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Race, Population Affinity, and Mortality Risk during the Second Plague Pandemic in Fourteenth-Century London, England

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ABSTRACT We investigate whether hazards of death from plague and physiological stress at a fourteenth-century plague cemetery (Royal Mint, London) differed between populations using $N = 49$ adults whose affiliation was established using macromorphoscopic traits. Compared to a nonplague cemetery ($N = 96$), there was a greater proportion of people of estimated African affiliation in the plague burials. Cox proportional hazards analysis revealed higher hazards of death from plague for those with estimated African affiliation. There were higher rates of linear enamel hypoplasia in those with estimated African affiliation, but this finding is not statistically significant. These results provide the first evidence that hazards of plague death were higher for people of estimated African affiliation compared to other affiliations, possibly because of existing inequalities, in addition to migration (free or forced) outcomes. These findings may reflect premodern structural racism's devastating effects.

Keywords: Second Plague Pandemic; mortality risk; population affiliation

Investigamos si los riesgos de la muerte resultando de la peste y estrés fisiológico en un cementerio de la peste del siglo XIV (Royal Mint, Londres) son diferente entre poblaciones de adultos ($N = 49$) quienes afiliación estuvieron establecido utilizando rasgos macromorfoscópicos. En comparación con un cementerio no asociado con la peste ($N = 96$), había una proporción más grande de gente estimado tener afiliación africana en los entierros asociados con la peste. Análisis de riesgos proporcional de Cox indicaron que había un riesgo de muerte de la plaga más alto por individuos estimados tener afiliación africana. Había índices más grandes de hipoplasia de esmalte dental en individuos de afiliación africana, pero el nivel estadístico no fue significativo. Los resultados demuestran la primera evidencia que los riesgos de la muerte de la peste fueron más altos por gente de afiliación africana en comparación a otras afinidades, posiblemente como resultado de disparidades sociales en combinación con los efectos de migración (libre o forzada). Los resultados se pueden reflejar las consecuencias devastadoras del racismo estructural premoderno.

Palabras claves: Segunda Pandemia de la Plaga; riesgo de mortalidad; affiliacion poblacional

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The Second Plague Pandemic's (SPP) first outbreak in the mid-fourteenth century A.D., commonly referred to as the Black Death, killed many millions of people across Eurasia and Africa and was one of the most catastrophic disease events the world has ever experienced (Ziegler 2016). The SPP continued in the form of outbreaks and isolated cases of plague for centuries afterward. Paleogenetic analysis of human remains from across Europe and Asia has established that the SPP was caused by *Yersina pestis*, the bacterium that continues to cause plague globally (Bos et al. 2011, 2012; Gourvennec 2019; Haensch et al. 2010; Kacki et al. 2011; Keller et al. 2019; Schuenemann et al. 2011; Spyrou et al. 2016, 2019, 2022; Willmott et al. 2020). Extensive land and sea trade networks promoted the rapid spread of the initial wave of the SPP (Byrne 2012; Ziegler 2016); some modeling suggests the disease traveled between 1.5 and 6 km a day (Christakos et al. 2005). Through dramatic depopulation, the fourteenth-century plague also wrought significant political and economic changes across Europe (Horrox 1994), and it resulted in many violent acts against minority groups, including the racial-religious cleansing of Jewish communities (Colet et al. 2016; Nirenberg 2015; Rambaran-Olm 2020). The pandemic led to increased tensions between different communities, status groups, and religions, although these detrimental divisions and structural inequalities (i.e., racism) already existed and had been rising for many years, in part due to the Little Ice Age's (1300–1870 A.D.) successive waves of famine and climatic instability (Fagan 2000; Hahn 2001; Heng 2018a; Ziegler 2016). Consequently, the pandemic affected countries whose populations were already compromised, as evidenced by the study of medieval human remains from across Europe (DeWitte 2015; Gamble et al. 2017; Scott and Hoppa 2019; Yaussy et al. 2016, 2018).

Despite some medieval primary sources suggesting the first wave of the SPP killed almost everyone it infected (Cohn 2008), bioarchaeological research has provided evidence that, in at least some contexts, it was not an indiscriminate killer. For example, in London, individuals with evidence of physiological stressors experienced prior to the epidemic, including those associated with developmental disruption during childhood, were more likely to die during the 1348–1350 A.D. outbreak compared to age-peers without evidence of such previous exposure to stress (DeWitte 2009, 2010a, 2010b, 2014a, 2014b, 2014c, 2014d; DeWitte and Hughes-Morey 2012; DeWitte and Wood 2008; Godde et al. 2020). Analysis of individuals who died in a plague in the latter half of the fourteenth century, likely the 1361 A.D. plague, which killed an estimated 10% to 30% of the English population, indicates a relatively high hazard of dying for individuals who were frail because of previous exposure to physiological stressors and those who were nutritionally compromised (DeWitte and Kowaleski 2017; DeWitte and Wissler 2022). Bioarchaeological research on the SPP has not yielded evidence of sex difference in plague mortality (Castex and Kacki 2016; DeWitte 2009). However, evidence from historical documents indicates a sex-selective effect (i.e., higher numbers of female deaths compared to nonplague years) during SPP outbreaks up through 1450 A.D. in the Netherlands (Curtis and Roosen 2017). Historical documents also yield evidence that mortality during the SPP was worse for poorer people than for the wealthy in some contexts (Alfani and Bonetti 2019; Cummins et al. 2016; DeWitte and Kowaleski 2017; Galanaud et al. 2020). In this way, the SPP documentary evidence reveals how gender and class categories (structural inequality) compound harm in populations. Research on premodern SPP in Sub-Saharan Africa has also revealed a substantial effect on populations and communities, especially in late medieval West Africa (Chouin 2018a, 2018b; Green 2018; see also Gomez 2020).

There is thus existing evidence that medieval plague mortality risks varied along both biopolitical and sociocultural dimensions. However, to date, no bioarchaeological research has addressed the potential effects of structural racism, despite primary source evidence showing that northern Europe had a diverse and racialized population during this period (Heng 2018a; Ray 2007; Williamson 2014). To further clarify the ways in which biosocial factors affected risks of mortality during the SPP, our study is the first to combine osteological evidence for population affiliation with skeletal data on sex, age-at-death, and physiological stress in human remains excavated from a London, fourteenth-century, SPP burial ground. We test the hypothesis that people who would have been identified as belonging to population affiliations other than white European and specifically connected to an African geographical affiliation, and who were therefore potentially racialized as Black in life or suffered the stressors associated with anti-Blackness, migration (forced or otherwise), and unfreedoms (at demise or over a lifetime), faced higher risks of death compared to white Europeans during the SPP. This is a premodern example of current discussions concerning race and COVID–19 (Columbia University 2020; Ogedegbe et al. 2020). There were other groups in premodern England's racialized landscape, including the Welsh, Irish, Jews, and Muslims. In future population discussions, we can examine the compounded harm via intersectionality of Black Jews and Black Muslims—although this cannot be confirmed for medieval

English Jewish cemeteries, because those human remains are reburied, often immediately after excavation (e.g., Historic England 2020; The Jewish Chronicle 2019; see also Belcastro and Mariotti 2021; Colomer 2014; Gleize et al. 2016). Currently, because our sites were Christian burial grounds, they do not yield any evidence for Black Muslims, although their presence may have been erased through being given a Christian burial treatment. Nevertheless, one can consider the further compounded harm of intersectionality in relation to anti-Blackness and racio-religious structural racism in these cases in future examinations of Muslim grave sites. Our article focuses on anti-Black structural racism within Christian cemeteries, racial capitalism's earlier genealogies, and medieval London as a location to highlight how a substantial community can be erased from history.

Autoethnography and Our Situatedness

An article about medieval bioarchaeology that discusses race, racism, pre-1500 A.D. medieval England, an earlier genealogy related to transatlantic chattel slavery, the archive of slavery, and a global pandemic's effect on racialized populations of varied states of unfreedom requires a self-reflexive, critical analysis of its methodologies and commitments, especially as the concurrent pandemics of COVID-19 and global anti-Blackness devastate racialized communities in the 2020s. Black Lives Matter. Black Methodologies Matter.

A discussion of decolonization and Black feminist theoretical praxis often begins with an autoethnography (Brown-Vincent 2019; Franklin 2001; Tuhiwai Smith 2022). This has been advocated as a necessary component in an antiracist, Black feminist, and decolonized approach to historical bioarchaeology (see Watkins 2020:19).

