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SOCIOECONOMIC DIFFERENCES IN MORTALITY AMONG EUROPEAN SETTLERS IN PRE-COLONIAL WESTERN AFRICA

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Socioeconomic differences in adult mortality are found consistently in high-income countries today. Previous studies have shown that there were, in contrast, no such differences before the twentieth century. The importance of infectious diseases as causes of death and lack of knowledge on how to prevent or cure diseases have been suggested as explanations for this. We investigate the differences in mortality between occupational groups among Europeans working on the west coast of Africa between 1683 and 1766. We use a newly constructed longitudinal dataset covering four different locations along the coast. There were no differences in mortality between the occupational groups when we analyzed all data jointly. The mortality was higher for some groups in some places but there is no consistent pattern in the differences when we then analyzed each location separately. To our surprise, we do find that the mortality was clearly lower for the civilian upper class when we focus on our best data. These results force us to allow for that there was something about the nutritional or health status, lifestyle or preventive measures of the upper class that protected them from some of the dangers they faced.

Introduction

Socioeconomic differences in adult mortality are found today in all populations in high-income countries. Individuals with more education or higher-ranking occupations consistently have a lower mortality than those with less education and lower-ranking occupations (e.g. Gallo et al. 2012; Toch-Marquardt et al. 2014; Mackenbach et al. 2016). The socioeconomic differences in mortality are an important underlying cause of preventable, premature deaths and therefore pose huge public health challenges to governments. The underlying causes are still poorly understood, despite a very large number of studies, and theories of social epidemiology are still underdeveloped (e.g. Elo 2009; Krieger 2001). The large number of possible causes and pathways leading to socioeconomic differences in mortality make it difficult to disentangle their relative importance.

Whether such socioeconomic differences in mortality also existed historically has been the focus of much previous research. Aaron Antonovsky (1967) famously reviewed previous historical research on socioeconomic differences in mortality and hypothesized about the causes behind the differences and developments he saw. He found that it was consistently the very poorest who had the largest increase in risk. This indicates that living conditions, such as nutrition, clothing and housing, could be important factors for increasing mortality. We know that there were socioeconomic differences in nutritional status because previous research has found consistent socioeconomic differences in height for historical populations (see, e.g., Öberg 2014 and the references there). Social differences in nutritional status ought to have been reflected in, at least, somewhat different levels of mortality from infectious diseases. Differences in living conditions during childhood should also be reflected in differences in health in adulthood (e.g. Bengtsson and Mineau 2009; Case and Paxson 2010).

Given the influence of living conditions on mortality, the expectation would be that socioeconomic differences in adult mortality were substantial historically when living conditions were poor, so that the worst-off faced much higher risks than the better off (compare Antonovsky 1967). But, results from research on socioeconomic differences in adult mortality in pre-twentieth century populations show conflicting results. Some studies do find socioeconomic differences in adult mortality in pre-twentieth century populations (e.g. England: Harris 2004, fig. 2; Jackson 1994, 520; France: Blum, Houdaille, and Lamouche 1990; USA: Kasakoff and Adams 2000; Geneva: Schumacher and Oris 2011), while other, recently published, research does not (Italy, the Netherlands, Sweden etc.: Bengtsson and van Poppel 2011; see also Smith et al. 2009; Edvinsson and Broström 2012). The research that did not find any differences used better data and methods and so provides compelling evidence that socioeconomic differences in adult mortality is not a universal or time-constant fact, but have varied between locations and over time. A potential weakness with this research is that it is mostly conducted on rural populations and so might miss the extremes of the social spectrum, which might have been the groups that differed from the others (compare Antonovsky 1967; Johansson 2010).

A plausible explanation why the socioeconomic differences in adult mortality were small historically is that some aspects of living conditions have a limited impact on the mortality risk of adults. Nutrition, for example, might not have had a major impact on mortality before the epidemiologic transition (Omran 1971; Livi-Bacci 1990). Any socioeconomic differences in mortality might also have been overshadowed in many populations by other causes of death that were not influenced by living conditions. A key explanation for the small social differences in mortality before the twentieth century is, according to this line of reasoning, the importance of infectious diseases as causes of death (Antonovsky 1967; Kunitz and Engerman 1992). Infectious diseases are "democratic" in the sense that they can infect anyone regardless of their social standing or living conditions. It is also difficult, at least without adequate knowledge and technology, to avoid being exposed to pathogens through food, water, infected people or disease vectors, such as the mosquitoes used by the yellow fever virus and the malaria parasite. In historical populations where mortality was dominated by highly virulent epidemic diseases, we ought therefore to expect zero (or only very small) socioeconomic differences in mortality.

