	-.0000244	.0000274	-0.89	-.0000785	.0000296
Female influenza deaths	.001403	.0080362	0.17	-.0144376	.0172436
Male influenza deaths	-.0003159	.0074269	-0.04	-.0149555	.0143238
Total Doctors	-.0015146	.0020872	-0.73	-.0056288	.0025996
_cons	.0497704	.2480699	0.20	-.439216	.5387568

*$p < .05$; ** $p < .01$; *** $p < .001$.

Appendix C – OLS Regression with Robust Standard Errors

Table 6.

OLS Regression with Robust Standard Errors for Total Suicides

Total suicides	β	Std. err.	t	[95% conf. interval]	
Total population	.000046***	9.43e-06	4.87	.0000262	.0000657
Total influenza cases	-.0001151**	.0000438	-2.63	-.0002068	-.0000233
Total influenza deaths	.0082527	.0085732	0.96	-.0096913	.0261967
Total Doctors	.0184746***	.0060281	3.06	.0058577	.0310916
_cons	-.7641909	.713226	-1.07	-2.25699	.7286084

*$p < .05$; ** $p < .01$; *** $p < .001$.

Using this test for serial autocorrelation with total suicides, total population, total influenza cases, total doctors and total influenza deaths, there were no first-order autocorrelations reported ($F(1,19) = 1.28$, $p = 0.27$). The null hypothesis of no autocorrelation was firmly accepted, therefore suggesting that there is no problem with autocorrelation in this model. This result indicates that this model predicts the independent variables with greater reliability than the dependent. All other models based on gender differences also did not present any first order autocorrelations.

The existence of autocorrelation could lead to heteroscedasticity and suggests that the model predicts some values of the dependent variable more accurately than others. Therefore, plots for residuals against the fitted values were observed. Mild heteroscedasticity was reported for total suicides, more so for male suicides, though not reported for females, which presented a clear pattern. In a well-fitting model, there is usually no pattern against the fitted values.

Table 7.

OLS Regression with Robust Standard Errors for Male Suicides

Male suicides	β	Std. err.	t	[95% conf. interval]

Male suicides	β	Std. err.	t	[95% conf. interval]	
Female Suicides	.0388622	.1209311	0.24	-.2749644	.3526889
Total population	.0000347***	8.41e-06	4.13	.0000171	.0000523
Total influenza cases	.00003	.0000359	0.84	-.0000451	-.0001051
Female influenza deaths	.0093154	.0167501	0.56	-.0257429	.0443738
Male influenza deaths	-.0216384	.0141106	-1.53	-.0511722	.0078954
Total Doctors	.0205826***	.0052909	3.89	.0095085	.0316566
_cons	-.5528424	.5738922	-0.96	-1.754013	.6483278

*$p < .05$; ** $p < .01$; *** $p < .001$.

Table 8.

OLS Regression with Robust Standard Errors for Female Suicides

Female suicides	β	Std. err.	t	[95% conf. interval]	
Male Suicides	.007196	.0228439	0.32	-.0406168	.0550088
Total population	9.84e-06***	1.95e-06	5.05	5.77e-06	.0000139
Total influenza cases	-.0000244	.0000269	-0.91	-.0000807	.0000318
Female influenza deaths	.001403	.0084091	0.17	-.0161975	.0190035
Male influenza deaths	-.0003159	.0064	-0.05	-.0137112	.0130795
Total Doctors	-.0015146	.0014824	-1.02	-.0046173	.0015881
_cons	.0497704	.202216	0.25	-.3734726	.4730134

*$p < .05$; ** $p < .01$; *** $p < .001$.

Appendix D – Between Effects Models

Table 9.

Within and Between Effects Descriptive Statistics

	Overall (N = 220)				Between (n = 20)		Within (T = 11)	
Variables	M	SD	Range	Total across all years	SD	Range	SD	Range
Total Influenza Cases	2811.89	5738.36	27 – 32458	618616	1314.41	333.27 – 5090.82	5592.86	-1298.75 – 30958.25
Total Influenza Deaths	46.90	116.49	0 – 806	10319	21.48	22.64 – 119.27	114.59	-68.37 – 733.63
Total Influenza Deaths Male	24.08	61.39	0 – 407	5298	10.20	12.27 – 55.18	60.58	-31.1 – 375.9
Total Influenza Deaths Female	22.82	55.56	0 – 399	5021	11.60	10.36 – 64.09	54.40	-39.27 – 357.73
Population	123964.80	46386.67	39126 – 259364		47077.31	41491.09 – 251106.6	6053.864	98408.7 – 149521.7
Doctors	57.59	59.89	12 – 348	12669	60.91	15.64 – 307.55	6.84	23.04 – 98.04
Total Suicides	5.93	4.14	0 – 24	1305	3.40	1.36 – 16	2.48	-3.07 – 13.93
Male Suicides	4.76	3.71	0 – 22	1047	3.01	1.1 – 13.81	2.27	-4.1 – 12.94
Female Suicides	1.17	1.17	0 – 5	258	.52	.18 – 2.18	1.1	-1.01 – 4.54

The between effects model (*B*) gives an average ($\bar{x}$) of all individual variables (x_{1i}) and demonstrates them in a regression model. The first between effects model examined in this study assessed the average total suicides with average of all variables, total population, total influenza cases, total influenza deaths and total doctors.

$$\bar{y}_i = \beta_{0B} + \beta_{1B}\bar{x}_{1i} + \beta_{2B}\bar{x}_{2i} + \beta_{3B}\bar{x}_{3i} + \beta_{4B}\bar{x}_{4i} + \varepsilon_{it}$$

Table 10.

Between Effects Regression with Total Suicides

Total suicides	β	Std. err.	t	[95% conf. interval]	
Total population	.0000258	.0000141	1.84	-4.16e-06	.0000558
Total influenza cases	.0007827*	.0003548	2.21	.0000264	.0015389
Total influenza deaths	.0028527	.0422675	0.07	-.0872384	.0929439
Total Doctors	.0222458*	.0081733	2.72	.0048247	.0396668
_cons	-.8423876	1.25241	-0.67	-3.511837	1.827062

*p < .05; ** p < .01; *** p < .001.

Table 11.

Between Effects Regression with Male Suicides

Male suicides	β	Std. err.	t	[95% conf. interval]	
Female Suicides	.5065166	.8886557	0.57	-1.413307	2.426341
Total population	.0000193	.0000154	1.26	-.0000139	.0000526
Total influenza cases	.00075778*	.00003113	2.92	.0067286	.0451614
Female influenza deaths	.0517193	.0885409	0.58	-.1395618	.0443738
Male influenza deaths	-.1163728	.0853781	-1.36	-.300821	.0680753
Total Doctors	.025945*	.008895	2.92	.0067286	.0451614
_cons	-.231805	.9355826	-0.25	-2.253008	1.789398

*p < .05; ** p < .01; *** p < .001.

Table 12.

Between Effects Regression with Female Suicides

Female suicides	β	Std. err.	t	[95% conf. interval]	
Male Suicides	.0481353	.0844507	0.57	-.1343094	.2305799
Total population	9.01e-06	4.36e-06	2.07	-3.99e-07	.0000184
Total influenza cases	-9.82e-06	.0001158	-0.08	-.0002599	.0002403
Female influenza deaths	.0210366	.027028	0.78	-.0373539	.0794272
Male influenza deaths	-.0265771	.027155	-0.98	-.0852418	.0320876
Total Doctors	-.002454	.0034607	-0.71	-.0099304	.0050224
_cons	.1552563	.2858697	0.54	-.4623277	.7728402

*$p < .05$; ** $p < .01$; *** $p < .001$.

Appendix E – Fixed Effects (within) Models

Male suicides reported a significant result and supported the use of a fixed effects model (X^2(6, N = 220) = 61.00, p <.001). Whilst overall suicides were non-significant (X^2(4, N = 220) = 8.04, p = .09), as was the result for female suicides (X^2(5, N = 220) = 5.39, p = .37), therefore, a random effects model was initiated with these variables.

Subsequently, male suicides (y) were investigated as a function of female suicides, female suicides, total population, total influenza cases, female influenza deaths, male influenza deaths and total doctors (X_{1-6}). The within variation ($c_i + e_{it}$) also includes the unexplained variance using the error term. There is a concern in this model that the cov($X_1 + c_i$) ≠ 0, and that an unmeasured variable may be related with another variable. However, it is plausible that this also affects more biased coefficients.

$$y_{it} = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + (c_i + e_{it})$$

Unit specific dummy variables were applied for all independent variables to estimate the fixed effect. In this model, male suicides were examined for each county. Here, male suicides were explored and categorised by county alongside total influenza cases. Kristiania was used as a reference category (represented by the intercept) and was consequently used to manually generate dummies.

Table 13.

Fixed Effects Using Dummies for Male Suicides and Influenza Cases

Male suicides	β	Std. err.	t	[95% conf. interval]	
Smaalenene	-.044762	.9849332	-0.05	-1.987008	1.897484
Akershus	-3.564481***	.986417	-3.61	-5.509653	-1.61931
Hedemarken	-2.096329*	.9862121	-2.13	-4.041097	-.1515617
Kristians	-2.460873*	.9852179	-2.50	-4.403679	-.5180657
Buskerud	-3.797297***	.9873125	-3.85	-5.744234	-1.85036
Jarlsberg and Lauvrik	-1.253565	.9850505	-1.27	-3.196042	.688912
Bratsberg	.4850687	.9848867	0.49	-1.457085	2.427222
Nedenes	-2.244241*	.9857638	-2.28	-4.188124	-.3003573

Male suicides	β	Std. err.	t	[95% conf. interval]	
Lister and Mandal	-1.50646	.9849552	-1.53	-3.448749	.4358291
Stavanger	-4.86996***	.9889348	-4.92	-6.820097	-2.919824
Søndre Bergenhus	4.0481***	.9849404	4.11	2.10584	5.99036
Bergen	-4.742412***	.988066	-4.80	-6.690836	-2.793989
Nordre Bergenhus	8.262211***	.9851016	8.39	6.319634	10.20479
Romsdal	2.076744*	.9850794	2.11	.13421	4.019277
Søndre Trondhjems	-.2782928	.9848517	-0.28	-2.220378	1.663792
Nordre Trondhjems	-.9355787	.9857878	-0.95	-2.879509	1.008352
Norland	-.341054	.9850319	-0.35	-2.283494	1.601386
Tromsø	-2.064503*	.9850122	-2.10	-4.006904	-.122102
Finmarken	-3.70812***	.9858783	-3.76	-5.652229	-1.764011
Total Influenza Cases	-.0001009***	.0000279	-3.61	-.0001559	-.0000458
_cons	5.994483***	.7034084	8.52	4.607392	7.381573

*$p < .05$; ** $p < .01$; *** $p < .001$.

Table 14.

Fixed Effects Using Dummies for Male Suicides and Influenza Deaths

Male suicides	β	Std. err.	t	[95% conf. interval]	
Smaalenene	-.0425531	1.018342	-0.04	-2.050679	1.965572
Akershus	-3.362629***	1.015594	-3.31	-5.365337	-1.359921
Hedemarken	-1.93881	1.016632	-1.91	-3.943564	.0659449
Kristians	-2.413503*	1.018516	-2.37	-4.421972	-.4050345
Buskerud	-3.527321***	1.01598	-3.47	-5.53079	-1.523852
Jarlsberg and Lauvrik	-1.127418	1.01907	-1.11	-3.13698	.8821448
Bratsberg	.501894	1.018228	0.49	-1.506008	2.509796
Nedenes	-2.041546*	1.018457	-2.00	-4.049899	-.0331924
Lister and Mandal	-1.401656	1.01888	-1.38	-3.410844	.6075314
Stavanger	-4.61144***	1.020705	-4.52	-6.624226	-2.598654
Søndre Bergenhus	4.00957***	1.015701	3.95	2.006652	6.012489
Bergen	-4.536146***	1.0234	-4.43	-6.554247	-2.518045

Male suicides	β	Std. err.	t	[95% conf. interval]	
Nordre Bergenhus	8.22967***	1.018285	8.08	6.221657	10.22768
Romsdal	1.969274	1.016704	1.94	-.0356219	3.97417
Søndre Trondhjems	-.1961637	1.022469	-0.19	-2.212429	1.820101
Nordre Trondhjems	-1.105013	1.015827	-1.09	-3.10818	.8981545
Norland	-.2203416	1.018818	-0.22	-2.229406	1.788723
Tromsø	-1.931496	1.021102	-1.98	-3.945064	.0820722
Finmarken	-3.600359***	1.019135	-3.53	-5.6510049	-1.590669
Total Influenza Deaths	-.0055408	.0000279	-0.65	-.0224345	.0113529
_cons	5.799061***	.7609177	7.62	4.298565	7.299558

*p < .05; ** p < .01; *** p < .001.

Consequently, the fixed effects reported the greatest relationship between male suicides, influenza cases, influenza deaths and total population in Nordre Bergenhus. Having said this, counties most impacted with fewer suicides were Stavanger explored with male suicides and influenza cases (β = -4.74, p <.001), influenza deaths (β = -4.61, p <.001) and Bergen for male suicides and total population (β = -9.58, p = .01).

Table 15.