We are keenly aware of the twinned whiteness of both anthropology and medieval studies. This double-whiteness has also meant a lack of Black researchers and "knowledge producers" in our fields. We hope to prioritize the methodologies of Black feminist archaeology and the interdisciplinary work we bring to bear on this archive (Watkins 2020:14). In addition, following "Archaeologies of the Heart," we emphasize our commitment "to position . . . work consciously and to practice a rigorous self-reflexivity in its conduct" (Supernant et al. 2021:6). We believe that our work is about "generating multiple perspectives on truth" (Supernant et al. 2021:7), especially how our interdisciplinary work crosses academic silos, enabling a "pluralistic approach" to a myriad of historical truths and methodological discoveries (Supernant et al. 2021:7).

Materials and Methods

Medieval London: people and plague

London provides an ideal context to examine structural racism's possible effects on risk of death during the SPP for two reasons: it contained a heterogenous population mix, and archaeological excavations have yielded skeletal samples with incredible chronological control, enabling a study of a relatively large sample of people known to have died during SPP (Grainger et al. 2008; Pfizenmaier 2016). London, medieval England's most important urban center, was home to the country's most powerful political, economic, and religious institutions. Connected to the world by its river port, which brought goods and people directly into fourteenth-century London, it was home to an estimated 80,000 people (Barron et al. 2017; Thrupp 1989). Primary source examination, from 1336–1584 A.D., reveal nearly 18,000 "foreigners" had come to London from India, Greece, Iceland, and mainland Europe (i.e., Italy) (Lutkin 2016); note that information about appearance (i.e., skin color) was not recorded in the source material. The majority were temporary residents, but mercantile and richer migrants stayed for several years and sometimes were accompanied by their entire households, which included free and enslaved servants and illegitimate children (Laufenberg 2016; Lutkin 2016; Thrupp 1957, 1989). Many enslaved people were forced into bondage in Italian and southern Spanish markets and originated from Sub-Saharan and northern Africa or Eastern Europe (Guidi-Bruscoli 2016; Hernæs and Iversen 2002; Miller 2002; Phillips 1985, 2013). The primary source and bioarchaeological evidence reveal that several population affiliation groups and mixed-race people lived in London, some of whom who had spent their early childhood in Britain, suggesting that they were (at least) second-generation migrants (Kendall et al. 2013; Redfern and Hefner 2019; Richard of Devizes 1192).

Before the plague reached England in 1348 A.D., extensive preparations had been made to cope with the epidemic. This included the creation of two emergency burial grounds—East Smithfield (close to the Tower of London) and West Smithfield, positioned further north in the city (Grainger et al. 2008; Pfizenmaier 2016). The plague reached London in fall 1348, resulting in 60% of the city's population dying, until it waned in 1351 A.D. (Byrne 2012; Horrox 1994; Sloane 2011). Sloane (2011) has shown that the city's parish

cemeteries (numbering over 100) buried the majority of plague victims. However, these cemeteries mostly have not been divided into pre- or postplague phases, meaning that the emergency burial ground populations remain unique.

Medieval London: race, anti-Blackness, and medieval England

This article includes data and tools that have been rightly critiqued for their role in perpetuating systemic racism, specifically the use of macromorphoscopic traits (Bethard and DiGangi 2020; contra. Stull et al. 2021). We acknowledge that any methodological overhaul and/or new theorized praxis is a process and that whiteness must be decentered to achieve this. As two white anthropologists, a white bioarchaeologist, and one woman of color medievalist, we must de-center our work. We choose to foreground contexts and complexities, as well as white supremacist genealogies in forensic anthropology and medieval studies, as a form of methodological praxis as process. In light of critique, we used five traits with known heritability: anterior nasal spine, interorbital breadth, nasal aperture width, inferior nasal aperture, and nasal bone contour (Plemons 2022).

Black feminist praxis and recent antiracist work that utilizes historical context to analyze a site informs our research (Barnes 2021). As Cho and colleagues (2021) advocate, we use the terms *population affinity* and *mixed race*, mindful that "racism is a social reality that can affect biology" (Cho et al. 2021). We also acknowledge the contextual nuances and specific details that must be discussed when working in race and science. As presented in Kim and Coles (2021:4–12), we understand that structural racism is built into science and agree that studies of the past must be specific to their temporality and location.

In this section, we contextualize the distinct specificities of time, geography, and conditions in relation to medieval England and race that is different from other European geographies. Despite scholars documenting the multiracial scene in early modern London (Habib 2008; Hall 1995) or more recently on an early modern English ship (Scorrer et al. 2021), the image of a white medieval England persists. This white nostalgia is rooted in the same white supremacist ideology that has fed contemporary violence. Likewise, medieval studies scholarship has boosted this "preracial" version of the premodern past that has allowed medieval cultures, societies, writers, and powerbrokers to hide behind "white innocence," when the truth is that race (structural racism) was invented, refined, and rehearsed in medieval England (Kim 2021).

Heng (2018a:3) explains that medieval race is "*a structural relationship for the articulation and management of human differences, rather than substantive content* . . . [with] religion—the paramount source of authority in the medieval period—could . . . for instance, [subject 'detested' people] to a political theology that could biologize, define, and essentialize an entire community as fundamentally and absolutely different." Our definition of race centers the Black feminist material turn (biopolitical and sociocultural)—dependent on location and temporality (Spillers 1987, 2003; Weheliye 2014). Although many historians have argued that using "race" to describe the medieval phenomena of structural racism is anachronistic, others in premodern critical race studies, as well as critical race theorists, have in the past several decades made it emphatically clear that the term to use is *race* rather than anything else (Heng 2021; Kim 2021; Mills 2020; among others).

Later medieval England (c. 1100–1500 A.D.) inherited, through its written and spoken culture, narratives of a racialized hierarchy connected to geographic space and climate, ideas that can be traced back to Hippocrates (Kennedy et al. 2013:35–41). Although Hippocratic work was not in circulation, its vision of a geographic/climatological organization of racial hierarchy is present in cartography (e.g., the Hereford Map, 1300 A.D.), which centers and gives more room to European places and territories. Medieval English white Christianity based its racialization on "population affinity" connected to organizing people by climatological/geographic racial difference, meaning that medieval English anti-Blackness included epidermal racialization (Heng 2018a:180–256; Whitaker 2019).

England had already begun practicing how to organize, categorize, and hierarchize nonhegemonic white Christian groups because it was an early racial state (Heng 2018a, 2018b). The English state, as part of a larger colonial project in the twelfth and thirteenth centuries, also racialized the Welsh and Irish in the British Isles, and Muslims in its Eastern Mediterranean crusader colony (Acre, lost in 1291 A.D.), using many of the same Orientalist tropes flung at both real and imagined Islamic foes (Heng 2018a; Lumbley 2019; Rajabzadeh 2019). Structural racism had different terrains and archives for different groups. In the case of the English racio-religious Jewish and Islamic difference, we can identify their populations by how they were buried in grave sites and, for the pre-1290 Jewish community in England, a small Anglo-Hebrew documentary archive (Olszowy-Schlanger 2015). For the Welsh and Irish who the English colonized in the twelfth and thirteenth centuries, we have substantial documentary archives of how the subaltern racialized populations spoke back to English colonial hegemony.

In contrast, Black people did not have emic documentation or viewpoints from which we hear directly about their lives or racial formations, or else the documentation has been completely whitewashed, because the white imaginary defined medieval England as a white population space. Concomitantly, hundreds of archives were destroyed during the Dissolution (1536–1540 A.D.) (Kim 2022), and medieval scholarship has deliberately whitewashed the presence of Black people in archives. We have two examples: one methodological and one documentary (from the medieval English literary canon) that demonstrate the consequences for the documentary and archaeological record.

Across Britain and Europe, the majority of osteoarchaeological professional recording standards do not record population affiliation or ancestry (e.g., Rose et al. 1991), due to a combination of factors: it was only recently being introduced in British standards (created 2004) in 2017 (Mitchell and Brickley 2017), not all bioarchaeology/human osteology/paleopathology courses teach these methods, and many archaeological contractors have not revised their standards for over a decade. Consequently, the white imaginary, which assumes a de facto white population, is used as the "empirical" evidence for a population discussion of all medieval European human remains, especially burial grounds (contra. Redfern and Hefner 2019, 2021; Our Migration Story n.d.; York Archaeology 2019). Therefore, the paucity of population affiliation data means that there is no "empirical" evidence for a white-only population in medieval England. Instead, immense work must be done to debunk the white supremacist scholarly and methodological structures that have upheld and kept the white racial imaginary in place for centuries and is central to white medieval "heritage politics" in contemporary far-right politics (Christmas 2019).