There is some support for the argument that the impact of exposure to pathogens on the mortality of historical populations made the living environment at least as important as other aspects of living conditions. Peter Razzell and Christine Spence (2004) conclude that poverty only became dangerous with social segregation, associating it with living in a poor neighborhood. Another indication of the importance of the living environment and its level of exposure to pathogens is the consistent "urban penalty" in mortality for (at least European) historical populations (e.g. Woods 2003).

Nutrition and other aspects of living conditions can be "passive" causes of differences in mortality. To the extent that these aspects of living conditions did influence adult mortality, they did so regardless of whether the persons knew they would or not. Another explanation for why socioeconomic differences in mortality could be smaller or non-existent in historical populations is related to "active" causes of differences in mortality, in other words things that people knew could influence their health and survival chances. The lack of adequate knowledge and technology to improve health and survival before the mid-nineteenth century (Easterlin 1999), according to this line of reasoning, led to smaller or zero socioeconomic differences in mortality. The etiology of diseases was not yet well understood before then, so no effective countermeasures could be taken even if one had the resources to try. As John Robert McNeill delights in explaining and exemplifying, conventional medicine before the nineteenth century was generally less than useful at improving health (McNeill 2010, chap. 3). If there was thus nothing that richer people could do to improve their survival chances, that the poor could not do, there would be smaller or non-existent socioeconomic differences in mortality.

If the lack of knowledge and technology to improve health and survival was an important factor in the lack of socioeconomic differences in adult mortality historically, then the emergence of new such knowledge and technology should lead to the emergence or widening of differences in mortality (Antonovsky 1967). When new possibilities arise to prevent mortality this is likely to give rise to increased inequality since groups that have a lot of resources will have the best opportunities to gain from these innovations.[1] Robert Woods and Naomi Williams (1995) reexamined Antonovsky's claims using new data and found support for many of his conclusions, among which the hypothesis of increasing social differences in mortality being associated with improvements in the level of mortality. Bruce G. Link and Jo C. Phelan (1995) reformulated this line of reasoning as social conditions being the "fundamental causes" of disease. The argument has recently been reinforced in the writings of David M. Cutler, Adriana Lleras-Muney and Tom Vogl (2011; see also Deaton 2013, 7).

There is some support for this kind of mechanism from historical populations as well (Razzell and Spence 2004). There is also more suggestive evidence from earlier centuries of a connection between the ability to influence health and mortality risk, and the socioeconomic differences in mortality. There is little evidence of any continuous trend in life expectancy in any period before 1600 CE, but there are some indications of a fall in adult mortality from that time on (Britain: Hollingsworth 1977; Geneva and Venice: Boucekkine, Croix, and Licandro 2003; Geneva: Schumacher and Oris 2011). What might be the emergence of differences in adult mortality between the elite groups and the population in general in the seventeenth century (Antonovsky 1967, 38; Jackson 1994) would therefore coincide with a decline in mortality. Other observers place such mortality decline in the eighteenth century, but still coinciding with the appearance of a social gradient (Woods and Williams 1995, 113-114; Harris 2004, fig. 2; Razzell and Spence 2004). This historical evidence is controversial and so is, as mentioned, suggestive rather than conclusive.

[1] Sheila Ryan Johansson (2010) argues a similar mechanism but takes the argument one step further in that she thinks that the eventual spread of the new knowledge and technology first used by the superrich was the reason behind the mortality decline (see also David, Johansson, and Pozzi 2010).

Philip D. Curtin (1964; 1989; 1990; 1998) has worked on documenting the death ratios of Europeans during historical expeditions to and periods of settlement in West Africa (along with other regions of the World). The death ratios of the relocating Europeans were shockingly high in all tropical areas, but especially so in West Africa (see also Davies 1975; Feinberg 1974; 1989). In some cases it is also clear from Curtin's figures that the occupations of these Europeans (mostly men) made a huge difference to their risk of dying. Almost half (490/1000) of the people of the Sierra Leone Company died during the first year after arrival in 1792 (Curtin 1964, 483-484). But the social differences were substantial, with a much higher risk among the settlers and soldiers than among the "servants", i.e. the government officials. The "upper servants" also had a lower death ratio (170/1000) than the "lower servants" (490/1000) and the ratios were even higher among the settlers. Curtin (1964, 485) also cites figures for the Sierra Leone Command, 1819-1836. The European officers had a much lower (209/1000) death ratio than the European military with other ranks (483/1000). None of these previous studies of Europeans in Africa used longitudinal data, but rather compared groups based on their occupation at death. This leads to the risk of overestimating the socioeconomic differences in mortality. Despite the historically extremely high mortality rate among the Europeans on the coast of West Africa there were some people who survived there for years and advanced in the hierarchy (compare Behrendt 1997, 60).

