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Trends in mortality and biological stress in a medieval polish urban population

Tracy K. Betsinger[a,*], Sharon DeWitte[b]

[a] SUNY Oneonta, Department of Anthropology, 108 Ravine Parkway, 138 Physical Sciences Oneonta, NY, 13820, USA
[b] University of South Carolina, Department of Anthropology, 817 Henderson Street, Gambrell 440, Columbia, SC, 29208, USA

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ABSTRACT

Urbanization in pre-modern populations may have had a variety of consequences related to population crowding. However, research on the effects of urbanization have provided inconsistent results regarding the biological impact of this transition on human populations. The purpose of this study is to test the hypothesis that urbanization caused an increase in overall biological stress in a medieval (10th–13th centuries AD) Polish population. A human skeletal sample (n = 164) was examined for the presence of porotic hyperostosis, cribra orbitalia, linear enamel hypoplasia, periosteal reaction, and specific infectious diseases. Prevalence rates were compared among three temporal samples: initial urbanization, early urbanization, and later urbanization. Results indicate no significant trends for any of the pathological conditions. Cox proportional hazards analyses, however, revealed a significant increase in the risk of death over time, which supports the hypothesis. These results reflect the necessity of using multiple analyses to address bioarchaeological questions. The lack of significant results from skeletal indicators may be due to an earlier urbanization trend in the population. This study illustrates that the association of urbanization with elevated biological stress is complicated and dependent on various factors, including culture and time period.

1. Introduction

Urbanization is one of the most significant changes in the last 10,000 year of human history. Today, over 50 percent of the modern global population resides in urban areas (United Nations, 2012; World Health Organization, 2010). Much contemporary urban growth is occurring in developing nations (e.g., Leon, 2008; United Nations, 2012), and substantial concerns have been outlined regarding the possible health impacts of such population accumulation, including especially the facilitation of the spread of infectious diseases in large agglomerated communities lacking in sanitation and adequate nutrition (Leon, 2008; United Nations, 2006; World Health Organization, 2007, 2010). While the possible negative consequences of a large, global, urban population have been argued by national and international organizations, the positive attributes of urban life have simultaneously been recognized by a variety of social scientists (Leon, 2008). In fact, it can be argued that urban centers have been the "…drivers of commercial, scientific, political and cultural life…" (Leon, 2008: 4), offering better employment, security, and in some cases better health care (Moore et al., 2003; World Health Organization, 2010). Although contemporary concerns regarding the health impact of urbanization are well known (e.g., World Health Organization, 2010), the consequences of urbanization for health in historic periods prior to the modern era are not especially well known.

Various bioarchaeological studies comparing rural-urban differences from European contexts have drawn differing conclusions (e.g., Budnik and Liczbińska, 2006; Gamble, 2014; Kaupová et al., 2014; Krenz-Niedbała and Łukasik, 2016; Lewis, 2002; Perrone, 2014; Redfern et al., 2015; Sundman and Kjellström, 2013) A study of Roman period cemeteries in England reveals higher frequencies of some, but not all, skeletal stress markers in urban vs. rural populations; estimated risks of mortality were higher for urban subadults compared to their rural peers, but the adult risks of mortality were lower in urban vs. rural areas (Redfern et al., 2015). These results suggest that the effects of urbanization on health varied by age in Roman Britain. Walter and DeWitte (2017) found that in medieval England (c. 1120 − 1539), urban adult females faced elevated risks of mortality and lower survivorship, and by inference poorer health, compared to rural females; however, survivorship and risks of mortality were not significantly different between urban and rural adult males, suggesting that urban environments in this period were more hazardous for women than men. Lewis (2002) found that urbanization did have some impact on

* Corresponding author.
E-mail addresses: Tracy.betsinger@oneonta.edu (T.K. Betsinger), dewittes@mailbox.sc.edu (S. DeWitte).

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Fig. 1. Location of Poznań in modern Poland. Adapted from the Regional Environmental Center for Central and Eastern Europe. http://www.rec.org/REC/Maps/pol_map.html

morbidity and mortality for subadults in medieval and post-medieval England, but that industrialization was more significant. The growth profiles of urban and rural subadults were very similar and there were no significant differences in the frequency of stress indicators. However, when severity and age-at-death were taken into consideration, there was evidence of more stress in the urban sample (Lewis, 2002). Gamble (2014), on the other hand, could find no consistent patterns in stress indicators between rural and urban samples from medieval Danish populations. Krenz-Niedbała and Łukasik (2016), in their study of maxillary sinusitis in subadults from medieval and post-medieval Poland, found no significant differences between rural and urban samples, which they argue may be due, in part, to the similar indoor exposure to air pollutants for both groups. Few studies (e.g., Daverman, 2008; Peck, 2009; Roberts and Cox, 2007) have investigated how the process of urbanization has impacted the health of a single population undergoing the transition, at least from a bioarchaeological standpoint (although see Larsen et al., 2015). The variable findings from previous bioarchaeological studies suggest that the impact of urbanization varied temporally and geographically and was likely dependent on local environmental conditions as well as on sociocultural factors, as emphasized by critics of the broad association of modern urbanization and declining health (Leon, 2007). Contemporary populations undergoing urbanization experience varying impacts on their health owing to a range of factors, such as where the greatest levels of poverty are found, vaccination coverage, and availability of treatments like oral rehydration therapy (Leon, 2007). While these factors are not necessarily applicable in historic populations, others may be relevant, such as population density, regular and ample food supply, palliative care, and access to clean drinking water.

Investigation of urbanization's impact on population health requires careful contextual analysis in addition to the reporting of comparative analyses. Skeletal samples from medieval Poland (10th-13th centuries AD) provide an opportunity to document and interpret the impact of urbanization on a geographically constrained population, for which archaeological and historical data are available to provide the necessary context. We note that in light of the complex nature of and difficulty of assessing health even for living people and the uncertainty that exists regarding the association between observable skeletal lesions and health (DeWitte and Stojanowski, 2015; Reitsema and McIlvaine, 2014; Temple and Goodman, 2014; Wood et al., 1992), in this study, we interpret skeletal lesions and demographic trends as measures of biological stress rather than health *per se*.

1.1. Medieval Poland (10th-13th centuries AD)

The medieval period in Poland was characterized by numerous political, religious, and other societal changes. Mieszko I (CE 960-992), a Piast ruler and duke of the Polanian state in the 10th century AD, transitioned the region from pagan beliefs to Christianity commencing with his baptism in CE 966. This action was primarily political, as it facilitated a wide coalescence of the country's independence and sovereignty (Davies, 1982; Gieysztor et al., 1968; Manteuffel, 1982). Under his centralized ducal rule, Mieszko I established "castle-towns" or *gróds*, which served as residences for ducal representatives (Gieysztor et al., 1968). *Gróds*, which usually included a stronghold, served an important role as the seat of governing dukes, which were accompanied by their courts, administrative officials, and fiscal authorities (Celka, 2007). In addition, a military garrison was established in each *gród* for the protection of the local lord as well as to enforce the commands of the lord or duke within the local populace (Celka, 2007; Gieysztor et al., 1968). During the 10th and 11th centuries, *gróds* and the territories surrounding them were an important settlement pattern as the large and fortified *gróds* served as local administrative centers (Koter and Kulesza, 1999). The stronghold had several adjacent ancillary settlements, many of which were also fortified (Buko, 2008). In conjunction, there were settlements of traders and craftmen that were attached to the *gróds*, providing services for the entire territory, enabling these settlements to become the most important centers of craft and trade for a region (Koter and Kulesza, 1999).