This has affected our analysis of the English documentary record. It is also a record in white scholarly methodologies, ontologies, and whitewashing. The white imaginary has trained scholars to skip over what is so plain to see. The work of fourteenth-century London poet Geoffrey Chaucer has been the subject of scholarship for centuries, and his *Canterbury Tales* has been a British colonial school text (Viswanathan 2014). Yet, only recently has race been discussed with respect to Chaucer's Cook's Tale. This tale, which describes an apprentice cook's (named Perkyn Revelour) London life, involves gambling, sex workers, and occasional prison stints. Revelour is physically described as: "Broun as a berye, a propre short felwe/ With lokkes blake ykembd ful fetisly" (Brown as a berry, a proper short fellow/ With black locks combed elegantly) (San Marino, Huntington Library MS Ellesmere 26 C9, f. 46v–47v). Hsy (2021:380) is the first to discuss Revelour in relation to race—"a racialized brownness"—using the potential of "racial speculation." The white gaze is so embedded that scholars see the darker skin in the Ellesmere manuscript's Cook's portrait as evidence of disease or low social class (Sweany 2018). There are over three dozen medieval English manuscripts that attest to the Black Cook. This is an example of a specific documentary archive in which all scholarship has skipped over the Cook as a Black servant in fourteenth-century London. Earlier Chaucer and race scholars had to temper their arguments, because the "empirical" population evidence upheld the white racial imaginary of a white medieval England (Hsy 2021; Whitaker 2019). Recording population affiliation would have a cascading and seismic effect in scholarship, prompting a reassessment of medieval European primary sources. Osteological data will allow medieval scholars to say that these Black men, women, and children, who have been recorded, are not a fantasy or just possibilities. Such data also would reveal an earlier start to England's adoption and practice of racialized unfreedoms (Fuentes and Rouse 2016; Morgan 2021; Otelle 2021).

Although medieval England's race technology was mutable, biopolitical, and sociocultural, English white Christian hegemony saw racial difference as immutable and in the blood. Anyone who was marked visually or embodied as originating outside of Europe, particularly if they fitted a "Black Ethiopian" description, would have been racialized. We identify "mixed-race" people as racialized based on what critical race legal theorists would identify as miscegenation laws appearing in the Fourth Lateran Council's Canon 68 (1215 A.D.). This ruling specifically forbade Christians from forming sexual relationships with Jews or Muslims due to concerns about mixed-race/religious children (Harris 1993:1739–1740; Heng 2018a:76–77).

Black feminist methodology

The Royal Mint site, in relation to the effects of pandemic disease and population affiliations, offers us an insight into medieval racial necropolitics and structural violence. As can be seen in COVID-19 pandemic data, there is a clear correlation between structural violence, particularly as it pertains to race, and disproportionately higher rates of mortality among Global Majority communities (Flagg et al. 2020).

The effects of structural racism can be found in archaeological data and health disparities observed in human remains (Nystrom 2014:756–766). To do justice to the human remains in our study, we foreground the work of Black feminist archaeology. Battle-Baptiste (2016:70) suggests this "takes into account the disadvantage of how these aspects of identity (primarily

race and gender) act as a doubled (and with class a triple) form of oppression" (see Franklin 2001:115–116). This sits alongside the work of Hill Collins (2019), Crenshaw (1991, 1989), and the Combahee River Collective (Taylor 2017) about intersectionality. We follow Hartman's (1997, 2007) work on the archive of slavery and McKittrick (2006, 2014, 2015) on Black geography to center Black feminist archive and data methodologies. Although much work done in Black feminist archaeology focuses on North American post-1492 A.D. sites, we apply these methods to London's fourteenth-century cityscape.

The Royal Mint site also reorients our understanding of the transatlantic chattel slavery archive's beginnings. Likewise, the discussion of structural racism and pandemic necropolitics (Mbembé and Meintjes 2003) remains an ongoing lens of analysis. We bring these multidisciplinary strands together in order to, in Battle-Baptiste's (2016:67) words, "create a purposefully coarse and textured analytical framework."

Our framework pulls from Black feminist work in the humanities, social sciences, and sciences. We contextualize the Royal Mint site as part of the archive of slavery, as well as what Wynter (1990) and McKittrick (2006) theorize as "demonic grounds," and to see medieval London as a Black diaspora geography: "demonic grounds . . . are not simply identifying categories of difference, absence, and the places and voices of black women and/or black feminism; they also outline the ways in which this place is an unfinished and therefore transformative human geography story" (McKittrick 2006:xxvi). Hartman (2008:2) remarks upon the "act of chance or disaster" that allowed us to even have a sentence, a phrase to mark Black women's presence in the archival records, when the standard encounter with the archive is silence, erasure, and "invisibility."

Given that a percentage of those killed by London plague epidemics were enslaved or formerly enslaved people, our Black feminist archaeology must first address the archive of slavery. Our archive, their remains, are precisely what Hartman (2008:2) characterizes as a "death sentence, a tomb, a display of the violated body, an inventory of property." We are reckoning with the impossibility of discussing premodern Black lives in any way that is not about pain and death. Their remains, "the violence that deposited these traces in the archive" (Hartman 2008:2), are our evidence and data points. This is why we must think through Black feminist archaeology to consider other ways to tell these narratives.

McKittrick (2014:17) addresses the archive of slavery, Black men and women as data, by calling attention to "the mathematics of the unliving." What McKittrick (2014:16) underlines is that these bodies (our osteological data) become an "object-commodity" in which there is no way to give life or to tell these stories. "If the source of blackness is death and violence," they argue, "the citation of blackness—the scholarly stories we tell—calls for the repetition of death and violence. . . . Put differently, historically present anti-black violence is repaired by reproducing knowledge about the black subjects that renders them less than human" (McKittrick 2014:17–18). This is the methodological knot we must unravel.

Hartman (2008:11) argues for a methodological shift to address this issue: what they call "critical fabulation." The purpose here is not "to *give voice* to the slave, but rather to imagine what cannot be verified, a realm of experience which is situated between two zones of death—social and corporeal" (Hartman 2008:12, 2019). McKittrick (2014:25) argues that Black studies is the method to work successfully on demonic grounds precisely "because the mathematics of blackness and white supremacy are seemingly knowable (because accountable and counted) and always laden with a chaotic uncertainty." Developing that concept, Flewellen (2017:73) proposes that "demonic grounds then become spaces that literally create new conceptualizations of being, a possessed form of being that cannot be knowable, yet act as a fruitful space for exploration and knowledge production, there by re-presenting human geography." Designating fourteenth-century London as a demonic ground allows us to reexamine our data to address these different possibilities.

The pandemic burial grounds are a form of Black spatial geography and especially a matter of Black diaspora. As Watkins (2020:20) explains, the works of Black feminist biopolitics and race "discuss racializing assemblages as key vehicles through which biocentricity is reinforced" and "involve[s] sociopolitical processes that discipline humanity into categories, such as human, not quite human, and nonhuman." Our approach aligns with this critical race genealogy: the biopolitical that thinks through racialized assemblages.

Lastly, Black feminist methodology asks that this work be a collaboration with a community of stakeholders as a form of social justice and an extension of Black feminist autoethnography. Watkins (2020:23) builds on the three-pillar structure advocated by Blakey (1991): (1) that "scientific investigation is not an objective or passive practice"; (2) that "decolonized study of human biology should readily contribute to broader, interdisciplinary investigations of human conditions and disparities"; and (3) "the explicit recognition of human responsibility in the production of scientific knowledge." We plan to bring these methods into our future work. There are no UK projects similar to Blakey's (2020) work at the New York African Burial Ground, as medieval and later burial grounds were not separated by race but rather by religious tradition, and

Figure 1. Map showing the location of London within the United Kingdom, scale 1:5,000,000 (OS OpenData Downloads).

archaeological contractors do not consistently record or report population affiliation data (see Redfern and Hefner 2019). But we agree with Franklin et al. (2020) that related communities must be collaborators and partners in archaeological practice. We intend to keep accountable to these larger methodological goals—we believe the recent work of Finding Ceremony (https://www.findingceremony.com/) is an excellent example of descendant community-centered work.

