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The air we breathe: a study into the impact of historical socioeconomic changes on the respiratory health of past Dutch populations (ca. 470-1850 CE)

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Summary

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Chapters 1 and 2

The first two chapters of this dissertation outline the research's objectives and scope, providing comprehensive clinical and paleopathological insights into the respiratory diseases under study (i.e., sinusitis, ear infections, and pleural inflammation).

Today, the global burden of respiratory disease is staggering, impacting millions and carrying significant mortality risks. Respiratory diseases range from mild ailments to severe, life-threatening conditions, with respiratory health risks further exacerbated by rapid urbanization and industrialization, primarily due to rising levels of air pollution. However, while respiratory diseases linked to poor air quality are often seen as a product of the modern world, historical records show that such conditions have been present since ancient times. Specifically, it is believed that the rapid urbanization of Europe in the late- and post-medieval periods significantly contributed to the spread of respiratory infections, with poorer and industrialized populations suffering higher rates of illness than their wealthier, less urbanized counterparts. While previous historical and archaeological research has shaped the trope of life dramatically worsening with urban development, it should be noted that urbanization and industrialization unfolded unevenly across Europe. This complicates efforts to assess how diverse patterns of urbanization influenced human health, as variations in socioeconomic conditions, environmental contexts, and running economies are seldom comprehensively examined. In this framework, osteoarchaeology (i.e., the study of human skeletal remains from archaeological contexts) is particularly relevant, as it allows researchers to examine health data at the level of an individual, thus providing a more nuanced view of the past. This dissertation examines archaeological human skeletons from 13 Dutch populations to explore how factors linked to urbanization (e.g., socioeconomic disparities, running economies, tobacco use) influenced respiratory health, providing a more accurate perspective on historical infectious disease patterns in historical Netherlands.

Chapter 3

Chapter 3 presents diachronic data on the prevalence of various respiratory diseases (i.e., chronic maxillary sinusitis, infectious middle ear disease, and pleural inflammation) among six Dutch populations spanning the early-medieval to post-medieval periods. The overall increasing rates of respiratory diseases over time observed in this study suggest that the expanding urban environment progressively affected population health negatively, both within cities and in the countryside. These findings emphasize the importance of addressing urban and rural environments not as isolated entities, but as interconnected realities, whose development and challenges constantly influenced one another and shaped the health of their inhabitants. Chapter 3 provides an extensive temporal analysis of Dutch urbanization, investigating disease patterns across a millennium-long timeframe. This approach underscores the significance of studying

urbanization as an ongoing process rather than a singular, fixed event, thereby providing a more nuanced context for understanding its implications for historical human health.

Chapter 4

Chapter 4 focuses on the relationship between socioeconomic status and (respiratory) health, aiming to investigate how varying economic circumstances impacted citizens' health. The paper presented in this chapter tests the hypothesis that poorer individuals were more adversely affected by the urban environment than their wealthier counterparts. This is assessed through the presence of non-specific stress markers and chronic maxillary sinusitis in four urban post-medieval populations representing various socioeconomic statuses. Contrary to expectations, the analysis presented in Chapter 4 reveals that differences in prevalence rates were not strictly tied to socioeconomic status, but rather seemed to reflect lifestyles. While sinusitis prevalence rates were relatively consistent across most socioeconomic classes, they were significantly lower among middle-low status individuals. These individuals (specialized workers such as shipbuilders, artists, and market stall owners) likely spent more time outdoors than other socioeconomic groups, and historically maintained greater autonomy over their daily routines, unlike industrial workers or members of the elite, whose lifestyles often involved more sedentary indoor activities.

These findings underscore the complex interplay between socioeconomic status, lifestyle, and health, challenging the traditional notion that poorer individuals faced exclusively hazardous health conditions while the wealthy were largely unaffected by the urbanizing environment. Instead, the results presented in Chapter 4 suggest that lifestyle factors played a more significant role than wealth in shaping (respiratory) health, offering a more nuanced perspective on the challenges of urban populations in the past.

