Severity and Selectivity of the Black Death and Recurring Plague in the Southern Netherlands (1349-1450)

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Abstract

The Black Death is the textbook villain when it comes to the study of historical diseases and to the general public it remains a thought-provoking subject. To illustrate, in 2017 over three million viewers accessed the English Wikipedia's Black Death page, compared to present-day Ebola which only had less than one million. Despite the wide drawing power of the Black Death, some of its most basic characteristics are still debated in academic circles. The focus of this paper will be on the severity of the Black Death and recurring plague outbreaks in the Southern Netherlands. More specifically it will reflect on the general assumption that plague evolved from a 'universal killer' to a more selective and less severe disease over time. Due to the scarcity of late medieval sources and a lack of quantifiable indicators, little is known about the causal mechanisms at work during the late Middle Ages. This paper offers a newly-compiled database of 25,610 individuals that died between 1349-1450 in the County of Hainaut to test a number of assumptions on the selectivity and severity of late medieval plague outbreaks.

Introduction

Plague is considered the most deadly infectious disease in history. Caused by the bacterium *Yersinia pestis*, it sparked off three widespread

pandemics: the Justinian plague of 541-767, the second pandemic which started with the Black Death in 1347,[1] and the third pandemic which occurred during the middle of the nineteenth century. Although less severe than the two previous pandemics, with mortality mostly affecting India, it spread plague to ports across the globe.[2]

Despite being perceived as a historical disease, plague is still present in wild animal reservoirs around the world and human plague-casualties are frequently reported.[3] In recent years, the increasing number of plague resurgences has led the World Health Organization to categorize the disease as a re-emerging global health threat.[4] Scholars have voiced concerns that future climate change may increase plague activity,[5] and some even consider it a potential bioterrorism agent.[6] In order to understand the causal mechanisms behind the spread, occurrence and severity of the disease, research is increasingly oriented towards historical plague in the hope that a long-term analysis will provide insights not attained by studies of contemporary (isolated) outbreaks.[7]

At the same time there is growing consensus that, in order to assess the socio-economic and demographic implications of diseases over time, debates on the nature of epidemics and the changing characteristics of pathogens also need to be taken into consideration.[8] Even though we cannot assume pre-industrial epidemiological experiences mirrored

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1 Black Death refers to the plague outbreak in 1347-1353, see: Monica Green, 'Editor's introduction to pandemic disease in the Medieval World: Rethinking the Black Death', *The Medieval Globe* 1 (2016) 9-26.

2 Myron Echenberg, *Plague ports: The global urban impact of bubonic plague, 1894-1901* (New York 2010) 350.

3 N.C. Stenseth et al., 'Plague: Past, present, and future', *PLoS Medicine* 5:1 (2008) 9-13.

4 World Health Organization et al., *Vector-borne diseases. Fact sheet 387*. World Health Organization, 2014.

5 N.C. Stenseth et al., 'Plague dynamics are driven by climate variation', *Proceedings of the National Academy of Sciences USA* 103:35 (2006) 13110-13115.

6 T.V. Ingelsby et al., 'Plague as biological weapon: Medical and public health management', *Journal of American Medical Association* 283:17 (2000) 2281-2290.

7 Ulf Büntgen et al., 'Digitizing historical plague', *Clinical Infectious Diseases* 55:11 (2012) 1586-1588; B.V. Schmid et al., 'Climate-driven introduction of the Black Death and successive plague reintroductions in Europe', *Proceedings of the National Academy of Science* 112:10 (2015) 3020-3025; K.L. Bos et al., 'Eighteenth century Yersinia pestis genomes reveal the long-term persistence of an historical plague focus', *eLife* 5 (2016) e12994; J.A. Lewnard and J.P. Townsend, 'Climatic and evolutionary drivers of phase shifts in the plague epidemics of colonial India', *Proceedings of the National Academy of Sciences of the United States of America* 113:51 (2016) 14601-14608.

8 Guido Alfani and Tommy Murphy, 'Plague and lethal epidemics in the pre-industrial world', *Journal of Economic History* 77:1 (2017) 314-343.

the modern one,[9] especially given the disparities between the second and the third plague pandemics,[10] a greater understanding of the biggest killer-disease ever to afflict mankind is fundamental to predict the dynamics of future large-scale epidemics.

Most research on late medieval plague has primarily focused on the initial outbreak of the disease, constituting a kind of myopia in which interest in the Black Death seems almost perennial while late medieval echo-epidemics have received far less attention.[11] Due to the scarcity of sources we know little about the characteristics of recurring plague outbreaks in the century following the Black Death.[12] As a result, a number of assumptions have gained foothold in the international literature without a solid empirical foundation. To highlight this problem, this article will reflect on the state of current knowledge regarding the severity of the Black Death and the role of selective mortality in later plague outbreaks to explain their reduced mortality rates (section 2).[13] As indicated, one of the biggest hurdles is the scarcity and disparate nature of available sources on epidemiological characteristics. In order to understand the impact this has had on our understanding of late medieval plague epidemics, this article introduces data from a single continuous source, the Hainaut mortmain accounts (section 3). Using a database of 25,610 individuals that died in the County of Hainaut between 1349-1450 this article will analyse severity (in the context of acquired immunity), geographic selectivity and gender selectivity during the Black Death and recurring plague waves. The results of this analysis will be contrasted with certain beliefs in current literature (section 4). To conclude, I will discuss the need to question assumptions in the absence of hard data when studying historical plague outbreaks (section 5).

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9   On this topic see: Daniel Curtis and Joris Roosen, 'The sex-selective impact of the Black Death and recurring plagues in the Southern Netherlands, 1349-1450', *American Journal of Physical Anthropology* (2017) 10.1002/ajpa.23266.

10   Disparities with regard to seasonality, contagiousness, severity, pervasiveness, longevity and intermediate hosts. See: Green, 'Editor's introduction', 9-26.

11   F.M. Getz, 'Black Death and the silver lining: Meaning, continuity, and revolutionary change in histories of medieval plague', *Journal of the History of Biology* 24:2 (1991) 265-289; W.P. Blockmans, 'The social and economic effects of plague in the Low Countries: 1349-1500', *Revue Belge de Philologie et d'Histoire* 58:4 (1980) 833-863.

12   Alfani and Murphy, 'Plague and lethal epidemics', 318.

13   On reduced plague mortality see: B. Campbell, *The Great Transition: Climate, disease and society in the late-medieval world* (Cambridge 2016) 307-308.

Black Death mortality

The Black Death caused demographic carnage of unprecedented magnitude, to which scholars have allocated a prime role in: regulating the equilibrium between population and resources,[14] determining the path of economic development,[15] the creation of institutions,[16] and both the little- and the great divergence.[17] Ascertaining the overall mortality rate has therefore attracted a fair amount of scholarly attention. Although absolute mortality from the 'Spanish' influenza pandemic of 1918-1919 was higher,[18] expressed as a percentage of the population, the Black Death was the biggest killer disease ever to have struck Europe, spreading to the Middle East and Northern Africa as well. Whilst earlier studies – relying on limited data – estimated overall mortality at 20 per cent to 35 per cent, current estimates have been pushed up to around half the European population. In fact, ongoing research is continuing to revise estimates upwards, a trend also seen in studies on early modern plague.[19]

The highest mortality estimate for the Black Death is 60 per cent and was advanced by Ole Benedictow in his seminal book, *The Black Death: The Complete History*.[20] Even though it may become the new standard estimate, there are some issues with how it was calculated. First, for the purpose of his argument, Benedictow tended to avoid data that contradicted his story of exceptionally high mortality.[21] Moreover, in calculating an estimate for the whole of Europe, he noted a remarkable similarity of mortality levels in different regions.[22] However, it is well

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14 Christiane Klapisch-Zuber, 'Plague and family life', in: Michael Jones (ed.), *The new Cambridge medieval history: vol. 6: c. 1300-c. 1415* (Cambridge 2000) 124-154.

15 Daron Acemoglu, James Robinson and Simon Johnson, 'Disease and development in historical perspective', *Journal of the European Economic Association* 1:3 (2003) 397-405.

16 S.R. Epstein, *Freedom and growth: The rise of states and markets in Europe, 1300-1750* (London 2000) 223.

17 Sevket Pamuk, 'The Black Death and the origins of the "Great Divergence" across Europe', *European Review of Economic History* 11:3 (2007) 289-317.

18 Niall Johnson and Juergen Mueller, 'Updating the accounts: Global mortality of the 1918-1920 "Spanish" Influenza pandemic', *Bulletin of the History of Medicine* 76:1 (2002) 105-15.

19 Alfani and Murphy, 'Plague and lethal epidemics'. For seventeenth century studies see: Alfani, 'Plague in seventeenth century Europe'; Ronald Rommes, 'Plague in Northwestern Europe: The Dutch experience, 1350-1670', *Popolazione e Storia* 16:2 (2015) 47-71.

20 O.J. Benedictow, *The Black Death, 1346-1353: The complete history* (Woodbridge 2004) 380-384.

21 Noted in: Andrew Noymer, 'Contesting the cause and severity of the Black Death: A review essay', *Population and Development Review* 33:3 (2007) 616-627.

