

EHES Working Paper | No. 206 | January 2021

Violence in the Viking World: New  
Bioarchaeological Evidence

Joerg Baten,  
University of Tübingen

Giacomo Benati,  
University of Tübingen

Anna Kjellström,  
University of Stockholm

## Violence in the Viking World: New Bioarchaeological Evidence\*

Joerg Baten<sup>1</sup>,  
University of Tübingen

Giacomo Benati,  
University of Tübingen

Anna Kjellström,  
University of Stockholm

### Abstract

Vikings – the Scandinavian seafaring populations that dominated the North Seas between the eighth and eleventh centuries CE – are usually described as pirates and warriors living in a highly aggressive society. But was this really the case? How violent were the Vikings among themselves? In this study, we compare the share of cranial trauma and weapon wounds that we can observe for several skeletal samples of Scandinavian societies with other European medieval populations (excluding military and warrior populations). This is the first time that Viking violence can be empirically compared with a standardised European sample of 2,379 skeletons. We find that Scandinavian rural and urban communities were characterised by remarkably low levels of interpersonal violence, relative to other Europeans. Given the lack of strong centralisation of states, police deterrence mechanisms and low literacy, the best possible explanation for this pattern may be found in the relatively high gender equality that characterised Viking rural communities – as attested by significant health levels of female skeletal remains, relative to males. Low population density, specialisation in cattle farming and extensive grazing entailed a more significant role for women in household economies. This, in turn, may have had an ameliorative effect reducing the motivation for violence in general. This discovery adds empirical evidence to recent literature in criminology and gender economics, indicating a nexus between gender inequality and homicide rates. We provide new explanations on how societies have solved the problem of violence and open new avenues of research on the use of archaeological proxies for addressing important topics in societies today.

JEL Codes: N00, N13, N33

Keywords: violence, early medieval, state formation, gender equality, vikings, Scandinavia

<sup>1</sup> Corresponding Author: Jörg Baten [joerg.baten@uni-tuebingen.de](mailto:joerg.baten@uni-tuebingen.de)

\*For excellent research assistance, we thank Sabrina Küspert and Larissa Zimmermann. For financial support, we thank the DFG (grant SFB 1070, subproject B06).

### Notice

The material presented in the EHES Working Paper Series is property of the author(s) and should be quoted as such. The views expressed in this Paper are those of the author(s) and do not necessarily represent the views of the EHES or its members

## Introduction

Popular accounts, fictional works and historical records usually show Vikings – the Scandinavian seafaring populations that dominated the North Seas between the eighth and eleventh centuries CE – as brutal pirates and ruthless warriors living in a highly aggressive society (Brink 2008). Given these assumptions, this study aims to analyse the question of how violent the Vikings were in reality.

To answer this question, we compare the share of cranial trauma and weapon wounds that we can observe for several samples of Scandinavian and Baltic societies with other European medieval populations. This allows us to assess the level of violence. We define violence here as extreme physical force exercised on persons resulting in substantial health loss or death (compare for a compatible definition: Simpson et al. 1989). Cowen (2004) uses a similar definition of violence when quantifying the Vikings' external violence. However, in contrast to Cowen, this paper concentrates on the assessment of internal violence of Scandinavians amongst themselves. This is the first time that Nordic interpersonal violence is empirically compared with a standardised European sample of 2,379 skeletons (on the latter, see Baten and Steckel 2019; Steckel et al. 2019 and a summary of results in Baten et al. 2019; on the Scandinavian violence level, see Kjellström 2014 and 2017).

We find a relatively low level of interpersonal violence (a similar tendency has been shown by Arcini 2018), which is certainly at odds with the popular image of Vikings today, who allegedly not only performed violent activities in the North Sea and Atlantic Coast countries but also among themselves. Our bioarchaeological evidence can contribute to partially correcting this idea. However, in contrast to earlier studies, our study is the first to empirically compare Scandinavian violence with a standardised European sample. In this study, we will not assess Viking violence in other regions related to their plundering and invasion activities, but we

concentrate only on the interpersonal violence in their home regions. Both in the Nordic sample and the European comparison sample, warriors and military graves were excluded (on higher trauma rates among Scandinavian and European warriors, see Appendix A)<sup>1</sup>. In the following, we will speak of ‘Scandinavian’ or ‘Nordic’ instead of ‘Viking societies’, as the focus will be on interpersonal violence of the whole Nordic population, not only of the seafaring ‘Viking’ populations that gave this period its name.

The result that interpersonal violence is low in Nordic societies is not only astonishing because of the contrast to the popular image today, but it is also puzzling because Scandinavian society was not strongly urbanised and centralised. In general, bioarchaeological studies mostly have observed low internal violence levels in cultures that were heavily urbanised and had developed state and policing capabilities (North, Wallis and Weingast 2009). For example, Bronze Age Mesopotamian states had relatively low internal violence levels compared to neighbouring polities located in the Anatolian, Iranian and Levantine regions (Sołtysiak 2015; Erdal and Erdal 2012; Cohen et al. 2012). This low internal violence contrasts with the violence they showed against their military enemies (Benati and Guerriero 2020; Richardson and Garfinkle 2020). Similarly, Steckel and Rose (2002) find that Central American polities such as the Mayas and Aztecs were the least violent internally on the American continents, despite a gruesome culture of human sacrifices and war orientations towards outside populations. In contrast, the equestrian tribes of the North American Plains represented the most violent societies of the Americas that have been documented so far. Baten and Steckel (2018) point out that within Europe, the region of today’s Netherlands and the German North Sea coast was the least

---

<sup>1</sup> Here we focus on internal, non-military violence. Moreover, another reason for this exclusion is that it is impossible to identify the correct share of the population with which military graves should enter the data set – relying on the randomness of excavation shares would certainly introduce substantial measurement error.

violent. The Frisian polities of the Early Medieval Period in today's Netherlands were among the earliest trading economies, and they developed some policing capabilities early on to support their trade against pirates (Jellema 1955). Moreover, Baten and Steckel (2018) find that the decline of violence began in urban sites in Europe.

At first glance, none of these characteristics – high urbanisation, state capability, monopoly of violence, policing activities of the state – apply to Scandinavian societies. Why were rural Scandinavians then relatively non-violent among themselves? We argue that one additional factor that distinguishes Norsemen society from any other low-urbanisation-high-violence society is the unusually high level of gender equality. This can be identified using the relative enamel hypoplasia values of women and men, and it can be confirmed with other archaeological and historical evidence (such as the relative height).<sup>2</sup> The underlying reason for the high gender equality is a specialisation in cattle agriculture in which women contributed substantially to household income, as Maravall and Baten (2019) argued.

Why would high gender equality lead to lower internal violence? One reason could be that women have a comparative disadvantage in interpersonal violence, given their usually more modest upper body strength and lower height average, relative to males. Hence, they would demand more non-violent settling of disputes if the overall gender equality of the society enabled them to realise this. One important point to note is that we do not argue that Viking society was not patriarchal in general. Several scholars have argued that Viking society was strongly patriarchal with a prevailing warrior ideal (Raffield et al. 2017). However, we do argue that the

---

<sup>2</sup> Additionally, Baten and Steckel (2018) also observed relatively low levels of violence in other Baltic (Lithuanian) samples. The Baltic region was strongly influenced by Scandinavian traders and settlers during the Early Medieval Period.

health status of women was relatively better than in other societies, which suggests that Scandinavian society was substantially less patriarchal than other societies of the time. Indeed, recent work on the nexus between gender inequality and homicide rates in modern societies highlighted that a more equal standing of women in society seems to be connected to a general lowering of interpersonal violence (Heirigs and Moore 2018).

The paper is structured as follows: In section 2, we present the main indicator that we use to estimate the levels of interpersonal violence in European societies based on bioarchaeological data, and we provide a critical evaluation of this approach. In section 3, we compare the evidence about interpersonal violence from the Scandinavian areas in the Viking Age with that of other European countries. In section 4, we review the main potential determinants for interpersonal violence and evaluate whether they could explain cross-sectional differences in Medieval Europe. Moreover, we focus on the nexus between specialisation in cattle breeding and gender equality to explain the low levels of interpersonal violence discovered in the rural Scandinavian samples. In section 5, we summarise our main findings and conclude by proposing further avenues of research for understanding the role of interpersonal violence in human societies.