Fixed Effects Using Dummies for Male Suicides and Total Population

Male suicides	β	Std. err.	t	[95% conf. interval]	
Smaalenene	.0596778	1.012461	0.06	-1.936852	2.056208
Akershus	-6.728906**	2.161978	-3.11	-10.99223	-2.465579
Hedemarken	-2.114707*	1.015582	-2.08	-4.117391	-.1120235
Kristians	-5.472118**	2.034069	-2.69	-9.483214	-1.461023
Buskerud	-7.236949**	2.327531	-3.11	-11.82674	-2.647158
Jarlsberg and Lauvrik	-1.236269	1.009314	-1.22	-3.226591	.7540542
Bratsberg	.6859734	1.017374	0.67	-1.320243	2.69219
Nedenes	-5.106132*	1.988229	-2.57	-9.026833	-1.185431
Lister and Mandal	-.8067135	1.073898	-0.75	-2.924393	1.310966
Stavanger	-7.674015***	2.043983	-3.75	-11.70466	-3.643369
Søndre Bergenhus	4.139918***	1.011967	4.09	2.144363	6.135473

Male suicides	β	Std. err.	t	[95% conf. interval]	
Bergen	-9.584609**	3.084578	-3.11	-15.66726	-3.501955
Nordre Bergenhus	12.79414***	2.808224	4.56	7.256449	18.33184
Romsdal	1.523628	1.044521	1.46	-.536122	3.583377
Søndre Trondhjems	-1.585064	1.254509	-1.26	-4.058902	.8887742
Nordre Trondhjems	-2.081204	1.155153	-1.80	-4.359116	.1967089
Norland	-2.1262	1.458388	-1.46	-5.002078	.7496773
Tromsø	-3.676331**	1.38745	-2.65	-6.412323	-.9403388
Finmarken	-7.25756**	2.338091	-3.10	-11.86817	-2.646946
Total Population	-.0000465	.0000264	-1.76	-.0000986	5.60e-06
_cons	12.69483**	4.073615	3.12	4.661835	20.72782

*p < .05; ** p < .01; *** p < .001.

Exploring the time fixed effects (within) regression for male suicides with female suicides, overall population, total influenza cases, total influenza deaths, female influenza deaths and male influenza deaths.

$$\rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2}$$

The rho value (ρ = .1004) reported that 10.04% of the variance in this model was due to differences across time (within units). Sigma *u* (σ_u = .844) represented the residuals within groups (counties) and Sigma *e* (σ_e = 2.53) reported the residuals overall. Subsequently, no other variables significantly impacted male suicides with the within this model.

Table 16.

Time Fixed Effect (within) Regression with Male Suicides

Male suicides	β	Std. err.	t	[95% conf. interval]	
Female Suicides	-.0187535	.1568868	-0.12	-.3280902	.2905832
Total population	.0000367***	6.06e-06	6.06	.0000248	.0000486
Total influenza cases	.0000434	.0000707	0.61	-.000096	.0001827

Male suicides	β	Std. err.	t	[95% conf. interval]	
Female influenza deaths	.0078888	.0183157	0.43	-.0282246	.0440022
Male influenza deaths	-.0203373	.0171635	-1.18	-.0541789	.0135044
Total Doctors	.019697***	.0045558	4.32	-.0107143	.0286797
_cons	-.7150942	.5661083	-1.26	-1.831301	.4011121
Sigma *u*	.844433065				
Sigma *e*	2.5263888				
Rho, ρ	.10047083				

*$p < .05$; ** $p < .01$; *** $p < .001$.

Appendix F – Random Effects Models

Here, the total number of suicides cannot be measured by overall influence, but by the differences between variables and reports which variable had most significant influence.

$$Y_{it} = \beta_{0RE} + \beta_{1RE}x_{1it} + \beta_{2RE}x_{2it} + \beta_{3RE}x_{3it} + \beta_{4RE}x_{4it} + v_i + e_{it}$$

The value of rho in this study (*p* = .1708) tells us that 17.08% of the variance is due to differences across time (within units). Sigma *u* (1.143) residuals within groups and Sigma *e* (2.518) reporting the residuals overall suggests that the observation within each unit was resemblant of one another.

Table 17.

Random Effects Model with Total Suicides

Total suicides	β	Std. err.	z	[95% conf. interval]	
Total population	.0000448***	.00001	4.46	.0000251	.0000645
Total Influenza Cases	-.0001294***	.0000316	-4.09	-.0001914	-.0000675
Total Influenza Deaths	.0079021	.0091514	0.86	-.0100344	.0258385
Total Doctors	.0176108*	.0076901	2.29	.0025386	.0326831
_cons	-.5162826	1.01132	-0.51	-2.498434	1.465869
Sigma *u*	1.1430425				
Sigma *e*	2.5184619				
Rho, *ρ*	.1708083				

*$p < .05$; ** $p < .01$; *** $p < .001$.

Furthermore, the rho value (*p* = .100) reports that 100% of the variance is due to differences across time (within units). Additionally, Sigma *u* (.103) residuals within groups and Sigma *e* (1.114) reporting the residuals overall suggests that the observation within each unit displayed a large variance.

Table 18.

Random Effects Model with Female Suicides

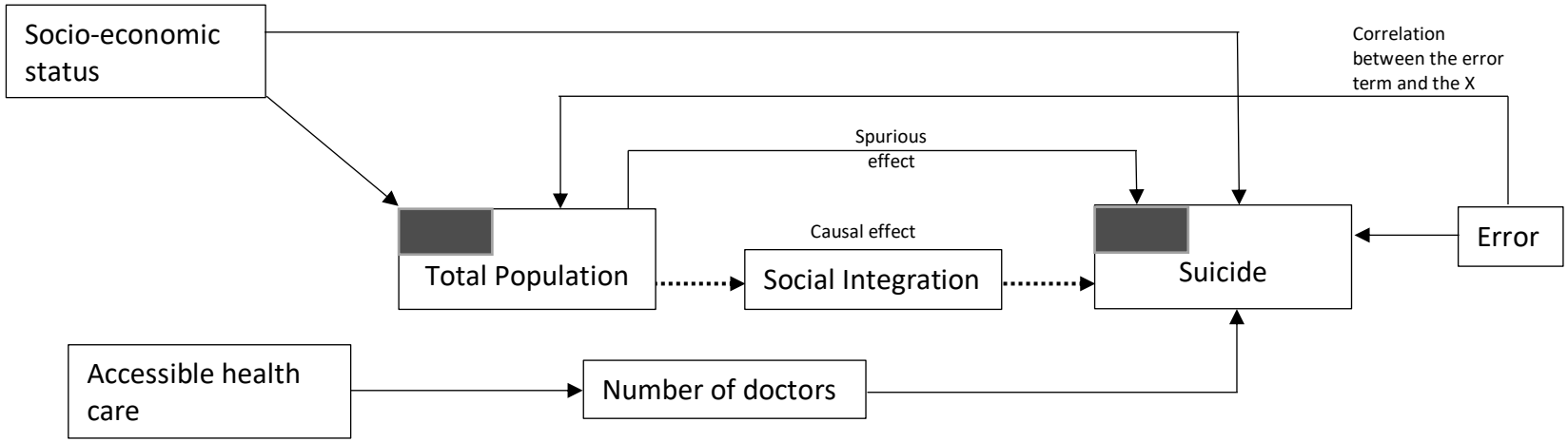
Female suicides	β	Std. err.	z	[95% conf. interval]	
Male Suicides	.0058671	.0296709	0.20	-.0522868	.0640211
Total population	9.90e-06***	2.83e-06	3.49	4.35e-06	.0000155
Total influenza cases	-.000251*	.0000275	-0.91	-.000079	.0000288
Female influenza deaths	.0012143	.0080499	0.15	-.0145633	.016992
Male influenza deaths	-.0000965	.027155	-0.01	-.0146652	.0144721
Total Doctors	-.0015032*	.0021604	-0.70	-.0057375	.0027311
_cons	.0493816	.2581466	0.19	-.4565764	.5553395
Sigma *u*	.10301867				
Sigma *e*	1.1143493				
Rho, *ρ*	.00847409				

*$p < .05$; ** $p < .01$; *** $p < .001$.

Appendix G – Causal Estimates Figure

Figure 3.

Causal Estimates



Appendix H – Time-Series Cross-Section (TSCS) Models, Lagged effects

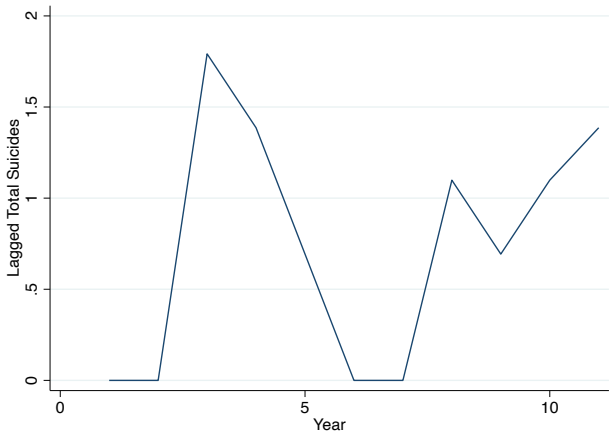
Time-series cross-section methods (TSCS) were applied. Using the TSCS model, there is a similar approach to the previous models used in this research, with the difference being that X-variables are lagged by one year. Therefore, this model assumes that previous year is what may have affected the following year and therefore lag variables were explored.

$$Y_{it} = \beta_0 + Y_{i,t-1} + \beta x_{i,t-1} + \varepsilon_{it}$$

Firstly, it is reasonable to assume that there may be correlations across panels. To correct the underestimated standard errors that result from serial dependence, the Beck and Katz (1995) panel-corrected standard errors package was operated in STATA 17.0. Following this, a normal distribution is needed for this test and due to unsuitability, variables were log-transformed to fit (Skew = -.53, Kurtosis = 2.85).

Figure 4.

Graph of Lagged Total Suicides

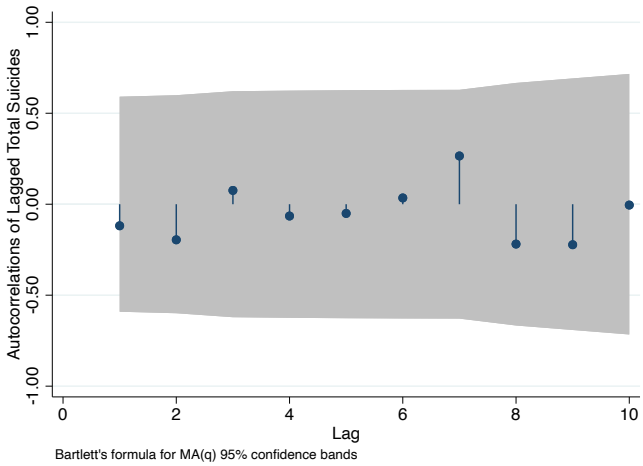


All mortality statistics were not accepted in this model including female and male influenza deaths as well as influenza deaths overall. Female suicides were therefore only examined

with male suicides, number of doctors and total population. With female suicides, skew and kurtosis was acceptable prior to analysis (Skew = .5, kurtosis = 1.89).

Figure 5.

Autocorrelations of Lagged Total Suicides in Akershus



Appendix I – Dickey-Fuller Test for Unit Root and Lagged TSCS

Subsequently, a Dickey-Fuller test for presence of a unit root (non-stationary) was executed (Dickey & Fuller, 1979). The null hypothesis of the Dickey-Fuller test is that the variable contains a unit root. The alternative is that a stationary process generated the variable. Consequently, a lag of one interval (one year) tested if the DV was non-stationary, however, this test does not allow panel data, so each unit (county) was explored individually.

Table 19.

Dickey-Fuller Test for Unit Root with Total Suicides

County	Z(t)	County	Z(t)
Smaalenene	0.0203	Stavanger	1
Akershus	0.0833	Søndre Bergenhus	0.2551
Kristiania	0.0249	Bergen	1
Hedemarken	0.9030	Nordre Bergenhus	0.5757
Kristians	0.3814	Romsdal	0.0075
Buskerud	0.8362	Søndre Trondhjems	0.0349
Jarlsberg and Lauvrik	0.6281	Nordre Trondhjems	0.3842
Bratsberg	0.6208	Norland	0.5562
Nedenes	0.0387	Tromsø	0.7049
Lister and Mandal	0.5719	Finmarken	0.0214

*$p < .05$; ** $p < .01$; *** $p < .001$.

Autocorrelation measurements were also examined and, for example, Akershus had the greatest correlation of suicides rates with 7 years prior. Figure 4. presenting Autocorrelations of Lagged Total Suicides in Akershus, includes the 95% confidence interval (shaded area), and correlations outside this area were significant. For Akershus, this is not the case for any variables and there was no consistent pattern found throughout and between counties.

The TSCS regression was now explored with total suicides and total population, total influenza cases, total influenza deaths and total doctors, whilst also clustered for county.

$$Y_{it} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 x_{1i,t-1} + \beta_3 x_{2i,t-1} + \beta_4 x_{5i,t-1} + \varepsilon_{it}$$

Table 20.

Regression with a Lagged Dependent and Independent Variables with Total Suicides

Total suicides	β	Std. err.	t	[95% conf. interval]	
L1. Total suicides	.2606328**	.0818501	3.18	.0893187	.431947
L1. Total population	7.58e-06***	1.46e-06	5.18	4.51e-06	.0000106
L1. Total influenza cases	7.64e-06	3.91e-06	1.95	-5.49e-07	.0000158
L1. Total influenza deaths	.0016477	.0024476	0.67	-.0034752	.0067706
L1. Total Doctors	-.0004505	.0007955	-0.57	-.0021154	.0012144
_cons	.186157	.1139488	1.63	-.0523406	.4246546

*$p < .05$; ** $p < .01$; *** $p < .001$.

Table 21.

Regression with a Lagged Dependent and Independent Variables with Female Suicides

Female suicides	β	Std. err.	t	[95% conf. interval]	
L1. Female suicides	-.2811121**	.0921265	-3.05	-.4746627	-.0875614
L1. Male Suicides	-.0129748	.0138347	-0.94	-.0420404	.0160909
L1. Total Population	4.73e-06*	1.95e-06	2.43	6.33e-07	8.82e-06
L1. Total Doctors	.0003572	.0008033	0.44	-.0013306	.0020449
_cons	-.0008496	.1803468	-0.00	-.3797441	.3780448

*$p < .05$; ** $p < .01$; *** $p < .001$.

Appendix J – Annual Statistics

Table 22.