The theoretical expectations described above, and the methodological deficiencies in the previous research, make it meaningful to investigate if there were socioeconomic differences in mortality among the European men relocating to work on the coast of West Africa in the pre-colonial era. In this paper we investigate if there were occupational differences in adult mortality among European men working on the west coast of Africa between 1683 and 1766. The mortality among the European settlers was appallingly high and most of the deaths seem to have been due to infectious diseases, including tropical diseases such as yellow fever and malaria (Öberg and Rönnbäck 2016). At least these tropical diseases were not sensitive to the nutritional status of the person infected (Bellagio Conference 1985, 308). There was also no effective knowledge or technology available in the eighteenth century to prevent or cure these diseases. We consequently expect to find no occupational differences in mortality among these men. Overall this population is a critical test of the explanations outlined above for the (possible) lack of socioeconomic differences in adult mortality in pre-twentieth century populations.

Data and Methods

For this study we use a newly constructed longitudinal dataset on a sample of Europeans employed by the British Royal African Company during the seventeenth and eighteenth century (Öberg and Rönnbäck 2016). The dataset has been constructed from bi-monthly Pay Bills and other employment records. These have been matched by name (and other information) to construct longitudinal observations of the men's time working on the coast of West Africa. The men are followed during the time they worked on the coast. The start of observation is their arrival on the coast, their un-commented appearance in the records or the first preserved record in an archival series. The men are then followed over time until death, emigration, last linkable observation or end of the archival series. We treat all reasons for the end of observation other than death as an uninformative censoring event.

Since the Company paid wages to everyone on the Pay Bills, the Company had an incentive to correctly report who was present, but also who had died and when.[2] Information about people migrating to and from the African coast, or between various forts along the coast, is for the same reason systematically reported in the source. A major drawback of our source is however that information about the men's age is missing.

[2] The reason for recording the deaths was primarily to keep accurate lists of who had worked and when, in order to pay them, or their heirs, the correct wage. The cause of death was therefore, in most cases, not recorded.

All the men included in the analyses were adults and were likely, most often, young adults. The source often recorded the ethnicity of the men. As we are interested in the mortality of the European men going to Africa, all men reported as being of African or mixed descent have been omitted from this analysis. There might however be a problem of underreporting of non-European ethnicity. The data, methods and estimates of the mortality rate are presented in greater detail in Stefan Öberg and Klas Rönnbäck (2016).

The dataset covers the period 1683-1766 and includes men working in four different locations on the coast of West Africa: the Gold Coast (in present-day Ghana), Gambia, Sierra Leone and Ouidah (in present-day Benin) (Table 1). The dataset includes data on 3,764 European men, who we can follow over 4,775.0 person-years. We use Kaplan-Meier survival curves and Cox regressions to estimate the differences in survival chances between the occupational groups. The models include only the occupational categories and indicators for the decade of the start of observation of a person. We adjust for the decades to reduce the risk of a confounding effect from changes in mortality and occupational composition over time. Because we, as mentioned, don’t have any information on the age of the men we have to instead use time on the coast as our analysis time.

We include the first three years of observation in the analyses. Only about half of the men survived for that long and we also lose track of men in the sources so that the number of observations becomes smaller with the time spent on the coast. Most of the men included worked on the Gold Coast or in Gambia. The samples for Sierra Leone and Ouidah are much smaller because there is less preserved source material for these areas and because the English establishments there were smaller. There are differences in the mortality risk between the locations, but the differences are small between the Gold Coast and Gambia for which we have the most and best information.

Table 1

Summary of samples of European, male employees on the coast of West Africa, 1683-1766

Location:	Individuals	Deaths	Person-years	Median survival time (years)
Gold Coast:				
everyone	2,184	702	2,682.0	3.5
new arrivals	685	300	892.2	2.2
others	1,500	402	1,788.0	5.1
Gambia	1,115	430	1,547.1	3.2
Sierra Leone	264	98	315.2	5.7
Ouidah	215	94	238.9	2.1
All locations	3,764	1,324	4,775.0	3.5

Note: The number of individuals, deaths and person-years of observation relate to the first three years of observation on the coast (as used in the regression analyses). The median survival times were estimated including the first six years of observation on the coast. The median survival times are based on the Kaplan-Meier estimate of the survival curve and correspond to the time after which half of the men had died.

