The Social Costs of War: Investigating the Relationship between Warfare and Intragroup Violence during the Mississippian Period of the Central Illinois Valley

by

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ABSTRACT

War exacts a great social cost, not only upon its direct participants, but also upon the lives of the friends, family, and community of those who experience it. This cost is particularly evident in the increased frequencies of aggressive behaviors, including homicide, assault, and domestic violence, enacted by Western military veterans with posttraumatic stress disorder (PTSD). Similarly, among contemporary non-Westernized peoples, a cross-cultural conducted by Ember and Ember (1994) found a relationship between war and various forms of intragroup violence, including domestic violence, assaults, homicides, and violent sports. It is unknown, however, if this positive association between warfare and intragroup violence extends longitudinally for prehistoric populations uninfluenced by modern states.

To test Ember and Ember’s (1994) results in an archaeological culture, this study examines whether or not an association between war and intragroup violence was present during the Mississippian Period (ca. AD 1000-1450) of the Central Illinois Valley (CIV). The Mississippian Period of the CIV represents an ideal context for examining war and violence questions, as considerable evidence of war and violence has been amassed from archaeological and bioarchaeological analyses. High rates of skeletal trauma, fortification construction, and the placement of habitations sites in defendable areas indicate war was of particular concern during this period. Yet, little is known regarding the diachronic and synchronic variation in violence in this region.

In this research, skeletal remains representing 776 individuals from five CIV sites (Dickson Mounds, Larson, Berry, Crable, and Emmons) were analyzed for violence-related skeletal trauma, biodistance, and mortuary data. From the aggregation of these
data, two models of intergroup violence and two models of intragroup violence were explored. The intergroup models examined were: 1) warfare victims from the local community and 2) warfare captives. The intragroup models assessed include: 1) domestic violence and 2) male-male fights. Results support the hypothesis that as intergroup violence increased during the Mississippian Period in the CIV, intragroup violence increased concomitantly. While warfare and intragroup violence occurred in low frequencies early in the Mississippian Period, after AD 1200, both intragroup and intergroup violence were likely endemic.
DEDICATION

To Jake
ACKNOWLEDGEMENTS

I owe tremendous gratitude to the Illinois State Museum for providing access to the Dickson Mounds, Larson, Crable, Emmons, and Berry skeletal collections. Dawn Cobb has been a wonderful friend, host, and research partner. She allowed me to take over her lab (and sometimes her home) while conducting research in Springfield. Terry and Claire Martin helped with collections access and were the best Springfield social ambassadors. I miss our Friday jazz nights. Alan Harn deserves a particular debt of gratitude for sharing his unpublished data and his knowledge of the archaeology of the Central Illinois Valley. Bonnie Styles, Jeffrey Saunders, Deanne Watt, Leslie Cline, and Becky Dyer also helped facilitate my research at the museum. Although the museum is such an irreplaceable resource, as of this writing, it is facing closure by the governor of Illinois, Bruce Rauner. There is no greater loss for the natural and cultural history of the state, as resources like the museum are too precious to lose.

I truly appreciate the guidance, support, and hard work of my chair, Jane Buikstra, and committee members: Katherine Spielmann, Christopher Carr, and George Milner. Each of them has pushed me to improve my scholarship and have helped develop the ideas in this dissertation. Special thanks goes to Lynne Goldstein for supplying the idea to conduct violence research on skeletal collections from the Central Illinois Valley. Thanks to Ashley Evans and Garrett Fox for helping with the figures in this dissertation. I also have had so many wonderful friends and colleagues during my stay at Arizona State University. There are too many to thank by name, but I will always appreciate our time at ASU together.
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CHAPTER 1 – INTRODUCTION