Table of Annual Statistics

Year	Doctors	Deaths	Suicides	Suicides M	Suicides F	Population	Total Influenza cases	Total Influenza deaths	Total Influenza deaths M	Total Influenza deaths F
1910	1126	32639	130	101	29	2 324 780	15843	186	82	104
1911	1091	30081	116	93	23	2 355 676	9893	79	23	56
1912	1122	32269	145	118	27	2 386 580	14008	71	23	48
1913	1121	31538	144	119	25	2 417 485	16680	103	48	55
1914	1154	32928	118	99	19	2 448 391	11161	46	21	25
1915	1163	32304	132	110	22	2 479 298	22604	199	66	133
1916	1128	34196	97	76	21	2 510 197	30785	178	74	104
1917	1157	34151	92	71	21	2 541 102	15178	91	38	53
1918	1183	42908	81	62	19	2 572 008	367231	7286	3845	3441
1919	1203	35589	124	101	23	2 602 911	76910	1716	879	837
1920	1221	33568	126	97	29	2 633 825	38323	364	199	165

Descriptive Results

Appendix K – Overall Statistics

Table 23.

Overall Statistics

i	Amt	Year	Population	Number of Suicides	Number of Male Suicides	Number of Female Suicides	Suicides per 100,000 per county	Total Influenza Cases	Total Influenza deaths	Male Influenza Deaths	Female Influenza Deaths	Influenza a Cases per 100,000	Influenza Deaths per 100,000	Number of Doctors per 100,000	Doctor per Suicide
1	Smaalenens Amt	1910	150690	9	8	1	5,97	1290	3	2	1	856,06	1,99	39,153	15,25
1	Smaalenens Amt	1911	151 573	8	8	0	5,28	383	3	0	3	252,68	1,98	38,925	13,56
1	Smaalenens Amt	1912	152 457	6	5	1	3,94	652	2	1	1	427,66	1,31	39,355	10,00
1	Smaalenens Amt	1913	153 341	9	7	2	5,87	952	8	1	7	620,84	5,22	39,128	15,00
1	Smaalenens Amt	1914	154 225	3	3	0	1,95	523	4	4	0	339,11	2,59	41,498	4,69
1	Smaalenens Amt	1915	155 109	8	5	3	5,16	2047	7	3	4	1319,72	4,51	41,906	12,31
1	Smaalenens Amt	1916	155 992	9	6	3	5,77	815	3	3	0	522,46	1,92	39,105	14,75
1	Smaalenens Amt	1917	156 876	5	5	0	3,19	769	3	2	1	490,20	1,91	41,434	7,69
1	Smaalenens Amt	1918	157 760	6	5	1	3,80	28154	360	177	183	17846,10	228,19	41,202	9,23
1	Smaalenens Amt/ Østfold	1919	158 644	7	5	2	4,41	6414	98	62	36	4043,01	61,77	42,233	10,45
1	Smaalenens Amt/ Østfold	1920	159528	4	4	0	2,51	2092	25	9	16	1311,37	15,67	40,118	6,25
2	Akershus Amt	1910	129 323	11	11	0	8,51	50	8	4	4	38,66	6,19	51,808	16,42
2	Akershus Amt	1911	134 434	11	7	4	8,18	590	1	0	1	438,88	0,74	49,839	16,42

i	Amt	Year	Population	Number of Suicides	Number of Male Suicides	Number of Female Suicides	Suicides per 100,000 per county	Total Influenza Cases	Total Influenza deaths	Male Influenza Deaths	Female Influenza Deaths	Influenza a Cases per 100,000	Influenza Deaths per 100,000	Number of Doctors per 100,000	Doctor per Suicide
2	Akershus Amt	1912	139 545	7	7	0	5,02	679	2	0	2	486,58	1,43	48,013	10,45
2	Akershus Amt	1913	144 656	15	12	3	10,37	971	5	4	1	671,25	3,46	52,538	19,74
2	Akershus Amt	1914	149 768	14	13	1	9,35	656	1	1	0	438,01	0,67	50,745	18,42
2	Akershus Amt	1915	154 879	13	13	0	8,39	1634	7	5	2	1055,02	4,52	50,362	16,67
2	Akershus Amt	1916	159 990	8	6	2	5,00	1671	4	0	4	1044,44	2,50	45,003	11,11
2	Akershus Amt	1917	165 102	13	12	1	7,87	1158	2	1	1	701,38	1,21	45,426	17,33
2	Akershus Amt	1918	170 213	4	4	0	2,35	22943	213	116	97	13478,99	125,14	42,300	5,56
2	Akershus Amt	1919	175 324	11	10	1	6,27	9981	80	39	41	5692,89	45,63	38,215	16,42
2	Akershus Amt	1920	180436	13	11	2	7,20	3971	18	10	8	2200,78	9,98	46,554	15,48
2	Kristiania Amt	1910	242 850	19	15	4	7,82	2924	36	10	26	1204,04	14,82	112,415	6,96
3	Kristiania Amt	1911	244 501	17	15	2	6,95	807	6	0	6	330,06	2,45	114,519	6,07
3	Kristiania Amt	1912	246 152	18	15	3	7,31	762	8	2	6	309,56	3,25	114,157	6,41
3	Kristiania Amt	1913	247 804	20	18	2	8,07	1265	19	7	12	510,48	7,67	116,624	6,92
3	Kristiania Amt	1914	249 455	24	22	2	9,62	448	4	2	2	179,59	1,60	119,861	8,03
3	Kristiania Amt	1915	251 107	14	14	0	5,58	1684	47	16	31	670,63	18,72	121,064	4,61
3	Kristiania Amt	1916	252 758	12	9	3	4,75	1643	26	6	20	650,03	10,29	120,669	3,93
3	Kristiania Amt	1917	254 409	12	9	3	4,72	950	18	3	15	373,41	7,08	126,961	3,72

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3	Kristiania Amt	1918	256 061	7	5	2	2,73	27678	806	407	399	10809,14	314,77	133,171	2,05
3	Kristiania Amt	1919	257712	17	17	0	6,60	6475	312	137	175	2512,49	121,07	135,034	4,89
3	Kristiania Amt	1920	259 364	16	13	3	6,17	3190	30	17	13	1229,93	11,57	131,090	4,71
4	Hedemarkens Amt	1910	133 633	11	10	1	8,23	201	14	9	5	150,41	10,48	37,416	22,00
4	Hedemarkens Amt	1911	135 230	7	6	1	5,18	427	0	0	0	315,76	0,00	35,495	14,58
4	Hedemarkens Amt	1912	136 827	11	7	4	8,04	417	1	1	0	304,76	0,73	35,812	22,45
4	Hedemarkens Amt	1913	138 424	11	10	1	7,95	1077	2	1	1	778,04	1,44	33,954	23,40
4	Hedemarkens Amt	1914	140 022	8	6	2	5,71	1224	2	0	2	874,15	1,43	34,995	16,33
4	Hedemarkens Amt	1915	141 619	12	10	2	8,47	1384	13	3	10	977,27	9,18	34,600	24,49
4	Hedemarkens Amt	1916	143 216	14	12	2	9,78	1486	3	0	3	1037,59	2,09	33,516	29,17
4	Hedemarkens Amt	1917	144 814	4	3	1	2,76	1159	1	0	1	800,34	0,69	33,837	8,16
4	Hedemarkens Amt	1918	146 411	10	7	3	6,83	32458	562	289	273	22169,10	383,85	32,784	20,83
4	Hedemarkens Amt/ Hedemark	1919	148008	10	10	0	6,76	5323	60	25	35	3596,43	40,54	34,458	19,61
4	Hedemarkens Amt/ Hedemark	1920	149 606	8	3	5	5,35	2272	9	5	4	1518,66	6,02	34,758	15,38
5	Christians Amt	1910	118 901	4	4	0	3,36	276	6	3	3	232,13	5,05	36,165	9,30
5	Christians Amt	1911	119 847	5	5	0	4,17	536	6	1	5	447,24	5,01	36,713	11,36

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5	Christians Amt	1912	120 793	10	9	1	8,28	837	4	2	2	692,92	3,31	37,254	22,22
5	Christians Amt	1913	121 740	12	8	4	9,86	1164	8	6	2	956,14	6,57	36,964	26,67
5	Christians Amt	1914	122 686	6	6	0	4,89	934	5	1	4	761,29	4,08	35,864	13,64
5	Christians Amt	1915	123 633	3	1	2	2,43	1308	8	3	5	1057,97	6,47	35,589	6,82
5	Christians Amt	1916	124 579	5	5	0	4,01	1724	5	2	3	1383,86	4,01	35,319	11,36
5	Christians Amt	1917	125 525	6	5	1	4,78	870	2	1	1	693,09	1,59	35,053	13,64
5	Christians Amt	1918	126 472	4	4	0	3,16	24964	524	261	263	19738,76	414,32	34,000	9,30
5	Christians Amt/ Opland	1919	127418	8	7	1	6,28	3881	54	28	26	3045,88	42,38	32,962	19,05
5	Christians Amt/ Opland	1920	128 365	7	5	2	5,45	1957	10	7	3	1524,56	7,79	35,056	15,56
6	Buskeruds Amt	1910	123 863	7	6	1	5,65	1121	17	7	10	905,03	13,72	62,973	8,97
6	Buskeruds Amt	1911	125 202	8	5	3	6,39	1175	4	1	3	938,48	3,19	19,169	33,33
6	Buskeruds Amt	1912	126 542	5	4	1	3,95	2096	4	2	2	1656,37	3,16	45,044	8,77
6	Buskeruds Amt	1913	127 882	7	5	2	5,47	2154	3	2	1	1684,37	2,35	42,226	12,96
6	Buskeruds Amt	1914	129 222	3	3	0	2,32	1270	1	0	1	982,80	0,77	44,110	5,26
6	Buskeruds Amt	1915	130 562	11	10	1	8,43	2543	12	1	11	1947,73	9,19	43,657	19,30
6	Buskeruds Amt	1916	131 901	5	5	0	3,79	3169	15	10	5	2402,56	11,37	41,698	9,09
6	Buskeruds Amt	1917	133 241	4	2	2	3,00	1760	4	0	4	1320,91	3,00	39,778	7,55

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6	Buskeruds Amt	1918	134 581	2	2	0	1,49	29921	405	226	179	22232,71	300,93	40,868	3,64
6	Buskeruds Amt	1919	135921	4	3	1	2,94	5388	53	29	24	3964,07	38,99	39,729	7,41
6	Buskeruds Amt	1920	137 261	5	5	0	3,64	5402	24	10	14	3935,57	17,48	40,070	9,09
7	Jarlsberg og Laurviks Amt	1910	103 333	7	6	1	6,77	486	6	3	3	470,32	5,81	36,774	18,42
7	Jarlsberg og Laurviks Amt	1911	105 064	5	5	0	4,76	552	9	3	6	525,39	8,57	36,168	13,16
7	Jarlsberg og Laurviks Amt	1912	106 795	11	9	2	10,30	623	5	1	4	583,36	4,68	36,519	28,21
7	Jarlsberg og Laurviks Amt	1913	108 527	10	9	1	9,21	881	7	1	6	811,78	6,45	37,779	24,39
7	Jarlsberg og Laurviks Amt	1914	110 258	5	3	2	4,53	477	3	1	2	432,62	2,72	38,092	11,90
7	Jarlsberg og Laurviks Amt	1915	111 990	12	11	1	10,72	1406	10	5	5	1255,47	8,93	37,503	28,57
7	Jarlsberg og Laurviks Amt	1916	113 721	1	1	0	0,88	1767	4	2	2	1553,80	3,52	35,174	2,50
7	Jarlsberg og Laurviks Amt	1917	115 452	6	2	4	5,20	1071	9	6	3	927,66	7,80	35,513	14,63
7	Jarlsberg og Laurviks Amt	1918	117 184	3	3	0	2,56	18503	125	70	55	15789,70	106,67	34,988	7,32
7	Jarlsberg og Laurviks Amt/ Vestfold	1919	118915	6	4	2	5,05	3862	54	34	20	3247,70	45,41	37,001	13,64
7	Jarlsberg og Laurviks Amt/ Vestfold	1920	120 647	11	6	5	9,12	1978	17	9	8	1639,49	14,09	36,470	25,00
8	Bratsbergs Amt	1910	106 791	9	7	2	8,43	654	7	3	4	612,41	6,55	44,011	19,15
8	Bratsbergs Amt	1911	108 593	8	7	1	7,37	603	5	3	2	555,28	4,60	43,281	17,02

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8	Bratsbergs Amt	1912	110 395	7	5	2	6,34	734	5	2	3	664,89	4,53	41,669	15,22
8	Bratsbergs Amt	1913	112 197	6	5	1	5,35	1036	9	4	5	923,38	8,02	40,108	13,33
8	Bratsbergs Amt	1914	113 999	5	5	0	4,39	722	0	0	0	633,34	0,00	42,983	10,20
8	Bratsbergs Amt	1915	115 801	5	2	3	4,32	915	4	1	3	790,15	3,45	41,450	10,42
8	Bratsbergs Amt	1916	117 603	6	4	2	5,10	1900	6	5	1	1615,61	5,10	40,815	12,50
8	Bratsbergs Amt	1917	119 405	2	1	1	1,67	1223	11	7	4	1024,25	9,21	42,712	3,92
8	Bratsbergs Amt	1918	121 207	2	0	2	1,65	17835	346	192	154	14714,50	285,46	43,727	3,77
8	Bratsbergs Amt/ Telemark	1919	123009	2	1	1	1,63	4210	66	45	21	3422,51	53,65	42,273	3,85
8	Bratsbergs Amt/ Telemark	1920	124 811	3	3	0	2,40	2191	8	5	3	1755,45	6,41	40,862	5,88
9	Nedenes Amt	1910	71 272	1	1	0	1,40	503	10	6	4	705,75	14,03	33,674	4,17
9	Nedenes Amt	1911	71 417	1	1	0	1,40	750	5	1	4	1050,17	7,00	33,605	4,17
9	Nedenes Amt	1912	71 563	6	6	0	8,38	1142	11	5	6	1595,80	15,37	33,537	25,00
9	Nedenes Amt	1913	71 708	4	3	1	5,58	945	4	2	2	1317,84	5,58	30,680	18,18
9	Nedenes Amt	1914	71 854	2	1	1	2,78	783	0	0	0	1089,71	0,00	32,009	8,70
9	Nedenes Amt	1915	72 000	1	1	0	1,39	1143	12	5	7	1587,50	16,67	38,889	3,57
9	Nedenes Amt	1916	72 145	1	0	1	1,39	1824	16	5	11	2528,24	22,18	40,197	3,45