22 Benedictow, *The Black Death, 1346-1353,* 433.

established that the Black Death did not hit all regions with the same severity.[23] Finally, Benedictow's claim that the data is sufficiently widespread and numerous to allow for a Europe-wide estimate, needs to be nuanced.[24] In truth there is an absolute scarcity of documentary evidence to furnish quantifiable indicators for mortality during the late Middle Ages, making it impossible to specify the exact numerical impact of the Black Death in a satisfactory manner. Even if sources are available, estimates remain inexact due to a lack of detailed accounts of deaths occurring during the time of plague.[25] Instead, mortality rates are usually calculated on the basis of anecdotes, chronicles and random samples of general economic data.[26]

Despite the challenges posed by historical sources, plague research has witnessed some remarkable breakthroughs in the past two decades, most importantly with the identification of *Yersinia pestis* as the causal agent of the Black Death.[27] In recent years, aDNA testing and genome sequencing has allowed micro-biologists and bio-archaeologists to study plague on a geographical scale that often dwarfs localized studies of the past.[28] The allure of this wide geographic scope has enticed scholars in the social sciences (often non-historians) to perform studies on a pan-European scale as well. They usually do so not by relying on evidence gathered in the field or in the laboratory, but by using pre-existing historical datasets. When employing this data, some scholars tend to loosen the rigorous standards of evidence and interpretation demanded in the field of history, undermining the reliability of their results.[29] At the core of this problem is the assumption that Black Death mortality estimates are hard data suitable for complex analysis. In what follows, I will illustrate that certain datasets provide a poor starting point

23 D.C. Mengel, 'A plague on Bohemia? Mapping the Black Death', *Past and Present* 211:1 (2011) 3-34.

24 O.J. Benedictow, 'The Black Death: The greatest catastrophe ever', *History Today* 55:3 (2005) 42-49.

25 Klapisch-Zuber, 'Plague and family life', 131.

26 Chris Fallow and Charles Evans, 'The mystery of plague in medieval Iceland', *Journal of Medieval History* 42:2 (2016) 254-284.

27 L.K. Little, 'Plague historians in lab coats', *Past and Present* 213:1 (2011) 267-290; Monica Green, 'Taking "pandemic" seriously: Making the Black Death global', *The Medieval Globe* 1 (2016) 27-62.

28 M.A. Spyrou et al., 'Historical Y. pestis genomes reveal the European Black Death as the source of ancient and modern plague pandemics', *Cell Host and Microbe* 19:6 (2016) 874-881. On the broader trend see: Daniel Curtis, Bas van Bavel and Tim Soens, 'History and the Social Sciences: Shock therapy with medieval economic history as the patient', *Social Science History* 40:4 (2016) 751-774.

29 Critiqued in: Lori Jones and Richard Nevell, 'Plagued by doubt and viral misinformation: The need for evidence-based use of historical disease images', *The Lancet Infectious Diseases* 16:10 (2016) 235-240.

for comparing the severity of the Black Death with that of later plague outbreaks. This problem is compounded by the fact that there is currently no systematic overview of mortality rates caused by many of the echo-epidemics. In fact, even datasets tracking plague occurrences geographically over time have proven to be problematic.[30] It is assumed the Black Death acted as a 'universal killer' causing it to be more severe than subsequent plague outbreaks because (among others): it hit an immunologically naïve population, was less selective in who it killed and was more territorially pervasive.[31] Recurring plague outbreaks, on the other hand, are said to have been more selective. However, our understanding of how these epidemiological characteristics evolved and how they influenced severity is limited.[32] The Hainaut mortmain database provides an excellent opportunity to unveil some of the characteristics behind the severity and selectivity of late medieval plague. Before turning to these issues let us turn to the starting point, the mortality estimates for the Black Death in the Southern Netherlands.

One of the most widely used datasets of Black Death mortality rates, building on pre-existing research, was compiled in the book, *Interdisciplinary public health reasoning and epidemic modelling: The case of the Black Death*.[33] Based on their data, George Christakos and co-authors argued that 'unlike Northern Italy, (Black Death) mortality in Belgium was the lowest among present-day countries, with about 20 per cent mortality at most'.[34] I will test the reliability of the data on which this claim is based as a way to reflect on the need to adhere to strict standards of interpretation when using historical sources.

First, let us examine the possibility of comparing on a 'country-by-country' level to substantiate the claim that Belgium witnessed the

30 For a commentary on these datasets see: Joris Roosen and Daniel Curtis, 'Dangers of noncritical use of historical plague data', *Emerging Infectious Diseases* 24:1 (2018) 103-110.

31 Some historians claim recurring plague tended to diminish in severity although the exact mechanisms are uncertain: J.C. Russel, *British medieval population* (Albuquerque 1948); Guy Fourquin, *Les campagnes de la région parisienne à la fin du Moyen Âge* (Paris 1964); Sevket Pamuk, 'The Black Death', 289-331. A notion echoed in other sciences as well: N.A. Boire et al., 'Lessons learned from historic plague epidemics: The relevance of an ancient disease in modern times', *Journal of Ancient Diseases and Preventive Remedies* 2:2 (2013) 10.4172/2329-8731.1000e118.

32 Alfani and Murphy, 'Plague and lethal epidemics', 318.

33 George Christakos et al., *Interdisciplinary public health reasoning and epidemic modelling: The case of the Black Death* (Berlin 2005) 320.

34 Christakos et al., *Interdisciplinary public health,* 222. This claim is not unique to this volume and has been expressed by many scholars, including Low Countries experts W.P. Blockmans et al., 'Tussen crisis en welvaart: sociale veranderingen 1300-1500', in: *Algemene geschiedenis der Nederlanden* IV (Haarlem 1980) 42-86.

lowest mortality rate of all present-day countries. To calculate the mortality estimate for an entire country, the authors were forced to extrapolate results from localised studies. This methodology has to contend with the fact that mortality rates could differ noticeably from one locality to the next.[35] For example, work with manorial sources for England and fiscal sources for France and Italy has revealed local population losses ranging from 30 per cent to 70 per cent.[36] For countries with a relative abundance of sources, such as England and France, the cross-referencing of multiple local estimates might yield some degree of reliability when extrapolated to a 'country-level' total. However, for countries such

Table 1 Number of locations for which information was available

Country	Used	Not used	Total
Austria	7	1	8
Belgium	8	5	13
Croatia	3	0	3
Czech Republic	1	1	2
Denmark	4	2	6
France	92	27	119
Germany	35	8	43
Gibraltar	1	0	1
Ireland	13	7	20
Italy	43	6	49
Norway	15	1	16
Poland	2	2	4
Portugal	6	8	14
Spain	50	24	74
Sweden	10	1	11
Switzerland	18	2	20
The Netherlands	4	1	5
United Kingdom	47	76	123
Total	**359**	**172**	**531**

Source: Christakos et al., Interdisciplinary public health *(2005).*

35 Blockmans, 'The social and economic effects', 837.
36 For an overview, see the England, Italy and France sections in: Benedictow, *The Black Death,* 91-95, 96-109, 123-145.

as the Czech Republic and Poland, which have far fewer sources, no meaningful estimates can be extrapolated. An overview of the number of locations providing information per country, as used by Christakos et al. is presented in table 1. The second column of the table indicates the number of locations for which the information on Black Death mortality was deemed unreliable and therefore were 'not used'. Unfortunately the authors do not provide an overview of which locations were excluded, it is thus not possible to check the sources, their reliability or the underlying selection process.

Next, let us consider the claim that Black Death mortality in Belgium was 20 per cent at most. Since this figure was attained by calculating the average for eight separate estimates, the question becomes 'how reliable is each individual estimate'? Table 2 represents the data used by Christakos et al., indicating the location, the start- and end date of the Black Death, the estimated mortality and the corresponding source.

Table 2 Black Death mortality estimates for Belgium

Place	Start	End	Mortality
Antwerp			20-25% Naphy and Spicer 2000:38-39
Ath	Summer of 1349 Benedictow 2004:113		16% Blockmans 1980:837
Brabant			Low Despy 1977:209
Bruges	May, 1349 Blockmans 1980:838	December, 1349 Nicholas 1992:266	20-25% Gottfried 1983:57
Brussels			20-25% Gottfried 1983:57
Flanders			16-25% Nicholas 1992:266
Ghent	July, 1349 Kowalewsky 1911:261		20-25% Gottfried 1983:57
Liège			Escaped the disease Scott and Duncan 2001:87
Louvain			Spared Kelly 2001:17
Maubeuge			24% Blockmans 1980:837
Mons	July, 1349 Biraben 1975:77		
Tournai	July, 1349 Biraben 1975:77		
Ypres	July, 1349 Biraben 1975:77		20-25% Gottfried 1983:57

Source: Christakos et al., Interdisciplinary public health *(2005) 179.*

For the cities of Bruges,[37] Brussels, Ghent and Ypres the mortality estimates were based on information from Robert Gottfried's contested book, *The Black Death: Natural and human disaster in Medieval Europe*, which stated that '(in) Ghent, Bruges, Ypres, Brussels, and Antwerp […] plague mortality was "only" about 20% to 25%, not much more than it had been during the great famines of the 1310s'.[38] These percentages were not calculated by Gottfried himself, instead they were taken from publications by Van Werveke and Blockmans.[39] The comparison with mortality during the Great Famine is problematic as Van Werveke stated that data was only available for Bruges and Ypres. Moreover, neither Van Werveke, nor Blockmans give explicit reference to a mortality rate for any of these cities (Brussels is never even mentioned!), and Blockmans specifically noted that 'we can bring little precision in the mortality figures'.[40]

It is therefore surprising that the mortality rates proposed by Blockmans for Maubeuge and Ath, 24 per cent and 16 per cent respectively, are so exact. These figures were calculated on the basis of the Hainaut mortmain account and refer to an average death rate per month. However, Blockmans exclusively used data from the first extant account which only covers the period from 24 June 1349 to 11 April 1350, while Black Death mortality was present until the end of 1351 in the County of Hainaut. Moreover, the mortmain documents for the Black Death period show several issues causing it to underreport mortality (see following section).