## **2. Bone Trauma and Indicators of Violence**

Our main measure of violence is the share of individuals with sufficiently well-preserved skeletal remains that present evidence of weapon-related wounds or cranial trauma. We compare the three non-military sites of Birka, Sigtuna and the Mälaren Valley discussed in Kjellström (2014, 2017). Moreover, we study a sample from the Baltic region that was under Scandinavian cultural influence (Baten and Steckel 2019). We compare this Scandinavian evidence with a European comparison sample (see Baten and Steckel 2019; Steckel et al. 2019). Our European

comparison dataset consists of information about traumata that was collected by a large anthropological team who coded the evidence by observing indicators of trauma and noting which bones were affected (Steckel et al. 2019; Baten et al. 2019). We focus on building the main indicator by counting the number of cranial traumata and weapon wounds relative to the total number of skeletons (following Baten and Steckel 2019). The three categories of skull trauma – sharp, blunt, projectile – were merged into one for our purpose. Postmortem traumata were excluded (see below).

Cranial trauma and weapon wounds are obvious indicators of some components of overall violence. As a caveat, we should mention that the level of violence cannot, however, be assessed comprehensively by this measure because not all weapon wounds leave marks on bones (in the following sections, see Baten and Steckel 2019). For example, lethal wounds to soft tissues, like a stab wound in the stomach, may not result in cut marks on bone surfaces, whereas other forms of killing, for example, poisoning, would not cause bone trauma at all. Assessing the level of violence by the occurrence of cranial trauma or bone marks is further complicated by the existence of both defensive and offensive weapon technology. For victims killed with some weapons such as a wooden stick instead of others such as a sword, it might be difficult to distinguish intentional violence from accidental trauma, especially if postcranial parts of the skeleton are affected. Baten and Steckel (2019) account for the omitted methods of killing by comparing cranial trauma and weapon wounds with other indicators, namely homicide, regicide (the killing of kings) and nobilicide (the killing of noblemen), for which they found very similar trends and cross-sectional differences. These other proxies of human violence include killing

with poison, stomach stabbing and so on.<sup>3</sup> The correlation between cranial trauma evidence, which covers many regions of Europe over the period of 300 to 1900 CE, and the homicide/regicide data is remarkably narrow; hence, we can rely on the correlation between these indicators for the purpose of this analysis (see the scattergram in Appendix B).

The special case of cranial trauma has been identified as very often being a result of interpersonal violence or inter-societal conflicts (Walker and Thornton 2002; Cohen et al. 2012). When Krakowka (2017) analysed skull trauma in comparison with the coroners' reports for the medieval city of London, she found that a large share of all homicides is directly related to skull trauma.<sup>4</sup>

Following Wahl and Zäuner (2015), several aspects need to be taken into account when proxying violence with evidence of trauma: (1) The skeletal sample studied for the population who lived at that time should be examined to ensure representativeness. In this respect, the collected data should not be from special cemeteries (such as elite cemeteries) or be otherwise unrepresentative of the population that one seeks to accurately reflect. (2) Survival biases of bones and trauma signs need to be considered since it may be the case that only a selection of

---

<sup>3</sup> But while the evidence on general population homicide is only available from the thirteenth century onwards for a few cities in Europe, the evidence on regicide and nobilicide only covers elite groups of the population.

<sup>4</sup> Another part of the body where marks on bones are likely to be caused by violence are the forearms, and in particular, so-called parry fractures (Judd 2008). These fractures mainly occur on the left ulna because the majority of the population would attack using their right arm while victims would defend the attack from violating their head by raising their left arm (Judd 2008). Parry fractures are often mentioned in bioarchaeological textbooks as a potential indicator of interpersonal violence, but they have not yet been quantitatively studied for large regions and time periods (Baten and Steckel 2019). Unfortunately, we were unable to use this indicator in our study because the exact location of fractures of the left ulna was neither recorded for most of the skeletons in our European comparison dataset nor in the Scandinavian data (for the whole set of criteria, see Judd 2008). One disadvantage of using parry fractures as a violence indicator is that falls may mimic true parry fractures (Judd 2008).

bones, and therefore trauma evidence, survived until the excavation. Especially in soils in which bone may decompose quickly, the signals of trauma cannot be identified in poorly preserved remains. Trampling behaviour of animals and a large number of other taphonomic agents that destroy bone also need to be taken into account because in this way large animals could have destroyed bones that were buried close to the surface. (3) Trauma needs to be differentiated into antemortem, perimortem or post-mortem, with the most important distinction being between the latter two because postmortem trauma does not indicate interpersonal violence but damage to the skeleton after death. As postmortem traumatic lesions can sometimes seem to be caused by perimortem violence, researchers – albeit with some measurement errors – identify postmortem damage by the amount of collagen of the bone that was already lost at the time of the fracture (Steckel et al. 2019). Postmortem fractures, often different in colour from the undamaged surface of the bone, tend to propagate at right angles to the bone surface, but perimortal trauma occurs at an oblique angle (Walker 2001).

(4) Some causes of death, such as poisoning or soft tissue wounds, do not leave marks on the bones (as discussed above, see Wahl and Zäuner 2015). (5) Finally, violent trauma has to be differentiated from accidental trauma. For this latter issue, the ‘hat brim line rule’ is one example of a suitable strategy to assess cranial trauma (Wahl and Zäuner, 2015),<sup>5</sup> and similar strategies exist for other parts of the human body.

Concerning Wahl and Zäuner’s (2015) first remark, the European comparison skeletal sample used in the study covers European regions very extensively and quite representatively, and the underlying evidence has been studied using a consistent methodology (Steckel et al.

---

<sup>5</sup> However, to discriminate between falls and blows in modern settings, similar blunt force trauma needs to be combined with other criteria associated with soft tissue and post-cranial injury patterns (Kremer & Sauvageau 2009; Guyomarc’h et al. 2010).

2019). Trauma evidence from skeletons from more than 70 sites in all European regions is included in the sample of Steckel et al. (2019). To minimise regional selectivity biases, Steckel et al. ensured that sites from all European regions across all main time periods were included and a diversity of topographical features (sites located at the coast and in the interior, for example), as well as a representative urban/rural composition, were secured. To account for social selectivity biases, they included skeletons from burial sites that covered as completely as possible whole villages or city populations, rather than elite burials or cemeteries for the poor. Burial sites with military specialisation, such as battlefields, were excluded. We applied the same method to the Scandinavian example by excluding one mass grave in Sigtuna that probably had a special conflict background. The Scandinavian evidence also covers rural as well as urban Nordic people of the Viking Age, and it is not socially limited to elites. We have to admit that, regionally, Central Sweden is covered, but this can be considered one of the core regions of Viking Scandinavia.

One potential issue for the case of Viking Age Scandinavia could be that we lack information about the social status of human remains that were buried after cremation. However, Matthias Toplak studied burial customs of Viking Age samples intensively and reported that a bias due to cremation versus body burial is unlikely.<sup>6</sup> Although we still do not know much about potential differences between individuals who were buried and those who were cremated, Toplak argues that any differences between buried and cremated individuals were rather small (see also Toplak 2017, 2020). He states that there is no evidence that the two groups did not come from the same underlying social group. His argument is based on an enormous amount of grave goods and other indicators, which he has analysed, that characterise the social status of both cremated

---

<sup>6</sup> We thank Matthias Toplak for the friendly communication.

and uncremated individuals. Burial customs were practised within the same society, within the same burial ground, and sometimes even within the same individual burial site (see also Arcini 2018). Some of the Viking Age Scandinavians were partly cremated and partly buried. The only potential difference that was identified as a determinant of the decision between a cremation and full-body burial was Christianisation – based on originally Jewish burial customs (that demanded an inhumation burial). Nevertheless, long before large-scale Christianisation took place, inhumation burials were customary in Scandinavia. Moreover, there were also inhumation burials of individuals who were non-Christian (Toplak 2017, 2020). At the same time, during the period of Christianisation, there were still cremations – partly even on Christian burial sites. Hence, Christianisation can only be regarded as one and not the only potential determinant. Using the case study of Gotland, another argument of Toplak is that during periods of uncertainty, both Christian and non-Christian Scandinavians considered it important to have their ancestors close to themselves in an uncremated form. The dead bodies served as metaphysical protection and a symbolic anchor as a signal of owning land and having a legitimised claim to it. Toplak argues that this makes particular sense because nomadic cultures often used cremation, whereas non-nomadic cultures more often used inhumation burial (Toplak 2020). Hence, we do not regard the lack of information on social status in our data as a relevant challenge to our analysis but recognise its representativeness.