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99	Nedenes Amt	1917	72 291	3	3	0	4,15	848	5	2	3	1173,04	6,92	37,349	11,11
99	Nedenes Amt	1918	72 436	2	1	1	2,76	10455	253	139	114	14433,43	349,27	34,513	8,00
99	Nedenes Amt/ Aust-Agder	1919	72582	3	3	0	4,13	1919	18	7	11	2643,91	24,80	39,955	10,34
99	Nedenes Amt/ Aust-Agder	1920	72 728	4	3	1	5,50	1005	13	9	4	1381,86	17,87	41,250	13,33
100	Lister og Mandals Amt	1910	77 237	2	1	1	2,59	226	11	4	7	292,61	14,24	41,431	6,25
100	Lister og Mandals Amt	1911	77 682	2	1	1	2,57	444	15	4	11	571,56	19,31	41,194	6,25
100	Lister og Mandals Amt	1912	78 127	4	3	1	5,12	174	3	0	3	222,71	3,84	43,519	11,76
100	Lister og Mandals Amt	1913	78 572	3	3	0	3,82	457	6	3	3	581,63	7,64	40,727	9,38
100	Lister og Mandals Amt	1914	79 017	3	2	1	3,80	231	0	0	0	292,34	0,00	40,498	9,38
100	Lister og Mandals Amt	1915	79 462	2	2	0	2,52	314	3	1	2	395,16	3,78	42,788	5,88
100	Lister og Mandals Amt	1916	79 907	4	1	3	5,01	775	7	3	4	969,88	8,76	38,795	12,90
100	Lister og Mandals Amt	1917	80 352	2	1	1	2,49	343	1	1	0	426,87	1,24	37,336	6,67
100	Lister og Mandals Amt	1918	80 797	3	3	0	3,71	10723	237	121	116	13271,53	293,33	38,368	9,68
100	Lister og Mandals Amt/ Vest Agder	1919	81242	7	5	2	8,62	2452	99	47	52	3018,14	121,86	40,619	21,21
100	Lister og Mandals Amt/ Vest Agder	1920	81 688	3	3	0	3,67	1014	5	3	2	1241,31	6,12	37,949	9,68
101	Stavanger Amt	1910	137 581	5	3	2	3,63	708	6	2	4	514,61	4,36	31,254	11,63

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11	Stavanger Amt	1911	140 438	6	5	1	4,27	736	8	3	5	524,07	5,70	32,043	13,33
11	Stavanger Amt	1912	143 296	10	9	1	6,98	936	6	2	4	653,19	4,19	31,404	22,22
11	Stavanger Amt	1913	146 153	7	5	2	4,79	654	5	2	3	447,48	3,42	31,474	15,22
11	Stavanger Amt	1914	149 011	8	7	1	5,37	547	1	0	1	367,09	0,67	32,883	16,33
11	Stavanger Amt	1915	151 869	11	9	2	7,24	1594	16	6	10	1049,59	10,54	34,240	21,15
11	Stavanger Amt	1916	154 726	4	4	0	2,59	2158	11	6	5	1394,72	7,11	31,669	8,16
11	Stavanger Amt	1917	157 584	0	0	0	0,00	1072	5	4	1	680,27	3,17	32,364	0,00
11	Stavanger Amt	1918	160 441	6	5	1	3,74	22679	173	74	99	14135,41	107,83	33,034	11,32
11	Stavanger Amt/ Rogaland	1919	163299	8	4	4	4,90	5706	115	58	57	3494,20	70,42	32,456	15,09
11	Stavanger Amt/ Rogaland	1920	166 157	12	11	1	7,22	2268	24	15	9	1364,97	14,44	31,898	22,64
12	Søndre Bergenhus Amt	1910	141613	5	5	0	3,53	596	4	4	0	420,87	2,82	27,540	12,82
12	Søndre Bergenhus Amt	1911	142779	6	3	3	4,20	103	0	0	0	72,14	0,00	27,315	15,38
12	Søndre Bergenhus Amt	1912	143945	9	5	4	6,25	345	6	1	5	239,67	4,17	25,704	24,32
12	Søndre Bergenhus Amt	1913	145112	8	7	1	5,51	212	1	0	1	146,09	0,69	23,430	23,53
12	Søndre Bergenhus Amt	1914	146278	6	4	2	4,10	230	4	1	3	157,23	2,73	26,662	15,38

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12	Søndre Bergenhus Amt	1915	147445	7	5	2	4,75	652	12	4	8	442,20	8,14	21,703	21,88
12	Søndre Bergenhus Amt	1916	148611	1	1	0	0,67	899	14	7	7	604,94	9,42	21,533	3,13
12	Søndre Bergenhus Amt	1917	149777	0	0	0	0,00	168	0	0	0	112,17	0,00	22,700	0,00
12	Søndre Bergenhus Amt	1918	150944	5	2	3	3,31	12155	400	188	212	8052,66	265,00	21,200	15,63
12	Søndre Bergenhus Amt/ Hordaland	1919	152110	6	5	1	3,94	2554	121	52	69	1679,05	79,55	21,037	18,75
12	Søndre Bergenhus Amt/ Hordaland	1920	153277	7	4	3	4,57	723	9	2	7	471,70	5,87	22,182	20,59
13	Bergen Amt	1910	75883	4	3	1	5,27	1323	5	1	4	1743,47	6,59	83,023	6,35
13	Bergen Amt	1911	77703	3	2	1	3,86	226	3	1	2	290,85	3,86	77,217	5,00
13	Bergen Amt	1912	79524	6	4	2	7,54	1000	5	1	4	1257,48	6,29	80,479	9,38
13	Bergen Amt	1913	81345	2	0	2	2,46	496	0	0	0	609,75	0,00	78,677	3,13
13	Bergen Amt	1914	83166	0	0	0	0,00	628	1	0	1	755,12	1,20	76,955	0,00
13	Bergen Amt	1915	84987	7	5	2	8,24	1154	19	5	14	1357,85	22,36	77,659	10,61
13	Bergen Amt	1916	86808	7	6	1	8,06	1734	14	5	9	1997,51	16,13	78,334	10,29
13	Bergen Amt	1917	88629	8	7	1	9,03	372	3	2	1	419,73	3,38	77,853	11,59

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13	Bergen Amt	1918	90450	1	1	0	1,11	18198	301	164	137	20119,40	332,78	78,496	1,41
13	Bergen Amt	1919	92271	4	4	0	4,34	2577	105	66	39	2792,86	113,80	73,696	5,88
13	Bergen Amt	1920	94 092	4	4	0	4,25	745	12	8	4	791,78	12,75	72,270	5,88
14	Nordre Bergenhus Amt	1910	55943	4	0	4	7,15	27	5	2	3	48,26	8,94	51,838	13,79
14	Nordre Bergenhus Amt	1911	59243	2	1	1	3,38	350	2	2	0	590,79	3,38	48,951	6,90
14	Nordre Bergenhus Amt	1912	62543	4	4	0	6,40	445	0	0	0	711,51	0,00	46,368	13,79
14	Nordre Bergenhus Amt	1913	65843	1	1	0	1,52	391	3	2	1	593,84	4,56	44,044	3,45
14	Nordre Bergenhus Amt	1914	69143	2	2	0	2,89	257	4	2	2	371,69	5,79	37,603	7,69
14	Nordre Bergenhus Amt	1915	72443	3	2	1	4,14	509	4	2	2	702,62	5,52	35,890	11,54
14	Nordre Bergenhus Amt	1916	75743	1	1	0	1,32	727	4	2	2	959,82	5,28	29,046	4,55
14	Nordre Bergenhus Amt	1917	79043	2	2	0	2,53	352	2	1	1	445,33	2,53	29,098	8,70
14	Nordre Bergenhus Amt	1918	82343	3	3	0	3,64	6931	222	100	122	8417,23	269,60	30,361	12,00
14	Nordre Bergenhus Amt/ Sogn og Fjordane	1919	85643	6	3	3	7,01	941	42	22	20	1098,75	49,04	31,526	22,22

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14	Nordre Bergenhus Amt/ Sogn og Fjordane	1920	88 944	7	4	3	7,87	661	9	5	4	743,16	10,12	31,480	25,00
15	Romsdals Amt	1910	143102	10	7	3	6,99	662	24	9	15	462,61	16,77	30,048	23,26
15	Romsdals Amt	1911	144621	4	3	1	2,77	651	6	2	4	450,14	4,15	30,424	9,09
15	Romsdals Amt	1912	146140	9	7	2	6,16	681	2	1	1	465,99	1,37	29,424	20,93
15	Romsdals Amt	1913	147659	5	5	0	3,39	1068	2	1	1	723,29	1,35	26,412	12,82
15	Romsdals Amt	1914	149178	3	2	1	2,01	579	4	3	1	388,13	2,68	28,825	6,98
15	Romsdals Amt	1915	150697	5	5	0	3,32	1143	7	4	3	758,48	4,65	30,525	10,87
15	Romsdals Amt	1916	152216	3	2	1	1,97	2647	16	5	11	1738,98	10,51	30,877	6,38
15	Romsdals Amt	1917	153735	5	5	0	3,25	908	6	3	3	590,63	3,90	28,621	11,36
15	Romsdals Amt	1918	155254	7	5	2	4,51	17965	532	295	237	11571,36	342,66	28,341	15,91
15	Romsdals Amt/ Møre	1919	156773	6	3	3	3,83	3112	94	47	47	1985,04	59,96	27,428	13,95
15	Romsdals Amt/ Møre	1920	158 293	7	5	2	4,42	1817	39	16	23	1147,87	24,64	27,165	16,28
16	Søndre Trondhjems Amt	1910	147343	7	5	2	4,75	1343	6	4	2	911,48	4,07	44,115	10,77
16	Søndre Trondhjems Amt	1911	149244	8	6	2	5,36	493	2	2	0	330,33	1,34	48,913	10,96
16	Søndre Trondhjems Amt	1912	151145	10	9	1	6,62	584	1	0	1	386,38	0,66	46,313	14,29

i	Amt	Year	Population	Number of Suicides	Number of Male Suicides	Number of Female Suicides	Suicides per 100,000 per county	Total Influenza Cases	Total Influenza deaths	Male Influenza Deaths	Female Influenza Deaths	Influenza a Cases per 100,000	Influenza Deaths per 100,000	Number of Doctors per 100,000	Doctor per Suicide
16	Søndre Trondhjems Amt	1913	153046	11	9	2	7,19	1273	6	4	2	831,78	3,92	46,391	15,49
16	Søndre Trondhjems Amt	1914	154947	7	7	0	4,52	347	1	0	1	223,95	0,65	45,177	10,00
16	Søndre Trondhjems Amt	1915	156848	7	7	0	4,46	1282	6	1	5	817,35	3,83	43,992	10,14
16	Søndre Trondhjems Amt	1916	158749	4	3	1	2,52	1864	7	2	5	1174,18	4,41	36,536	6,90
16	Søndre Trondhjems Amt	1917	160650	7	5	2	4,36	544	3	1	2	338,62	1,87	38,593	11,29
16	Søndre Trondhjems Amt	1918	162551	7	6	1	4,31	28240	531	294	237	17373,01	326,67	41,218	10,45
16	Søndre Trondhjems Amt/ Sør trondelag	1919	164452	5	5	0	3,04	3543	91	48	43	2154,43	55,34	43,174	7,04
16	Søndre Trondhjems Amt/ Sør trondelag	1920	166 353	6	5	1	3,61	2874	36	24	12	1727,65	21,64	40,877	8,82
17	Nordre Trondhjems Amt	1910	84640	8	6	2	9,45	946	8	3	5	1117,67	9,45	37,807	25,00
17	Nordre Trondhjems Amt	1911	85110	4	3	1	4,70	237	2	0	2	278,46	2,35	39,948	11,76
17	Nordre Trondhjems Amt	1912	85581	1	0	1	1,17	325	0	0	0	379,76	0,00	40,897	2,86
17	Nordre Trondhjems Amt	1913	86052	3	3	0	3,49	541	3	2	1	628,69	3,49	38,349	9,09

i	Amt	Year	Population	Number of Suicides	Number of Male Suicides	Number of Female Suicides	Suicides per 100,000 per county	Total Influenza Cases	Total Influenza deaths	Male Influenza Deaths	Female Influenza Deaths	Influenza a Cases per 100,000	Influenza Deaths per 100,000	Number of Doctors per 100,000	Doctor per Suicide
17	Nordre Trondhjems Amt	1914	86523	8	7	1	9,25	271	3	1	2	313,21	3,47	40,452	22,86
17	Nordre Trondhjems Amt	1915	86994	6	5	1	6,90	509	6	0	6	585,10	6,90	39,083	17,65
17	Nordre Trondhjems Amt	1916	87464	2	2	0	2,29	798	6	3	3	912,38	6,86	36,586	6,25
17	Nordre Trondhjems Amt	1917	87935	5	4	1	5,69	474	5	1	4	539,03	5,69	35,253	16,13
17	Nordre Trondhjems Amt	1918	88406	3	2	1	3,39	13750	211	114	97	15553,24	238,67	32,803	10,34
17	Nordre Trondhjems Amt/ Nord Trondelag	1919	88877	9	7	2	10,13	3647	70	34	36	4103,42	78,76	41,631	24,32
17	Nordre Trondhjems Amt/ Nord Trondelag	1920	89 348	0	0	0	0,00	837	6	4	2	936,79	6,72	36,934	0,00
18	Nordlands Amt	1910	161105	5	2	3	3,10	1225	9	5	4	760,37	5,59	37,243	8,33
18	Nordlands Amt	1911	162045	9	8	1	5,55	494	1	0	1	304,85	0,62	35,793	15,52
18	Nordlands Amt	1912	162986	7	6	1	4,29	1056	4	1	3	647,91	2,45	31,905	13,46
18	Nordlands Amt	1913	163926	6	5	1	3,66	881	8	3	5	537,44	4,88	32,942	11,11
18	Nordlands Amt	1914	164867	7	3	4	4,25	762	7	5	2	462,19	4,25	29,721	14,29
18	Nordlands Amt	1915	165807	5	3	2	3,02	981	3	0	3	591,65	1,81	30,759	9,80
18	Nordlands Amt	1916	166748	6	5	1	3,60	2387	12	4	8	1431,50	7,20	31,185	11,54