We use these data to investigate if there were social differences in mortality among these European men working on the West African coast in the eighteenth century. We divide the men along two dimensions, military/civilian and “upper”/“lower” ranks. Classification by rank was already provided in the source: the accounts consistently reported “upper”- and “lower”-ranked personnel separately on the Pay Bills. We have also complemented this contemporary classification by including any other highly skilled, non-manual occupations in the upper-rank civilian category. This gives us four broad occupational groups: soldiers, civilian workers (virtually all of them skilled, since slaves were exploited for tasks requiring no skills), military commanders and upper-class civilians. A table with examples of the occupations included in each category is presented in Table A1 in the appendix.

There are a large number of different occupational titles in the data among the civilian workers (c. 70 different titles) and upper class (c.40). A large share of the men in the sample worked as soldiers (Table 2). But there were also large numbers of civilian workers, especially in Gambia and Sierra Leone, and a relatively large group of civilian administrators etc.

Table 2

Occupational structure by location along the West African coast, 1683-1766

Occupational category	Share of population (percent) Gold Coast, everyone	Gambia	Sierra Leone	Ouidah
Soldiers	59	34	27	42
Civilian workers	12	38	45	13
Military commanders	5	5	6	6
Civilian upper class	24	16	22	29
No information on occupation	—	7	—	10
Total	100	100	100	100
Number of individuals	2,184	1,115	264	215

The men belonging to these occupational groups were exposed to different risks. The sources do however unfortunately not allow us to determine the cause of death more than in a couple of particular cases. The purpose of separating military and civilian occupations within the “upper” and “lower” occupational groups is to evaluate whether the military personnel were exposed to higher risks than the civilians. The different occupational groups also received different levels of pay for their work (Rönnbäck 2015). There was also variation in pay within the categories we use here, but in general the “upper”-ranking groups received higher pay than the “lower” ranks.

The groups (most likely) had quite different standards of living. We cannot document this in our data, but the higher pay, if nothing else, must have allowed the "upper" ranks to live more comfortably. These differences in diet, clothing and living and working environments could have resulted in differences between the occupational groups in the risk of mortality. But even if the men might have lived in different quarters they all lived and worked in relatively small company forts. It was therefore not easy to separate oneself from the dominant risk factors for Europeans in the tropical environment: tropical and other infectious diseases. All men were, for example, exposed to the same risks through the use of contaminated sources for water and systems for excreta and waste disposal.

The classification is based on the occupation the men had when we first observe them as working on the coast. For many of the men this corresponded to when they relocated to the coast, but others had already been there for some time or had worked there before. There are, as mentioned, three different ways the observations start for the men: their arrival on the coast, their un-commented appearance in the records or the first preserved record in an archival series. It is only for the Gold Coast that systematic records were kept on whether a man had just arrived on the coast. For the other locations, and for a large group of men also on the Gold Coast, we do not know exactly when they arrived on the coast. Using the occupation from the earliest observation of the men thus reduces, but does not resolve the problem for our analyses caused by surviving veterans who advanced in the ranks.

Both the analysis time (years spent working on the west coast of Africa) and the occupational classification are more precisely defined for the group that we observe as arriving from Europe to the Gold Coast. We therefore first analyze the data from the Gold Coast and separate the new arrivals from the other men (Table 3). We then move on by including the data for the other locations along the coast (Table 4). We do the analysis on the pooled data by estimating one regression model but interacting the indicators for both the occupational categories and the decades with indicators for the locations. In this way we allow the occupational differences in mortality, as well as the changes over time, to be different in the different location.

We present the results in Table 4 in which all (combined) coefficients correspond to how the mortality risk of that group differed from that of the reference group: soldiers in Gambia. In the appendix we have combined the coefficients to enable easy comparisons between occupational groups, within locations (Table A3) and between locations, within occupational groups (Table A4).

The regression model presented in Table 4 (and Tables A3 and A4 in the appendix) assumes the same underlying hazards function for all locations. This seems to be reasonable because the results are very similar when the models are estimated on the data for each location separately (compare the results in Tables 3 and A2 with those in Table 4).

Cox proportional hazards regressions assume proportional hazards, i.e. that the mortality risk for the different groups is similar except having different levels. In our case it means that the development of the mortality risk over time should be similar for the different groups. We have to reject the assumption of proportional hazards in our data. The mortality risks are not proportional between the different locations. There are also deviations from proportionality between the occupational groups in the data for Gambia and Sierra Leone. We also evaluated the proportional hazards assumption graphically for each location separately. There are several violations of proportionality, but most occur because the lines are so close to each other. The categories most clearly violating the assumption are the military commanders in Gambia and Sierra Leone, but excluding them from the analyses for these locations does not solve the problem. Given that our data violates the assumption of the method used, our regression results should be interpreted with care.