For the city of Antwerp, the reference is to a book by Naphy and Spicer in which they argued that, 'many historians comment on the

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37 For a more recent overview of mortality rates for these cities see for Bruges: Jan Vandeburie, 'De Zwarte Dood te Brugge: Een status questionis en enkele nieuwe beschouwingen', *Handelingen van het Genootschap voor Geschiedenis te Brugge* 147:2 (2010) 269-308. For Ghent and Ypres: Joren Vermeersch, *De Zwarte Dood in Vlaanderen en Europa, economische impact en politieke reacties* (Unpublished Masterthesis Rijksuniversiteit Gent 2015).

38 R.S. Gottfried, *The Black Death: Natural and human disaster in medieval Europe* (New York 1983) 203. Gottfried was accused of plagiarism in the following review article: Stuart Jenks, 'The Black Death: Natural and human disaster in medieval Europe. Review Article', *The Journal of Economic History* 46:3 (1986) 815-823.

39 Hans van Werveke, 'De Zwarte Dood in de Zuidelijke Nederlanden (1349-1351)', *Mededelingen van de koninklijke Vlaamse academie voor wetenschappen, letteren en schone kunsten van België* 12:3 (1950) 28; Hans van Werveke, 'La famine de l'an 1316 en Flandre et dans les régions voisines', *Revue du Nord* 41:1 (1959) 5-14; Blockmans, 'The social and economic effects'. Van Werveke was the first scholar to deny the presence of the Black Death in large parts of the Low Countries. See: Hans van Werveke, 'Nogmaals de Zwarte Dood in de Nederlanden', *Bijdragen betreffende de geschiedenis der Nederlanden* 8:1 (1954) 251-258.

40 Blockmans, 'The social and economic effects', 861.

"mild" plague that struck Antwerp [...] (which) "only" killed one out of every four or five persons'.[41] This claim is highly contentious as there is no reference to literature or archival sources to substantiate it.

The final area for which the mortality rate was quantified is the County of Flanders for which a mortality rate of 16 to 25 per cent was based on the following quote by David Nicholas, 'Flanders may have lost one-quarter to one-sixth of its population during the plague of 1349, which is less severe than most other areas'.[42] Nicholas referenced the work by Adriaan Verhulst, who in turn used publications by Sivéry, Blockmans and Van Werveke to attain these estimates.[43] As such, it is merely a summary of the estimates already presented for individual localities.

For the remaining cities of Louvain and Liège the mortality estimates were not quantified, instead Christakos et al. indicated 'no impact' by relying on an *argumentum ex silentio*, assuming that an absence of sources mentioning plague equalled an absence of plague activity. For Liège, a book by Scott and Duncan was used, referencing the claim that 'places such as Milan, Liège and Nuremberg, escaped the disease', again without reference to literature or archival sources.[44] For Louvain, a book by Maria Kelly was referenced in which we find the unsubstantiated claim that, 'plague spared some crowded urban centres like Milan, Ghent and Louvain'.[45] All these claims are unconvincing, as Ole Benedictow has persuasively argued that absence of evidence should not be interpreted as evidence of absence, especially when dealing with scanty late medieval sources.[46]

Finally, for the region of Brabant, where the impact was deemed low, an article by Despy was referenced in which the impact of the Black Death is described as mild.[47] This claim is based on a narrative source

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41 William Naphy and Andrew Spicer, *The Black Death and the history of plagues 1345-1730* (Stroud 2007) 31-32.

42 D. Nicholas, *Medieval Flanders* (London 1992) 265-266.

43 A. Verhulst, *Précis d'histoire rurale de la Belgique* (Brussels 1990) 224; Gérard Sivéry, 'Le Hainaut et la Peste noire', *Mémoires et Publications de la Société des Sciences, des Arts et des Lettres du Hainaut* 79:1 (1965) 431-447; Blockmans, 'The social and economic effects'.

44 Susan Scott and Christopher Duncan, *Biology of plagues: Evidence from historical populations* (Cambridge 2001) 87-88.

45 Maria Kelly, *A History of the Black Death in Ireland* (Stroud 2001) 248.

46 O.J. Benedictow, *The Black Death and later plague epidemics in the Scandinavian countries: Perspectives and controversies* (De Gruyter Open 2016) 27, 47-49, 398-399.

47 George Despy, 'La Grande Peste Noire de 1348, A-t-elle touché le Roman pays de Brabant?', in: *Centenaire du Séminaire d'Histoire Médiévale de l'Université Libre de Bruxelles*, 195-217.

from the second half of the fifteenth century,[48] however, Despy also mentioned an earlier chronicle from the late fourteenth century which does indicate severe mortality during the Black Death.[49]

Although it is beyond the scope of this article, it would be interesting to see how estimates for other countries (in the dataset) hold up to scrutiny. If the case study for Belgium is anything to go by, the basic data on the impact of the Black Death compiled by Christakos et al., is flawed to say the least.[50] However, this has done little to deter scholars from employing the data at face value for complex regression- and spatiotemporal analyses.[51]

What this section has shown is that mortality estimates for the Black Death used in recent literature do not provide an adequate basis for comparing severity, both across regions and across time. This makes any general claim on the diminished severity of recurring plague outbreaks difficult to demonstrate empirically.

The mortmain database

In order to shed new light on the selectivity and severity of the Black Death and recurring plague outbreaks, I present findings from a database of 25,610 individuals found in the mortmain accounts of the County of Hainaut during the period 1349-1450.[52] The term 'mortmain' is reminiscent of the legal term found in regions with English, French and Anglo-Norman juridical authorities, referring to the alienation of land to the dead hand of the church.[53] However, the Hainaut mortmain accounts are more comparable to English heriot taxes since both were

48 *Anecdota ex codicibus hagiographicis Johannis Gielemans* (Brussels 1895).

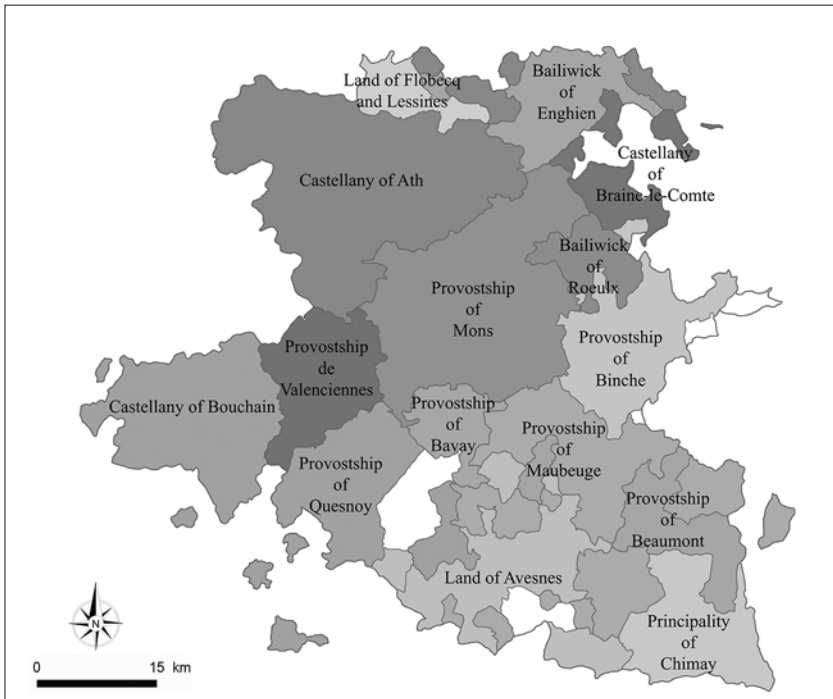49 Radulp De Rivo, *Historia episcoporum Leodiensium* (Liège 1616).

50 Much of the problem has to do with a lack of a standardized methodology to calculate mortality rates, which in turn is due to the disparate nature and scarcity of available sources.

51 For example see: George Christakos, Richardo Olea and H.L. Yu, 'Recent results on the spatiotemporal modelling and comparative analysis of Black Death and bubonic plague epidemics', *Public Health* 121:9 (2007) 700-720; Richardo Olea and George Christakos, 'Duration of urban mortality for the 14th-century Black Death epidemic', *Human Biology* 77:3 (2005) 291-303; Jean Gaudart et al., 'Demography and diffusion in epidemics: Malaria and Black Death spread', *Acta Biotheoretica* 58:3 (2010) 277-305; Mark Welford and Brian Bossak, 'Revisiting the Medieval Black Death of 1347-1351: Spatiotemporal dynamics suggestive of an alternate causation', *Geography Compass* 4:1 (2010) 561-575.

52 Archives Départementales du Nord (hereafter ADN), Lille, B 12122-12226 and National Archives of Belgium, Brussels (hereafter ARB), I, 004, 17867-17873.

53 Ellen Kittell, 'Death and taxes: Mortmain payments and the authority of the Count in fourteenth-century Flanders', *Continuity and Change* 28:2 (2013) 187-211.

Map 1 Map of the county of Hainaut in mid-fifteenth century with indication of district-level boundaries

paid as a death duty in the form of the best movable possession of the deceased. The main difference is that heriots were levied on tenants payable to a manorial lord, while mortmain was levied on a broad range of people that came from an ancestral lineage of servitude.