i	Amt	Year	Population	Number of Suicides	Number of Male Suicides	Number of Female Suicides	Suicides per 100,000 per county	Total Influenza Cases	Total Influenza deaths	Male Influenza Deaths	Female Influenza Deaths	Influenza a Cases per 100,000	Influenza Deaths per 100,000	Number of Doctors per 100,000	Doctor per Suicide
18	Nordlands Amt	1917	167688	4	2	2	2,39	849	6	2	4	506,30	3,58	31,606	7,55
18	Nordlands Amt	1918	168629	4	3	1	2,37	19335	426	259	167	11466,00	252,63	31,430	7,55
18	Nordlands Amt	1919	169569	5	5	0	2,95	3758	67	40	27	2216,21	39,51	30,666	9,62
18	Nordlands Amt	1920	170 510	5	4	1	2,93	1668	21	14	7	978,24	12,32	35,189	8,33
19	Tromsø Amt	1910	80551	0	0	0	0,00	580	1	1	0	720,04	1,24	31,036	0,00
19	Tromsø Amt	1911	81351	1	1	0	1,23	116	0	0	0	142,59	0,00	35,648	3,45
19	Tromsø Amt	1912	82152	1	1	0	1,22	177	1	1	0	215,45	1,22	34,083	3,57
19	Tromsø Amt	1913	82953	2	2	0	2,41	112	3	3	0	135,02	3,62	27,727	8,70
19	Tromsø Amt	1914	83754	3	2	1	3,58	77	1	0	1	91,94	1,19	31,043	11,54
19	Tromsø Amt	1915	84555	0	0	0	0,00	195	2	0	2	230,62	2,37	26,019	0,00
19	Tromsø Amt	1916	85356	4	3	1	4,69	357	1	0	1	418,25	1,17	22,260	21,05
19	Tromsø Amt	1917	86157	2	1	1	2,32	149	4	1	3	172,94	4,64	23,213	10,00
19	Tromsø Amt	1918	86958	0	0	0	0,00	484	484	257	227	556,59	556,59	24,150	0,00
19	Tromsø Amt/ Troms	1919	87759	0	0	0	0,00	610	33	18	15	695,09	37,60	21,650	0,00
19	Tromsø Amt/ Troms	1920	88 560	2	2	0	2,26	809	18	7	11	913,50	20,33	25,971	8,70
20	Finmarkens Amt	1910	39126	2	1	1	5,11	702	0	0	0	1794,20	0,00	40,894	12,50
20	Finmarkens Amt	1911	39599	1	1	0	2,53	220	1	0	1	555,57	2,53	42,930	5,88

i	Amt	Year	Population	Number of Suicides	Number of Male Suicides	Number of Female Suicides	Suicides per 100,000 per county	Total Influenza Cases	Total Influenza deaths	Male Influenza Deaths	Female Influenza Deaths	Influenza a Cases per 100,000	Influenza Deaths per 100,000	Number of Doctors per 100,000	Doctor per Suicide
20	Finmarkens Amt	1912	40072	3	3	0	7,49	343	1	0	1	855,96	2,50	42,424	17,65
20	Finmarkens Amt	1913	40545	2	2	0	4,93	150	1	0	1	369,96	2,47	41,929	11,76
20	Finmarkens Amt	1914	41018	1	1	0	2,44	195	0	0	0	475,40	0,00	43,883	5,56
20	Finmarkens Amt	1915	41491	0	0	0	0,00	207	1	1	0	498,90	2,41	38,563	0,00
20	Finmarkens Amt	1916	41964	0	0	0	0,00	440	4	4	0	1048,52	9,53	38,128	0,00
20	Finmarkens Amt	1917	42437	2	2	0	4,71	139	1	0	1	327,54	2,36	28,277	16,67
20	Finmarkens Amt	1918	42910	2	1	1	4,66	3860	175	102	73	8995,57	407,83	32,626	14,29
20	Finmarkens Amt/ Finmark	1919	43383	0	0	0	0,00	557	84	41	43	1283,91	193,62	32,271	0,00
20	Finmarkens Amt/ Finmark	1920	43857	2	2	0	4,56	849	31	20	11	1935,84	70,68	34,202	13,33

Appendix L – Absolute Age Distribution of Male Suicides

Figure 6.

Absolute Age Distribution of Male Suicides

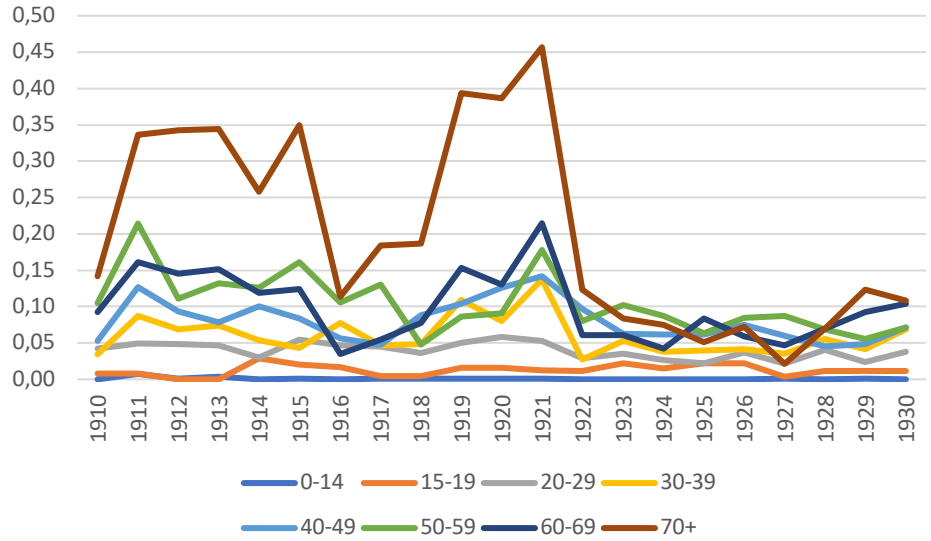


Figure 7.

Most Affected Age Group for Male Suicides 1910-1925.

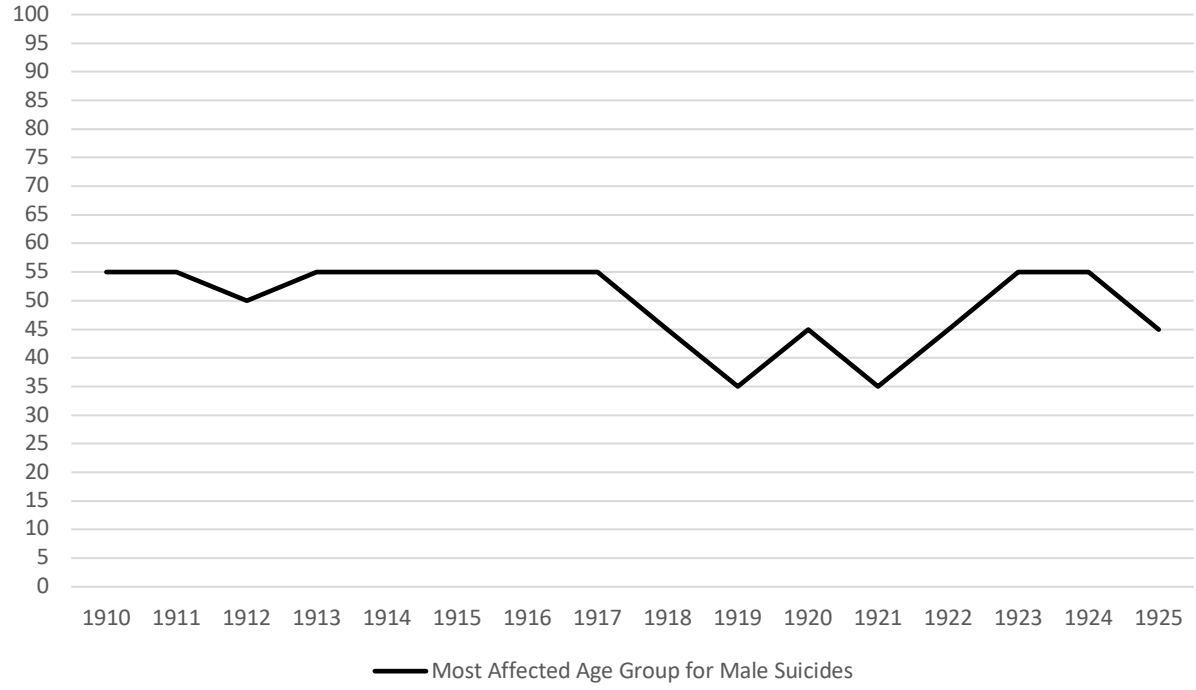


Figure 8.

Total Numbers for most Affected Age Group for Male Suicides 1910-1930.

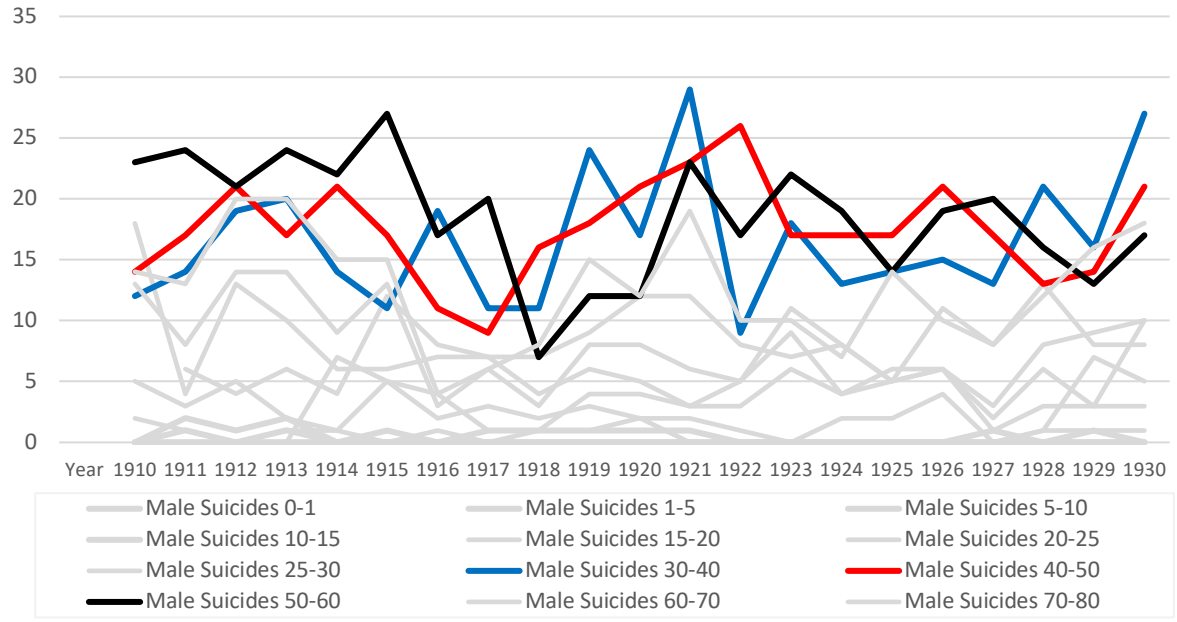


Figure 9.

Total Numbers for most Affected Age Group for Male Suicides 1910-1925.

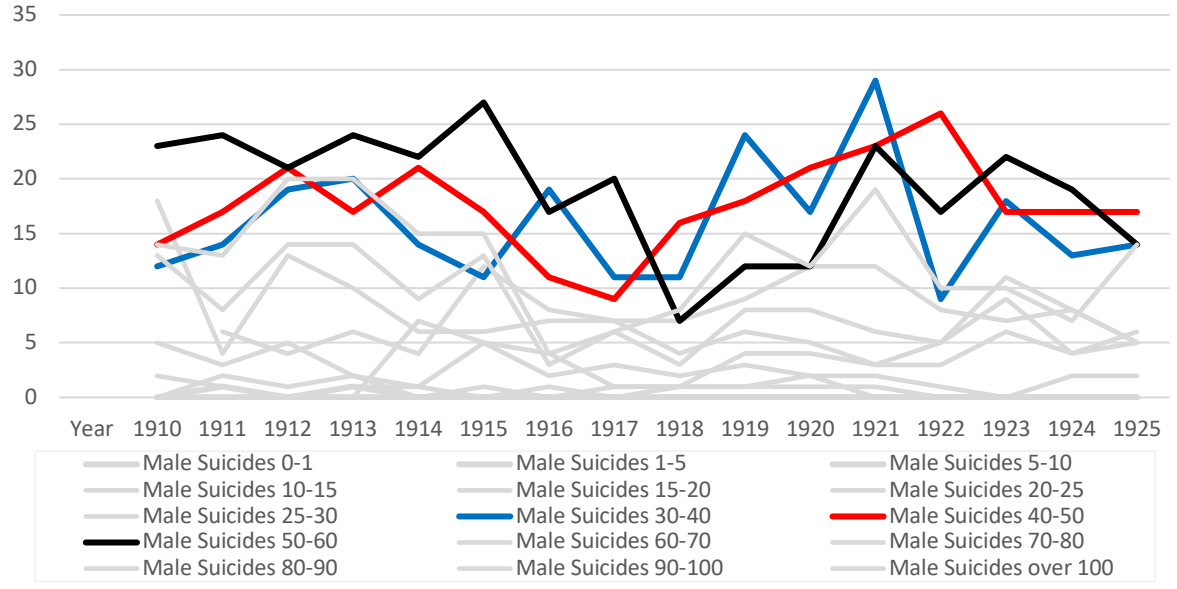


Table 24.