Results

The mortality rate among European men working on the African west coast was extremely high, more comparable in level to the contemporary European mortality rates for infants (see Öberg and Rönnbäck 2016 for further discussion). About three hundred men per thousand died within the first year working on the coast (Figure 1). This extremely high mortality fits well with previous research on Europeans relocating to West Africa in the pre-colonial era (Curtin 1964; 1990; Davies 1975; Feinberg 1974; 1989). The first months on the coast were especially dangerous with some reduction in risk among the men who survived their initial exposure to tropical and other infectious diseases. This can be seen in the sharp drop in the share surviving during the early months and the gradual flattening of the curve with time spent on the coast. This effect was called "seasoning" by contemporaries, and the somewhat reduced risk of dying after the first six months was explained by that the men had then had time to adjust themselves to the tropical climate.

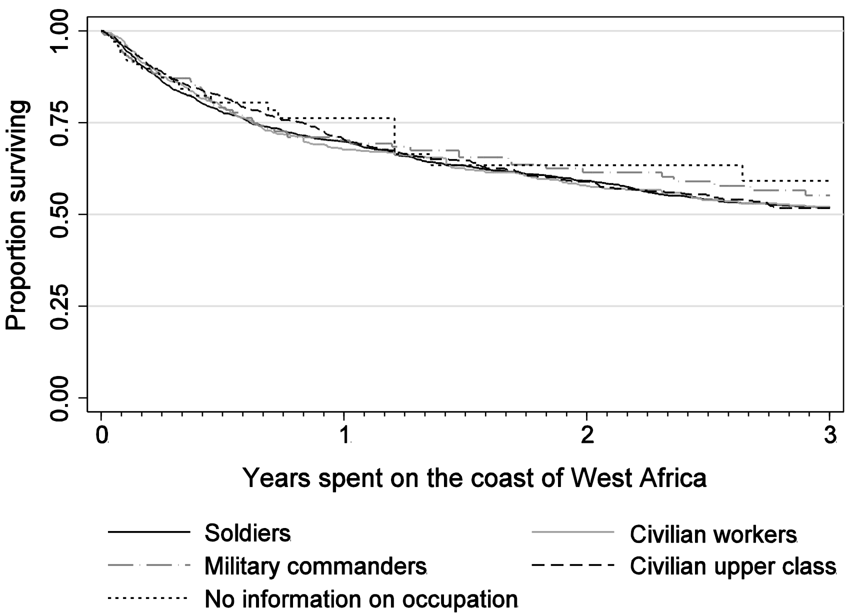

Figure 1

Survival curves of European, male employees on the coast of West Africa, 1683-1766, by occupational category

There are no occupational differences in mortality in the pooled sample covering all the different locations on the coast (Figure 1). The survival curves have almost identical shapes and are mostly indistinguishable. This is also confirmed in formal tests of the similarity of the curves. There are no statistically significant differences between the survival curves of the different occupational groups (Log-rank test: Chi2(4) = 1.06, *p*-value 0.901; Wilcoxon-Breslow-Gehan test: Chi2(4) = 1.81, *p*-value 0.770).

As mentioned earlier, we first estimate the occupational differences in mortality on the Gold Coast, where we can separate the men just arriving from Europe from the others (Table 3). The differences in mortality risk are small in the sample that includes everyone. The civilian workers have an increased risk compared to the soldiers but this is only marginally statistically significant (p = 0.081). The risk is also slightly increased and reduced, but not statistically significant in either case, for military commanders and the civilian upper class respectively.

Table 3

The occupational and geographical differences in mortality among European, male employees, 1683-1766

	Gold Coast, everyone	Gold Coast, new arrivals	Gold Coast, others
Soldiers (reference category)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Civilian workers	1.22†	1.25	1.18
Military commanders	1.18	1.71	1.20
Civilian upper class	0.92	0.67**	0.99
Indicators for decades	Yes	Yes	Yes
Wald chi2, *p*-value	0.021	0.002	0.093
Proportional hazards, *p*-value	0.762	0.427	0.323

Note: The coefficients presented are odds ratios from Cox proportional hazards regressions. The model included indicators for the occupational categories and decades (with the 1720s as reference category). Wald chi2 is a test of the overall statistical significance of the model. The proportional hazards test is based on the Schoenfeld residuals. The results show that we do not need to reject the null hypothesis of proportional hazards.