Skeletal samples

The individuals in this study are curated by the Museum of London. The plague victims ($n = 49$) included in this study were excavated from the Royal Mint site (London) (MIN86) in the 1980s and derive from two phases of burial at the site (Figs. 1–2). The first phase is the East Smithfield cemetery (1348–1350 A.D.), a planned emergency burial ground whose creation and use is recorded in a number of primary sources, with dates supported by coins from a purse found during excavation of the inhumations (Grainger et al. 2008). Plague victims from the City were buried there with care and respect in grave rows or previously prepared mass burial trenches. Although the names of some people buried at the cemetery are known from their wills, which stipulated their place of internment, none can be associated with an individual skeleton (Grainger et al. 2008). In 1350 A.D., the Royal household purchased adjacent land, enabling King Edward III to found a Cistercian abbey. This served the plague burial ground but also established its own cemetery, which was in use from 1350 to 1538 A.D.; again, although the names of some people buried there are documented,

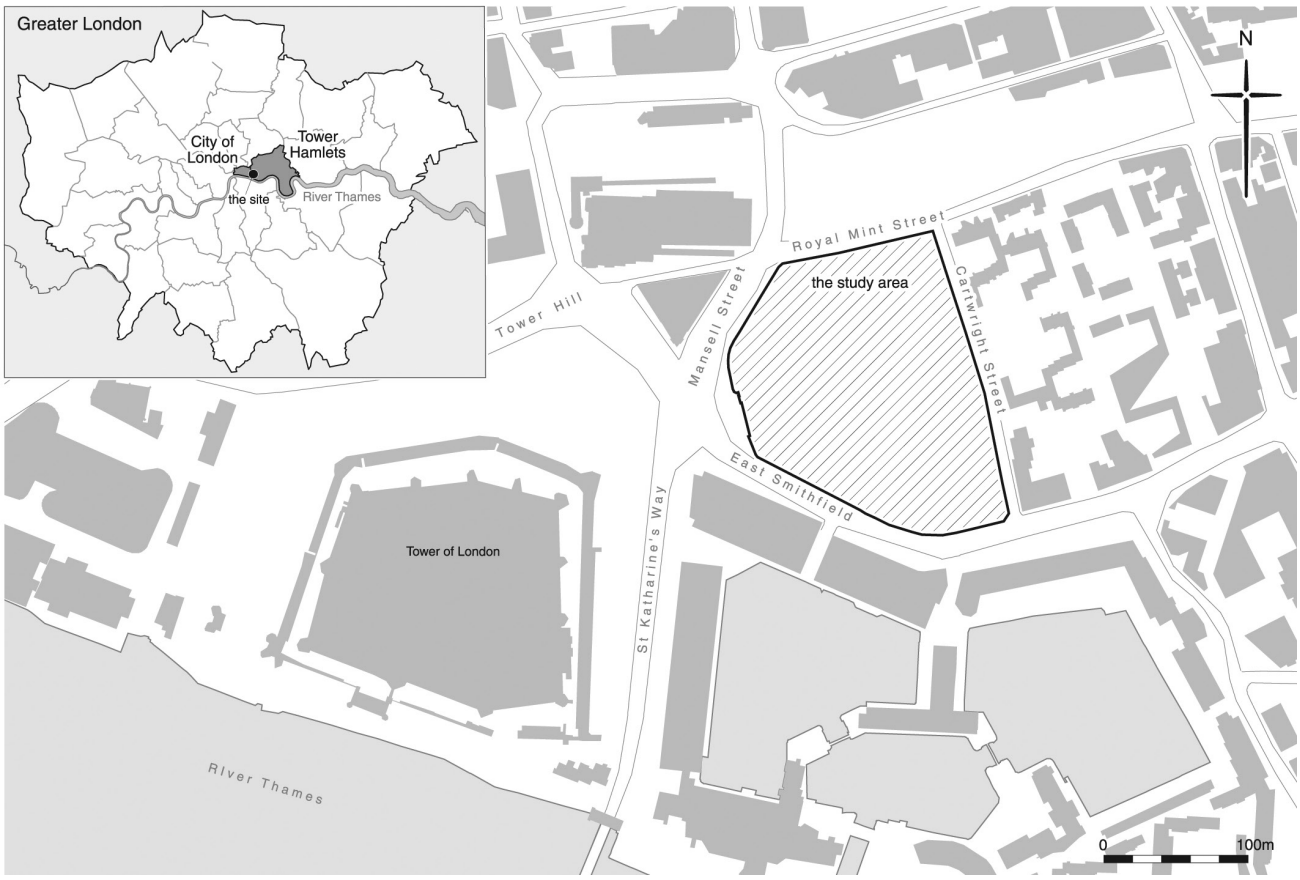

Figure 2. Map showing the location of the East Smithfield (MIN86) burial ground in London, England. © Museum of London Archaeology.

none of the human remains in our study could be associated with a particular individual (Grainger and Phillpotts 2011). Archaeological and primary source evidence has established three burial phases at St. Mary Graces, but only individuals from the first phase are included in our study, as they date from 1350–1400 A.D., when the plague was still present in London, including during the second major outbreak of plague in 1361 A.D. (Grainger and Phillpotts 2011). Ancient DNA analysis of skeletons excavated from the emergency burial ground and the first burial phase of St. Mary Graces has identified *Y. pestis* at both sites (Bos et al. 2011; Klunk et al. 2019; Schuenemann et al. 2011).

Individuals who died from causes other than plague (the nonplague individuals, $n = 96$) included in this study were excavated from areas of St. Mary Graces not associated with plague outbreaks ($n = 7$) and from the St. Mary Spital cemetery (SRP98, $n = 89$) (Fig. 3) (Connell et al. 2012). The SRP98 cemetery was used over four distinct phases (as determined by archaeological and radiometric evidence): 1100–1200, 1200–1250, 1250–1400, and 1400–1540 A.D. To ensure as best as possible that our analyses compared hazard rates (see below) for population affiliations during the SPP relative to nonplague mortality, we did not include individuals buried in SRP98 between 1250 and 1400 A.D.

The human remains from MIN86 and SRP98 were recorded using the Wellcome Osteological Research Database (WORD) using published standard methods (Powers 2007, 2012): a total of 636 individuals from East Smithfield and 199 from the first burial phase at St. Mary Graces were recorded (Centre for Human Bioarchaeology 2007a, 2007b). Of these, 49 adult (> 18 years old) individuals were included in our study: 40 from East Smithfield and nine from St. Mary Graces. They had previously been selected for population affiliation analysis (Redfern and Hefner 2019, 2021) because they had the cranial vault and facial bones present that are used in the macromorphoscopic method (MMS) (Hefner and Linde 2018). The modern constructed identities often associated with race, such as "white" or "Black," are not biological realities and the continuous and overlapping nature of human variation does not permit a rigid determination. Instead, any method only calculates probabilities of membership into some a priori established reference samples. To detach our estimates from the typological underpinnings of forensic anthropology, we utilized cranial data to estimate affinity, which Spradley and

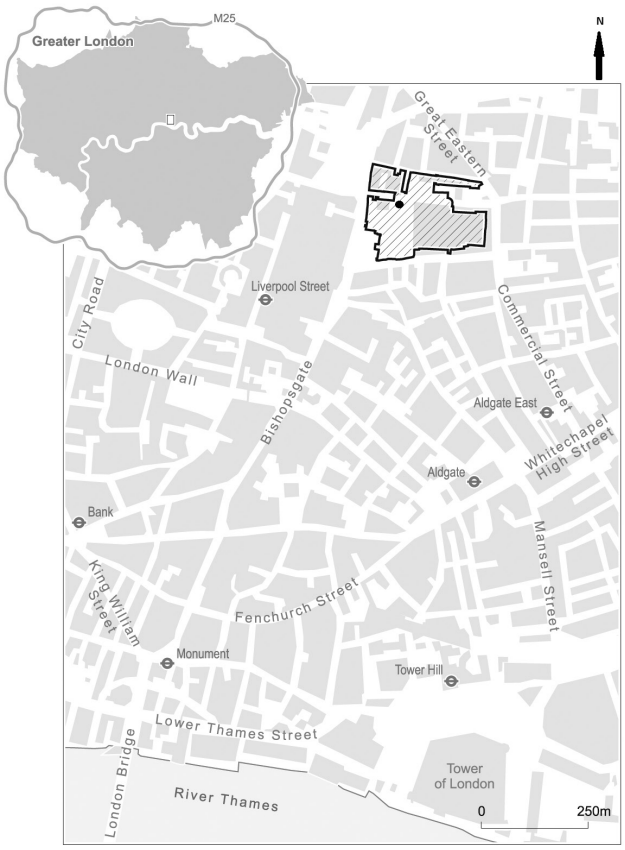

Figure 3. Location of St. Mary Spital (SRP98) within London. © Museum of London Archaeology.