Absolute Age Distribution of Male Suicides per 100,000

	Age							
	0-14	**15-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70+**
Year								
1910	0,00	0,01	0,04	0,03	0,05	0,10	0,09	0,14
1911	0,01	0,01	0,05	0,09	0,13	0,21	0,16	0,34
1912	0,00	0,00	0,05	0,07	0,09	0,11	0,15	0,34
1913	0,00	0,00	0,05	0,07	0,08	0,13	0,15	0,34
1914	0,00	0,03	0,03	0,05	0,10	0,13	0,12	0,26
1915	0,00	0,02	0,05	0,04	0,08	0,16	0,12	0,35
1916	0,00	0,02	0,05	0,08	0,06	0,11	0,03	0,11
1917	0,00	0,00	0,04	0,05	0,05	0,13	0,05	0,18
1918	0,00	0,00	0,04	0,05	0,09	0,05	0,08	0,19
1919	0,00	0,02	0,05	0,11	0,10	0,09	0,15	0,39
1920	0,00	0,02	0,06	0,08	0,13	0,09	0,13	0,39
1921	0,00	0,01	0,05	0,14	0,14	0,18	0,21	0,46
1922	0,00	0,01	0,03	0,03	0,10	0,08	0,06	0,12
1923	0,00	0,02	0,04	0,05	0,06	0,10	0,06	0,08
1924	0,00	0,01	0,03	0,04	0,06	0,09	0,04	0,07
1925	0,00	0,02	0,02	0,04	0,06	0,06	0,08	0,05
1926	0,00	0,02	0,04	0,04	0,07	0,08	0,06	0,07
1927	0,00	0,00	0,02	0,04	0,06	0,09	0,05	0,02
1928	0,00	0,01	0,04	0,06	0,05	0,07	0,07	0,07
1929	0,00	0,01	0,02	0,04	0,05	0,06	0,09	0,12
1930	0,00	0,01	0,04	0,07	0,07	0,07	0,10	0,11

Appendix M – Spurious Relationships

Figure 10.

Spurious relationship with mental health

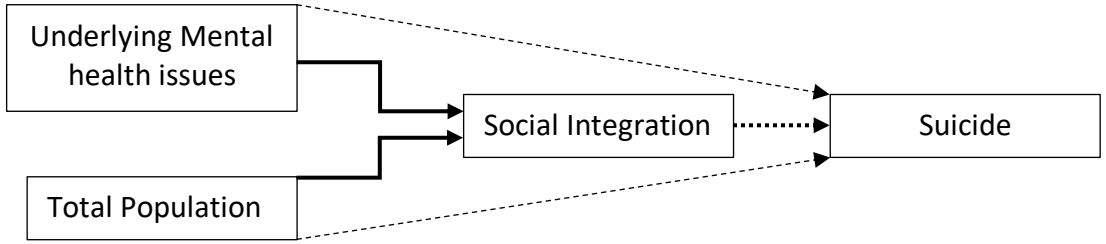
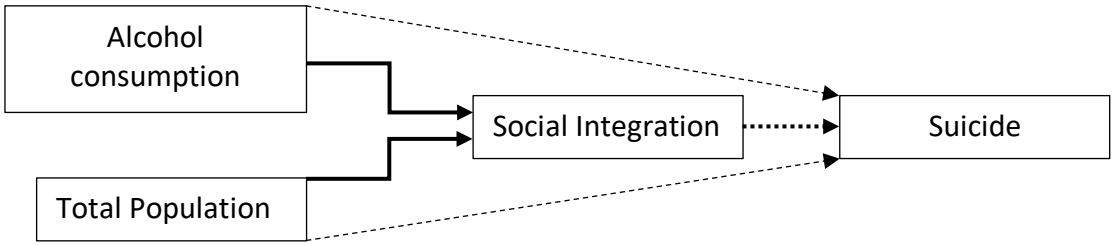


Figure 11.

Spurious relationship with alcohol consumption



Article:

The Association Between the 1918 Influenza Pandemic and Suicides in Norway

The 1918 Influenza and Suicides in Norway

Carla Louise Hughes

Oslo Metropolitan University [1]

Faculty of Social Science

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Abstract

The 1918 influenza pandemic affected several areas of society, including increased mortality, as well as several other detrimental health impacts. It is well established that suicides and life-threatening behaviours are associated with the changes in levels of social integration that occur during pandemics. However, there is an absence of research exploring these associations between the 1918 influenza pandemic and suicides in Norway during the years 1910-1920. To test this association, panel data for suicides, population size and numbers of doctors between 1910 and 1920 were analysed using Pooled OLS, Fixed effects (within estimator), Between effects, Time fixed effects, Random effects, and Time-series cross-section methods (TSCS). The results showed an association between influenza cases and deaths with total numbers of suicides and male suicides during these years. Results also determined that larger population size predicted a higher number of suicides for total suicides and male suicides, even when clustered by county. Finally, results rejected any association between numbers of doctors and suicides, even when controlled by population size. Throughout all models, female suicides did not present a significant association with the 1918 influenza pandemic. On this basis, the influence of social integration must be considered when exploring suicides with future pandemic research.

Keywords: *Suicide, Influenza, Pandemic, 1918, Norway, Social Integration.*

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[1] Oslo Metropolitan University, P.O. Box 4 St. Olavs Plass, N-0130 Oslo, Norway.

Introduction

Suicide is a still a current issue in Norway and public health organisations have an active role in reducing suicides across the country. In a public health report for *The Norwegian Institute for Public Health* (NIPH) titled *Suicide in Norway* (2018), defines suicide as " the result of a self-inflicted injury with the intent to end life". This definition will also be used in this study. This report by NIPH also states that approximately 600 people commit suicide in modern day Norway; two-thirds of whom are male, often in their mid-to-late 40's (Reneflot et al., 2018). Whilst males commit suicide at a significantly greater rate than females, there is evidence to suggest that suicidal thoughts and behaviours are more common in females (Crosby, 2011). However, there is a lack of robust research on numbers of suicide, including sex differences, at the time of the 1918 influenza pandemic in Norway, and this article aims to fill this gap in the literature.

The 1918 Influenza Pandemic is commonly known as The Great Influenza Pandemic, and unfairly also known as the Spanish Flu (Barro, 2020). The name "Spanish flu" began circulating across the globe as a result of the Spanish being so good at spreading the word of the virus that they were consequently blamed with spreading the virus itself. At this time, Spain had a freer press than many other countries, meaning that they could report current news events without the control of government. More specifically on 28th May 1918, the Madrid newspaper *El Sol* (The sun) published that a new virus was wreaking havoc in even the smallest cracks of the community (Rao & Greve, 2017). This newspaper claimed "The fever of the three days. In Madrid there are 80.000 attacked" and warned the inhabitants of Madrid that a deadly illness was attacking anyone that stood in its way (S. M. EL REY, 1918). Whilst the origin of the virus is unclear, it is somewhat possible to know when the virus first arrived in Norway. According to Statistics Norway (1918b), the first recorded mention of the Spanish influenza in the capital of Kristiania (renamed Oslo in 1924) was on the 29th June 1918, and it has since been suggested that the first cases had travelled from Scotland across the North Sea (Mamelund, 1998). Modern literature has determined several relationships and associations between the 1918 flu and mortality (Garrett, 2008; Mamelund et al., 2016; Rao & Greve, 2017), however, there is an absence of research examining the specific association between deaths by suicide and the 1918 flu in Norway. Therefore, this article

will be the first to explore this association and will push the front in the state of the art by also analysing sex specific data on both suicides and the pandemic disease burden.

Existing research reports that after the arrival of the virus in 1918, a total of 14,676 deaths were recorded in Norway throughout the pandemic, which at the time was approximately 0.6% of the total population (Johnson & Mueller, 2002; Mamelund, 1998, 2004). This was an unanticipated shock of mortality, particularly with those who had poor health, or were in lower socioeconomic groups (Karlsson et al., 2014; Mamelund, 2006). Though, most affected during the 1918 influenza pandemic were young people in their 20s and 30s. Reports suggest that although there was high mortality in children and the elderly, mortality peaked between the ages 20 to 34 years (Dahl, 2020). Thus, mortality during the great influenza pandemic has a characteristic W-shaped mortality curve (Rao & Greve, 2017). Consequently, this paper aims to address to what extent this shock of mortality impacted numbers of suicides in Norway during the 1918 pandemic and the years surrounding it.

The relationship between suicides and the 1918 influenza pandemic in the United States has been well-established in a journal article titled *The Impact of Epidemic, War, Prohibition and Media on Suicide: United States, 1910-1920* by Wasserman (1992) concluding that suicide rates were more greatly affected by the flu pandemic than the by the coinciding world war. Norway was a country that remained neutral during the First World War (WWI) and this neutral standpoint means that there is no requirement to control for WWI deaths in this study. Norway's Scandinavian neighbour, Sweden, also remained neutral during WWI and previous research exploring the association between several pandemics and suicide mortality rates in Sweden shows that suicide mortality rates were unchanged from the norm during the 1918 influenza (Rück et al., 2021). No studies have yet examined the relationship between the 1918 influenza and suicides in Norway, therefore this research will push the front in this area.

The key concepts that will be explored in this paper includes rates of suicide and life-threatening behaviours that coincide with global pandemics. This study is the first to search for explanations of the suicide rates in Norway alongside the 1918 influenza pandemic with co-determinants of total influenza cases, influenza deaths, suicides, and numbers of doctors

by using panel data analysis of within 20 municipalities and controlling for gender. Supported by pervious theoretical literature, it is expected in this study that suicides will be negatively associated with numbers of influenza cases in Norway between 1910 – 1920. Furthermore, this article will contribute to the field of social science by explaining how suicides may be impacted by external influences such as access to medical care and identify any potential confounding variables.

In light of the current COVID-19 pandemic, and with reference to life-threatening behaviours, this paper will determine to what extent pandemics and mass infection may result in changes in numbers of suicides across Norway and to answer the research question "How is the 1918 influenza pandemic associated with rates of suicide in Norway?" using the following hypotheses:

H^1 There is a negative association between the 1918 influenza cases/deaths and numbers of suicides in Norway.

H^2 Higher populated counties predicts more suicides between 1910-1920 in Norway.

H^3 Greater access to healthcare predicts fewer suicides between 1910-1920 in Norway.

Theories surrounding reasons why one might commit suicide is well established by Emile Durkheim in *The Theories of Suicide (Durkheim, 1897).* Relevant theories in this article include Egoistic Suicide and Altruistic Suicide. Egoistic suicide occurs as a consequence of feeling outcast from society and is a result of reduced overall social integration. Conversely, altruistic suicide is the act of committing suicide due to excessive integration within society (Durkheim, 2005). This suggests that although excessive individuation induces suicide, that lack thereof also has the same effect. A common theme throughout these theorised suicide types is the influence of social integration. During 1918, social integration was impacted by several consequences of pandemics, including job losses and business closures, but this may also include aspects of fear, bereavement of lost loved ones and reduced trust in government. Therefore, it is likely that during years of peak infection, social integration increased due to boosted solidarity and togetherness, suggesting that suicides should decrease during this time. However, this also implies that as solidarity is no longer peaking, levels of social integration will likely rebound, and the excessive integration will increase

suicides. This study aims to address and explain variations in numbers suicide during the years 1910-1920 in Norway using these theories.

In order to reduce infection during pandemics, health policies, interventions and preparedness-plans must be in place. One preventative measure for protecting against a virus is to introduce and produce a vaccine, however, vaccines and other methods of protection were not available during the 1918 influenza pandemic. The absence of a vaccine will have had a significant influence on rates of survival at this time. Amongst several other responsibilities, doctors were already obligated to report all annual statistics including numbers of patients and their individual diagnoses to central health authorities (Irgens, 2015). Therefore, doctors were unprepared for the destructive and unprecedented effects of the first three waves of the pandemic, which may have strained quality of care (Karlsson et al., 2014). Therefore, health professionals played an integral role in maintaining all aspects of health care during the 1918 pandemic, as well as contributing to much of the data explored in this article.

Materials & Methods

Population size was measured by the number of inhabitants in each county, each year, in Norway between 1910 – 1920. This study used annual statistics from Norway's medical records titled *The State of Health and The Medicinal Conditions Yearbook* (*Sundhetstilstanden og medisinal-forholdene*) (Statistics Norway, 1910c, 1911b, 1912b, 1913b, 1914b, 1915b, 1916b, 1917b, 1918b, 1919b, 1920c) including numbers of suicides (with sex differences), influenza cases (with sex differences), influenza deaths (with sex differences), in addition to number of medical doctors living within different counties in Norway. All counties were implemented in this study, which encompasses the 20 counties in Norway at the time of reporting, compared to the 11 today.

All historical mortality statistics and population data were also extracted from comprehensive annual reports in *The Statistical Yearbook for the Kingdom of Norway* (*Statistisk Aarbok for Kongeriket Norge*) at Statistics Norway (SSB) as part of the county and municipal database (Statistics Norway, 1910b, 1911a, 1912a, 1913a, 1914a, 1915a, 1916a, 1917a, 1918a, 1919a, 1920b). Data was cleaned prior to analysis and no missing data was reported. STATA reported strongly balanced data in preparation for analysis. Groups were set as ID (County name 1-20) and time set as year (1910-1920). Internal validity and external

validity may be impacted due to the age of the data and method of data collection. However, this is the most reliable source of data regarding suicides between 1910 and 1920 in Norway.