On the Wahl and Zäuner (2015) issue (2) of survival of bones bias, Baten and Steckel (2019) use the level of bone preservation to assure that this issue does not generate bias. The cranial trauma share is calculated for skeletons for which at least 75% of the cranial vault was preserved. In other words, they included only evidence for which sufficient bone of the skull was available to calculate the rates. For the Scandinavian samples, the three samples of Sigtuna,

Birka and Mälaren Valley (all total samples) are inclusive (i.e. a crude prevalence; all skeletons are included without selecting by preservation status). We will see that this does not affect the results, as the upper limit of Scandinavian violence is also lower than in any European comparison region except Switzerland. Moreover, the osteological paradox could play a role, which implies that if premortem violent trauma cumulated over the lifetime of an individual, the populations of these individuals with higher life expectancies would look more violent (Wood et al. 1992). However, in our case, Scandinavian populations had one of the highest health levels, based on enamel hypoplasia and height indicators (that tend to correlate with life expectancy; see Baten and Komlos 1998), in the samples included here. Hence, any potential bias would have exaggerated their violence level, not that of the European comparison populations (Maravall and Baten 2019). In other words, if this bias would apply, this would strengthen our argument below that Scandinavian interpersonal violence was lower.

Moreover, on (3) the issue of postmortem violence, perimortem trauma was already carefully distinguished from postmortem damage by the team of bioarchaeologists who collected and coded the data.

For the potential neglect of some causes of death that do not leave obvious marks on wounds (4), we can rely on the correlations of our indicator of trauma and weapon wounds with other indicators of violence, such as homicide, regicide and nobilicide, as mentioned above. Finally, (5) on the distinction between violent and accident trauma, the study of Baten and Steckel (2019) calculated the correlation between (a) the share of violent trauma above the hat

brim line and (b) the share of all cranial trauma.<sup>7</sup> Given that the correlation was strong for the large European sample, we would expect the same for our Scandinavian sample. In sum, the potential biases of bone survival, postmortem trauma, other killing methods and accident trauma are not likely to apply to our comparison of Nordic, Baltic and other European violence.

In conclusion, the often violence-related cranial traumata, as well as weapon wounds, are now an established research instrument to assess the differences in interpersonal violence between time periods, regions and groups. Although other parts of the body may show marks as well, according to earlier studies, the likelihood that these were caused by violence is lower than that of the former. Lower limb trauma, for example, is one of the most frequent traumata of all but often the result of accidents rather than of violence (Merbs 1989; Goodman and Martin 2002).

### **3. Evidence on Nordic and other European Early and High Medieval Violence**

Our evidence on the Northern European regions is representative of the core Viking area of Central Sweden (Table 1). Moreover, the Baltic region is also represented. We focus on comparing the trauma share encountered in the Scandinavian skeletal sample, dating from the Early and High Medieval Periods, with a cross-section of European countries (Switzerland, UK, Hungary, Germany, Austria, France, Poland, Portugal, Ukraine and Romania) that cover the same time periods of the Early and High Middle Ages. We organised the data according to sites

---

<sup>7</sup> Baten and Steckel (2018) follow Kremer et al. (2008) with regard to the distribution of traumata below and above the hat brim line. The latter argued that cranial trauma located above the hat brim line – the line where an imagined hat brim touches the head – is probably caused by violence that more often affects this part of the skull (the parietal or the frontal bones). Accordingly, accidents, such as falling, are more likely to cause cranial trauma below the hat brim line (Kremer et al. 2008). Baten and Steckel (2019) found a close correlation between violence evidence based on the hat brim line rule and all cranial trauma (see the scattergram and the correlation coefficient in Appendix B).

located within countries defined by modern country boundaries. This sample totals 2,379 European comparison cases.

For the Scandinavian sample, the first part of data was collected from the Mälaren Valley in Sweden, which represents a rural region (Table 1). This sample comprises 136 individuals from burials excavated across the rural Mälaren Valley and dating mostly from 700–1050 CE (Kjellström 2017: 197, Fig. 1). Secondly, the important urban site of Birka produced a sample of 245 skeletons dating ca 750–950 CE (Kjellström 2017: 197). Birka was a trading settlement located on the island of Björkö, in Lake Mälaren, and the skeletal sample reflects a heterogeneous group of people in a proto-urban setting specialising in international trade (Kjellström 2017: 197). Moreover, another urban sample reflects the violence situation in Sigtuna, representing a sample of 267 cases (Kjellström 2014).<sup>8</sup> Sigtuna was the second urban site in Sweden at the end of this period. From the total sample, we needed to exclude the mass grave (19 cases), as a military background could be assumed (otherwise, the sample would have been 286 cases).

Another interesting region for this study is the Baltic due to the strong Scandinavian cultural and partly settlement influence. The sample of Steckel et al. (2019) includes a collection of 88 Baltic skeletons, thanks to the excellent work of Jankauskas and his team.

The comparison data for this study have been collected from a large number of European sites and reflect time periods of the Early Middle Ages and High Middle Ages (Table 1). Evidence was observable for 2,415 crania, which had at least 75% of the cranial bones preserved. For weapon wounds, we use the same preservation criterion. However, postcranial weapon

---

<sup>8</sup> Although the Sigtuna materials were included in the ‘Backbone of Europe’ study, the violence variable was not coded in Baten and Steckel (2019).

wounds were relatively few. We include both healed and unhealed (antemortem and perimortem) cranial trauma, as both indicate violence. Postmortem traumata were excluded from our data set.

Most of the individuals in the European comparison sample date to the Early Medieval Period (74.8%).<sup>9</sup> The High Medieval Period is represented by a share of 25.2%. As to representativity of the sample, there are roughly equal shares of people buried at archaeological sites in North-Eastern Europe, North-Western Europe, and Central and South-Eastern Europe; only the South is somewhat underrepresented (Table 1). Of the sample, 47.3% was female; hence, the female deficit is observable but not very strong. Roughly 11.8% of the data come from people buried in urban areas and the others from rural contexts, which indicates a modest oversampling of urban places, as the European population in this period was slightly less urban (Koepke and Baten 2008).

Notably, the most striking pattern that emerges by comparing the trauma share from the Scandinavian skeletal sample with that from the other European sites is the extremely low level of traumata in the Viking skeletons – ranging from 0.7% share in the Mälaren Valley skeletons to 1.2% in the Birka sample and 2.1% in the Sigtuna case.<sup>10</sup> Also, the Baltic/Lithuanian region (0%) is an interesting case of low violence, because the Baltic region was strongly influenced by Scandinavian – and Viking – culture and society. Comparably low levels of cranial trauma are attested only in the samples from Switzerland (0.6%) and the UK (2.1%). All the other regions are characterised by trauma shares ranging from 3.1% (Hungary) to 14.3% (Romania). In total, between 0.6% and 14.3% of the people in the European comparison dataset had cranial trauma

---

<sup>9</sup> In our study, the Early Medieval Period consists of the period spanning from the sixth to the tenth century CE; the High Medieval, eleventh–twelfth century CE.

<sup>10</sup> This correlates with the different degrees of preservation, but all three levels are very low and the differences between them is not important for our argument.

and/or a weapon wound (if both applied, we counted this under ‘cranial trauma’ in this calculation). Hence, we have four different samples for the Nordic region, which indicated a low level of internal violence before 1100, whereas the European comparison sample had a substantially higher cranial trauma and weapon wound rate.

#### **4. How (Relative) Gender Equality Might Explain Low Levels of Violence in Medieval Scandinavia: Amelioration Hypothesis for the Viking World**

##### **4.1. Determinants of Violence**

Before we discuss potential reasons for the low internal level of violence in Viking Age Scandinavia, we first review the general determinants of violence, which have been reported in the literature (overview Baten et al. 2014). Several factors might affect interpersonal violence in early societies: (1) rule of law/state monopoly on violence/deterrence mechanisms; (2) demography (percentage of adult males between 20 and 30); (3) income/opportunity costs; (4) inequality; (5) trade-connected incentives; and (6) education and human capital/social stigma of violence (Baten and Steckel 2019). In this section, we evaluate which of these factors may explain the cross-sectional differences in our sample.