Jantz (2021) and Ross and Pilloud (2021) suggest is not attached to definitions of race and ethnicity, and does provide useful data for identification efforts and biodistance analysis. Therefore, we selected global reference samples from the MMS Databank, representing populations from Europe, North and South Africa, North and Southeast Asia, the Americas, South Pacific Islands, and the Middle East (Hefner and Linde 2018). Five MMS traits with demonstrable heritability estimates were selected to capture cranial morphological variability and ecogeographical patterns of human variation. These data were passed through a classification model to produce a probabilistic estimate of population affiliation for each. Two associated statistics inform our analysis: (1) the accuracy of the models and (2) the probability estimates of each classification. Each model used leave-one-out cross-validation and had accuracies around 75% to 80% (95% CI: 70.1% to 90%) for up to seven reference groups. In general, posterior probability values closer to 1.0 represent more similarity to the reference sample, while lower values suggest less likelihood of a correct classification. At East Smithfield, three individuals had cranial morphologies most similar to the Asian sample, five to the African sample, and 32 to the white European sample. Of the nine plague individuals from St. Mary Graces, two were most similar to the white European sample, three to the Asian sample, and four to the African sample. Nonplague individuals from St. Mary Graces and SRP98 included 87 individuals similar to the white European sample, one individual to the Asian sample, and eight individuals similar to the African sample. Tables 1 and 2 summarize these data for each site. Redfern and Hefner (2019, 2021) provide additional details on this approach and our decision to pool those with white European and Asian population affinity estimates.

Using site archive information and the ancient DNA (aDNA) evidence for *Y. pestis*, it was possible to establish that they were from the emergency burial ground or first phase of burial at St. Mary Graces and, therefore, were plague victims (Table 2). Previous research by DeWitte (2010a, 2014a, 2018) used transition analysis to estimate age-at-death for individuals from MIN86 and SRP98. This method of adult age estimation uses Bayesian statistics to avoid the problem of age-mimicry (i.e., estimates biased toward the known-age reference sample used to derive age estimation methods) that limits conventional methods of age estimation (Boldsen et al. 2002). Importantly, it also yields point estimates of age for all possible adult ages, rather than broad interval estimates with an open-ended terminal category (e.g., > 45 years old), as is the case with conventional methods, thereby allowing for analysis of mortality patterns at advanced ages. Our previous research on selective mortality during the SPP used transition analysis age estimates. Therefore, for consistency, we used these age estimates because transition analysis estimates are less prone to age-mimicry and potentially more informative about mortality patterns at advanced adult ages. Although like most skeletal age estimation methods, the accuracy of this approach is not ideal (see Milner and Boldsen 2012), we have used the same method across all individuals in this study and are less concerned with individual estimates than with the aggregate pattern. Transition analysis age estimates were generated using the Anthropological Database, Odense University (ADBOU) Age Estimation software and selecting the informative "archaeological" prior distribution of ages at death. The archaeological prior, which is based on data from seventeenth-century Danish rural parish records, represents a generalized preindustrial mortality curve and is thus suited to medieval samples (Bullock et al. 2013).

We assess variation in risk of mortality, survivorship, and evidence of exposure to physiological stress across population affinity groups within these cemetery samples. With respect to skeletal markers of physiological stress, we are mindful of the potential

Table 1. List of individuals from St. Mary Spital (SRP98), context (skeleton number), date, burial type, sex, and population affiliation group (PPG). M (male), P.M (probable male), F (female), I (intermediate); SRP98 burial types: A/B/C (attritional cemetery), D (multilayered, horizontal stacked rows within a single grave cut) (Connell et al. 2012:13).

Context	Date	Burial Type	Sex	PPG	Age (years)	Context	Date	Burial Type	Sex	PPG	Age (years)
1334	1200–1250	A	M	White European	20.62	14307	1200–1250	A	PM	White European	34.3
1716	1100–1200	B	F	White European		14493	1400–1539	A	F	White European	27.19
2344	1400–1539	A	F	White European	28.94	14868	1200–1250	A	M	White European	31.46
2487	1400–1539	D	F	White European	51	15030	1200–1250	A	F	White European	19.33
2646	1400–1539	A	PM	White European	33.74	15339	1200–1250	A	M	White European	18.5
2657	1400–1539	A	PM	White European	39.01	17496	1200–1250	A	F	White European	30.09
2679	1400–1539	A	M	African	65.44	19503	1400–1539	D	F	White European	19
2907	1400–1539	A	PM	White European	40.93	19618	1400–1539	A	M	White European	35.74
3037	1400–1539	A	PM	African	35.71	19950	1200–1250	D	F	White European	49.9
3172	1200–1250	A	M	White European	22.46	20082	1200–1250	A	F	African	19.35
3515	1400–1539	A	M	African	24.19	20184	1400–1539	A	PM	White European	36.47
3533	1100–1200	A	F	White European		20255	1400–1539	A	F	White European	36.32
3538	1200–1250	B	F	White European	30.6	20360	1200–1250	A	PM	White European	21
3775	1400–1539	A	F	White European	47.01	20462	1400–1539	A	M	White European	24.88
3934	1200–1250	D	F	White European	59.8	20682	1200–1250	D	M	White European	30.5
5275	1200–1250	A	M	White European	35.31	21011	1400–1539	A	M	White European	33.33
5510	1100–1200	A	F	White European	42.4	21099	1400–1539	A	M	African	19.51
5561	1100–1200	C	F	White European		21273	1100–1200	A	M	White European	
5677	1100–1200	A	F	White European	34.4	21371	1400–1539	A	M	White European	30.28
5794	1100–1200	A	F	White European		21569	1400–1539	A	M	White European	17.5
5869	1100–1200	A	F	White European		22105	1400–1539	A	M	White European	26.14
6427	1400–1539	A	M	White European	34.39	22640	1200–1250	D	F	White European	18
6571	1100–1200	A	M	White European		22648	1200–1250	A	I	White European	23.71
7127	1400–1539	A	F	White European	19.05	23103	1200–1250	A	F	White European	26.6
7266	1400–1539	A	F	White European	29.36	23441	1400–1539	A	M	White European	25.8
7383	1200–1250	A	M	White European	32.79	23448	1400–1539	A	P.F	African	18
7616	1400–1539	A	PM	White European	48.59	23514	1200–1250	D	M	White European	26
7701	1400–1539	A	M	White European	23.56	24010	1100–1200	D	F	White European	30.3
7796	1400–1539	A	F	White European	32.44	24185	1100–1200	D	F	White European	50
7915	1400–1539	A	M	White European	34.17	25492	1200–1250	A	PM	White European	25.44
8264	1400–1539	A	F	White European	30.74	25737	1200–1250	A	M	White European	18.5
9260	1400–1539	A	M	White European	21.94	25832	1200–1250	A	I	White European	18.71
9420	1100–1200	A	F	White European		27177	1400–1539	A	F	White European	18.5
9632	1100–1200	D	M	White European	21.5	27476	1100–1200	A	M	African	
9789	1100–1200	D	M	White European	34.8	29462	1400–1539	A	F	White European	15
10124	1400–1539	A	I	White European	24.99	29698	1200–1250	A	F	White European	31.8
10765	1400–1539	A	F	White European	34.15	30039	1200–1250	A	P.F	White European	16.56
10794	1400–1539	A	PM	White European	76.39	30212	1200–1250	D	M	White European	74.7
11050	1400–1539	A	M	White European	15.49	30448	1200–1250	A	M	White European	20.5
11136	1400–1539	A	M	White European	26.1	30939	1200–1250	A	PM	White European	15
11221	1400–1539	A	F	White European	30.18	31245	1200–1250	A	PM	White European	24.25
11428	1400–1539	A	F	White European	19.71	32091	1200–1250	A	F	White European	44.5
12238	1400–1539	A	M	White European	18.5	32302	1200–1250	D	M	White European	18.5
12714	1200–1250	A	M	White European	29	33167	1200–1250	A	F	White European	31.6
12923	1200–1250	A	I	White European	30.77						