Dependent variables: Suicides

Statistics for suicides including sex differences were collected from *The State of Health and The Medicinal Conditions Yearbook* (*Sundhetstilstanden og medisinal-forholdene*). Although *The Statistical Yearbook for the Kingdom of Norway* (*Statistisk Aarbok for Kongeriket Norge*) also reports suicide rates for each year, they are categorised less reliably. *The Statistical yearbook* reports suicides under "violent deaths" and does not offer county-specific details. In addition to this, these violent deaths also summarise all suspicious deaths as suicides, including hanging, drowning, shooting, stabbing, or cutting and poisoning as well as "Other or undisclosed means of death". Conversely, *The State of Health and The Medicinal Conditions Yearbook* categorises suicides as "known deaths", which offers a clearer understanding of cause of death.

Independent Variables: Influenza Cases and Deaths

The number of influenza cases including sex differences is registered throughout *The Health and Medicinal Conditions Yearbook*. There was no distinction between those who died of seasonal influenza and the Spanish influenza pandemic.

Confounding Variables: Doctors and Population Size

Population data by age was only available in the census years of 1910, 1920 and 1930 (*Folketællingen i Norge*) (Statistics Norway, 1910a, 1920a, 1930), therefore change in population was calculated using intercensal populations statistics.

Furthermore, Number of doctors was extracted from The State of Health and The Medicinal Conditions Yearbook (*Sundhetstilstanden og medisinal-forholdene*). Though there is no missing data, there were some discrepancies between reports of population between yearbooks and may have impacted estimates made throughout.

Unit of Analysis

The number and borders of counties throughout Norway have changed several times throughout history, due to dynamic and ever-changing rulings; particularly under Danish reign. Between 1910 and 1918, Norway comprised 20 counties (*Amt*): Smaalenene, Akershus, Kristiania, Hedemarken, Kristians, Buskerud, Jarlsberg og Lauvrik, Bratsberg,

Nedenes, Lister og Mandal, Stavanger, Søndre Bergenhus, Bergen, Nordre Bergenhus, Romsdal, Søndre Trondhjems, Nordre Trondhjems, Norland, Tromsø and Finmarken. For the purposes of analysis and clarity, these counties will maintain these names throughout this study.

Research Design

The study uses quantitative methods using panel data to examine the associations between suicide rates and the intensity of the 1918 flu pandemic with Norwegian counties as the unit of analysis. An examination of each individual variable was assessed using Pooled OLS, Fixed effects (within estimator), Between effects, Time fixed effects, Random effects, and Time-series cross-section methods (TSCS). All data analysis was performed using *StataMP 17.0*.

All variables were categorised by sex difference prior to analysis. Therefore, all models for total suicides were explored together with total population, total influenza cases, total influenza deaths and total doctors. All models for male suicides were examined with female suicides, total population, total influenza cases, female influenza deaths, male influenza deaths and total doctors. Finally, all models for female suicides were explored with male suicides, total population, total influenza cases, female influenza deaths, male influenza deaths and total doctors.

Ethics

Data collected in this study were archived by Statistics Norway (SSB). This article was written in accordance with rules for statistical results and analyses, including for research purposes relating to official statistics and Statistics Norway. Additionally, much of the digitalised data used in this article was previously used by Kotsadam et al. (2021). All of which was shared with approval for research purposes by Jo Thori Lind (Universitet i Oslo), and all other co-authors of this paper, in February 2021.

Access to use of municipal data for research purposes was confirmed by Norwegian Centre for Research Data (NSD) in January 2022. Furthermore, privacy of participants can be assumed due to the nature of data collection in this study and all data collection was coordinated in line with Oslo Metropolitan University current ethics policy.

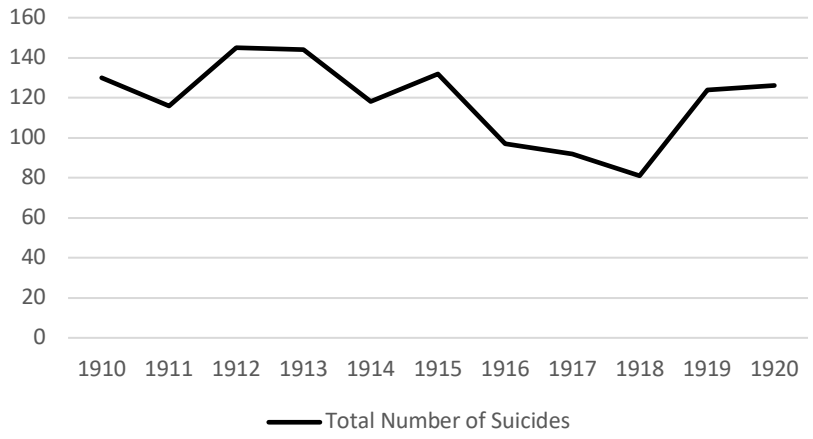
Results

Descriptive Results

In 1918, Norway had an estimated population of 2,572,008 and 7286 deaths were caused by the flu during this year. This implied a death rate of 0.28%. Furthermore, Norway had an average of 1151 doctors each year between 1910 and 1920. During the peak of infection in 1918, most doctors (n = 341, 133.17 per 100,000) were located in Kristiania and the fewest in Finmarkens (n = 14, 32.62 per 100,00). Furthermore, influenza deaths between 1910 – 1917 consisted of 55.46% females, however, in 1918, males accounted for 52% of all total influenza deaths in Norway and continued to be marginally more affected in both 1919 and 1920.

Figure 1.

Total Number of Suicides in Norway 1910-1920



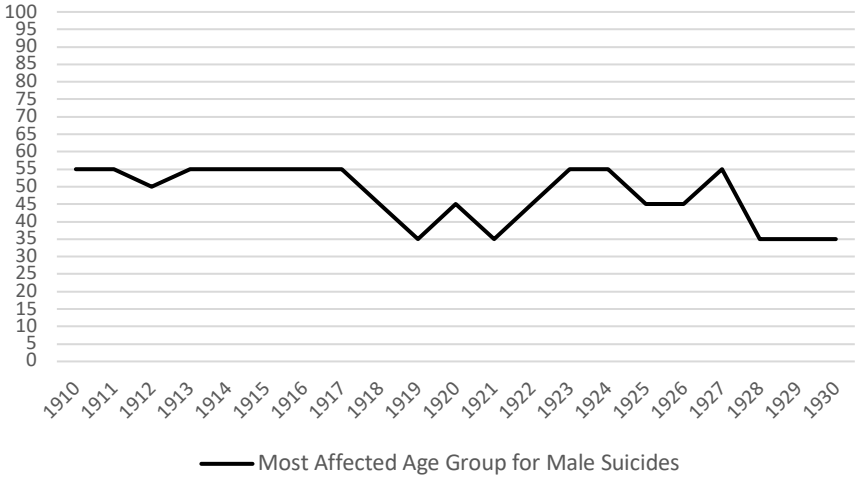
[2]

[2] Total number of suicides decreases in 1918 to 81 suicides.

There was an average of 118 suicides per year between 1910 and 1920, ranging from 81 in 1918, to 132 in 1915 during this time (See Figure 1 for Total Number of Suicides in Norway 1910-1920). Across all counties, the total number of suicides was highest in Kristiania with 176 suicides between 1910-1920, equalling an average of 16 per year (6.39 per 100,000). The fewest number of suicides occurred in Tromsø, with a total of 15 (1.61 per 100,00) between 1910-1920.

Figure 2.

Modal Age of Male Suicides in Norway 1910-1930



[3]

[3] Modal age of suicides decreased during the year 1918 and 1922.

Norway had an average of 74.9% male suicides between 1910 and 1920, with the greatest sex difference reported in Akershus county, with 89.03% of its suicides being male. Consistently throughout the years 1910 to 1917, males between the ages 50-60 were the most affected by suicide. In 1918, male suicides peaked between the ages 40-50, in 1919 most affected males were aged 30-40, and then rebounded back to 40–50-year-olds in 1920 (See figure 2. for Modal Age of Male Suicides in Norway 1910-1930). This suggest that there are sex differences between suicides (most suicides are committed by men) and that the 1918 influenza pandemic had an impact on the modal age of suicides (young adults 20-40 years were the prime 1918 flu victims, hence the decrease to most suicides committed among the younger groups in 1918 and 1919).

H^1 There is a negative association between the 1918 influenza cases/deaths and numbers of suicides in Norway.

A pooled OLS reported a significant overall relationship for total suicides (R^2 = .53, F(4, 215) = 61.81, *p* <.001). Individual variables from the pooled OLS and robust errors OLS displayed a statistically significant, negative, relationship between suicides and total influenza cases (β = <-.001, *p* <.001), confirming H^1. However, a robust errors OLS model reported an increase in standard error for all variables, suggesting that there could have been other underlying variables affecting levels of suicide.

A between effects model for total suicides reported that increase influenza cases predicted fewer suicides overall suicides (β = .00078, *p* = .43). The between effects explored for male suicides also reported statistically significant overall regression (R^2 = .90, F(6, 13) = 19.79, *p* <.001). The R-squared result of this model suggested a better fit for sex differences, and total number of influenza cases significantly predicted male suicides (β = .00075, *p* = .030), further confirming H^1. Between effects did not present any other explanatory variables.

The fixed effects model using dummies for counties with total influenza cases and male suicides reported R^2 = .65, F(20, 199) = 18.30, *p* <.001. Several counties had the most significant positive relationship between male suicides and influenza cases, however, the strongest positive correlation was found in Nordre Bergenhus (R^2 = 8.26, *p* <.001). The same model applied within counties with total influenza deaths and male suicides reported

R^2 = .63, F(20, 199) = 16.62, *p* <.001 overall. This model also had the strongest correlation within Nordre Bergenhus (R^2 = 8.22, *p* <.001); though, this model reported a lower value of correlation.

The random effects model for total suicides presented a weighted average of the within and between estimators for total suicide of R^2 = .53, X^2(6, *N* = 220) = 96.90, *p* <.001. This concludes that a key determinant for total suicides was number of influenza cases (β = -.001, *p* <.001), confirming H^1. The random effects estimator also presented a weighted average of the within and between estimators for female total suicides and reported a strong correlation of R^2 = .12, X^2(6, *N* = 220) = 26.37, *p* <.001. Female suicides were also negatively predicted by total influenza cases (β =-.000025, *p* = .361), further supporting the confirmation of H^1.

H^2 Higher populated counties predicts more suicides between 1910-1920 in Norway.

Individual pooled OLS reported that total suicides were significantly associated with larger populations (β = 6.51, *p* < .000) and confirms H^2. The Robust standard errors OLS, clustered by groups for total suicides reported a significant regression overall (R^2 = .53, F(4, 19) = 117.49, *p* <.001). The pooled OLS for sex differences for male suicides reported R^2 = .52, F(6, 213) = 39.06, *p* <.001. These results suggest that males who lived in more populated areas were more likely to commit suicide (β = 0.000035, *p* < .001), further confirming H^2. The same pooled OLS model was initiated for female suicides reported (R^2 = .11, F(6, 213) = 4.77, p = <.001) overall. The results additionally suggest that a greater population size predicted greater number of suicides in females (β = 0.00001, *p* < .001).

Pooled OLS regression and robust standard errors OLS also explored male suicides, whilst also clustered by ID (county). This reported a significant regression overall for both models (R^2 = .52, F(6, 19) = 190.18, *p* <.001). However, increase in standard errors in the robust standard errors OLS model for total numbers of doctors and total population could suggests that there may be other unmeasured variables affecting levels of suicide. Moreover, pooled OLS and robust standard errors OLS explored female suicides with total population whilst also clustered by ID (county) reported a significant regression overall for both models (R^2 = .11, F(6, 19) = 28.95, *p* <.001). However individual significance reported

that only population size predicted greater suicides with females (R^2 = 9.84, *p* <.001), consequently confirming H^2.

Fixed effects for total population and male suicides reported R^2 = .63, F(20, 199) = 16.97, *p* <.001. This also reported significant positive relationships for several counties. Nordre Bergenhus presented the strongest correlation between male suicides and population (R^2 = 12.79 *p* <.001).

The random effects model explored how individual variables affected total suicides and reported R^2 = .53, X^2(6, *N* = 220) = 96.90, *p* <.001. Individual results reported that total suicides were significantly correlated with population size, (β = .000045, *p* <.001), supporting H^2.

The TSCS regression also reported R^2 = .47, F(5, 19) = 93.87, *p* <.001 for total suicides and population size, suggesting that there is a significant overall relationship when measured at the same point in time. Overall, total suicides were most impacted by population size whilst also clustering for county and lagging years size (β = 7.58, *p* <.001), which confirmed H^2. Lagged female suicides, also clustered by county, reported (R^2 = .18, F(4, 18) = 12.31, *p* <.001). Female suicides were also most impacted by population size whilst also clustering for county and lagging years size (β = 4.73, *p* = .026), thus confirming H^2.

H^3 Greater access to healthcare predicts fewer suicides between 1910-1920 in Norway.

The pooled OLS reported for total suicides presented that greater numbers of doctors were also associated with greater numbers of suicides (β = .02, *p* < .000). The between effects model reported a significant overall regression (R^2 = .87, F(4, 15) = 25.38, *p* <.001). Between effects displayed no significant relationships between any variables with the exception of numbers of doctors (β = .022, *p* < .000), which rejects H^3 and suggests that a greater number of doctors predicted higher suicides.

A between regression explored male suicides and the overall regression was statistically significant (R^2 = .90, F(6, 13) = 19.79, *p* <.001). Male suicides were significantly predicted by total numbers of doctors (β = .025945, *p* = .012). This report rejects H^3. A

further between regression explored female suicides and reported an overall significant relationship (R^2 = .68, F(6, 13) = 4.68, *p* = .009). Despite the overall significant relationship, the between effects for female suicides did not display any significant relationships with individual variables and may be explained by spurious relationships with unmeasurable variables.