As veterans of contemporary wars in Vietnam, Afghanistan, and Iraq have returned to civilian life, researchers have documented high frequencies of homicides, assaults, and domestic violence perpetrated by these former soldiers with posttraumatic stress disorder (PTSD) (e.g., Beckham et al. 1997; Freeman and Roca 2001; Marshall et al. 2005; Sherman et al. 2006; Shin et al. 2012). Similarly, high rates of intragroup violence have also been noted in non-Western societies that participate in warfare. Ember and Ember (1994) identified strong correlations between warfare and homicides and assaults cross-culturally in non-state societies. They hypothesize that once soldiers are socialized for warfare, they continue to act violently in other aspects of life even after warfare-related conflict has ended (see also Ember and Ember 2007). Their findings are concordant with a number of ethnographic and sociological studies that link warfare to increased incidences of assault and homicide (e.g., Russell 1972; Eckhardt 1973), greater frequencies of war-like sports (Sipes 1973; Chick et al. 1997; Chick and Loy 2001), and wife beating (Levinson 1989; Erchak and Rosenfeld 1994).

Although a positive association between warfare and intragroup violence for contemporary societies has been established, as Ember and Ember (1994, 1995, 1997) have stated, additional research is required to evaluate whether this association also occurred in prehistoric cultures. Such an examination is necessary because, as Ferguson (1990) has critiqued, modern state influence may have increased the bellicosity of the non-state warfare described in ethnographic and ethnohistoric studies. Ethnographic analogies may not, therefore, accurately describe non-state prehistoric peoples living prior to the development of Western colonialism. Ferguson (2013) has also recently
expanded his criticism, arguing that archaeologists have overestimated the evidence for prehistoric warfare, causing exaggerations of war’s effects on mortality and social life.

To test the strength of the association between warfare and violence in prehistory, this study investigates the following research question:

Is an increase in intragroup physical violence associated with warfare in precontact non-state societies?

I examine this problem using bioarchaeological data from 780 individuals dating to the Mississippian Period (ca. AD 1050-1425) of the Central Illinois Valley (CIV), Illinois. These individuals are sampled from five CIV sites, Dickson Mounds, Berry, Larson, Crable, and Emmons, and represent each of the four Mississippian subphases in the region.

The Mississippian Period in the United States Midcontinent and Southeast is an ideal context to study the research question, as archaeological evidence suggests it was a period of intense war and violence (e.g., Dye 1995, 2006; Emerson 1997, 2007; Milner 1999; Blitz 1999; King 1999). In the Central Illinois Valley, Mississippians erected fortifications and established their settlements in defensible locations to protect themselves during war (Santure 1981; Conrad 1991; Harn 1994). High frequencies of skeletal trauma resulting from interpersonal violence are associated with archaeological evidence for war in the region (Steadman 2008; Neumann 1940; Milner et al. 1991). Despite large museum collections of Mississippian skeletons, few population-level studies of skeletal trauma have been conducted to assess the ubiquity of war during this time. This study does just that by investigating samples dating throughout the early and late Mississippian Period.
Identification of intragroup and intergroup violence required the use of behavioral models constructed from ethnohistoric reports of violence among Native Americans after European contact (e.g., Thwaites 1898-1901; Swanton 1946) and patterns identified in other Native American bioarchaeological research (e.g., Martin and Akins 1991; Milner 1991, 1999). In this research, I explore two models of intergroup violence and two models of intragroup violence. The intergroup models distinguish between members in the community killed locally in warfare from members of enemy groups taken as captives. In contrast, the intragroup models, domestic violence and male-male fights, differentiate assaults on women and men, respectively.

To explore these models, three primary research methods are employed in this research. First, each individual is assessed for interpersonal violence-related skeletal trauma. Trauma frequencies, type, and time since insult are analyzed in conjunction with the individual’s age and sex. Next, biological distance (biodistance) analysis is conducted using dental cervical measurements (Hillson et al. 2005) to estimate the phenotypic relationships between individuals in the sample. Finally, a mortuary analysis examines patterns of burial type, corpse position, and associated funerary artifacts between individuals who exhibit trauma and the rest of the cemetery sample.

Definitions

Because violence is a culturally constituted phenomenon (Whitehead 2004), it may be enacted in myriad forms beyond physical harm (e.g., Galtung 1969, 1990; Riches 1986). Each culture may interpret different acts as being violent or not violent (e.g., witchcraft or sorcery) and legitimate or illegitimate (Riches 1986; Walker 2001). As skeletal trauma is a physical correlate of violent behavior, however, this research is
limited to identification of physical violence. Physical violence consists of numerous behaviors, such as “homicide, ritualized combat, hand-to-hand fighting, scalping, sacrifice, cannibalism, domestic abuse, warfare” (Martin and Frayer 1997:xvi), that cause death or bodily harm. A single episode of physical violence may include one of these acts in isolation or multiple acts together.

