



Why did many more diamond miners than gold miners die in South Africa during the 1918 influenza pandemic?

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ABSTRACT

The very large difference in mortality rates between Kimberley diamond miners and Witwatersrand gold miners during the 1918 influenza pandemic has never been explained. We examined extant epidemiological records from South African mining operations and other related activities to determine if mortality risk factors could be measured. During October 1918 when pandemic influenza struck in South Africa, the mortality rates in Kimberley diamond miners (22.4%, $n = 11\,445$) were >35 times that of Rand gold miners (0.6%, $n = 200\,000$). There were no differences discernable between diamond and gold miners regarding their recruitment, working conditions, housing or medical care that would explain the great variance in mortality rates. Reports of influenza-like illness in Natal Province some weeks prior to the main pandemic suggest infection from a mild version of influenza and thus protection of the gold miners from mortality whereas the more isolated diamond miners only experienced the second, more lethal, wave. The huge mortality difference between South African diamond and gold miners in 1918 is most likely explained by the circulation of a related but not identical virus to the A/H1N1 pandemic strain which reached Johannesburg prior to October 1918 because of its better transportation connections.

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1. Introduction

The influenza pandemic of 1918–9 is the largest documented single human mortality event. However, during the pandemic, death rates across populations and locations sharply varied, from the relatively low rates experienced during seasonal epidemics to 22% of the population of Samoa.¹ Since 1918, there has been a vast increase in understanding of the causes and effects of the 1918 pandemic. For example, in 1918, influenza viruses had not yet been discovered; in modern times, the 1918 pandemic strain has been reconstructed from influenza A/H1N1 genes that were recovered from archival samples. Yet it is not

understood why some populations were affected so much more severely than others.^{1–3} The outstanding and still unexplained observation of the 1918–9 pandemic was its unusual ability to kill young adults rather than those at the extremes of age.^{2,3} Of note, several waves of influenza-like illness were recorded in various populations during 1918; however, only the highly lethal wave in late 1918 has been associated with influenza A/H1N1 strains (recovered from fatal cases in South Carolina and Brevig Mission, Alaska, USA).^{2,3}

During the 1918 pandemic in Africa, many people died of influenza, but relatively few were systematically counted through formal medical systems. In contrast, among industrial groups in South Africa, locally recruited labour forces were required by law to be accounted for due to parliamentary concerns of exploitation.⁴ As a result, diamond mines in Kimberley and gold mines of

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the Witwatersrand (Rand) near Johannesburg carefully documented their workforces, both for legal reasons and because healthy young men were in short supply due to the demands of the First World War.^{4,5} Besides disrupting industrial and war efforts, influenza killed many South Africans. For reasons that were unclear at the time and have yet to be explained, influenza-related death rates were much higher among Kimberley diamond miners than Johannesburg gold miners.^{5,6} We reviewed extant contemporaneous records to identify mortality risk factors that may have been distributed differently between the two, otherwise very similar, mining populations.

2. Methods

2.1. Source of Data

The bibliography of the monograph *Black October: the impact of the Spanish influenza epidemic of 1918 on South Africa* by Prof H Phillips was used to identify published and unpublished reports written in the immediate aftermath of the 1918 pandemic.⁵ Detailed reports from De Beers Consolidated Mines Ltd⁶ and the official government Influenza Commission⁷ were reviewed in detail. Medical journals including the *South African Medical Record*, *British Medical Journal* and *Lancet* were searched by sequential issue from 1918–20 for references specific to South Africa. Data were summarized using Microsoft Excel[®] (Excel is a registered trademark of the Microsoft Corporation, Redmond, WA, USA).

2.2. Use of ethnic descriptions

The diamond miner mortality rates are reported by racial group as that is how they were reported in 1918 when large differences in working conditions and housing existed between the white and black miners.

3. Results

Miners in South Africa: Pneumonia was a major occupational hazard of South African gold miners.⁸ When the highly lethal wave of pandemic influenza attacked the Johannesburg gold mines in October 1918, many men were incapacitated but relatively few died (0.6% of population estimated at 200 000). The mortality in gold miners in late 1918 differed in regard to pneumococcal pneumonia epidemics as pneumococcal pneumonia primarily affected new miners whereas influenza caused disease in all miners.^{5,8}

The relatively low mortality among the gold miners provided false hopes to the managers and medical staffs of the more isolated Kimberley diamond mines. Unfortunately, during widespread influenza epidemics at De Beers Consolidated Mines Ltd diamond mines, mortality quickly rose to extreme levels.⁶ The overall death rate among De Beers Consolidated Mines Ltd diamond miners during the month of October was >22% (Figure 1). The effect of influenza on the De Beers Consolidated Mines Ltd work force during 1918–9 is shown in Figure 2. Among diamond miners, mortality risk was highest among those