Time fixed effects examined the same effects across time and reported that total numbers of suicides were significantly predicted by number of doctors (β = .02, *p* = <.001). This result rejected H^3 that greater access to healthcare predicts fewer suicides.

The random effects estimator presented a weighted average of the within and between estimators for total suicides with total population and reported a significant overall regression (R^2 = .53, X^2(6, *N* = 220) = 96.90, *p* <.001), however numbers of doctors had a positive relationship with numbers of suicides and falsified H^3.The random effects estimator female total suicides also displayed a positive overall regression(R^2 = .12, X^2(6, *N* = 220) = 26.37, *p* <.001). Furthermore, female suicides were also predicted by number of doctors (β = -.0015, *p* = .49), rejecting H^3. All other models were rejected.

Discussion

The purpose of this study was to gain a better understanding and provide new insight into the association between the 1918 influenza pandemic and suicide rates in Norway between the years 1910 and 1920. Suicides in Norway decreased during years of greater social integration and solidarity, which is suggested to occur during pandemic years. Analysis demonstrated that Norway had the fewest number of reported suicides in 1918 compared to any other year between 1910 and 1920. Whilst these findings contradict previous investigation by Wasserman (1992), they are consistent with findings from Gaddy (2021) that higher influenza mortality do not correlate with higher numbers of suicides. Gaddy (2021) re-examined Wasserman's work using a more powerful analysis, investigating NPI data, and reported that not only did the effect of lockdowns between 1918 and 1919 not correlate with increased rates of suicides, but also that cities in the US that had higher mortality of influenza did not have higher rates of suicide. Therefore, analysis indicated and

supported that influenza cases had the greatest influence on change in rates of suicide and emphasises the negative relationship between suicides and the 1918 influenza.

Descriptive data in this study reinforced earlier findings that males commit suicide at a substantially greater rate than females (Reneflot et al., 2018). The analysis suggested that the age group most affected by suicide between 1910 and 1917 was males between the age 55 and 70. However, during the years of the pandemic, this age decreased to males between 40 and 50 and then in 1919 decreased again to males aged 30 to 40. This change suggests that the impacts of the influenza pandemic did more than just reduce the number in suicides, but also affected the age of those most at risk. This confirmed H^1 that suicides had a negative relationship with the influenza pandemic.

This confirmation of H^1 could have been confounded by the notion that those in higher risk categories for suicide may also have similarities with the groups most at risk for influenza, and so increased influenza mortality removed these individuals from the pool of expected suicides. Examples of high-risk populations include those with lower socioeconomic status, poor health, or disability. Another plausible explanation for this could be that the groups affected most by the flu, i.e., young working adults in their 20s (Garrett, 2008; Mamelund et al., 2016; Rao & Greve, 2017), were at higher risk for spouses committing suicide, dissolution of marriage due to death and consequential bereavement of lost loved ones, or loss of financial resources. Therefore, whilst the 1918 pandemic is negatively associated with suicides in Norway, this association may also be explained by these other confounding influences.

The findings of all models consistently reported larger populations in association with greater numbers of suicides. It is plausible that this a size effect and that greater number of people in one location will simply increase the number of those considered at risk. This association is evidenced by between effects reports that significant relationships were reported for highest populated areas and least populated. This suggests that population size is relative to rates at which suicides occurred in both directions, even when clustering by county.

Contrary to the hypothesized association, greater access to healthcare did not predict fewer suicides in this research. It appears that access to healthcare, measured as total number of doctors, was greater in more populated counties in the country and therefore correlated more strongly with greater numbers of suicides. Evidence has suggested that access to medical care does not have an impact on survival and recovery from the virus during this pandemic, but that much of the survival was attributed to quality of medical care (Mamelund, 2011). Therefore, it is plausible that doctors were overworked at this time and may have registered suicide deaths as influenza since the person may have also died with the flu when the suicide occurred. Despite this, these results contributed to confounding variables and impacts associated with suicides that were beyond the scope of this paper. Unmeasured confounding variables also include alcohol consumption, mental health issues and ethnic backgrounds.

Conclusion and recommendations

While several previous studies have focused on countries involved in the first world war, these results demonstrate that the Spanish influenza virus impacted rates of suicides during the years that coincided with the war in a neutral context. Results from this study confirmed H^1 and H^2 and rejected H^3, suggesting that there is an association between the 1918 influenza pandemic and suicides in Norway, but that numbers of medical staff were not related to total numbers of suicides, including sex and population differences. Therefore, in line with the hypothesis, outcomes of the current study suggest that more populated counties and numbers of influenza cases and deaths in Norway predicted greater suicides.

Although the present results support the claim that numbers of suicides were associated with the 1918 influenza pandemic, it is appropriate to recognize several potential limitations. Data issues may affect reliability. For example, the age of the data may influence to what degree data can be trusted for the reason that data in this study have been collected by hand and archived and scanned in historical documents. Furthermore, the definition of suicide may be different in 1910 as it is now since mental health was not recognised as a common societal issue in the early 20th century, and in many cases

individuals with severe mental health issues were registered as insane. An example of discrepancies between the understanding of mental health in the 20th and 21st centuries can be evidenced in mortality reports between 1910 and 1920. In these reports, doctors recorded cause of death as suicide for several children under the age of 10. This study defined suicide as "the result of a self-inflicted injury with the intent to end life", therefore, contemporary reports may contest to what extent children are aware that physically harming themselves will lead to death.

In terms of future research, it would be valuable to establish to what extend other unmeasured variables affect rates of suicide during the 1918 flu pandemic. An example of this could be socioeconomic status measured by annual incomes. In light of these contradictory findings, future research may consider examining socioeconomic status in addition to number of medical professionals, including nurses, since this may offer a more revealing aspect of influence on suicides. Another weakness of this study from a health perspective is that pneumonia deaths, which were known to be highly correlated with influenza deaths, were not included, meaning that the impact of the pandemic may be underestimated.

These results build on existing evidence that suicides are related to aspects of the 1918 influenza pandemic and shed light on life-threatening behaviours. This research replicated similar methods of analysis as Wasserman (1992), though findings contribute to a growing body of evidence that social integration was not a risk factor for suicide increase during the 1918 influenza pandemic. With this considered, it is possible to conclude that suicides were associated with the 1918 influenza pandemic in Norway.

References

Beck, N., & Katz, J. N. (1995). What to do (and not to do) with Time-Series Cross-Section Data. *The American Political Science Review, 89*(3), 634-647. https://doi.org/10.2307/2082979

Borza, T. (2002, 01/01). Spanish flu in Norway 1918-19. *Tidsskrift for den Norske lægeforening : tidsskrift for praktisk medicin, ny række, 121*, 3551-3554.

Correia, S. L., Stephan; Verner, Emil. (2020). Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu. http://dx.doi.org/10.2139/ssrn.3561560

Crosby, A. O., LaVonne;Melanson, Cindi;. (2011). *Self-directed violence surveillance; uniform definitions and recommended data elements*. https://stacks.cdc.gov/view/cdc/11997

Dahl, C. M. H., Casper Worm; Jensen, Peter Sandholt (2020). The 1918 Epidemic and a V-shaped Recession: Evidence from Municipal Income Data. *The Scandinavian Journal of Economics, 124*(1), 139-163. https://doi.org/https://doi.org/10.1111/sjoe.12456

Drukker, D. M. (2003). Testing for Serial Correlation in Linear Panel-data Models. *The Stata Journal, 3*(2), 168-177. https://doi.org/10.1177/1536867x0300300206

Durkheim, E. (2005). *Suicide: A study in sociology*. Routledge.

Durkheim, É. (1897). *Le Suicide: Étude de sociologie* (F. Alcan, Ed.). Ancienne Librairie Germer Bailliere et C.

Gaddy, H. G. (2021, 2021/12/01/). Social distancing and influenza mortality in 1918 did not increase suicide rates in the United States. *SSM - Population Health, 16*, 100944. https://doi.org/https://doi.org/10.1016/j.ssmph.2021.100944

Garrett, T. (2008, 02/01). Pandemic Economics: The 1918 Influenza and Its Modern-Day Implications. *Review, 90*, 74-94. https://doi.org/10.20955/r.90.74-94

Hatchett, R. J., Mecher, C. E., & Lipsitch, M. (2007). Public health interventions and epidemic intensity during the 1918 influenza pandemic. *Proceedings of the National Academy of Sciences, 104*(18), 7582-7587. https://doi.org/doi:10.1073/pnas.0610941104

Irgens, L. M. (2015). The roots of Norwegian epidemiology–Norwegian epidemiology in the 19th century. *Norsk Epidemiologi, 25*(1-2).

Johnson, N. P., & Mueller, J. (2002, Spring). Updating the Accounts: Global Mortality of the 1918-1920 "Spanish" Influenza Pandemic. *Bulletin of the History of Medicine, 76*(1), 105-115. https://doi.org/10.1353/bhm.2002.0022

Karlsson, M., Nilsson, T., & Pichler, S. (2014, 03/25). The impact of the 1918 Spanish flu epidemic on economic performance in Sweden. *Journal of health economics, 36C*, 1-19. https://doi.org/10.1016/j.jhealeco.2014.03.005

Kotsadam, A., Lind, J. T., & Modalsli, J. (2021). Call the midwife. health personnel and mortality in norway 1887–1920. *Cliometrica*, 1-34.

Mamelund, S.-E. (1998). Diffusjon av influensa i Norge under spanskesyken 1918-19. *Norsk Epidemiologi, 8*(1).

Mamelund, S.-E. (2004). Can the Spanish Influenza Pandemic of 1918 Explain the Baby Boom of 1920 in Neutral Norway ? *Population, 59*(2), 229-260. https://www.cairn-int.info/article-E_POPU_402_0269--.htm
https://www.cairn-int.info/load_pdf.php?ID_ARTICLE=E_POPU_402_0269

Mamelund, S.-E. (2006, 2006/02/01/). A socially neutral disease? Individual social class, household wealth and mortality from Spanish influenza in two socially contrasting parishes in Kristiania 1918–19. *Social Science & Medicine, 62*(4), 923-940. https://doi.org/https://doi.org/10.1016/j.socscimed.2005.06.051

Mamelund, S.-E. (2011, 2011/03/01/). Geography May Explain Adult Mortality from the 1918–20 Influenza Pandemic. *Epidemics, 3*(1), 46-60. https://doi.org/https://doi.org/10.1016/j.epidem.2011.02.001

Mamelund, S.-E., Haneberg, B., & Mjaaland, S. (2016). A Missed Summer Wave of the 1918–1919 Influenza Pandemic: Evidence From Household Surveys in the United States and Norway. *Open Forum Infectious Diseases, 3*(1). https://doi.org/10.1093/ofid/ofw040

Rao, H., & Greve, H. R. (2017, 2018/02/01). Disasters and Community Resilience: Spanish Flu and the Formation of Retail Cooperatives in Norway. *Academy of Management Journal, 61*(1), 5-25. https://doi.org/10.5465/amj.2016.0054

Reneflot, A., Øien-Ødegaard, C., Straiton, M. L., Zahl, P. H., Myklestad, I., Stene-Larsen, K., & Hauge, L. J. (2018). *Suicide in Norway*. https://www.fhi.no/en/op/hin/mental-health/suicide/

Rück, C., Mataix-Cols, D., Malki, K., Adler, M., Flygare, O., Runeson, B., & Sidorchuk, A. (2021). Swedish nationwide time series analysis of influenza and suicide deaths from 1910 to 1978. *BMJ Open, 11*(7), e049302. https://doi.org/10.1136/bmjopen-2021-049302

S. M. EL REY, E. (1918, 177). LA FIEBRE DE LOS TRES DIAS; EN MADRID HAY 80.00 ATACODOS. *El Sol,* 1. http://hemerotecadigital.bne.es/issue.vm?id=0000188376&page=2&search=&lang=es

Statistics Norway, S. (1910a). *Folketællingen i Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/nos/nos_vi_077.pdf

Statistics Norway, S. (1910b). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1910.pdf

Statistics Norway, S. (1910c). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_v_181.pdf

Statistics Norway, S. (1911a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1911.pdf

Statistics Norway, S. (1911b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_v_216.pdf

Statistics Norway, S. (1912a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1912.pdf

Statistics Norway, S. (1912b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_019.pdf

Statistics Norway, S. (1913a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1913.pdf

Statistics Norway, S. (1913b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_056.pdf

Statistics Norway, S. (1914a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1914.pdf

Statistics Norway, S. (1914b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_094.pdf

Statistics Norway, S. (1915a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1915.pdf

Statistics Norway, S. (1915b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_133.pdf

Statistics Norway, S. (1916a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1916.pdf

Statistics Norway, S. (1916b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vi_186.pdf

Statistics Norway, S. (1917a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1917.pdf

Statistics Norway, S. (1917b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_003.pdf

Statistics Norway, S. (1918a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1918.pdf

Statistics Norway, S. (1918b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_058.pdf

Statistics Norway, S. (1919a). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1919.pdf

Statistics Norway, S. (1919b). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_108.pdf

Statistics Norway, S. (1920a). *Folketællingen i Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/nos/nos_vii_161.pdf

Statistics Norway, S. (1920b). *Statistisk Aarbok for Kongeriket Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/aarbok/1920.pdf

Statistics Norway, S. (1920c). *Sundhetstilstanden of Medicinalforholdene* Direktøren for det civle Medicinalvæsen. https://www.ssb.no/a/histstat/nos/nos_vii_138.pdf

Statistics Norway, S. (1930). *Folketællingen i Norge* Statistiske Centralbyraa. https://www.ssb.no/a/histstat/nos/nos_viii_182.pdf

Wasserman, I. M. (1992). The impact of epidemic, war, prohibition and media on suicide: United States, 1910–1920. *Suicide and Life-Threatening Behavior, 22*(2), 240-254.