Although a state formation process was well underway during the tenth century, with Denmark having already been established as a centralised monarchy that converted to Christianity and Norway to a large extent also a monarchy, Sweden was still fragmented into different centres of power (Hedenstierna-Jonson 2009: 93; Brink 2008: 23). In addition, the Iron Age and Early Medieval Scandinavian society can be defined as a militarised one, where free men and women were ideologically and practically prepared for violent conflict (Hedenstierna-Jonson 2009: 102), and so it would appear that there was no strong monopoly on violence by the state. In fact, from the eleventh century, monarchs with growing power attempted to limit the

private settling of disputes – feuds – but with little success initially (Sundman and Kjellström 2020: 2; Þorláksson 2007). Furthermore, written laws were eventually fixed in writing in Scandinavia only between the eleventh and fourteenth centuries CE (Brink 2008: 24), on the roots of older provincial law-rules: (Brink 2008: 27–29). Altogether, this evidence would suggest that conditions (1) should not be considered a strong candidate for explaining the low levels of interpersonal violence in Viking Age Scandinavian societies.

As to demography and the share of young male people (2), the evidence is not sufficiently precise to thoroughly test the eventual correlation between population fluctuations and trauma shares. Moreover, we have no evidence that Scandinavian populations were much older during this period compared to other European regions.

In terms of income (3), the general trend seems to suggest a negative correlation between income and violence in pre-Modern Europe, but the cross-sectional evidence is contradictory, with lower rates of violence in North-Western Europe, which, at least in the Late Medieval Period, had much lower per capita income than Mediterranean Europe (Baten 2016).

Today, economic inequality (4) is generally associated with high homicide rates (Baten et al. 2014). However, there seems to be no correlation between the general trend of trauma shares and the increasing long-term inequality trends in Europe after the Black Death, which are well documented: inequality was rising from the fourteenth to the nineteenth centuries, but violence was decreasing up to the early nineteenth century (e.g. Alfani and Ammaniti 2017, Keywood and Baten 2020).

Turning to the last two factors (5), economic specialisation in trading has been considered by Baten and Steckel (2018: 318–319) as a possible explanation for the low levels of violence that are observed in the continental North Sea area. This may apply to the settlement of Birka as

well, since it was a trading centre specialising in contacts with other Baltic Sea emporia (Ambrosiani 2008). As a matter of fact, Svendsen and Svendsen (2016) highlighted that the partial switch from plundering to long-distance trade – between the ninth and the tenth centuries CE – triggered a process of development of trust-based norms – vital for trade – which led to a considerable accumulation of social trust in Medieval Scandinavia. Indeed, in the Early Medieval Period, Sindbæk (2008: 151) and Svendsen and Svendsen (2016: 201) found that the Vikings were the only society able to establish trade outside close ethnic networks. In the absence of written contracts, they were able to do so by establishing shared cultural norms and procedures of exchange (Sindbæk 2008: 155), such as standardised tools of payment (Gustin 2016: 30–31), and by enforcing a strong culture of trust (Svendsen and Svendsen 2016: 203). Moreover, they provided physical and legal protection to traders, as indicated by the fortifications protecting the Baltic Sea emporia and by the fact that foreigners were legally protected inside these sites (Gustin 2016: 30). This argument is germane to N. Elias's (cited in Eisner 2014: 92) idea that networks of functional interdependency – such as trading networks – promote diplomacy and nonviolent means to solve disputes; in other words, they provide incentives for actors to be well-mannered and disciplined since low self-control is detrimental to the maintenance of complex networks.

Finally, education and human capital (6) rely on the idea that less-educated societies have fewer options for resolving conflicts without resorting to violence (Baten and Steckel 2019: 319–320). There is a modest negative correlation between cranial trauma rates and human capital, as approximated by the overall production of manuscripts in Medieval Europe (Baten and Steckel 2019: 319). However, a closer examination of Viking culture indicates that, despite the rich mythological, poetic and legal oral tradition, the use of writing – runic from 400 CE then

alphabetic from 1110 CE – was limited to magical-religious purposes, and Vikings were mostly non-literate until the tenth century (Svendsen and Svendsen 2016: 199). Indeed, a substantial expansion of the use of writing took place only during the twelfth century, when laws were fixed in writing (Quinn 2000: 32–33) and when the elite wanted to create religious conformity by standardising liturgy and religious beliefs (Nedkvitne 2004: 22). Overall, up to the Gregorian reform, writing remained firmly in the hands of the church and its clerics (Nedkvitne 2004: 33).

Summarising, it is only in the second half of the twelfth century that the process of state formation in Scandinavia gained momentum and brought about the increasing social influence of the state and the church on society, increasing the control of legitimate violence in the hands of the king and an expansion of literacy (Nedkvitne 2004: 33). In the same vein, among the other predictors of interpersonal violence, only violence-averse trading specialisation seems to be a promising candidate for explaining low trauma shares in Viking and Baltic societies. However, this cannot explain the whole picture because the lowest trauma shares are seen in the samples retrieved from cemeteries connected to farming communities in the Mälaren Valley. Hence, we should evaluate additional explanations. In the following section, we review possible additional factors that may help us explain the low levels of interpersonal violence of the rural Scandinavian samples.

#### **4.2. Gender Equality in Rural Scandinavia**

The literature on gender relationships in Medieval Scandinavia is split into two divergent streams, one advocating that women had a strong standing in Viking society, the other emphasising the militarised character of Viking society and alleging a subordinate role for women.

Abundant anecdotal evidence indicates a strong role for women in Viking society (Magnúsdóttir 2008: 46–47). The sagas contain many representations of ‘strong women’: women who go against their husbands, who make political decisions without consulting them, who divorce their husbands and act independently (Magnúsdóttir, 2008). In most cases, these examples feature women who are socially superior to their husbands, and the saga writers use this difference in social standing as an explanation for the women’s behaviour. In addition, Raffield et al. (2017) explained that from the legal standpoint, Viking women in certain circumstances enjoyed substantial rights, allowing them to inherit and own property, to initiate divorce – especially in the phases before Christianisation – and in general to be on a fairly equal standing with men (Raffield et al. 2017: 197–198).

This interpretation is also sustained by archaeological evidence, as attested by the spectacular discovery that the high-status warrior burial excavated in Birka was indeed occupied by a female individual (Hedenstierna-Jonson et al. 2017; Price et al. 2019). Moreover, the rich grave furnishings strongly indicate that this was not only a warrior burial, but the occupant of Bj.581 was probably a cavalry commander under the immediate authority of a royal war leader (Price et al. 2019: 184). This and other discoveries – for example, the famous Oseberg ship mound burial (Ruffoni 2011) – suggest that in Viking society women could take up arms and even rise to positions of command (Price et al. 2019: 193).

In contrast, Raffield et al. (2017) have challenged the assumption of gendered egalitarianism in Viking Age Scandinavia. Based on cultural/historical sources about marital patterns – especially related to practices such as polygyny and concubinage – they suggested that these may have induced the creation of misogynistic social attitudes and increased aggressive behaviours in a competitive marriage market (and channelled also towards other spheres, such as

raiding). In the same vein, Raffield (2019) examined archaeological and literary evidence about children's pastimes and concluded that Scandinavian societies perpetrated social norms that were dominated by militarism and hegemonic masculinity.