Here, intragroup violence is defined as what Ember and Ember (1997:3-4) called “individual aggression,” which is “attempts to hurt or injure others within the community or local group.” This study also employs the terms intergroup violence and warfare synonymously. Following Webster (1993), war is a planned, potentially lethal, and socially sanctioned confrontation engaged in by discrete and spatially distinct groups that advances the participant groups’ interests. An inclusive definition of war is necessary for non-state societies, as their warfare took diverse forms. War could involve small-scale ambushes and raids or massacres of entire communities. Furthermore, definitions that require warfare to be enacted between disparate political entities (e.g., Malinowski 1941) are not used here, as political boundaries in non-state societies tend to be fluid (e.g., Chagnon 1988). High population and individual mobility coupled with complex or segmentally organized group membership identities make recognition of political entities difficult in non-state cultures.

In non-state warfare, social substitution precludes discrimination between combatant and non-combatant statuses all enemy group members may be targeted for violence. As Raymond Kelly (2000) asserted, social substitution allows any member of an enemy group, including noncombatants, to become an appropriate target of lethal physical aggression during warfare. It follows that men, women, and children would
each be fair targets of massacres and ambushes. Thus, all members of a population engaged in a war would be at risk, albeit not equal due to differences in exposure, for violence and might alter their lifeways to avoid such dangers.

**A Brief History of the Anthropology of War in Small-Scale Societies**

Anthropological work on non-state war traces its genesis to the European early modern philosophies of Thomas Hobbes and Jean Jacques Rousseau. These theorists formed a debate on the nature of early non-state peoples that influenced social thought for centuries. In *Leviathan* (1999, [1651]:77), Hobbes contended that humans in a state of nature were innately violent and were engaged in a constant battle over access to material resources. As a result, early peoples lived an existence that was “nasty, brutish, and short (Hobbes 1999 [1651]:78),” due to a perpetual “warre” of “every man against every man (1999 [1651]:77).” The state ultimately developed as a solution to violent competition between non-state peoples.

Rousseau (1984 [1782]), in contrast, argued that early non-state cultures were inherently peaceful. Acts of violence among these peoples were only committed in self-defense. Early in humanity’s existence needs were limited and difficult to monopolize by a single person. But as populations increased in their size and density, public esteem began to motivate the actions of individuals. Any affronts to standing would result in the offending individual taking revenge upon the injurer. The beginnings of inequality manifested from differences in the achievement of public esteem. Inequality was further created from the development of metallurgy and agriculture. Differences between individuals in the success of using these technologies caused differential power and private property accumulation, eventually segregating the rich and strong from the poor.
and weak. War and violence then erupted as the rich pillaged from the poor in a perpetual cycle. To break this cycle, the rich convinced the weak that unity was in their self-interest, and formed the state as a social contract that formalized their power. While internal war was reduced, external wars increased as arms were taken up in the name of the state.

Hobbes’ and Rousseau’s thoughts have formed the basis of anthropological understandings of non-state war. The influence of these views is visible in the work of Franz Boas, the founder of American Anthropology, and his students. While Boas was largely silent on the subject of war in his cultural ethnographies, he did write about the genesis of war for social activist literature. In a pamphlet produced for the American Association for International Conciliation, Boas (1912) explained that prehistoric non-state societies existed in a state of continuous warfare designed to protect group members from dangerous outsiders. Over time, defeated groups would be absorbed into the conquering group, enabling large political units that reduced warfare. Boas (1912:94) stated:

Thus the most primitive form of society presents to us the picture of continuous strife. The hand of each member of one horde was raised against each member of all other hordes. Always on the alert to protect himself and his kindred, man considered it an act of high merit to kill the stranger . . . Weaker hordes, who still followed the older methods of hunting and food gathering, were exterminated or, profiting by the example of their neighbors, learned their new arts and also increased in numbers. Thus the groups that felt a solidarity among themselves became larger and by the extermination of small, isolated hordes, that remained in more primitive conditions, the total number of groups that stood opposed to one another became gradually less.
War for Boas was a primary contributor to the development of political complexity. Similar to Hobbes, Boas viewed the modern state as a solution to endemic warfare by promoting the peaceful coexistence of diverse peoples.