By the fourteenth century only a small minority of the population in Hainaut were still serfs and mortmain no longer functioned as an exclusive sign of servile status.[54] As early as June 1349 (first extant document) the accounts offered a separate rubric that read 'received from serfs, bastards and foreigners', highlighting their separate status from the 'wider' population paying mortmain (see illustration 1).[55] While heriots targeted a specific socio-economic subset of society, mostly (male)

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[54] Leo Verriest, *Le servage dans le Comté de Hainaut. Les sainteurs, Le meilleur catel* (Brussels 1910) 736.
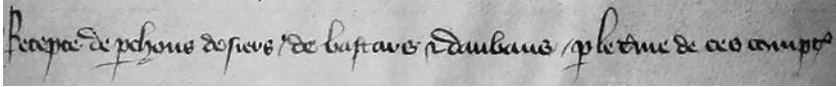
[55] ADN, Lille, B 12122.

Illustration 1 Image of separate rubric heading for serfs, foreigners and bastards (source: ADN 12122, fo. 10ro).

tenant heads of households, the reach of the mortmain was wider including all men and women who had reached age of majority (and sporadically emancipated children).[56] The main criteria was that an individual came from an ancestral line of servility, for which the mortmain accounts recognized three distinct lineage groups.[57] These groups were (a) people whose ancestry came from a lineage of serfdom in the broad sense, (b) the so-called *'sainteurs'* who initially stood under the patronage of an ecclesiastical institution, and (c) people who originally stood under the patronage of a lay lord, the so-called *'gens d'avouerie'*.[58]

The number of people subjected to mortmain payment in Hainaut was substantial. An estimated 10 to 16 per cent of total mortality was recorded in the rural localities that appeared in the mortmain accounts during the first half of the fifteenth century (see appendix). Considering the coverage of probate inventories for Ghent between 1349-1400 has been estimated at 10 per cent, and factoring in the wider geographical reach, the mortmain accounts offer a significant insight in mortality in Hainaut.[59]

More important than the numerical coverage, however, is the fact that mortmain was levied on a wide range of socio-economic groups. Only three groups were specifically exempt from payment due to their socio-economic status, these were: (a) *'les gens d'origine franche'* (form of noble status transferred through maternal lineage), (b) *'les seigneurs haut-justiciers'*, and (c) religious professionals.[60] Despite the exclusion of certain groups with high social status, not all high-ranked individuals were omitted from the accounts, and titles such as *'sire'* and *'mayeur de [x]'* are found in the documents. The accounts also extended to the

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56 Previous scholars working on the Hainaut mortmain record assumed it was only for heads of household: Benedictow, *The Black Death*; Sivéry, 'Le Hainaut et la Peste noire'; Blockmans, 'The social and economic effects', 837.

57 Verriest, *Le servage,* 170, 266-272.

58 P.C. Boeren, *Etude sur les tributaires d'église dans le comté de Flandre du IXe au XIVe siècle* (Amsterdam 1936).

59 Luc Wynant, *Regesten van de Gentse Staten van Goed. Eerste reeks, 1349-1400. Vol. I: 1349-1370* (Brussels 1979) 530.

60 Verriest, *Le servage dans le Comté de Hainaut*, 312-317.

poorest in society, labelling them as *'pauvre'* or *'mendiant'*. The mortmain accounts also recorded a significant proportion of women (43.7 per cent of the entire database). When removing a number of localities that had specific stipulations excluding women, a sex ratio of mortality of 1.07:1 can be derived from the data, indicating slightly more men.[61]

Overall, it would seem that the mortmain accounts are one of the most complete and continuous sources on late-medieval mortality. However, their reliability as a proxy for mortality crisis has been criticized, most notably by Ellen Kittell who examined these documents for the County of Flanders.[62] There are some general source limitations – such as delayed on incomplete registration in times of crisis. Yet due to their serial nature, the principal advantage of mortmain accounts is that deaths can be compared in known crisis years with 'normal' years.[63] However, Kittell has pointed out that the count of Flanders was increasingly able to subject more people to mortmain payment in the course of the late fourteenth century, exploiting a population weakened by persistent plagues and upsurges in conflict. It was only after 1380 that people were recorded in a standardized way, the rubric of the document itself began to change, and explicit reference to the precise item seized occurred.

This was not the case for Hainaut, both structure and terminology of the documents remained unchanged from the first extant document of 1349 all the way up to 1500. Moreover, there do not seem to be any structural increases in the amount of people recorded not linked to mortality crises identified in the literature. The issue instead was that the number of districts (and therefore localities) included in the account showed fluctuations over time (see appendix). In order to assess the mortality spikes in the data, it is therefore preferable to show the average mortality per locality instead of absolute mortality, as shown in figure 1 below. Apart from the Black Death, for which raised mortality can be seen in the period 1349-51, figure 1 shows recurring plague outbreaks in the County of Hainaut during the years 1358-1363, 1368-1369, 1380-1382, 1400-1401, 1413-1416, 1425-1426 and 1438-1439.[64]

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61 Curtis and Roosen, 'The sex-selective impact of the Black Death'.

62 Kittell, 'Death and taxes'.

63 Erik Thoen and Isabelle Devos, 'Pest in de Zuidelijke Nederlanden in de Middeleeuwen en de Moderne Tijden. Een status quaestionis over de ziekte in haar sociaal-economische context', *Medisch historische beschouwingen 650 jaar na de Zwarte Dood. Vierde symposium der geneeskundige wetenschappen* (1999) 20-43.

64 Curtis and Roosen, 'The sex-selective impact of the Black Death'.

Figure 1 Annual mortality based on individuals owing mortmain, Hainaut, 1349-1450 (average deaths per locality)
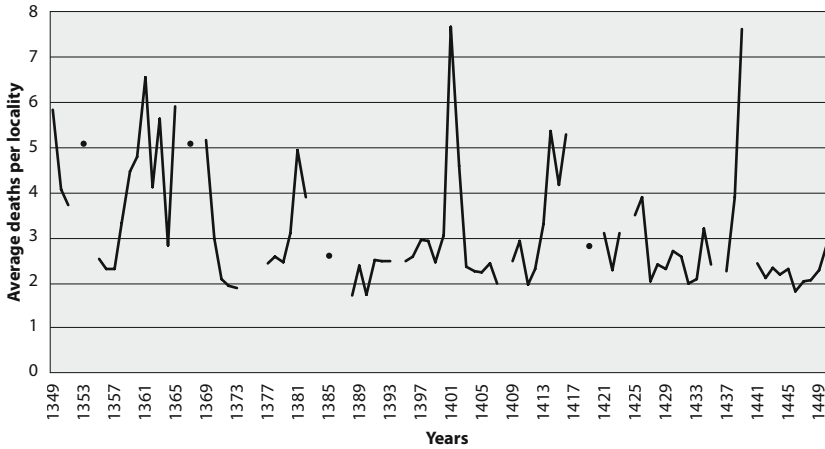
Source: ADN, B 12122-12226; ARB, I, 004, 17867-73.

Unfortunately, the mortmain accounts only show a minimum impression of Black Death mortality for several reasons. (a) The first extant account, starting in June 1349, is in poor physical condition, approximately 20 per cent of the content is missing (see illustration 2), (b) this first document only covers a period of ten months, while most other accounts span twelve months, (c) the accounts during the Black Death period contain second recordings of additional deaths for certain localities, something not seen in any of the other accounts up to 1450 and probably indicative of disruption in local administration which was (d) in all likelihood caught off guard by sudden hyper-mortality.[65] Despite these issues, the mortality peak during the Black Death is clearly visible for the County of Hainaut in figure 1.

The use of mortmain accounts is not a novel approach to the study of demographic history in the Southern Netherlands. The documents were first used to analyse the impact of recurring plague outbreaks in a MA thesis written by Wilfried Vangassen in 1952.[66] In 1965 French historian Gérard Sivéry used the mortmain accounts to prove that the Black Death had a more severe impact on the County of Hainaut than previously assumed.[67] The following year, Sivéry used the documents to ana-

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65 First extant document, ADN 12122 began in June 1349 when Black Death mortality took off.

66 Wilfried Vangassen, *De pestepidemieën na 1350 voornamelijk deze van 1400 en 1438 in Vlaanderen en Henegouwen* (unpublished Masterthesis Rijksuniversiteit Gent 1952).

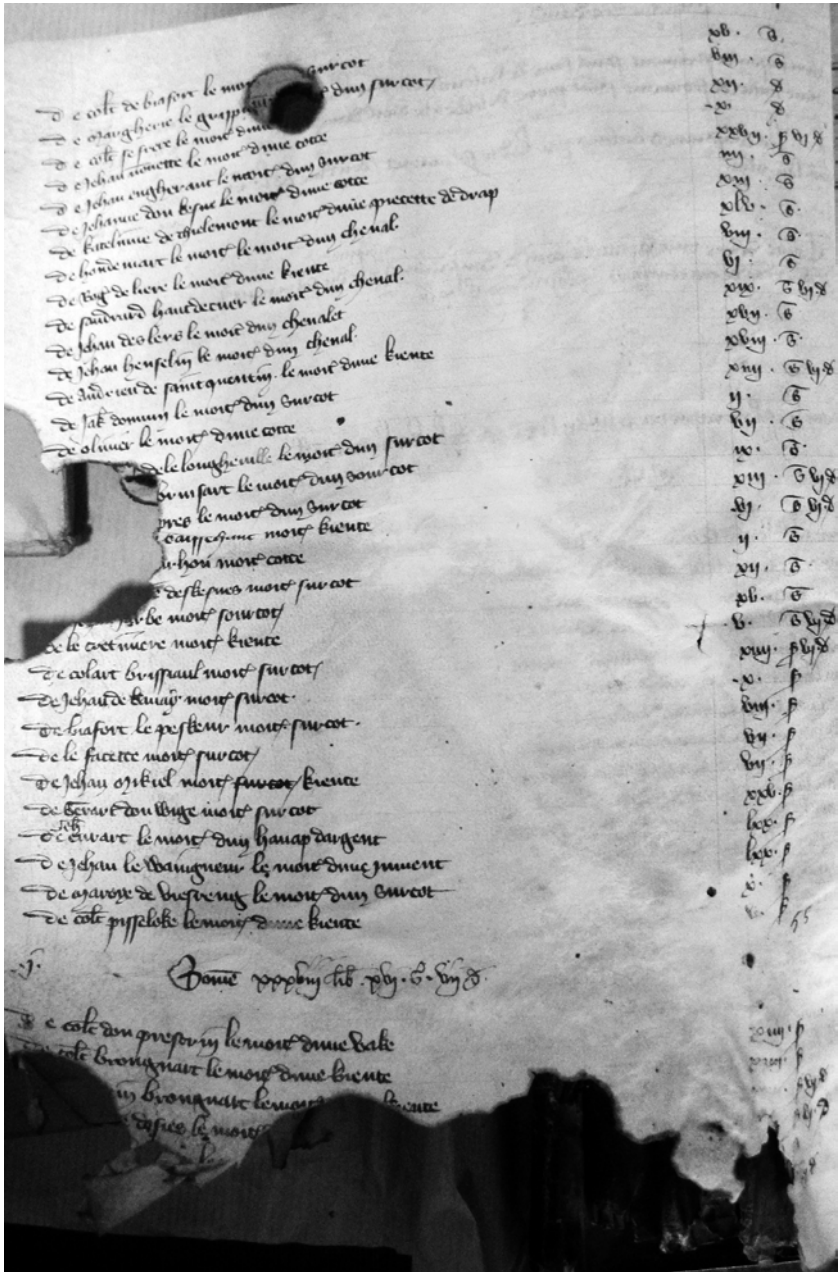67 Sivéry, 'Le Hainaut et la Peste noire'.