However, one important issue with cultural-historical sources is their representativeness and their unclear reflection of the historical reality. Moreover, they are difficult to compare between societies given the high degree of later transformation of texts and myths and customs. Bioarchaeological evidence has some advantages for comparative studies over anecdotal and cultural-historical evidence (even if bioarchaeological evidence is admittedly also not without issues).<sup>11</sup> Maravall and Baten (2019) suggested a new indicator for gender equality through the evaluation of health and nutritional status of skeletons obtained by observing the linear enamel hypoplasia (LEH), building on a descriptive study by Guatelli-Steinberg (1999). By analysing a sample of Scandinavian and other European skeletal remains, these authors found that females in the rural periphery of Nordic countries during the Viking Age and the later Middle Ages had relatively high status, resulting in substantial nutritional and health resources being allocated to girls. This, in turn, seems to be explained by the specialisation in cattle farming and extensive grazing of the Scandinavian communities, which entailed a larger household contribution for women compared with grain-based agriculture (Maravall and Baten 2019: 189–190). Indeed, the specialisation in cattle farming was mostly focused on obtaining milk and derived products – such as butter, which was a highly valued commodity widely used as a means of payment in Medieval Scandinavia (Gullbekk 2005: 13–14) – and women were the ones in charge of processing the milk into cheese and butter (Myrdal 2011: 105–106). Therefore, Maravall and Baten (2019) conclude that female equality was remarkable in rural Scandinavia, especially in

---

<sup>11</sup> However, these issues can be more often explicitly studied and the degree of bias can be bounded.

comparison to other European regions during the Early Middle Ages. On the one hand, this finding fits Boserup's ideas about the conditions that foster higher equality in gender roles in agrarian societies – that is, low population densities, long-fallow/small plots systems and large-scale grazing (Maravall and Baten 2019: 190). On the other hand, it provides a further factor for explaining the low levels of interpersonal violence that characterised the Early Medieval Viking skeletal samples from proto-urban and rural contexts.

Indeed, recent research on the nexus between gender inequality and homicide in the twentieth century (Heirigs and Moore 2018) indicates that societies characterised by higher gender equality have overall lower homicide rates since a more equal standing of female individuals in society contributes to lowering the recurrence of violence against women and to reducing motivations for all violence. This so-called 'amelioration hypothesis' – stating that when gender equality increases, violence decreases – helps us to explain why Early Medieval Scandinavian skeletal samples from rural areas are characterised by both very low trauma shares and remarkable health for female individuals.

Although not conclusive, these findings indicate that the specialisation in cattle farming in areas characterised by low population densities may have been responsible for the relative gender equality of rural Scandinavian society, which, in turn, may have contributed strongly to maintaining low levels of interpersonal violence in Early Medieval Scandinavia. Moreover, this view is reconfirmed by the fact that other European regions with a high share of cattle farming (Switzerland, UK, Hungary) also had low cranial trauma shares.

## **5. Conclusions**

Viking Age Scandinavian society has a reputation for violence being an accepted way to solve conflicts or to obtain resources using brutal violence. This is certainly the case if external

plundering and invasion activities are considered. However, when we studied internal interpersonal violence in Scandinavia itself, a more nuanced picture of violence in the Viking Age emerged. For this, we took into consideration factors such as gender, status and social context. Our study suggests that Nordic societies were not equally violent across all social strata.

We found that by comparing the trauma share from the Scandinavian skeletal sample with that from the other European sites, Viking skeletons show extremely low levels of traumata, hence violence – ranging from a 0.7% share in the Mälaren Valley skeletons to 1.2% in the Birka sample to 2.1% in the Sigtuna case. Also, the Baltic/Lithuanian region (0.00%) is an interesting case of low violence. Since the Baltic region was strongly influenced by Scandinavian – and Viking – culture and society, this impact could be interpreted as a possible cause of the outstandingly low violence levels in the Baltic/Lithuanian region. We observed comparably low levels of cranial trauma only in the samples from Switzerland (0.6%) and the UK (2.1%). All other regions are characterised by much higher trauma shares, ranging from 3.1% (Hungary) to 14.3% (Romania). In total, between 0.6% and 14.3% of the people in the European comparison dataset had cranial trauma and/or a weapon wound. Hence, we have four different samples of the Nordic region that indicated a low level of internal violence before 1100, whereas the European comparison sample has a substantially higher cranial trauma and weapon wound rate. As a caveat, we would like to mention that we rely on buried Scandinavians and do not know about the cremated ones. Burial experts did not observe a substantial difference between the cremated and the buried corpses, looking at grave goods and other criteria of social status. In Appendix A, we discuss the possibility that violence increased during the late High Middle Ages and the Late Medieval Period (ca. 1100–1500).

We also suggest that, in line with recent advances in criminology, gender inequality may also be a strong predictor of interpersonal violence in the pre-Modern world. These findings suggest possible new pathways for explaining how ancient societies could have solved development problems, such as containing and managing violence (cf. North, Wallis and Weingast 2009). Furthermore, they open important new avenues of research on Viking and, in general, on preindustrial societies based on the use of archaeological proxies.

## References

- Alfani, Guido and Francesco Ammannati. 2017. “Long-Term Trends in Economic Inequality: The Case of the Florentine State, c. 1300–1800.” *The Economic History Review* 70(4):1072–1102.
- Ambrosiani, Björn. 2008. “Birka.” Pp. 94–100 in *The Viking World*, edited by S. Brink and N. Price. London-New York: Routledge.
- Arcini (2018). *The Viking Age: A Time with Many Faces*. Oxbow Books 2018.
- Baten, J. (Ed.). (2016). *A history of the global economy*. Cambridge University Press.
- Baten, J., and John Komlos (1998). Height and the Standard of Living *Journal of Economic History* 57-3, pp. 866-870.
- Baten, J., Bierman, W., van Zanden, J. L., & Foldvari, P. (2014). Personal security since 1820, in: van Zanden, J. L., Baten, J., Mira d’Hercole, M., Rijpma, A., Smith, C., Timmer, M. (Eds.), *How Was Life? Global Well-being since 1820*. OECD, Paris, 139-158.
- Baten, J., Keywood, T., Wamser, G. (2020). Elite violence and elite numeracy in Europe from 500 to 1900 CE: roots of the divergence. *Cliometrica*, 1-71.
- Baten, Joerg and Alexandra de Pleijt. 2019. “Female Autonomy Generates Superstars in Long-Term Development: Evidence from 15th to 19th Century Europe.” CEPR Working Paper 13348
- Baten, Joerg and Richard H. Steckel. 2019. “The History of Violence in Europe: Evidence from Cranial and Postcranial Bone Trauma.” in *The Backbone of Europe: Health, Diet, Work and Violence over Two Millennia*, edited by C. A. Roberts, C. S. Larsen, J. Baten, and R. H. Steckel. Cambridge: Cambridge University Press, pp. 300–324.
- Baten, Joerg, Richard H. Steckel, Clark Spencer Larsen, and Charlotte A. Roberts. 2018. “Multidimensional Patterns of European Health, Work, and Violence over the Past Two Millennia.” in *The Backbone of Europe: Health, Diet, Work and Violence over Two Millennia*, edited by R. H. Steckel, C. S. Larsen, C. A. Roberts, and J. Baten. Cambridge: Cambridge University Press, pp. 381–96.
- Benati, Giacomo and Carmine Guerriero 2020. “The Origins of the State: Technology, Cooperation, and Institutions.” Working Paper Available at SSRN: <https://ssrn.com/abstract=3582116> or <http://dx.doi.org/10.2139/ssrn.3582116>
- Brink, Stefan. 2008. “Who Were the Vikings?”, in: *The Viking World*, edited by S. Brink and N. Price. London-New York: Routledge. Pp. 4-10.
- Cohen, H., I. Sarie, B. Medlej, F. Bocquentin, T. Toledano, I. Hershkovitz, and V. Slon. 2012. “Trauma to the Skull: A Historical Perspective from the Southern Levant (4300BCE–1917CE).” *International Journal of Osteoarchaeology* 24(6):722–36.