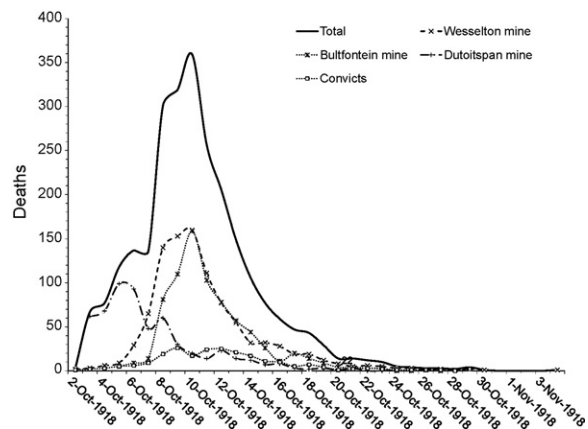


Figure 1. Number of miner deaths per day during the influenza pandemic of October 1918 at the De Beers Consolidated Mines Ltd diamond mines in Kimberley, South Africa for the three major mines (Wesselton, Bultfontein, Dutoitspan) and for convict labourers working in Kimberley.

who worked underground; specifically, cumulative mortality was more than twice as high among underground workers (22.6%) than Europeans who worked above ground (9%).⁶ Overall, black miners died at higher rates than white miners; however, among miners who worked underground, approximately one-fourth died regardless of their race.⁶ For migrant black labourers, housing conditions were abysmal; however, they did not significantly vary between the gold mines of the Witwatersrand and the diamond mines of Kimberley.^{5,6} Labour compounds both at gold and diamond mines were designed and constructed to the same standard based on cost alone. Black workers were recruited for 6–12 month periods from South Africa and the surrounding countries; however, the process did not differ between the gold and diamond mines. The Kimberley diamond miners were a subset of a larger mining labour population which was dominated by the needs of the much larger gold mines of the Witwatersrand.⁴ It is implausible that the objectives or activities inherent to mining gold

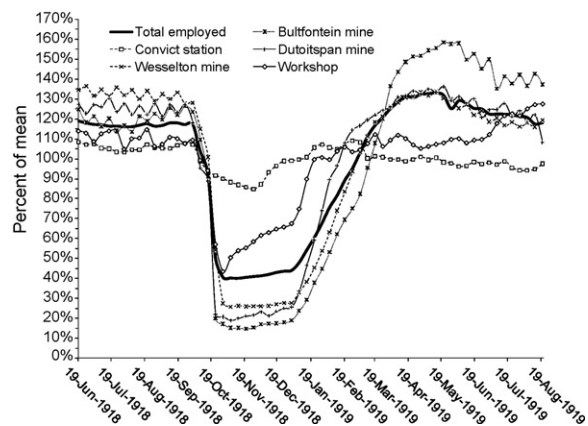


Figure 2. Relative number of mine workers before, during and after the influenza pandemic of October 1918 at the De Beers Consolidated Mines Ltd diamond mines in Kimberley, South Africa in the major mines (Wesselton, Bultfontein, Dutoitspan) and selected labourer (workshop, convict) groups. Total number of miners involved was 11 445.

or diamonds significantly determined mortality risk after influenza; both involved arduous work underground in silicosis-prone atmospheres.

3.1. Influenza illness / mortality in South Africa

The South African Influenza Epidemic Commission stated that since at least July 1918, ships had been arriving in Durban and Cape Town with illnesses described as 'ordinary catarrhal colds which are commonly called influenza'.⁷ The earliest reports of influenza-like illness in Natal Province were in Ladysmith in late August 1918.⁹ Prior to the main pandemic (actual time not stated), influenza-like illness with no mortality spread with extraordinary rapidity in the Military Hospital, Durban. The 6 September 1918 issue of the *Natal Advertiser* newspaper noted a 'mild outbreak of fever has been reported in the Natives in the Redhill district'. After the arrival in Durban of the *SS Salamis* on 5 September 1918 from Somalia, several hundred people employed in the harbour area became acutely ill with a disease diagnosed as simple influenza.⁷ Several mildly ill stevedores were noted at the port of Durban in September 1918.⁵

It therefore appears likely that in September 1918, a wave of non-lethal influenza-like illness may have spread to the Rand gold mines via railway traffic from the port of Durban through Pietermaritzburg and Ladysmith.¹⁰ We are unaware of reports of mild influenza-like illness in Kimberley prior to October 1918. In the general population of South Africa in 1918, the lowest influenza-related mortality was in Natal Province; of note, mortality in Cape Province was three times higher.⁷ This suggests that the early wave of influenza-like illness entered South Africa from Durban and spread in-country along rail lines;⁵ in turn, those infected during the early wave were relatively protected from death during the highly lethal second wave.

3.2. Prisoners

In South Africa in 1918, prisoners worked in mines to fulfill sentences with hard labour. During the October 1918 pandemic in Kimberley, mortality rates were lower among prisoners (12.2%) than other diamond miners (22.4%).^{5,6} At the time, the difference in mortality between prisoners and other miners was thought to be due to the restriction of prisoners to work above ground (security concerns precluded criminals from working underground under variable supervision).⁶ Figure 3 shows the expected one week lag between influenza infection and death from secondary pneumonia for all prisoners (not just miners) in the Kimberley gaol; the overall mortality among prisoners in the gaol was 15.5%. The experience in the Kimberley gaol resembles that on the island prison colony of the Andaman Islands.¹¹ In the Andaman Islands prison colony, most prisoners worked in labour gangs throughout the isolated islands; however, new prisoners were confined throughout their first year.¹² A mild epidemic of influenza affected the colony in July–September 1918. Although 1.8% of all prisoners died during the severe outbreak from November 1918–January 1919, the death rate among first year prisoners was less than one-half the mortality rate overall.