Illustration 2 Image of document damage in first extant document (source: ADN 12122, fo. 7vo).

lyse the severity of the plague outbreak of 1400-1401 in Hainaut, showing significant mortality.[68] Most notably, however, was Wim Blockmans' use of the accounts in his authoritative article on the social and economic effects of late medieval plague in the Low Countries.[69] In this article, Blockmans refuted the claims made by Van Werveke that the Black Death had not reached the central areas of the Low Countries.[70] A notion which, until that time, had been accepted in the international literature.[71] Instead of a miraculous escape from plague, Blockmans introduced the notion that the Black Death had been comparatively mild in the Low Countries, antithetical to its status as a densely populated, commercialized and highly urbanized region.

However, there are several issues with the use of the mortmain accounts in previous scholarship that need to be addressed here. The article by Blockmans seems to rely mostly on the dataset compiled by Vangassen in 1952 which poses several problems. Key among them are the errors that occurred either due to the recording of double entries or the failure to record more than one person in a line. More surprising is the fact that neither Sivéry nor Blockmans incorporated the account of 1350-1351 in their research.[72] A rather sizeable gap in the data considering the Black Death was not a one-year event. Similarly, the article by Sivéry which focused on the 1400-1401 plague outbreak did not incorporate the account from September 1400 to September 1401.[73] Moreover, previous research never analysed the mortmain accounts as a continuous serial source and ignored its value for analysing urban and rural plague dynamics, or gender-relate mortality effects.

Selective mortality effects

Based on the data compiled from the mortmain accounts, it is possible to analyze several factors that have been used in the literature to explain the diminished severity of recurring plague waves. A first factor thought

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68 Gérard Sivéry, 'La Peste Noire et l'épidémie de 1400-1401: Questions de méthodologie', *Annales de la Société belge d'histoire des hôpitaux* 4:1 (1966).

69 Blockmans, 'The social and economic effects'.

70 Van Werveke, *De Zwarte Dood*; 'Nogmaals: de Zwarte Dood'.

71 For instance: Jean-Noël Biraben, *Les hommes et la peste en France et dans les pays européens et méditerranéens* (Paris-The Hague 1975); W.H. McNeill, *Plagues and peoples* (New York 1976).

72 ARB 17867.

73 Sivéry, 'La Peste Noire et l'épidémie de 1400-1401'. ARB, 17870.

to have caused lower severity in recurring plague outbreaks is the notion that humans could build up immunity to plague over time.[74] The assumption is that, because the Black Death affected a 'virgin soil' population, it caused higher mortality than subsequent plague outbreaks.[75] However, the prevalent idea that populations could permanently acquire immunity to plague (or other pathogens) if part of that population survived a previous epidemic has been deemed misleading.[76] The assumption that the Black Death was more severe than plague outbreaks in the following hundred years is constrained by the fact that there is an absolute scarcity of quantitative evidence for much of this period.[77] Based on the Hainaut database it is difficult to provide a conclusive answer because the documents offer only a minimum estimate for Black Death mortality. However, there are indications of higher severity of certain recurring plague outbreaks, despite prolonged contact of local population with the pathogen. For example, judging by the results from figure 1, the outbreak of 1400-1401 seems to be much more severe than the outbreaks of 1368-1369 and 1380-1382.[78]

A second factor used to explain diminished severity is linked to the notion that the population was so immunologically naïve that the Black Death killed indiscriminately.[79] This has been compared to research on recurring plague outbreaks which suggests a higher selectivity with regard to age and pre-plague health status. On the topic of age, bio-arche-

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74 Stephen Ell, 'Immunity as a factor in the epidemiology of medieval plague', *Reviews of Infectious Disease* 6:6 (1984) 866-879; Samuel Cohn, 'Epidemiology of the Black Death and successive waves of plague', *Medical History* s27 (2008) 74-100; Ann Carmichael, 'Universal and particular: The language of plague, 1348-1500', *Medical History* s27 (2008) 17-52.

75 Massimo Livi-Bacci, *A concise history of world population* (London 2001) 251.

76 Green, 'Editor's introduction', 19. For a full overview of issues of immunity to plague see: Crespo Fabian and Matt Lawrenz, 'Heterogeneous immunological landscapes and medieval plague: An invitation to a new dialogue between historians and immunologists', *The Medieval Globe* 1:1 (2016) 229-257.

77 Alfani and Murphy, 'Plague and lethal epidemics'.

78 For the Southern Netherlands, there is a strand of literature pointing to the potentially greater severity of the echo-epidemics of the later fourteenth century: Thoen and Devos, 'Pest in de Zuidelijke Nederlanden'; Alain Derville, 'La population du Nord au Moyen Age', *Revue du Nord* 80 (1998) 524-527; Etienne Helin, 'Les Pays-Bas', in: J.P. Bardet and J. Dupâquier (eds.), *Histoire des populations de l'Europe. 1: Des origines aux prémices de la révolution démographique* (Paris 1997) 413-424; Bernard Delmaire, 'Contribution à l'étude de la peste au bas moyen âge. Un fragment de compte inédit de l'abbaye de Warneton et de la région', *Mémoires de la Société de Comines-Warneton et de la Région* 11 (1981) 35-50; G. Sivéry, 'La Peste Noire et l'épidémie de 1400-1401'. However, this does not necessarily entail that the Black Death was therefore mild.

79 Sharon DeWitte and James Wood, 'Selectivity of Black Death mortality with respect to pre-existing health', *Proceedings of the National Academy of Sciences USA* 105:5 (2008) 1436-1441.

ological evidence suggests that the Black Death was selective towards adults with mortality risk increasing with age.[80] For subsequent plague outbreaks, however, this selectivity seems to have gone the opposite direction by affecting children to a disproportionate degree.[81] In the case of England or Florence, the second plague outbreak of the early 1360s is often labelled the 'plague of children'. However, according to Ann Carmichael, this may simply be due to a large baby-boom generation which dominated the population at risk a decade after the Black Death.[82]

Concerning pre-plague health status, research has suggested a connection between the Great Bovine pestilence, which resulted in the loss of normal dairy consumption for people born in this period, and the severity of the Black Death.[83] Bio-archaeological research has indicated that stress seen in late thirteenth- and early fourteenth-century Northwestern Europe may have created favorable conditions for a severe plague epidemic.[84] However, historical research on pre-industrial famines has not found a clear causal connection between famines and plague.[85]

Whatever the possible selective effects of recurring plague might have been with regard to age and health, there is research that suggests that the Black Death also had a selective impact despite causing mortality on a truly massive scale.[86] Unfortunately, the Hainaut database offers no direct information on health status or age. However, the database

80 Dominique Castex, 'Identification and interpretation of historical cemeteries linked to epidemics', in: Didier Raoult and Michel Drancourt (eds.), *Paleomicrobiology: past human infections* (Berlin 2008) 23-48; Sharon DeWitte, 'Age patterns of mortality during the Black Death in London, A.D. 1349-1350', *Journal of Archaeological Science* 37:12 (2010) 3394-3400.

81 John Hatcher, *Plague, population, and the English economy, 1348-1530* (London 1977); Ann Carmichael summarized the disagreement among historians about the age-selectivity plague: Ann Carmichael, *Plague and the poor in renaissance Florence* (Cambridge 2014) 90-93.

82 Ann Carmichael, 'Plague persistence in Western Europe: A hypothesis', *The Medieval Globe* 1 (2016) 157-192.

83 Sharon DeWitte and Philip Slavin, 'Between famine and death: England on the eve of the Black Death: Evidence from paleoepidemiology and manorial accounts', *Journal of Interdisciplinary History* 44:1 (2013) 37-60; Philip Slavin, 'The Great Bovine Pestilence and its economic and environmental consequences in England and Wales, 1318-50', *Economic History Review* 65:4 (2012) 1239-1266.