Chapter 5

Chapter 5 focuses on the Dutch coastal region of Zeeland, which stood among Europe's most urbanized areas until the 17th century, largely due to its flourishing maritime international trade networks. During this period of economic prosperity, the population benefitted from improved employment opportunities and comparatively better working conditions than elsewhere in the Netherlands. However, it is likely that the rapid growth of Zeeland's urban centers also posed challenges, particularly regarding access to essential resources such as food, clean water, and housing. By the 19th century, Zeeland experienced a sharp economic decline as maritime trade waned, leading to significant de-urbanization and a drastic reduction in its urban population.

This chapter examines how these shifts in urbanization and economic conditions influenced the health of Zeeland's inhabitants over time. Specifically, it analyzes the prevalence of chronic maxillary sinusitis and non-specific stress markers in a sample of 246 individuals from three sites dating from 1030 to 1800 CE. The results reveal significant differences in the prevalence of health markers between the medieval and post-medieval periods, with notably higher rates during times of urban and economic decline. These findings suggest that de-urbanization in the 19th

century negatively impacted respiratory health and overall wellbeing, likely due to deteriorating working conditions and reduced food availability.

By exploring a context of urban decline rather than the commonly studied thriving industrial settings, this study contributes to a broader understanding of the complexities of urbanization in bioarchaeological research. Together with Chapter 3, Chapter 5 highlights the diachronic complexity of urbanization and socioeconomic changes, offering valuable insights into their long-term effects on public health in the Netherlands across different historical contexts and economic systems.

Chapter 6

According to clinical research, children are particularly susceptible to respiratory diseases due to various physiological and behavioral factors. Chapter 6 examines this susceptibility by analyzing chronic maxillary sinusitis in non-adults from 13 Dutch sites spanning the medieval and post-medieval periods. The study investigates how increasing urbanization, living environment (rural vs. urban), and socioeconomic status influenced childhood respiratory health. Results show that post-medieval non-adults were nearly three times more likely to develop sinusitis than their early-medieval counterparts, with adolescents being particularly affected, experiencing an eightfold increase in risk. While the aim of this study was to explore how urbanization impacted non-adults specifically, adolescents' increased susceptibility likely reflects exposure to adult-like working and living conditions. These results underscore the role of societal and temporal changes in shaping respiratory health rather than specific social or environmental contexts.

Chapters 7 and 8

Today, tobacco use is a well-documented major risk factor for respiratory diseases, significantly contributing to conditions like sinusitis, otitis, lung disease, and other chronic respiratory issues. Despite its importance, the impact tobacco had on past populations remains to date severely underexplored in bioarchaeological research. To address this gap, Chapter 7 focuses on osteologically distinguishing smokers in four diachronic skeletal assemblages, providing new insights into the historical impact of tobacco use. The findings challenge prevailing historical narratives by demonstrating that tobacco consumption transcended socioeconomic boundaries and was widely popularized already before 1630 CE, contrary to previous assumptions stemmed from written and visual sources. This study also argues that smoking was not an exclusively male practice, as substantial female participation was observed across all analyzed post-medieval sites.

Building on these perspectives, Chapter 8 investigates whether smokers that were identified osteologically were more susceptible than non-smokers to respiratory diseases by analyzing individual-level patterns of chronic maxillary sinusitis, infectious middle ear disease, and pleural inflammation. In less industrialized contexts, smokers were found to be five times more likely to develop sinusitis and three times more likely to experience pleural inflammation compared to non-smokers. However, these significant differences were not observed in more industrialized

settings, suggesting that additional factors such as air pollution and poor living or working conditions likely exacerbated respiratory health challenges. These findings are particularly significant in the context of this study, as they highlight the interplay between tobacco smoke and environmental factors, providing critical insights into how diverse living conditions shaped health challenges in the past as well as in the present.

Chapter 9

The final chapter of this dissertation reflects on the contributions this study offers to the understanding of the complex relationship between respiratory diseases and environmental, social, and economic factors in historical Dutch populations. It highlights how changing living situations (e.g., increasing/decreasing urbanization, socioeconomic developments, and tobacco use) shaped respiratory health over time, while also emphasizing the challenges of addressing the various risk factors that likely coexisted and interplayed in the same environment. This work offers a unique context for understanding health patterns over more than a millennium, emphasizing the complexities of human behavior and their contributions in shaping health outcomes. Ultimately, it advocates for more interdisciplinary, comprehensive, and nuanced approaches to studying the effects of historical urbanization on human health, aiming to achieve a more complete understanding of the past while better addressing contemporary health challenges.