Statistical significance: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We then estimate the occupational differences in mortality for the men we are observing from the time when they arrive on the coast. We get similar results in that the risk is increased for civilian workers and military commanders. These differences are, however, not statistically significant. The more interesting result is that the mortality risk is clearly lower for the civilian upper class compared to the soldiers. This difference is also highly statistically significant. The risk is lower for the upper class from when they arrive on the coast, and remains so for the first three years (Figure A1 in the appendix). If this difference was attributable to soldiers experiencing violent deaths to a greater degree, we ought to find a difference not just between civilian upper class and soldiers, but also between civilian workers and soldiers. As can be seen from the table, the data does not support such a conclusion: the estimated mortality risk for the civilian workers is in contrast even higher than those for the soldiers (but generally not statistically significant).

That the mortality was clearly lower for the civilian upper class is an as surprising as intriguing result. It is contrary to our expectations for all the reasons presented in the introduction. It is also, counterintuitively, when we remove the risk of bias from the upwards social mobility of the survivors that we find the differences in mortality. Our expectation was that this bias would work to create occupational differences in mortality, nor conceal them. But, when we estimate the occupational differences among the men we know had worked on the coast before the date when we start observing them we find no occupational differences at all in mortality.

We then estimate the occupational differences in mortality for all locations on the coast while allowing them to vary across locations (Table 4). The coefficients presented in Table 4 combine the geographical and occupational differences in mortality. The coefficients should therefore all be related to the reference category: soldiers in Gambia.[3] The mortality risk was generally lower on the Gold Coast compared to the other

[3] For results focusing on either occupational or geographical differences, see Tables A3 and A4 in the appendix.

locations. Other than that, the geographical differences are small. The occupational differences in mortality, in contrast, varied a lot between locations.

Table 4

The occupational and geographical differences in mortality among European, male employees on the west coast of Africa, 1683-1766

	Gold Coast, everyone	Gambia (ref. cat.)	Sierra Leone	Ouidah
Soldiers (reference category)	0.57***	1.00 (ref.)	1.98**	0.89
Civilian workers	0.70*	0.81†	0.93	2.18*
Military commanders	0.68†	0.64†	1.02	0.45
Civilian upper class	0.52***	1.01	1.31	0.94
No information on occupation	—	0.65	—	1.87
Indicators for decades	Yes			
Wald chi2, *p*-value	0.000			
Proportional hazards, *p*-value	0.000			

Note: The coefficients presented are odds ratios from Cox proportional hazards regressions. The regression was done on the pooled sample covering all four locations along the coast of West Africa. The model included indicators for the occupational categories, locations and decades (with the 1720s as reference category). The occupational indicators were interacted with the indicators for the different locations. Wald chi2 is a test of the overall statistical significance of the model. The proportional hazards test is based on the Schoenfeld residuals. The statistically significant result of the test means that we should reject the null hypothesis of proportional hazards. The regression results should therefore be interpreted with care.

Statistical significance: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The most striking results are the increased risk for soldiers in Sierra Leone and for workers (and men without information on occupation) in Ouidah.[4] Both groups had about double the risk of dying compared to the soldiers in Gambia. There are no obvious explanations for these large differences based on what we currently know.

Other than these two large differences, most differences in mortality risk between the occupational categories are small and not statistically significant. If the living conditions and social position of the men did have an effect on their exposure to risk and their survival chances we would expect in particular that the military commanders and civilian upper class differed from the soldiers and workers. The civilian upper class did not have any different risk of mortality from the soldiers in any of the locations when we include all observations. It is only, as described above, when we separate out the men we are observing from the time when they arrive from Europe that we find that the civilian upper class, surprisingly, had a lower risk.

The military commanders, for their part, did have a lower risk of dying than the solders had in Gambia, Sierra Leone and Ouidah. This might suggest support for the existence of socio-economic differences in mortality. Soldiers who survived long enough do however often seem to have been promoted to (lower-ranking) commanding positions. It is therefore possible that a share of these commanders was "seasoned" veterans with improved survival chances. On the Gold Coast, however, military commanders instead had a higher risk of dying than the soldiers did, contrary to what would be expected from this explanation.

[4] The results for the Gold Coast also look striking from Table 4 but are the result of the generally lower mortality there compared to Gambia. The occupational differences within the Gold Coast can be better seen in Table 3.

The civilian workers had higher mortality than the soldiers on the Gold Coast[5] and in Ouidah, but lower in Gambia and Sierra Leone. Violent deaths among the soldiers do not seem to be the most important explanation for the differences, as far as it is possible to tell from the sources. We can, unfortunately, not check this for Sierra Leone, but in the sources for Gambia there are some notations of violent deaths. Excluding the twenty deaths (4.7% of all observed deaths in Gambia) indicated as being caused by violence leaves the results almost identical (Table A2 in the appendix).