84 Sharon DeWitte and Gail Hughes-Morey, 'Stature and frailty during the Black Death: The effect of stature on risks of epidemic mortality in London, A.D. 1348-1350', *Journal of Archaeological Science* 39:5 (2012) 1412-1419; Sharon DeWitte, 'Setting the stage for medieval plague: Pre-Black Death trends in survival and mortality', *American Journal of Physical Anthropology* 158:3 (2015) 441-451.

85 Guido Alfani and C. Ó Gráda (eds.), *Famines in Europe* (Cambridge 2017).

86 Samantha Yaussy, Sharon DeWitte and Rebecca Redfern, 'Frailty and famine: Patterns of mortality and physiological stress among victims of famine in medieval London', *American Journal of Physical Anthropology* 160:2 (2016) 272-283.

does provide sex-disaggregated data for those who died so the potential difference in sex-selective mortality effects for the Black Death and re-curring plague can be analyzed.[87]

In 2009 Sharon DeWitte published a bio-archaeological study which found no conclusive sign that sex played a role in plague's potential discriminatory effect during the Black Death.[88] In a follow-up article, however, DeWitte offered a more nuanced hypothesis. Either the Black Death killed more men who were vulnerable due to prior physiological stress, or it killed more women who were otherwise healthy.[89] Two main limitations of previous research has limited the progress on this topic. First, sample sizes are usually small because bio-archaeologists are re-stricted to using a limited amount of skeletons from a limited number of burials sites. Historians on the other hand usually focus on the results from isolated case studies, making it difficult to discern broader pat-terns. Second there is the problem of ascertaining whether differences in mortality rates between sexes are caused by factors intrinsic to plague or the result of differential exposure.[90] In late medieval and early mod-ern Europe, women started migrating to the cities to a greater degree than men who remained in the countryside to work. Thus higher female mortality may be due to the disease ravaging urban localities.[91] What is needed to attain reliable results is data that can be compared over a long timespans between plague-years and 'normal'-years, as well as data be-yond individual burial sites to compare sex ratios in mortality between rural and urban environments. This is where the Hainaut database offers a unique insight as it provides sex disaggregated data over the course of a century for both countryside and city.[92] Figure 2 indicates the main plague periods from 1349-1450, the peaks in mortality they caused and the sex ratios (%). The figure shows that both the Black Death and most of the recurring plagues during the late Middle Ages had a ten-dency to kill more women than normal. This is represented by the fact that when a major plague occurred, there was an inverse relationship

87 Based on results from: Curtis and Roosen, 'The sex-selective impact of the Black Death'.

88 DeWitte, 'Age patterns of mortality during the Black Death'.

89 Sharon DeWitte, 'Sex differentials in frailty in medieval England', *American Journal of Physical An-thropology* 143:2 (2010) 285-97.

90 Elisabeth Carniel, 'Plague today', *Medical History* s27 (2008) 115-22.

91 Maryanne Kowaleski, 'Single women in medieval and early modern Europe: The demographic per-spective', in: Judith Bennett and Amy Froide (eds.), *Single women in the European past, 1250-1800* (Phil-adelphia 1999) 38-81; Sandy Bardsley, 'Missing women: Sex ratios in England, 1000-1500', *Journal of British Studies* 53:2 (2014) 273-309.

92 Curtis and Roosen, 'The sex-selective impact of the Black Death'.

Figure 2 Gender ratios in mortality (%) against overall mortality levels, Hainaut, 1349-1450
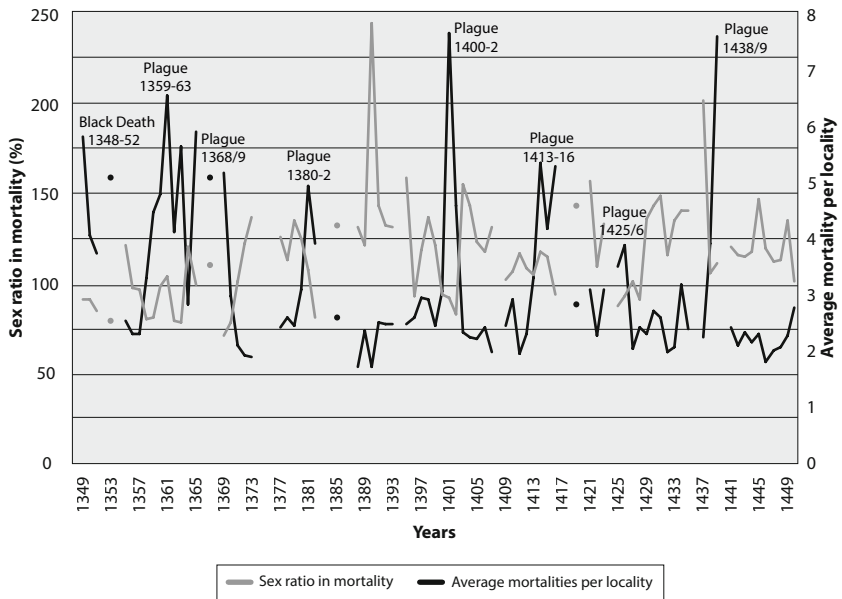
Source: ADN, B 12122-12226; ARB, I, 004, 17867-73.

with the sex ratio in mortality. The notion that the Black Death killed indiscriminately and that this effect changed in later plague outbreaks does not seem to hold for Hainaut, at least with regard to sex-selectivity.

A third and final factor is rooted in the assumption that the Black Death was a universal killer, hitting city and countryside in equal measure. Recurring plague, on the other hand, is seen as more selective and therefore less territorially pervasive,[93] with outbreaks often confined locally or regionally.[94] What happened in the period immediately after the Black Death is still largely unknown,[95] although according to Naphy and Spicer, 'the second outbreak and subsequent plagues differed in that it was more confined to urban areas'.[96] This assumption is

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93 Alfani, 'Plague in seventeenth century', 408.

94 Blockmans, 'The social and economic effects'. Mentioned for the fourteenth and fifteenth century plague by L.R. Poos, 'Plague mortality and demographic depression in later medieval England', *Yale Journal of Biology and Medicine* 54:3 (1981) 227-234.

95 For the early modern period the notion of plague as an exclusively urban phenomenon has been refuted for the Low Countries: Daniel Curtis, 'Was plague an exclusively urban phenomenon? Plague mortality in the seventeenth century Low Countries', *The Journal of Interdisciplinary History* 47:2 (2016) 139-170.

96 Naphy and Spicer, *The Black Death,* 34-35.

Figure 3   Average trend in mortmain dead compared to 'previous years' (%), urban and rural Hainaut, 1349-1450
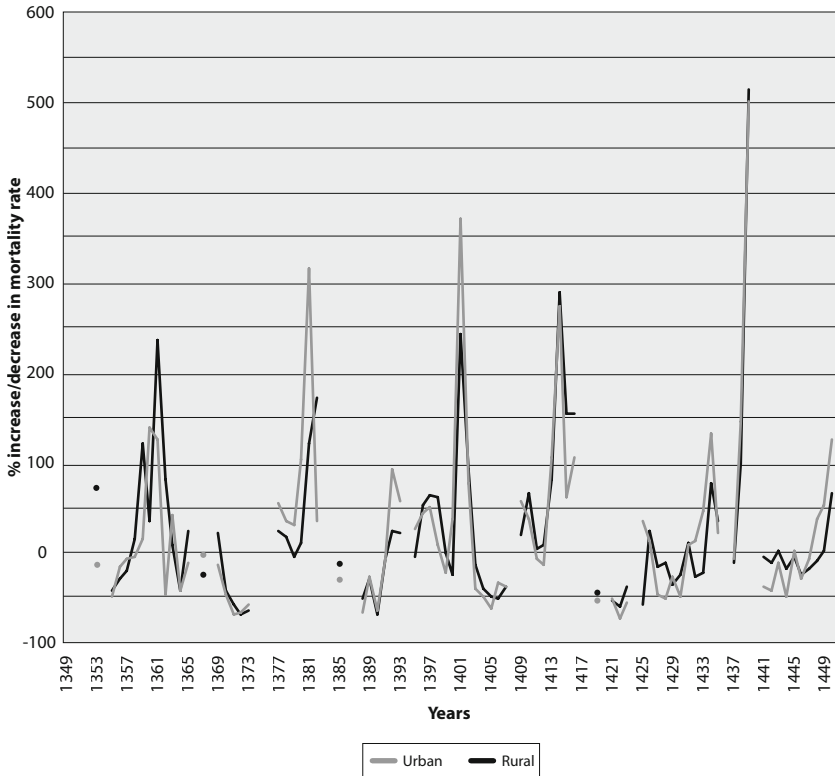
in line with a strong tendency of historians of European plagues to focus on data-rich environments, remaining unimpressed by patchy and problem-ridden evidence from rural hinterlands.[97] This has led to the common claim that plague became an almost exclusively urban phenomenon in (Southern) Europe by the fifteenth century.[98] Once again it seems that much of this assumption is based on the scarcity of data to systematically assert the 'universal' nature of the Black Death in contrast to later plague outbreaks. Using the Hainaut database to compare plague severity between rural and urban localities, it is possible to test this assumption. However, before turning to the analysis of the data, it

[97] Carmichael, 'Plague persistence', 161.
[98] For example in: Guido Alfani, *Calamities and the economy in Renaissance Italy: The grand tour of the horsemen of the apocalypse* (New York 2013) 257.

must be acknowledged that, within the context of the Low Countries, the County of Hainaut does not provide an ideal test case for comparing rural and urban plague activity. In 1400, 30 per cent of the people lived in an urban environment in Hainaut, compared to 31 per cent in Brabant, between 33-36 per cent in Flanders and 33 per cent in Holland. By 1500, Holland and Brabant had experienced an increase in urbanization rate, to 45 and 35 per cent respectively. In Flanders, however, there was a noticeable decline to 25 per cent, while Hainaut almost managed to attain a status-quo with an urbanization rate of 29 per cent.[99] Hainaut was therefore one of the least urbanized regions in the late medieval Low Countries. However, the Low Countries were one of the most urbanized parts of Europe, second only to northern Italy during the late Middle Ages.[100] Compared to the rest of Europe, Hainaut still provides a relevant case study for studying urban and rural plague dynamics.