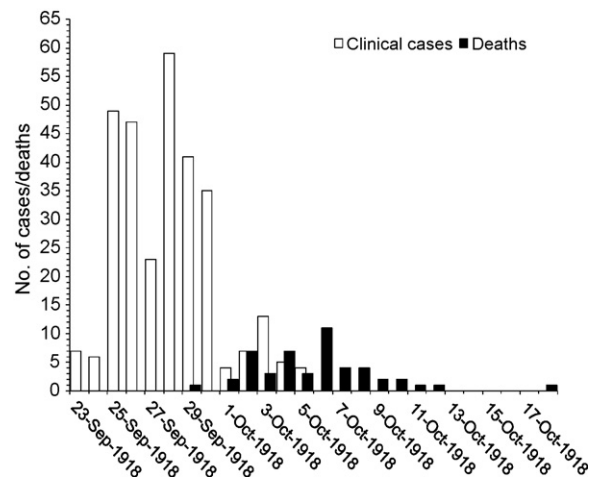


Figure 3. Daily morbidity and mortality in Kimberley gaol during September–October 1918 influenza pandemic. Total number of prisoners was 316.

The finding suggests that, relative to prisoners who were dispersed throughout the islands, confined prisoners may have been infected at higher rates during the mild first wave and in turn protected from death during the lethal second wave.¹¹

4. Discussion

During the 1918 influenza pandemic, there were extreme differences in mortality between Kimberley diamond miners and gold miners near Johannesburg.^{5,6} Investigations at the time revealed no plausible explanations for the difference: the groups were similar in terms of their recruitment, working conditions, housing arrangements and medical care (although all were extremely sub-optimal by today's standards). Work underground was a strong mortality risk factor during the pandemic; this is not surprising given the concentrated exposure to respiratory pathogens that can occur in poorly ventilated, confined spaces.⁸ Indeed, other mining groups across the world had high mortality rates during the influenza pandemic of 1918–9.^{13,14}

Phillips suggested that different influenza viruses entered South Africa either through Cape Town or Durban.⁵ The viruses were qualitatively different; infection by the less lethal variety traveling from Durban protected the Rand gold miners from death during subsequent infection with the highly lethal pandemic strain.⁵ Our review confirms this as a reasonable hypothesis; even though there are very few references to mild influenza-like illness in Natal (one would not expect numerous detailed reports regarding the spread of a self-limited respiratory illness that caused little or no mortality). It is possible that heterosubtypic immunity from a different but related influenza virus could have prevented mortality but not infection in South African gold miners; a similar experience has been documented among Australian Army soldiers in Europe in 1918.¹⁵ The hypothesis that partial immunity from recent infection with a related virus could affect

mortality rates during lethal influenza epidemics country-wide is supported by the finding that pneumonia/influenza mortality rates in 1918–9 were relatively low in coastal areas of India where sea-borne arrival of an earlier mild influenza virus could have induced partial immunity in coastal populations.¹⁶

Modern influenza virology suggests a possible mechanism for this two virus hypothesis. Extensive genotypic analyses of a very large number of different influenza viruses suggests that prior to 1918 three separate lineages of A/H1 viruses existed; they subsequently evolved into pandemic A/H1, seasonal A/H1 and swine A/H1.¹⁷ In the absence of archival pathology material from the mild first wave of the pandemic (a circumstance that is not surprising given the mild nature of pre-October 1918 influenza-like illnesses), it is likely that its microbial cause will never be definitively documented. Absent laboratory confirmation of the cause of the first wave, improved understanding of the epidemiologic and clinical relationships between the first and second waves of the 1918 pandemic – as reflected in the experiences of South African gold and diamond miners – becomes more important. For example, the South African experience suggests that a rapid increase in viral pathogenicity of a single influenza virus lineage is unlikely to have occurred.^{17,18}

The findings and implications of this report are relevant to modern times because they call into question the hypothesis that the A/H1 virus that caused widespread epidemics of mild influenza-like illness in the spring-summer 1918 suddenly increased in lethality prior to causing worldwide fall-winter epidemics. The lack of an historical precedent for a sudden increase in lethality of an A/H1 influenza virus may be reassuring as the world encounters a novel A/H1 influenza strain that appears to have a relatively mild clinical expression in otherwise healthy adults.²

The influenza pandemic of 1918 was such a large mortality event that consideration of all influenza pandemics since have inevitably been coloured by the fear that such a lethal virus might reappear. Until what actually happened in 1918 is better understood, we live in doubt of what the influenza virus could do given its access to avian viral genes through reassortment and evolutionary adaptation to humans by passage in pigs.^{1–3,19} Detailed examination of persistent public health mysteries such as that of the diamond and gold miners of South Africa may be the best way to illuminate the as yet unexplained events of the first influenza pandemic of the Twentieth Century.

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