- Erdal, Yılmaz Selim and Ömür Dilek Erdal. 2012. "Organized Violence in Anatolia: A Retrospective Research on the Injuries from the Neolithic to Early Bronze Age." *International Journal of Paleopathology* 2(2–3):78–92.
- Goodman, A. H.; Martin, D. L. (2002). Reconstructing health profiles from skeletal remains. In: Steckel, R. H.; Rose, J. (eds.), *The Backbone of History: Health and Nutrition in the Western Hemisphere*, Cambridge: Cambridge University Press, pp. 11–61.
- Guatelli-Steinberg, D.; Lukacs, J.R. Interpreting sex differences in enamel hypoplasia in human and non-human primates: Developmental, environmental, and cultural considerations. 1999 *Am. J. Phys. Anthropol.* 110 73-126
- Gullbekk, Svein H. 2005. "Natural and Money Economy in Medieval Norway." *Scandinavian Journal of History* 30(1):3–19.
- Gustin, Ingrid. 2016. "Trade and Trust in the Baltic Sea Area During the Viking Age." Pp. 25–40 in *Maritime Societies of the Viking and Medieval World*, edited by J. H. Barrett and S. J. Gibbon. London: Routledge.
- Guyomarc'h, P., Campagna-Vaillancourt, M., Kremer, C., & Sauvageau, A. (2010). Discrimination of falls and blows in blunt head trauma: A multi-criteria approach. *Journal of Forensic Sciences*, 55(2), 423-427.
- Hedenstierna-Jonson, Charlotte, Anna Kjellström, Torun Zachrisson, Maja Krzewińska, Veronica Sobrado, Neil Price, Torsten Günther, Mattias Jakobsson, Anders Götherström, and Jan Storå. 2017. "A Female Viking Warrior Confirmed by Genomics." *American Journal of Physical Anthropology* 164(4):853–60.
- Hedenstierna-Jonson, Charlotte. 2009. "Social and Political Formations in the Scandinavian Areas, 8th-10th Century. The Martial Perspective." Pp. 91–103 in *Symposium Internacional Poder y Simbología en Europa, siglos VIII-X:(Actas del Symposium Internacional convocado en Oviedo, 22-27 de septiembre del 2008)*, edited by F. J. Fernández Conde and C. G. de Castro Valdés. Oviedo: Ediciones de la Universidad de Oviedo.
- Heirigs, Mark H. and Matthew D. Moore. 2018. "Gender Inequality and Homicide: A Cross-National Examination." *International Journal of Comparative and Applied Criminal Justice* 42(4):273–85.
- Jellema, Dirk. 1955. "Frisian Trade in the Dark Ages." *Speculum* 30(1):15–36.
- Judd, M. A. (2008). The Parry Problem. *Journal of Archaeological Sciences*, 35: 1658–1666.
- Keywood, T., Baten, J. (2020). Elite violence and elite numeracy in Europe from 500 to 1900 CE: roots of the divergence. *Cliometrica*, 1-71.

- Kjellström, Anna. 2014. "Interpreting Violence. A Bioarchaeological Perspective of Violence from Medieval Central Sweden." Pp. 237–50 in *The Routledge Handbook of the Bioarchaeology of Human Conflict*, edited by C. J. Knüsel and M. J. Smith. London: Routledge.
- Kjellström, Anna. 2017. "People in Transition: Life in the Mälaren Valley from an Osteological Perspective." in *Shetland and the Viking World. Papers from the Proceedings of the 17th Viking Congress 2013*, edited by V. Turner. Lerwick: Shetland Amenity Trust.
- Koepke, N., and Baten, J. 2008. "Agricultural specialization and height in ancient and medieval Europe." *Explorations in economic history*, 45(2), 127-146.
- Krakowka, L. 2017. Patterns and prevalence of violence-related skull trauma in medieval London, *American Journal of Physical Anthropology*, 164: 488–504.
- Kremer, C., & Sauvageau, A. (2009). Discrimination of falls and blows in blunt head trauma: assessment of predictability through combined criteria. *Journal of forensic sciences*, 54(4), 923-926.
- Kremer, C.; Racette, S.; Dionne, C. A.; Sauvageau, A. (2008). Discrimination of falls and blows in blunt head trauma: systematic study of the hat brim rule in relation to skull fractures, *Journal of Forensic Science*, 53(3): 716–719.
- Magnúsdóttir, Auður G. 2008. "Women and Sexual Politics." Pp. 40–48 in *The Viking World*, edited by S. Brink and N. Price. London-New York: Routledge.
- Maravall Buckwalter, L. and J. Baten. 2019. "Valkyries: Was Gender Equality High in the Scandinavian Periphery since Viking Times? Evidence from Enamel Hypoplasia and Height Ratios." *Economics and Human Biology* 34:181–93.
- Merbs, C. F. (1989). Trauma. In: *Reconstruction of Life from the Skeleton*, İşcan, M. Y.; Kennedy, K. A. R. (eds.), New York: Alan R. Riss, pp. 161–199.
- Myrdal, Janken. 2011. "Farming and Feudalism, 1000–1700." Pp. 72–117 in *The Agrarian History of Sweden. 4000 BC to AD 2000*, edited by J. Myrdal and M. Morell. Lund: Nordic Academic Press.
- Nedkvitne, A. 2004. *The Social Consequences of Literacy in Medieval Scandinavia*. Turnhout: Brepols.
- North, Douglass C., J. J. Wallis, and B. R. Weingast. 2009. *Violence and Social Orders. A Conceptual Framework for Interpreting Recorded Human History*. Cambridge: Cambridge University Press.
- Price, Neil, Charlotte Hedenstierna-Jonson, Torun Zachrisson, Anna Kjellström, Jan Storå, Maja Krzewińska, Torsten Günther, Verónica Sobrado, Mattias Jakobsson, and Anders

- Götherström. 2019. "Viking Warrior Women? Reassessing Birka Chamber Grave Bj.581." *Antiquity* 93(367):181–98.
- Price, T. D., Arcini, C., Gustin, I., Drenzel, L., & Kalmring, S. (2018). Isotopes and human burials at Viking Age Birka and the Mälaren region, east central Sweden. *Journal of Anthropological Archaeology*, 49, 19-38.
- Quinn, Judy. 2000. "From Orality to Literacy in Medieval Iceland." *Cambridge Studies in Medieval Literature* 42:30–60.
- Raffield, Ben, Neil Price, and Mark Collard. 2017. "Polygyny, Concubinage, and the Social Lives of Women in Viking-Age Scandinavia." *Viking and Medieval Scandinavia* 13:165–209.
- Raffield, Ben. 2019. "Playing Vikings Militarism, Hegemonic Masculinities, and Childhood Enculturation in Viking Age Scandinavia." *Current Anthropology* 60(6):813–35.
- Richardson and Garfinkle 2020. "Community Violence in Middle Bronze Age Mesopotamia." *Unpublished*.
- Richardson, Seth and S. Garfinkle. 2020. "Community Violence in the Middle Bronze Age." in *A Study of Violence in the Ancient Near East and its Neighbors*, edited by V. Juloux and L. Pace. Leiden: Brill.
- Ruffoni, Kirsten. 2011. "Viking Age Queens. The Example of Oseberg." MA Thesis. University of Oslo.
- Sindbæk, Søren Michael. 2008. "Local and Long-Distance Exchange." Pp. 150–58 in *The Viking World*, edited by S. Brink and N. Price. London-New York: Routledge.
- Sołtysiak, Arkadiusz. 2015. "Antemortem Cranial Trauma in Ancient Mesopotamia." *International Journal of Osteoarchaeology* 27(1):119–28.
- Staecker, J., & Toplak, M. (Eds.). (2019). *Die Wikinger: Entdecker und Eroberer*. Ullstein Buchverlage.
- Steckel, Richard H. and Jerome C. Rose. 2002. *The Backbone of History: Health and Nutrition in the Western Hemisphere*. Cambridge: Cambridge University Press.
- Steckel, Richard H., Clark Spencer Larsen, Charlotte Roberts, and Joerg Baten. 2018. *The Backbone of Europe: Health, Diet, Work and Violence over Two Millennia*. edited by C. Roberts, C. S. Larsen, and J. Baten. Cambridge: Cambridge University Press.
- Sundman, Elin Ahlin and Anna Kjellström. 2020. "Medieval Masculinities and Violence: Weapon-Related Trauma in Skeletal Assemblages from Two Religious Houses in Iceland and Sweden." *European Journal of Archaeology* 1–18.