The Company seems to have employed a number of people of African or mixed descent at the Gold Coast Castle in particular. This could contribute to the difference seen there if there was underreporting of African or mixed descent in the sources. The native population experienced lower mortality than the Europeans, due to many of them having already acquired resistance or even immunity to certain tropical diseases.

In Gambia and Sierra Leone, the civilian workers instead had a lower risk of death than the soldiers. This might be explained by a smaller problem with bias induced by underreporting of ethnicity: the Company seems to have employed far fewer people of African or mixed descent in these two locations, as far as it is possible to tell from the primary sources. The sources for both Gambia and Sierra Leone also include a substantially larger share of (European) seamen. If these men also spent long periods of time at sea, they might have been less exposed to some of the vectors of epidemic diseases, such as mosquitoes, than the men residing in forts on shore. Many of these sailors might also have sailed to tropical destinations previously, and then acquired a certain degree of resistance or immunity to some of the tropical diseases that were responsible for many of the deaths.

[5] Here it is important to remember that the mortality was in general lower on the Gold Coast than in Gambia. The increased risk for civilian workers compared to soldiers on the Gold Coast can be seen from comparing their respective odds ratios. The risk for the civilian workers was 23 percent higher than for soldiers (0.70/0.57=1.23).

Concluding Discussion

We do not find any unambiguous support for occupational differences in adult mortality in our population. The analysis of the pooled data shows no differences in mortality risk between the occupational groups despite them having different living conditions, working environment and being exposed to different risks. Disaggregating the analysis geographically did however reveal that there were different levels of risk in the different locations. Much of the differences found on a disaggregated level might however be due to imperfections in the data, with possible biases and omitted variables, such as timing of arrival and social mobility, potentially driving some of the results. Even though there are thus reasons to be cautious about our results, we think that they (being based on longitudinal data) are more reliable overall than indications in previous research (based on cross-sectional data) of clear occupational differences in mortality (e.g. Curtin 1964, 483-485). Studies based on cross-sectional data run the risk of overestimating the differences because of the upward social mobility of "seasoned" veterans.

The most interesting result from our study is that when we test for occupational differences using the best data available to us, we do find a clear difference between soldiers and the civilian upper class. It does not seem possible to attribute this to violent deaths, as civilian workers exhibited as high, or potentially even higher, mortality risk as the soldiers did. This result is surprising, given that it was not easy to separate oneself from the most important risk factors for Europeans in this tropical environment: infectious diseases. There was furthermore still no useful knowledge for preventing, let alone curing, these diseases. Because of this, the men were exposed to much of the same sources of contamination regardless of their living conditions or social position. There was in other words not much that the richer could buy to improve their own survival chances.

It was still difficult to prevent exposure to or illness from tropical diseases among Europeans relocating to West Africa during the early twentieth century. But during this time non-officials—miners, missionaries and merchants—often fared worse than the soldiers and the officials (Curtin 1990, 87). The soldiers and officials were living in specially designed houses, often separated from the rest of the population, to prevent them from falling ill (e.g. Raynes 1930; Dumett 1968). Still, the rates of mortality and invalidity from tropical diseases were also high among the soldiers and officials (e.g. Horn 1912). But they were, importantly, lower than for the well-off groups among the non-officials. The preventive measures did have some effect despite inadequacies in the understanding of the diseases and in the medical technology available.

The extreme environment that the men studied in this paper were living in should have cancelled out any effect from their differences in background and living conditions on their risk of dying. The study of this population should therefore, as mentioned, be seen as a critical test of the hypothesis that "democratic" infectious diseases and lack of meaningful knowledge on how to prevent them can lead to there being no socioeconomic differences in adult mortality. In the seventeenth and eighteenth centuries there was still insufficient understanding of the causes of tropical and other infectious diseases to allow for any, possibly socially stratified, preventive measures. Still, our results force us to allow for the possibility that there was something about the nutritional or health status, lifestyle or preventive measures of the upper class that protected them from some of the dangers in "The White Man's Grave".