Figure 3 separates urban and rural mortmain data. In order to accommodate for different aggregate mortmain figures between city and countryside and changing population levels across time, urban and rural data were separated by using an average increase/decrease in deaths compared to the moving average of previous years. Previous averages are calculated by skipping back a year and calculating the average of the five previous years (excluding highest and lowest figures). The mortmain figure in the year in question is then divided by the average of the previous years, multiplied by 100 with 100 subtracted. For the Black Death, no previous documents were available. However, the urban aggregate mortmain comes very close to that of the rural one (209 to 228) and it is possible that the Black Death had a greater impact on the cities than the countryside. Figure 3 shows that many of the key-medieval plagues had discernible mortality effects on the countryside, with trends similar to the cities.

Conclusion

Current knowledge regarding the severity and selectivity of late medieval plague is still limited, mostly due to the scarcity and disparate na-

99   Bas van Bavel, *Manors and markets: Economy and society in the Low Countries 500-1600* (Oxford 2010) 281-282.
100   Paolo Malanima, 'The economic consequences of the Black Death', in: Elio Lo Cascio (ed.)*, L'impatto della 'peste antonina'* (Bari 2012) 311-328.

ture of available sources seen throughout Europe. It is clear that certain datasets on Black Death mortality rates 'which have been widely used for spatiotemporal- and regression analysis' are unfit (for this purpose). A general revision of all pre-existing datasets by carefully checking mortality estimates against the actual content of available sources is necessary to ensure the continued and reliable contribution of historical data to the field of plague studies. However, this endeavour should go beyond reconstructing mortality rates for the Black Death, in fact, each widespread plague outbreaks that followed is deserving of the same amount of scholarly attention dedicated to the initial fourteenth century outbreak. This article has shown how a comparative study of plague severity, either across regions or across time, still has to contend with incomplete and flawed data.

Based on the Hainaut mortmain database, there are no noticeable changes in the selectivity of plague between 1349 and 1450. As such, certain assumptions on selective mortality effects can be refuted. In short, the narrative on selective mortality effects and diminished severity is not as black-and-white as some scholars argue. One possible explanation is that plague only became a 'selective' disease from the late fifteenth century onwards.[101] The assumed selectivity in mortality effects proposed by certain authors for the late medieval period might have been influenced by results for early modern plagues.

However, the findings of this article also have broader implications. In order to understand the diverging directions of socio-economic and demographic development seen after plague outbreaks,[102] it is vital to take into consideration the changing epidemiological characteristics of the disease over time.[103] It is therefore important to move beyond cemented assumptions to allow historical investigation to engage more fully with recent trends in plague ecology. With other sciences such as micro-biology and bio-archaeology becoming fully mature in their study of historical diseases, it is up to historians to insure their data(reliability) and methods mature at an equal rate. Future research will undoubtedly seek to incorporate the historical data, as the lack of long-term analysis is one of the major gaps in current disaster studies.[104] This

101 Campbell, *The Great Transition*, 351.

102 Robert Brenner, 'Agrarian class structure and economic development in pre-industrial Europe', *Past and Present* 70:1 (1976) 30-75.

103 Alfani and Murphy, 'Plague and lethal epidemics', 314.

104 Melissa Dell, Benjamin Jones, and Benjamin Olken, 'What do we learn from the weather? The new climate-economy literature', *Journal of Economic Literature* 52:1 (2014) 740-798; Bas van Bavel and

offers a great opportunity for the field of history, one we should face by applying rigorous critique and standards of interpretation to historical datasets but also to long-held beliefs and assumptions.

About the author

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Daniel Curtis, 'Better understanding disasters by better using history: Systematically using the historical record as one way to advance research into disasters', *International Journal of Mass Emergencies and Disasters* 34:1 (2016) 143-169.

Appendix

Sources and dataset

In section 3 of the article, it is mentioned that the number of districts (and as a direct consequence the number of localities) included in the mortmain accounts fluctuated over time. Map 2 below shows the distribution of rural- and urban localities as they appear in the accounts in the period 1349-1450. It illustrates how the heartland and the northern part of the County of Hainaut are better represented than the southern part. Urban localities have been indicated by name so they are easily distinguishable from the rural localities.

Figure 4 gives an indication of the total number of rural- and urban localities as well as the number of districts throughout the period 1349-1450.[105] We can clearly see a trend towards a higher inclusion of districts over time. During certain periods the right to levy mortmain in a specific district could be leased

Map 2 Map of the county of Hainaut with indication of rural localities and cities found in the mortmain documents, 1349-1450

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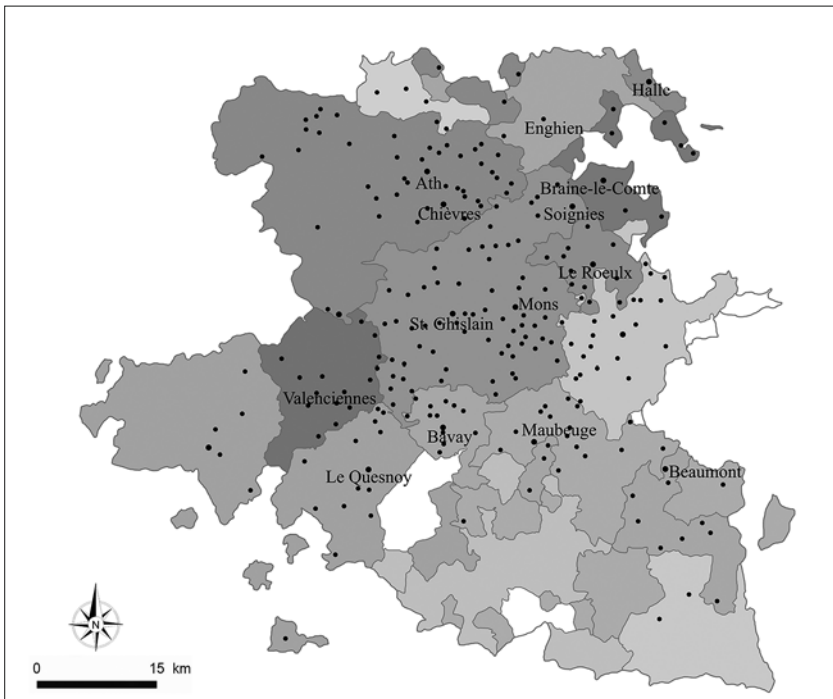
105   Because districts are clustered together at certain times without mention of the individual districts, their quantity is indicate through the number of rubrics in the accounts that illustrate the counts of a new district.

Figure 4 Number of rural and urban localities appearing in the mortmain accounts, 1349-1450
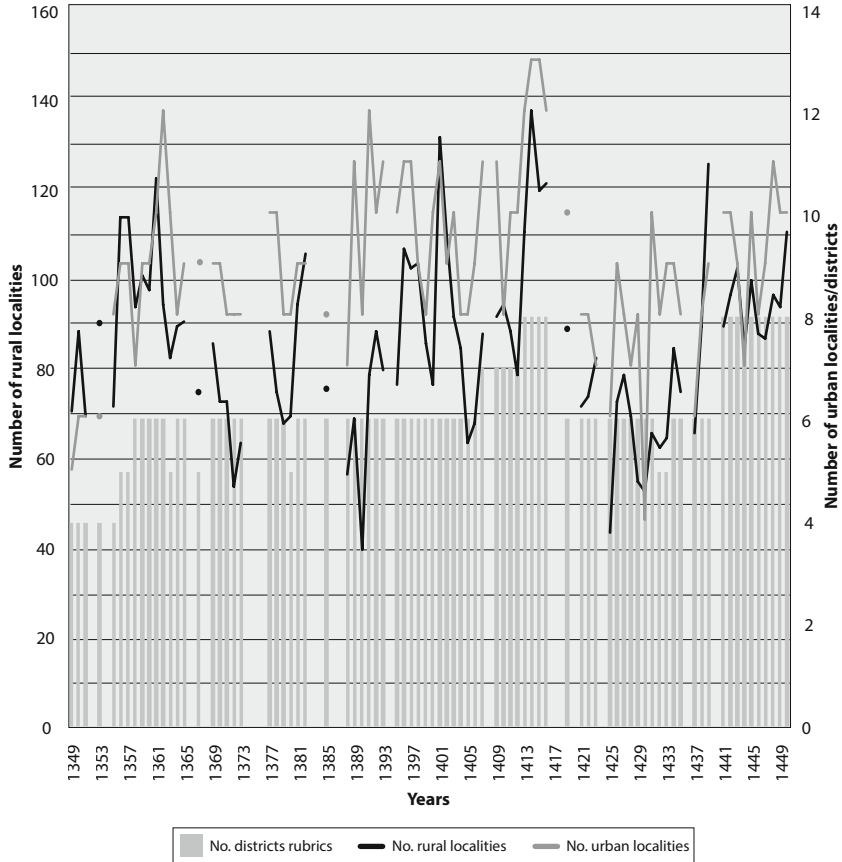
Source: ADN, B 12122-12226; ARB, I, 004, 17867-73.