- Svendsen, Gunnar Lind Haase and Gert Tinggaard Svendsen. 2016. "How Did Trade Norms Evolve in Scandinavia? Long-Distance Trade and Social Trust in the Viking Age." *Economic Systems* 40(2):198–205.
- Porláksson Helgi, 2007. Feud and Feuding in the Early and High Middle Ages: Working Descriptions and Continuity.' in: *Feud in Medieval and Early Modern Europe*, eds. Jeppe Büchert Netterstrøm and Bjørn Poulsen, Aarhus, Aarhus University Press, 69–94.
- Toplak, M., 2019. "Körpermodifikationen als Embodiment von sozialer Identität und als sozio-kulturelle Ressource. Das Fallbeispiel der artifiziellen Schädelformationen in der skandinavischen Wikingerzeit." Mit einem Beitrag zur Kranimetrie von V. Palmowski, *Germania* 97 (im Erscheinen).
- Wahl, J. and S. Zäuner. 2015. "Anmerkungen Zum Gewaltpotential in (Prä)Historischen Gesellschaften – Eine Rechnung Mit Vielen Unbekannten." *Beiträge Zur Archäozoologie Und Prähistorischen Anthropologie* 10:175–87.
- Walker, P. L. (2001). A bioarchaeological perspective on the history of violence. *Annual Reviews in Anthropology*, **30**: 573–596.
- Walker, P. L.; Thornton, R. (2002). Health, nutrition, and demographic change in native California. In: Steckel, R.; Rose, J. (eds.), *The Backbone of History: Health and Nutrition in the Western Hemisphere*, Cambridge: Cambridge University Press, pp. 506–523.

**Table 1: Violence among the Scandinavian and European comparison populations of the Early and High Medieval periods**

	Number of skeletons	Trauma share
Scandinavia		
Mälaren valley (farmsteads), rural	136	0.74
Birka, urban	245	1.22
Sigtuna (before 1100), urban	267	2.1
Scandinavian influence		
Baltic/Lithuania	88	0.00
Sites in other countries		
Switzerland	174	0.57
UK	141	2.13
Hungary	188	3.19
Germany	950	4.21
Austria	206	5.34
France	164	5.49
Poland	355	5.92
Portugal	12	8.33
Ukraine	52	11.54
Romania	49	14.29
Total <sup>12</sup>	2415	

Note: As a caveat, we should mention that the preservation of the crania in Birka is relatively problematic. This value needs to be viewed as having low measurement quality for violence. To a lesser extent this also applies to the Mälaren skeletons. The one case of violence for Mälaren and three cases for Birka are maximum numbers, Birka might have just two violence cases.

Sources: Sigtuna: Kjellström (2014), her Table 13.2. The mass grave was excluded, as it probably had a military background.

Countries of Scandinavian influence and other countries: Global Health database, first analysed by Baten and Steckel 2019.

---

<sup>12</sup> The total refers to the full sample, including the European comparison sample and the Baltic region as well as the 36 skeletons of the well preserved sample.

## **Appendix A: Violence among warriors and for the general population in the late medieval period**

Between 1100 and 1500 – in the late high and late medieval period – the urban centre of Sigtuna (Sweden) had 2.7% weapon-related trauma associated with interpersonal violence (Kjellström 2014: Table 13.2, excl. mass grave). This is notably higher than the 1.0% of Sigtuna in the early medieval and early high medieval period (950-1100). Can we conclude from this, that there was an increase in violence between before 1100 and thereafter? This seems to be the case, as many other samples display relatively high violence. Similar trauma shares also characterize other samples from religious household cemeteries in Norway, Denmark, Iceland and England (Sundman and Kjellström 2020).

To assess this, we can also use elite violence indicators and the early homicide rates estimated by Eisner (2014: Figs. 5, 7, and Keyword and Baten 2020). Eisner (2014: fig. 7) documents a peak of elite violence (regicides) – a rough proxy for overall violence before 1200 AD – between 1000 and 1100 AD, and a peak of homicide rates between 1300 and 1400 AD. It is only from around 1640 AD that Europe witnessed a steady decrease of homicide rates, as a result of stronger states, improvements in criminal justice systems, reforms pushing self-control and tighter moral codes, and broader diffusion of reading and writing abilities. Similarly, Keyword and Baten (2020) find that the Nordic countries were among those with the highest regicide rate in the late medieval period. As a caveat to this increase in violence we should note that some of the later samples are related to the military or to warrior groups. Weapon-related traumas seem to be particularly significant in adult male individuals with high social standing – specialising in warfare and violent confrontations – whereas females and other social strata were markedly less exposed to violence. Hence, circa 4.9% on average.

Sundman and Kjellström (2020) examined skeletal samples from mostly Late Medieval cemeteries connected to religious households and discovered that interpersonal physical violence seems to be most attested among males pertaining to the elite strata, warriors, and only to a lesser extent to clerics and other categories of laymen and laywomen. This is consistent with other studies showing that in urban environments, lower classes were more prone to interpersonal violence, whereas in small towns and rural areas mostly the upper strata of society were exposed to it (Sundman and Kjellström 2020: 3). Overall, these discoveries indicate that violence in Viking society was context-specific and highly variable.

The underlying reasons for the low-population-density-high-cattle-intensity of rural Scandinavia that influenced high gender equality and low internal violence already began to disappear during the Viking period. In a cross-section, Maravall and Baten (2019) only observed this for rural Scandinavia, whereas the slowly growing urban centres were less characterized by this agricultural specialisation and gender equality. From this cross-sectional perspective, we can speculate that later-on in the process the increasing urbanisation and population growth that reduced cattle farming in favour of grain agriculture might have removed the basis of this low-violence society system, but this should be researched in much more detail.

## **Appendix B: Correlations of hat-brim-line-rule-adjusted cranial trauma with all cranial trauma, and between cranial trauma with regicide**

In this appendix, we are using the cranial trauma and weapon wounds that were first analysed by Baten and Steckel (2019). We compare the overall rates with the cranial trauma that fulfil the head brim line rule (Kremer et al. 2008). Baten and Steckel (2018) follow Kremer et al. (2008) concerning the distribution of traumata above and below the hat brim line. The latter argued that cranial trauma located above the hat brim line – the line where an imagined hat brim touches the head – is probably caused by violence which more often affects this part of the skull (the parietal or the frontal bones). Accordingly, accidents, such as falling, are more likely to cause cranial trauma below the hat brim line (Kremer et al. 2008). Baten and Steckel (2019) found a close correlation between violence evidence based on the hat brim line rule and all cranial trauma over time.

Here we compare the two possibilities to calculate cranial trauma by (modern) country and time period. Hence we aggregate both variables by region and time period because this allows generating a more informative data set of 30 observations. As Baten and Steckel (2019), we exclude military sites and human remains with less than 50% cranial preservation. The time periods we look upon are the premedieval period (=antiquity), the early, high, and late medieval period, the early modern period and the industrial period. We drop country-period units with less than 15 underlying number of cases (of individual skeletons or skulls). Correlating cranial trauma in weapon wounds in general on the one side, and cranial trauma with only those fulfilling the head brim line rule (and weapon wounds are always added, although these are few), we obtain a correlation coefficient of 0.96. ( $p = 0.000$ ,  $n = 30$ ). The scattergram of the two suggests a very close correspondence. One case with slightly higher overall cranial trauma was

Portugal in the early modern period. Yet, this was a minor deviation to the upper left.

Furthermore, we calculated a regression, so that future researchers who might lack the information about which bone of the skull was affected, can convert general cranial trauma to cranial trauma adjusted to the hat brim line rule.