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APPENDIX

Table A1

Examples of occupations in the occupational categories, European, male employees on the coast of West Africa, 1683-1766

Soldiers	Civilian workers	Military commanders	Civilian upper class
Drummer	Apprentice	Captain	Accountant
Fifer	Armorer	Captain general	Agent
Gunner	Blacksmith	Captain lieutenant	Assistant
Gunner's mate	Boatswain	Commander	Chief
Soldier	Bomboy	Corporal	Chief agent
Trumpeter	Bricklayer	Ensign	Chief merchant
	Carpenter	General	Factor
	Cook	Lieutenant	Governor
	Cooper	Second	Secretary
	Gardener	Sergeant	Steward
	Mason		Surgeon
	Master		Surveyor
	Mate		Writer
	Miner		
	Sailor		
	Sawyer		
	Servant		
	Smith		
	Surgeon's mate		

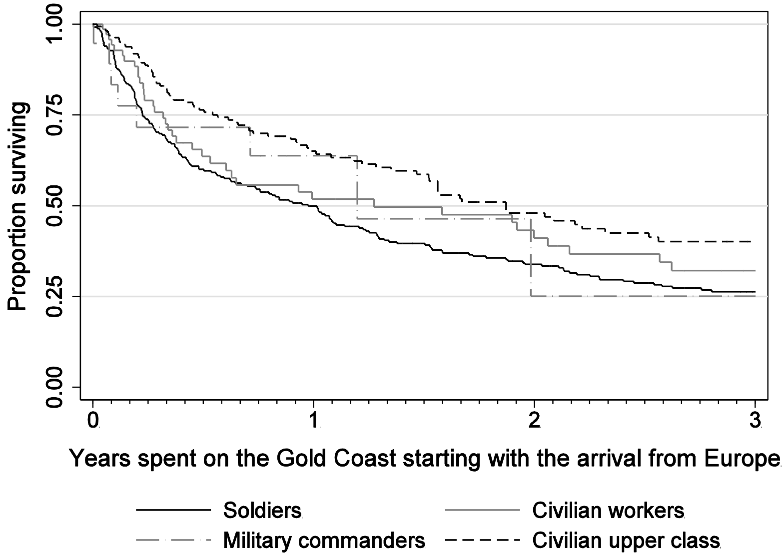

Figure A1

Survival curves of male employees from the time they arrived from Europe to the Gold Coast, 1707-1766, by occupational category

Note: The proportion surviving is the Kaplan-Meier survival curve estimates. The estimates were adjusted for decade as in the regression presented in Table 3.

Table A2

Occupational differences in mortality among European, male employees, 1683-1745, by location along the West African coast

	Gambia, everyone	Gambia, excl. 20 violent deaths	Sierra Leone	Ouidah
Soldiers (reference category)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Civilian workers	0.81†	0.80†	0.46**	2.11**
Military commanders	0.64†	0.64†	0.53	0.52
Civilian upper class	1.00	1.06	0.65	1.04
No information on occupation	0.66	0.68	—	1.81
Indicators for decades	Yes	Yes	Yes	Yes
Wald chi2, *p*-value	0.000	0.000	0.000	0.006
Proportional hazards, *p*-value	0.000	0.000	0.003	0.271

Note: Odds ratios from Cox proportional hazards regressions estimated separately by location. The regression models include indicators for the occupational categories and for decades (with the 1720s as reference category). Wald chi2 is a test of the overall statistical significance of the model. The proportional hazards test is based on the Schoenfeld residuals. The non-significant results mean that we cannot reject the null hypothesis of proportional hazards for Ouidah. We do reject the null hypothesis of proportional hazards for Gambia and Sierra Leone. The regression results for these locations should therefore be interpreted with care.

Statistical significance: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A3

Occupational differences in mortality among European, male employees, 1683-1766, by location along the West African coast

	Gold Coast, everyone	Gambia	Sierra Leone	Ouidah
Soldiers (reference category)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Civilian workers	1.22†	0.81†	0.47**	2.45**
Military commanders	1.19	0.64†	0.51	0.50
Civilian upper class	0.92	1.00	0.66	1.05
No information on occupation	—	0.65	—	2.10

Note: Odds ratios from the Cox proportional hazards regression presented in Table 4. The combined coefficients and statistical significance presented here correspond to the occupational differences in mortality by location. The results should be interpreted by column, i.e. by location.

Statistical significance: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A4

Geographical differences in mortality among European, male employees, 1683-1766, by occupational group

	Gold Coast, everyone	Gambia	Sierra Leone	Ouidah
Soldiers (reference category)	0.57***	1.00 (ref.)	1.98**	0.89
Civilian workers	0.85	1.00 (ref.)	1.15	2.68**
Military commanders	1.06	1.00 (ref.)	1.59	0.70
Civilian upper class	0.52***	1.00 (ref.)	1.30	0.93
No information on occupation	—	1.00 (ref.)	—	2.86†

Note: Odds ratios from the Cox proportional hazards regression presented in Table 4. The combined coefficients and statistical significance presented here correspond to the geographical differences in mortality by occupational group. The results should be interpreted by row, i.e. by occupational group.

Statistical significance: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$