out, this explains (in part) the fluctuations in the number of districts. The most common pattern is that plague years not only cause higher mortality in localities that are ever-present in the accounts, it also causes low-population (or localities where the population subject to mortmain is low) localities to appear in greater numbers. These are localities that, in 'normal' mortality years, do not show a death in every single account, hence they are not ever-present. The increase in the number of (especially rural) localities during plague years has a direct impact on the representation of plague severity in figure 1. Because this figure calculates mortality over the number of localities, the actual severity may be underestimated. This is the result of the high number of localities that are present in these years that are not ever-present in 'normal' mortality years. The total number of deaths are therefore divided by a much larger group of localities. However, the increase in localities is in itself a sign of widespread mortality and thus a fac-

Table 3 Estimated coverage of mortmain, 1406

		Estimated total population			
		Multiplier 3.5	Multiplier 4	Multiplier 4.5	Multiplier 5
Total hearths*	4861	17013,5	19444	21874,5	24305
5y avg. mortmain**	96.4				
Estimated coverage of mortmain for 87 localities		**Mortality 3%**			
	Coverage % mortmain	595,5	680,5	765,6	850,7
		16,2	14,1	12,6	11,3
		Mortality 3.8%			
	Coverage % mortmain	646,5	738,9	831,2	923,6
		14,9	13	11,6	10,4
		Mortality 4%			
	Coverage % mortmain	680,5	777,7	875	972,2
		14,1	12,4	11	9,9

*   *M.A. Arnould,* Les dénombrements.
** *The 5 year average of the following years in the mortmain accounts were used: 1404, 1405, 1406, 1407, 1409 (no data for 1408). Archives Départementales du Nord, Lille B, 12165-12171.*

Table 4 Estimated coverage of mortmain, 1444

		Estimated total population			
		Multiplier 3.5	Multiplier 4	Multiplier 4.5	Multiplier 5
Total hearths*	6863	24020,5	27452	30883,5	34315
5y avg. mortmain**	136.2				
Estimated coverage of mortmain for 110 localities		**Mortality 3%**			
	Coverage % mortmain	840,7	960,8	1080,9	1201
		16,2	14,2	12,6	11,3
		Mortality 3.8%			
	Coverage % mortmain	912,8	1043,1	1173,6	1303,9
		14,9	13	11,6	10,4
		Mortality 4%			
	Coverage % mortmain	960,8	1098	1235,3	1372,6
		14,2	12,4	11	9,9

*   *M.A. Arnould,* Les dénombrements.
** *The 5 year average of the following years in the mortmain accounts were used: 1442, 1443, 1444, 1445, 1446. Archives Départementales du Nord, Lille B, 12208-12212.*

tor of plague epidemics. In any case, it does not influence the conclusion made in section 4 that the 1400-1401 plague outbreak was more severe than several previous plague waves. The number of localities in 1400-1401 is higher than at any point in the fourteenth century and still the severity is noticeably elevated.

Estimates coverage of mortmain accounts
In an effort to analyse the importance of the Hainaut mortmain accounts relative to the total population in the County of Hainaut, I present an estimation of the coverage. In correspondence with the available hearth counts, a coverage has been calculated for 1406 and 1444.[106] The calculations below are based on a number of assumptions which will be explained more in-depth in the final section of this appendix. Most important are the average size of hearths (expressed as a multiplier) and the average mortality during 'normal' years (expressed as a percentage of total population).

Tables 3 and 4 use the following method to calculate the coverage. (1) First they take the absolute number of hearths for those localities that appear both in the mortmain account and in the hearth count. (2) Next, a multiplier ranging from 3.5 to 5 is applied to calculated the total population represented by the hearth counts for these localities. (3) Based on these results we attain a number that indicates the 'estimated total population' of those localities. These differ according to the average hearth size (multiplier) that has been applied. (4) The following step is to calculated the average mortality using 'normal' mortality rates of 3, 3.8 and 4 per cent. (5) This results in the number of people that likely died during the year in which the hearth count was performed based on the assumption that it was a year showing average mortality. (6) Based on the mortmain accounts, a five year average is calculated of the people that died in the selected localities, the corresponding hearth count year is used as middle value for this calculation. This has been done to insure that any outliers specific to one single year are removed from the calculations, thereby providing an estimate of the average mortality. (7) This result is compared to the total number of deaths attained by the previous calculation to arrive at a percentage that indicates the likely coverage of the mortmain accounts in the recorded localities. The calculation is represented schematically below.

$$\frac{Mortmain\ 5y\ avg}{(HearthCount\ *\ multiplier)\ *\ avg\ mortality\ \%} = est\ coverage\ \%$$

Based on the calculations, the overall coverage of the mortmain is very similar for 1406 and 1444, between 10 and 16 per cent. However, the sample is

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106   M.A. Arnould, *Les dénombrements de foyers dans le comté de Hainaut (XIVe-XVIe siècle)* (Brussels 1956) 771.

not completely constant as the number of localities that were registered in the mortmain accounts fluctuated over time. Overall, there were 72 overlapping localities for both years.

Information regarding hearth size and mortality rate
This section provides further information regarding the average size of a hearth and the 'normal' mortality rate that have been used in the calculation of the coverage of the mortmain accounts.

Average size of hearth
In his study on medieval overpopulation in France and the Low Countries, Norman Pounds employed a multiplier of 5 on the assumption that the resulting total would be large enough to cover the classes excluded from hearth surveys.[107] This multiplier also seems to fit the data for rural population in other parts of Europe.[108] In a later publication by Pounds and Roome, it was explained that such a multiplier would cover both successful attempts at evasion and those classes which were exempt from the hearth tax: the nobility, the clergy, and the homeless, wandering poor.[109] However, in using this multiplier, Pounds did not differentiate between countryside and town. He did indicate that it perhaps underestimated urban population and, more likely, overestimated rural population. Pounds himself admitted that a multiplier of 4 might in fact be closer to reality for the countryside.[110] A multiplier between 4 and 5 has been put forth for northern France. For the Artois countryside, Bocquet proposed a multiplier of 4.5 for 1469.[111] Maurice Arnould, who studied the hearth counts for Hainaut proposed a multiplier of 4.5 for rural hearths in 1540/1.[112] However, lower multipliers have also been proposed in the literature, for instance Russell preferred a multiplier of 3.5 for hearths,[113] and the same figure was proposed by Alain Derville for rural hearths in northern France around 1300.[114] It should be noted that there is a degree of artificiality in choosing a fixed multiplier. As Pounds pointed out, it is probable that the

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107   N.J.G. Pounds, 'Overpopulation in France and the Low Countries in the Later Middle Ages', *Journal of Social History* 3:3 (1970) 225-47.

108   Roger Mols, *Introduction à la démographie historique des villes d'Europe du XIVe au XVIIIe siècle*, vol. I (Louvain 1954) 69-70.

109   N.J.G. Pounds and C.C. Roome, 'Population density in the fifteenth century France and the Low Countries', *Annals of the Association of American Geographers* 61:1 (1971) 116-130.

110   N.J.G. Pounds, 'Overpopulation in France and the Low Countries', 230.

111   A. Bocquet, *Recherches sur la population rurale de l'Artois et du Boulonnais pendant la période bourguignonne (1384-1477)* (Arras 1969) 197.

112   M.A. Arnould, *Les dénombrements,* 292.

113   J.C. Russell, 'Late Ancient and Medieval Population', *Transactions of the American Philosophical Society* 48:3 (1958) 152.

114   Alain Derville, 'La population du Nord au Moyen Age: Avant 1384', *Revue du Nord* 80:326 (1998) 501-530.

average size of a hearth tended to fluctuate quiet considerably during the late Middle Ages.[115] For example, Jan Dumolyn claims that after a period of scarcity, famine and epidemic disease the multiplier should be lowered.[116] This is why the calculated coverage of the mortmain accounts used multipliers ranging from 3.5 to 5 when estimating the total population.

Mortality rate

The tables below give a brief overview of the mortality rates that have been proposed in the literature for the Southern Netherlands during the late medieval period. Because the hearth counts for Hainaut only contain rural localities, the choice was made to use the mortality rates for rural settings.

Table 5 Average mortality rate

Period	#/1000	Region
Late 14th-early 15th century	40-50	Land of Aalst
End 15th century	30-35	Land of Aalst
Ancien Régime (general)	25-30	County of Flanders

Source: Erik Thoen and Isabelle Devos, 'Pest in de Zuidelijke Nederlanden in de Middeleeuwen en de Moderne Tijden. Een status quaestionis over de ziekte in haar sociaal-economische context,' Medisch historische beschouwingen 650 jaar na de Zwarte Dood. Vierde symposium der geneeskundige wetenschappen *(1999) 20-43.*

Table 6 Average mortality rate (urban vs rural)

Period	#/1000	Region
1395-1423	38	Land of Aalst
1395-1423	47	City of Ronse

Ibidem.

Table 7 Average mortality rate per period

Period	#/1000	Region
1395-1404	51.7	Land of Aalst
1405-1414	30.8	Land of Aalst
1415-1425	34.1	Land of Aalst

Source: Erik Thoen, Landbouwekonomie en bevolking in Vlaanderen gedurende de late middeleeuwen en het begin van de moderne tijden. Testregio: de kasselrijen van Oudenaarde en Aalst (eind 13de-eerste helft 16de eeuw), *vol I (Ghent 1988) 77.*

115 N.J.G. Pounds, 'Population and settlement in the Low Countries and Northern France in the later Middle Ages', *Revue Belge de Phililogie et d'Histoire* 49:2 (1971) 369-402.

116 Jan Dumolyn, 'Population et structures professionnelles à Bruges aux xive et xve siècles', *Revue du Nord* 91:329 (1999) 43-64.