Figure A.1: Cranial trauma overall, compared with weapon wounds and only cranial trauma based on the hat brim line rule (weapon wounds are always added)

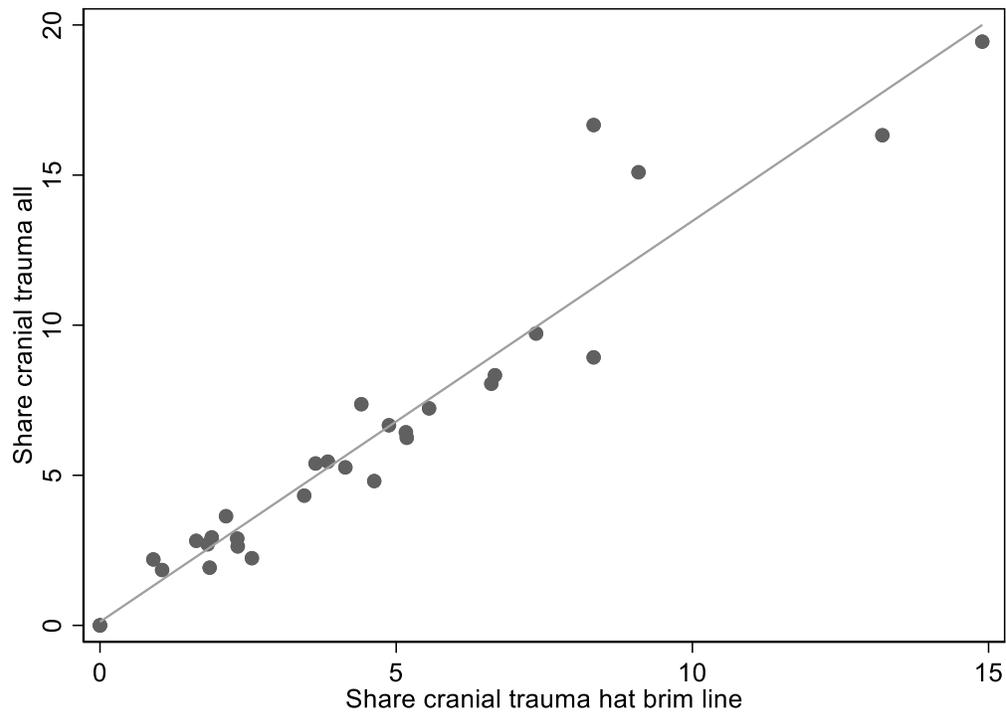


Table B.1 Regression of cranial trauma and weapon wound share (adjusted for hat brim line rule) on overall cranial trauma and weapon wound share(robust regression, White S.E.)

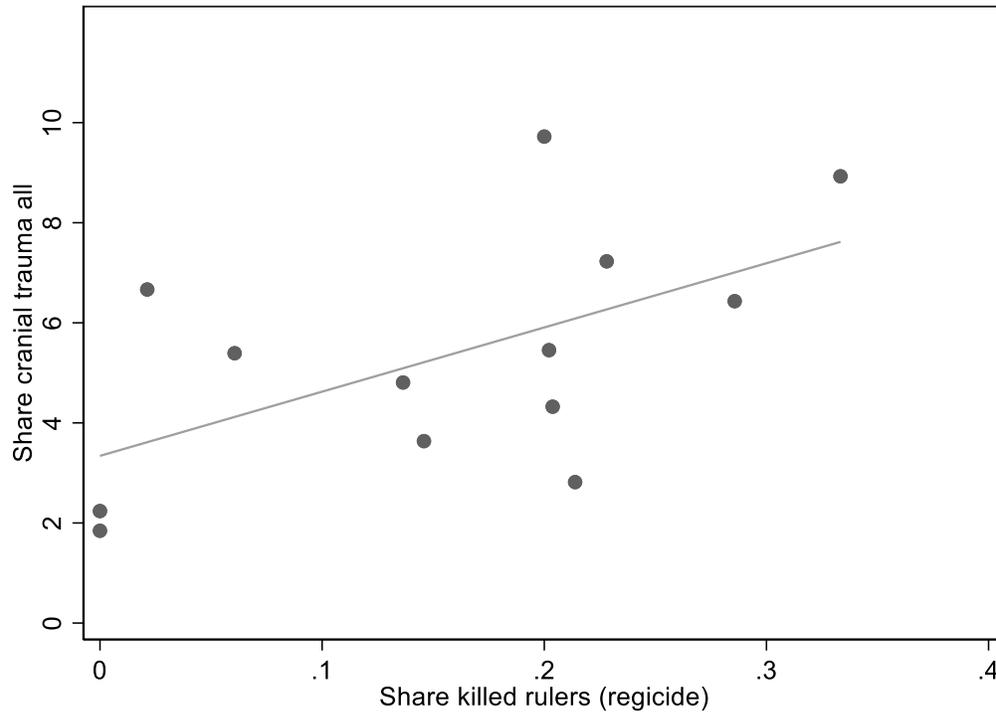
```
Linear regression           Number of obs   =    30
                          F(1, 28)         =   108.17
                          Prob > F          =    0.0000
                          R-squared         =    0.9210
                          Root MSE      =    1.0208
```

```
-----+-----
          |           Robust
cranialthat~p |   Coef.  Std. Err.   t   P>|t|   [95% Conf. Interval]
-----+-----
cranialt_weap |   .6898617  .0663312  10.40  0.000   .5539883   .8257351
   _cons |   .2819254  .2934169   0.96  0.345  -.3191119   .8829628
-----+-----
```

### **Appendix C: Correlations of the cranial trauma/weapon wounds share with the regicide share**

We also calculated the relationship between cranial trauma and weapon wounds on the one side, and regicide, the killing of kings, on the other side. For the latter variables, we included both clearly documented cases of regicide as well as those which were slightly dubious (Baten, Keywood and Wamser 2020 and Keywood and Baten 2020 discussed these issues and found that these should be included). We may consider a case as dubious when, for instance, a ruler died a sudden death and people suspected poison as its cause or when a leader died in prison and everybody expected that the ruler would have been killed by the person who put him into prison. The historical evidence indicates that most of these suspicions were justified (Baten, Keywood and Wamser 2020). We aggregate both variables by region and time period because this allows generating a more informative data set of 30 observations. As Baten and Steckel (2019), we exclude military sites and human remains with less than 50% cranial preservation. The time periods we study are the premedieval period (=antiquity), the early, high, and late medieval period, the early modern period and the industrial period. We drop country-period units with less than 15 underlying number of cases (of individual skeletons or skulls). We find that the correlation between the two variables is quite close, being 0.59 ( $p = 0.43$ ,  $n = 13$ ). Unfortunately, we have only 13 cases for which the country and time period overlap between regicide and cranial trauma observation. Nevertheless, the correlation is quite close, as it is also indicated by the scattergram. We ran a regression so that the regicide can be used to estimate the cranial trauma and weapon wound share (for cases in which the latter might be missing). In the regression, the coefficient is 0.83. The regicide is defined between 0 and 1. Hence, the change

between 0% regicide and 50% regicide would be related with 6.4 additional cranial trauma and weapon wound cases per 100 human remains.



Note: Here we aggregate Lithuania and Poland into one entity (they were united a large part of the period), otherwise N would be even smaller.

Table C.1 Regression of cranial trauma and weapon wound share on regicide (robust regression, White S.E.)

```

Linear regression      Number of  obs  =    13
                      F(1, 11)   =    6.73
                      Prob > F    =    0.0249
                      R-squared    =    0.3235
                      Root MSE    =    2.0902

```

Robust

cranialt_weap	Coef.	Std. Err.	t	P>t
regicide	12.83021	4.945461	2.59	0.025
Constant	3.341209	.9843848	3.39	0.006

## EHES Working Paper Series

### Recent EHES Working Papers

#### 2021

EHES 205     Productivity, Mortality, and Technology in European and US Coal Mining, 1800-1913  
*Javier Silvestre*

#### 2020

EHES 204     Globalization and Empire: Market integration and international trade between Canada, the United States and Britain, 1750-1870  
*Maja Uhre Pedersen, Vincent Geloso, Paul Sharp*

EHES 203     Opening the Black Box of the Danish Dairy Cooperatives: A Productivity Analysis  
*Sofia Henriques, Eoin McLaughlin, Paul Sharp, Xanthi Tsoukli, Christian Vedel*

EHES 202     On the Origins of the Demographic Transition. Rethinking the European Marriage Pattern  
*Faustine Perrin*

EHES 201     Did taller people live longer? Influence of height on life span in rural Spain, 1835-2019,  
*Francisco J. Marco-Gracia, Javier Puche*

EHES 200     Regional market integration and the emergence of a Scottish national grain market,  
*Daniel Cassidy, Nick Hanley*

EHES 199     The Pre-kautilyan Period: a sustainable model through ancient economic ideas and practices,  
*Satish Deodhar, Sriram Balasubramanian*

EHES 198     Accounting for Growth in Spain, 1850-2019,  
*Leandro Prados de la Escosura, Joan R. Rosés*

EHES 197     Capital in Spain, 1850-2019,  
*Leandro Prados de la Escosura*

All papers may be downloaded free of charge from: [www.ehes.org](http://www.ehes.org)

The European Historical Economics Society is concerned with advancing education in European economic history through study of European economies and economic history. The society is registered with the Charity Commissioners of England and Wales number: **1052680**