effects of the osteological paradox (Wood et al. 1992), that is, that the presence of stress markers may not be a clear reflection of poor health in this context. Specifically, it is possible that the presence of stress markers may reflect resilience in some people, and the absence of them might reflect low frailty (or "good health"), contrary to conventional interpretations. Previous work on these populations has demonstrated that all of the nonspecific skeletal markers of physiological stress used in this study were related to higher mortality risk during the SPP (DeWitte 2010b, 2014b, 2014c, 2015, 2018; DeWitte and Wood 2008; Godde et al. 2020). Previous work in this context has also demonstrated that although the presence of periosteal new bone formation (PNBF) in general is associated with elevated risks of mortality (DeWitte and Wood 2008), healed PNBF is associated with higher survivorship and thus may reflect resilience (DeWitte 2014). That is, by leveraging age-structured data to overcome some of the potential limitations posed by heterogeneous frailty and selective mortality (DeWitte and Stojanowski 2015; Wood et al. 1992), our previous research has established that these skeletal stress markers are, at least in this context, useful markers of frailty or resilience. Therefore, we used data collected by the second author for presence/absence of linear enamel hypoplasia (LEH) on the left mandibular canine, cribra orbitalia (CO) on the left orbit, and PNBF

Table 2. List of individuals from the Royal Mint site (MIN86) organized by burial ground: East Smithfield (plague burials) and St. Mary Graces (potential plague and nonplague burials), plague score, context (skeleton number), sex (M male, F female) and population affiliation group (PPG) and code, and transition analysis age estimate.

Site Code	Site Name	Plague	Context	Sex	PPG	PPG Code 3 (0: white European, 1: African, 2: Asian)	PPG Code 2 (0: white European/ Asian, 1: African)	Plague Code (0: nonplague, 1: plague)	Age (years)
MIN86	East Smithfield	Plague	5272	M	White European	0	0	1	57.45
MIN86	East Smithfield	Plague	5281	M	African	1	1	1	20.19
MIN86	East Smithfield	Plague	5283	F	White European	0	0	1	17.63
MIN86	East Smithfield	Plague	5285	M	White European	0	0	1	33.28
MIN86	East Smithfield	Plague	5741	F	African	1	1	1	31.16
MIN86	East Smithfield	Plague	5902	F	African	1	1	1	15
MIN86	East Smithfield	Plague	5960	M	White European	0	0	1	31.74
MIN86	East Smithfield	Plague	6428	F	White European	0	0	1	17.9
MIN86	East Smithfield	Plague	6467	F	White European	0	0	1	18.72
MIN86	East Smithfield	Plague	6532	F	White European	0	0	1	38.82
MIN86	East Smithfield	Plague	7065	M	White European	0	0	1	24.05
MIN86	East Smithfield	Plague	7094	M	White European	0	0	1	15
MIN86	East Smithfield	Plague	7163	F	White European	0	0	1	30.69
MIN86	East Smithfield	Plague	7381	F	Asian	2	0	1	15
MIN86	East Smithfield	Plague	8277	M	White European	0	0	1	26.41
MIN86	East Smithfield	Plague	8343	M	White European	0	0	1	32.25
MIN86	East Smithfield	Plague	8427	F	White European	0	0	1	29.01
MIN86	East Smithfield	Plague	9540	M	African	1	1	1	19.8
MIN86	East Smithfield	Plague	9807	F	White European	0	0	1	19.45
MIN86	East Smithfield	Plague	11108	F	Asian	2	0	1	43.1
MIN86	East Smithfield	Plague	11109	F	White European	0	0	1	20.34
MIN86	East Smithfield	Plague	11115	M	White European	0	0	1	28.21
MIN86	East Smithfield	Plague	11118	M	White European	0	0	1	33.52
MIN86	East Smithfield	Plague	11193	M	White European	0	0	1	43.01
MIN86	East Smithfield	Plague	11244	F	African	1	1	1	20.77
MIN86	East Smithfield	Plague	11430	F	White European	0	0	1	28.19
MIN86	East Smithfield	Plague	11625	M	Asian	2	0	1	18.88
MIN86	East Smithfield	Plague	11627	M	White European	0	0	1	18.67
MIN86	East Smithfield	Plague	11857	M	White European	0	0	1	78.13
MIN86	East Smithfield	Plague	11914	M	White European	0	0	1	15
MIN86	East Smithfield	Plague	11944	M	White European	0	0	1	48.5
MIN86	East Smithfield	Plague	12566	M	White European	0	0	1	23.89
MIN86	East Smithfield	Plague	12567	M	White European	0	0	1	39.3
MIN86	East Smithfield	Plague	12643	F	White European	0	0	1	22.66
MIN86	East Smithfield	Plague	12700	F	White European	0	0	1	35.21
MIN86	East Smithfield	Plague	12790	F	White European	0	0	1	45.87
MIN86	East Smithfield	Plague	12813	M	White European	0	0	1	57.18
MIN86	East Smithfield	Plague	12814	F	White European	0	0	1	34.19
MIN86	East Smithfield	Plague	12815	M	White European	0	0	1	15
MIN86	East Smithfield	Plague	20003	F	White European	0	0	1	
MIN86	St. Mary Graces	Potential plague	6272	F	Asian	2	0	1	18.73
MIN86	St. Mary Graces	Potential plague	6371	M	African	1	1	1	17.5
MIN86	St. Mary Graces	Potential plague	6565	F	White European	0	0	1	33.61
MIN86	St. Mary Graces	Potential plague	8015	F	African	1	1	1	21.04
MIN86	St. Mary Graces	Potential plague	8108	M	African	1	1	1	
MIN86	St. Mary Graces	Potential plague	9519	F	African	1	1	1	19.5
MIN86	St. Mary Graces	Potential plague	9901	M	Asian	2	0	1	17.01
MIN86	St. Mary Graces	Potential plague	11030	M	Asian	2	0	1	72.3
MIN86	St. Mary Graces	Potential plague	12664	F	White European	0	0	1	24.47
MIN86	St. Mary Graces	Nonplague	9395	M	White European	0	0	0	
MIN86	St. Mary Graces	Nonplague	9417	M	Asian	2	0	0	75.22
MIN86	St. Mary Graces	Nonplague	9425	M	African	1	1	0	68.21
MIN86	St. Mary Graces	Nonplague	10170	M	White European	0	0	0	17.5
MIN86	St. Mary Graces	Nonplague	12297	F	White European	0	0	0	30.73
MIN86	St. Mary Graces	Nonplague	12339	F	White European	0	0	0	72.24
MIN86	St. Mary Graces	Nonplague	13935	M	White European	0	0	0	35.26

on the left tibia. The first two can only occur during childhood and have multifactorial origins, with LEH reflecting disruptions of ameloblast activity during enamel development (Towle and Irish 2020) and CO often in response to anemia (Brickley 2018). PNBF also has multifactorial origins, such as infection or trauma, but can form at any point during life (Weston 2012). Although these signs of physiological stress have multifactorial origins, making diagnosis of specific etiologies difficult or impossible, bioarchaeological research has demonstrated that they provide crucial insights into stress and, by careful inference, health in past populations (Larsen 2015). Comparison of these skeletal markers across the groups in this study thus has the potential to reveal differences in exposures to physiological stressors or frailty/health based on population affinity.

Statistical analyses

We initially performed analyses comparing all three population affinity groups. We also pooled samples estimated as white European and Asian for all analyses. We did so for a number of supportable reasons, including the weak likelihood estimates among the Asian-estimated sample and preliminary analysis revealing no significant differences in hazards of dying between those with estimated white European and Asian population affiliation (indicating pooling would not result in loss of resolution or reduced power for the overall hazard model). Differences in hazards of dying among the population affinity were assessed using the Cox proportional hazards model. The Cox proportional hazards model evaluates the hazard of an event (in this case, death from plague) and is thus also reflective of survival, with estimated hazard ratios above 1 indicating decreased survival times associated with the variable of interest, and hazard ratios below 1 indicating greater survival times. This semi-parametric model allows for the estimation of differences in hazards of dying (or survival) within a sample based on variables of interest but does not require the specification of a parametric baseline hazard function and is thus suited to the relatively small sample sizes available for this study. For analyses of all three population affinity groups, individuals estimated to be white European were assigned a score of 0, those with estimated African population affiliation were assigned a score of 1, and those with estimated Asian population affiliation were assigned a score of 2. For analysis using pooled data from those with estimated white European and Asian population affiliations, individuals estimated to be white European or Asian were assigned a score of 0 and those with estimated African population affiliation were assigned a score of 1. Following Godde et al. (2020), we applied the Cox model to data from both plague and nonplague burials, using a binary outcome variable of "death from plague" (coded as 1 for individuals buried in East Smithfield or the plague area of St. Mary Graces) or "other cause of death" (coded as 0 for individuals buried in St. Mary Graces >c. 1400, SRP98, c. 1100–1250, and SRP98 c. 1400–1540), with age-at-death as the time scale (Tables 1 and 2). We take an intersectional approach and avoid the assumption that the experiences of people of different population affinities would have been uniform across sex within each population affinity group. To determine whether the intersection of sex and population affinity amplified poor outcomes, we compare survivorship and hazards of mortality separately by estimated sex.

Due to limited sample sizes, differences in numbers of males and females, proportions of individuals of estimated population affiliations, and the presence/absence of skeletal physiological stress indicators among the groups were evaluated using Fisher's exact tests. In some contexts, skeletal indicators of physiological stress have been shown to be associated with age, and previous research has demonstrated that the frequency of PNBF increases with age (DeWitte 2014c; Grauer 1993). It is therefore possible that observed differences between groups in the frequencies of skeletal indicators of physiological stress might be an artifact of the interaction between age-associated skeletal indicators of stress and differences between the age-at-death distributions of those groups, rather than reflecting true differences in exposure to physiological stress. For example, one group might have a higher frequency of PNBF compared to another simply because it has a greater proportion of older adults. To determine whether this might have an effect on our findings, binary logistic regression was used to evaluate the relationship between age and each skeletal indicator of stress used in our study.

All analyses were performed in SPSS. We selected a priori a p-value of less than 0.1 as indicative of a trend worthy of consideration. As in previous work, we chose this alpha level in light of the fact that, as is typical in bioarchaeology, we are working with small sample sizes, and adherence to a conventional alpha level of 0.05 could hinder dissemination of results that might reflect larger population patterns and stimulate additional study.

Results

Analysis of adults from the population affiliation groups (Tables 1 and 2) did not reveal any significant differences among the groups with respect to sex

ratios for either the plague or the nonplague samples. Using data from all three population affiliation groups, there are significantly higher proportions of people of estimated African and Asian affiliation in the plague burials compared to the nonplague burials, as shown in Table 3. Similarly, when using data from the pooled white European/Asian vs. African population affiliation groups, there is a significantly higher proportion of people of estimated African affiliation in the plague burials compared to the nonplague burials (18.4% vs. 8.3%, Fisher's exact $p = 0.076$). The mean ages at death and the corresponding 95% confidence intervals for each group among the plague burials are shown in Table 4. The results of Cox proportional hazards analyses of all three population affiliation groups and of the pooled white European/Asian vs. African population affiliation groups are shown in Table 5. These results indicate that for the female-only sample, individuals of estimated African population affinity have a significantly higher estimated hazard of dying of plague compared to those with estimated white European affinity. There are no significant associations for any of the other comparisons. When we pool people with estimated white European and Asian population affinity, using the pooled-sex sample and the male- only sample, these analyses did not reveal evidence of significant differences in hazard rates between population affiliation groups. However, using the female-only sample, the results indicate that individuals with estimated African affiliation have a significantly higher estimated hazard of dying of plague compared to those with estimated white European/Asian affiliation. This result suggests how intersectionality—the compounded harm of race and gender and misogynoir (Bailey 2021; Crenshaw 1989, 1991)—may have impacted mortality during medieval pandemic disease.

The results of binary logistic regression to evaluate the association between age and each physiological stress indicator for the plague burials are shown in Table 6. As has been shown previously (DeWitte 2014b, 2014c, 2018), there is a significant positive association between age and PNBF. However, neither LEH nor CO are significantly associated with age. Comparison of frequencies of physiological stress between the affiliation groups (Table 7) revealed higher rates of LEH but lower rates of CO and PNBF in individuals with estimated African affiliation and compared to those with white European/Asian affiliation. None of these differences were statistically significant.

Table 3. Frequencies of individuals of each estimated population affiliation group in the plague vs. nonplague burials.

Population Affiliation	Plague	Nonplague	*p*-value
African	9 (18.4%)	8 (8.33%)	0.002
Asian	6 (12.2%)	1 (1.04%)	
White European	34 (69.4%)	87 (90.63%)	
African	9 (18.4%)	8 (8.3%)	0.076
White European/Asian	40 (81.6%)	88 (91.7%)	

Table 4. Mean ages at death in years (and corresponding 95% confidence intervals) for each population affiliation among plague burials.

Population Affiliation	Mean Age at Death	95% CI
White European ($n = 33$)	31.435	26.621–36.249
African ($n = 8$)	20.620	17.362–23.878
Asian ($n = 6$)	30.837	12.586–49.087
White European/Asian ($n = 39$)	31.34	26.52–36.17
African ($n = 8$)	20.62	17.36–23.88

Table 5. Cox proportional hazards analysis results comparing (a) all three population affiliation groups and (b) white European/Asian and African: hazard ratios, Exp(β), with corresponding 95% confidence intervals. The asterisk indicates, for each comparison, which population affiliation is the reference group; significant results are indicated in bold.

a	Population Affiliation	Exp(β)	95% CI	*p*-value
Pooled sexes	White European* ($n = 111$) and African ($n = 15$)	1.323	0.765–2.288	0.317
	White European* ($n = 111$) and Asian ($n = 7$)	0.699	0.319–1.529	0.37
	African* ($n = 15$) and Asian ($n = 7$)	0.613	0.215–1.747	0.36
Female	White European* ($n = 47$) and African ($n = 7$)	3.21	1.373–7.506	**0.007**
	White European* ($n = 47$) and Asian ($n = 3$)	1.532	0.470–4.997	0.479
	African* ($n = 7$) and Asian ($n = 3$)	0.699	0.141–3.464	0.661
Male	White European* ($n = 60$) and African ($n = 8$)	0.932	0.439–1.977	0.854
	White European* ($n = 60$) and Asian ($n = 4$)	0.598	0.211–1.692	0.332
	African* ($n = 8$) and Asian ($n = 4$)	0.426	0.086–2.110	0.296
b				
Pooled sexes	White European/Asian* and African	1.374	0.798–2.366	0.252
Female	White European/Asian* and African	2.995	1.290–6.950	**0.011**
Male	White European/Asian* and African	1.029	0.488–2.167	0.941

Table 6. Results of binary logistic regression of age and each physiological stress indicator among plague burials. LEH (linear enamel hypoplasia), PNBF (periosteal new bone formation).

Pathology	Exp(β)	95% CI	*p*-value
LEH ($n = 39$)	1.004	0.95–1.07	0.88
PNBF ($n = 28$)	1.13	1.02–1.26	0.018
Cribra orbitalia ($n = 35$)	0.974	0.91–1.04	0.45

Table 7. Frequencies of physiological stress indicators and *p*-values from Fisher's exact tests of differences among population affiliations (plague burials). LEH (linear enamel hypoplasia), PNBF (periosteal new bone formation).

Pathology	White European	Asian	African	*p*-value
LEH	21/26 (80.8%)	1/4 (20%)	8/8 (100%)	0.005
PNBF	6/20 (30%)	0 (0%)	1/5 (20%)	0.803
Cribra orbitalia	8/26 (30.8%)	0 (0%)	1/7 (14.3%)	0.804

Discussion

These results suggest that, at least for females, individuals with estimated African affiliation faced higher hazards of dying of plague compared to individuals of estimated white European affiliations of similar ages. The higher observed rates of LEH in individuals in the plague burials with estimated African (100%) compared to those with white European/Asian population affiliation (71%) might be an artifact of small sample sizes. Alternatively, this might reflect differences in either exposure to stressors or survival of acute physiological stress during childhood, potentially reflecting enslavement/unfreedom.

For past populations, just as much as for living populations, it is essential that we are careful to avoid the incorrect and harmful implication that there is a biological basis of race, and we actively oppose the incorrect inference that there is something inherent to people assigned to a certain racial category that makes them more vulnerable to disease. Instead, we emphasize here that variation by race in susceptibility to and hazard of dying from disease reflects the biological and psychosocial effects of racism, which was present in the medieval world (Heng 2018a); race is a social classification and is not based in biological reality, but it does have biological consequences (American Association of Biological Anthropologists 2019; Fuentes and Rouse 2016; Gravlee 2009; Lans 2020; McLean 2019; Weheliye 2014).

The data that we have analyzed here reveal that Black women, because of the structural harm of misogynoir, had a higher risk of SPP death. But what are the potential contexts of this higher risk? Along with anti-Blackness and misogyny, these women would have dealt with issues around class because they would have primarily been in the working class, especially domestic labor. The use of a Black feminist methodology has meant that we can now analyze these data specifically with a "multi-issue" lens. We point to Crenshaw's discussion of how intersectionality works in relation to discrimination and compounded harm as a way to consider why Black women would have been at higher risk:

> The point is that Black women can experience discrimination in any number of ways and that the contradiction arises from our assumptions that their claims of exclusion must be unidirectional. Consider an analogy to traffic in an intersection, coming and going in all four directions. Discrimination, like traffic through an intersection, may flow in one direction, and it may flow in another. If an accident happens in an intersection, it can be caused by cars traveling from any number of directions and, sometimes, from all of them. Similarly, if a Black woman is harmed because she is in the intersection, her injury could result from sex discrimination or race discrimination. (Crenshaw 1989:149)

However, in our case with our data, we would like to add to the sentence "if a Black woman is harmed because she is in the intersection, her injury could result from sex discrimination or race discrimination," the issue of class discrimination and disability discrimination.

Because of the white imaginary in relation to the Black population's erasure in medieval England, there is little scholarship that discusses the contours of the labor of Black women. However, if we look at the scholarship in early modern England, the discussion is more robust and has pointed to Black women primarily being working class, especially as domestic labor (Akhimie 2018; Brown 2021). A Black woman's situation in domestic service also brings up the specter of labor theft, hard manual labor, as well as sexual harassment, coercion, if not assault because of her status as household servant. Harris (2022) speaks of this most in relation to Chaucer and the recent reassessment happening in regards to his "rape/*raptus*" case that involves Cecily Chaumpaigne. As she discusses "the numerous female servants" in Chaucer's oeuvre, she explains that "We must think about how these figures are subject to assumptions about women's labor and who owns it, how they embody gendered vulnerability, and how they are expected to subordinate their wills to those of others" (Harris 2022:477). Harris (2022:477) further points to Phipps's (2020:141–142) work on "*raptus*" (the very wide term for rape that included abduction to physical assault in

the Middle Ages) occurring in court cases "involving servant women in late medieval town courts" (Phipps 2020:141–142). She also examines Lewis's (2016) work on the osteology of medieval "urban servant women" to discuss how the gender and class discrimination manifested in these women's remains. She quotes Lewis's conclusion: "There are suggestions that domestic service caused strain on the legs and backs of the urban females. . . . Overall it was the urban females that carried the burden of respiratory and infectious diseases, suggesting they may have been the most vulnerable group in medieval society" (Harris 2022:478; Lewis 2016:138–171). The osteological discussion aligns with what our data show in relation to infectious pandemic disease. The osteological information also reveals the ways in which urban servant women would have been prone to physical disability because of their manual labor work and exposure to disease. Harris (2022) finishes this section of her article to point to the many scholars who have discussed the sexual vulnerability of domestic women servants in the late Middle Ages (see Kettle 1995; McIntosh 1984; Werner 2016). We can further speculate about the lives that these women may have lived and even their potential literacy if we consider Phillips's recent work (2022, 2023) on Black servants and their consumption of conduct books in early modern Europe.

All these contextual considerations and speculations would not have been possible without a Black feminist bioarchaeological methodology. For example, if we were to revisit Lewis's (2016) group of women's remains analyzed as part of "Work and the Adolescent in Medieval England (AD 900–1550): The Osteological Evidence," and we used a Black feminist methodology that included race as an analytic category, what further nuance in the bioarchaeological analysis could we find? What could align with our current discussions about misgnoir and intersectionality?

Conclusions

We are currently witnessing, on a horrifying scale, the biological effects of racism in the COVID-19 pandemic. Evidence is emerging that Black communities across the Global North comprise an alarmingly disproportionate number of cases and deaths (Fuentes 2020; Paton et al. 2020; Rossen et al. 2020). Pirtle (2020) compellingly argues that this demonstrates the effects of racial capitalism increase the risk of comorbid conditions in Black Americans (see African American Policy Forum 2020).

Clearly, medieval England, and the embodied experiences of London's racialized Black population, as attested in the primary sources (Adi 2019), and based on preliminary data from a sample of 89 individuals from two cemeteries, who appear to make up 20% to 30% of the population (Redfern and Hefner 2021), are not directly comparable to modern populations. However, this study's results suggest that the health outcomes of structural and anti-Black racism we see today might have had parallels during the SPP.

This study's findings, in addition to improving how we understand the history of racialized marginalization's effects on human health and mortality, highlight the heterogeneity that exists within the human remains that we rely on to reconstruct premodern life. Much of the variation in frailty and embodied experiences present in archaeological human remains is largely hidden from our view (DeWitte and Stojanowski 2015; Wood et al. 1992). Our previous work focused on those variables most often utilized in bioarchaeology: age, sex, and pathological conditions. But the patterns revealed by analyzing just those data mask a tremendous amount of underlying variation and the outcomes of intersections across varied biosocial dimensions. By applying multiple analytical approaches to and lines of evidence from these skeletal samples, we have the potential to uncover some of that once hidden heterogeneity to better understand the forces that shaped past lives. We also argue that the way forward in medieval bioarchaeology is with a Black feminist methodology, which we believe has revealed an example of how intersectionality works in relation to pandemic disease.

We recommend that intersectionality and critical race theories become integrated into medieval bioarchaeological studies, as well as the pandemic necropolitics seen in certain premodern racialized communities. Although not without issue, we hope that geographically, temporally, and local, condition-specific MMS can make a contribution to reassessing the medieval European archive of remains, documentary, and visual evidence. We believe Black feminist methodology is foundational to narrate the lived experience of Black people, whose substantial premodern English community has been elided and erased.

We conclude here by taking a small step and cue from Hartman's (2019) "Wayward Lives" to methodologically reimagine one Black woman from our study here and resituate her in the space of medieval London. This is just a sketch of possibilities and the strands that can be pulled to begin piecing a counternarrative of a medieval Black London. In Chaucer's Cook's Tale, Perkyn Revelour plans to move in with his gambling friend and his sex-worker wife—the living situation suggests a potential polyamorous relationship. He is described earlier as carousing with a "wench," gambling, and playing music. In these short lines, we get a picture of medieval London's urban

street culture, where Perkyn watches the parades in Cheapside and gets himself locked up in Newgate prison on occasion. Harris (2019) has written and discussed the contours of racialized and gendered terminology around the word *wench* in relation to transatlantic chattel slavery in the British and American context. *Wench* was a reference to Black women servants (i.e., ones who were enslaved) who were seen as "sexually available" in nineteenth-century American media. Harris (2019) does a philological deep-dive into the development of *wench* in late medieval English. Specifically in Chaucer, they reveals how its use always references the social hierarchy of servant, below a lady (Merchant's Tale), and consistently is coupled with sexual availability (Merchant's Tale), including that of toxic rape culture and gender-based sexual violence (Reeve's Tale). Can Perkyn Revelour's "wench" be another Black woman servant also working and living in the London streets but finding time to dance, play dice, and drink with a medieval Black cook? Can we imagine her in Hartman's (2019) opening to *Wayward Lives* but in London's fourteenth-century urban streets filled with brothels, shops, outdoor dice games, and taverns selling beer:

> You can find her in the group of beautiful thugs and *too fast* girls congregating on the corner and humming the latest rag, . . . Watch her in the alley passing a pitcher of beer back and forth with her friends. . . . Step onto any of the paths that cross the sprawling city and you'll encounter her as she roams. (Hartman 2019:3)

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