Similarly, Boas’ students Ruth Benedict, Margaret Mead, and Alfred Kroeber echoed elements from the Hobbes-Rousseau debate. Benedict and Mead typically presented non-state societies as more peaceful than states. Although recognizing that non-state societies participated in war, Benedict (1959) depicted this form of war as primarily non-lethal and unserious. It was engaged in for individual goals, like prestige, and the larger political group had no interest in the practice. Mead also had a tendency to emphasize the peaceful nature of many non-state societies. In her seminal publication, *Coming of Age in Samoa*, Mead (1936) described Samoan culture as innately peaceful. Her focus on their gentle nature, however, brought accusations of a systematic disregard of evidence for violence in Samoan society (Freeman 1983).

In contrast, Kroeber (1963) described prehistoric non-state Eastern Woodlands Native Americans as existing in a Hobbesian state of perpetual war. To explain what he perceived to be low prehistoric population densities in the eastern United States, Kroeber concludes:

> Of social factors, the most direct may be considered to have been warlike habits. Reference is not to systematic, decisive war leading to occasional great destructions but also to conquest, settlement, and periods of consolidation and prosperity. Of all this the Eastern tribes knew nothing. They waged war not for any ulterior or permanent fruits, but for victory; and its conduct and shaping were motivated, when not by revenge, principally by individual desire for personal status within one's society. It was warfare that was insane, unending, continuously attritional, from our point of view; and yet it was so integrated into the whole fabric of Eastern culture, so dominantly emphasized within it, that
escape from it was well-nigh impossible. Continuance in the system became self-preservatory. The group that tried to shift its values from war to peace was almost certainly doomed to early extinction. This warfare, with its attendant unsettlement, confusion, and destruction, and famines, was probably the most potent reason why population remained low in the East [Kroeber 1963:148].

While Kroeber viewed war in the prehistoric eastern United States as an inescapable phenomenon, its aims were more frivolous than those of states. These peoples went to war merely to attain status, rather than permanent material rewards.

The Hobbes-Rousseau debate also shaped early 20th century interpretations of war in archaeology. Grafton Elliot-Smith and Frederic Wood-Jones (1910) excavated a cemetery in the Nubian site of Shellal, Egypt, finding evidence of violent death. They believed the cemetery contained the remains of those who died in a frontier raid between Nubia and Roman Egypt. This evidence of warfare, dating to a politically complex period in Egyptian history, likely influenced Elliot-Smith’s later views on war and peace in prehistory. In a 1927 lecture to the Conway Hall Ethical Society, Elliot-Smith argued that hunter-gatherer societies were largely peaceful; it was only with the development of social complexity that warfare became a regular practice.

By the 1940s, the brutality of World War II caused anthropologists to more critically compare warfare in Western states against the indigenous cultures they studied. This research orientation resulted in a distinction between wars practiced by modern states versus those of “primitive” societies. Termed, “primitive war” by Keeley (1996), these studies considered war in non-state societies as less dangerous and more fanciful than war in modern states. This primitive war concept was largely found in the work of Quincy Wright (1942) and Harry Holbert Turney-High (1949). They asserted that only
state-level societies were capable of engaging in “true warfare,” as states were motivated to war by a political goal. “True war” also requires forces capable of conducting tactical operations with sufficient supply and organizational support for a prolonged military campaign. To both Wright and Turney-High, few primitive societies were capable of meeting these requirements for “true war.” Additionally, Turney-High’s experiences as an officer in the United States Army during World War II influenced his view that regular armies were required for “true war”. Yet, both authors concede that many primitive peoples had advanced tactical and organizational abilities in warfare. For example, Turney-High (1949:55) states that among Native American groups, the Iroquois, peoples of the Pacific Coast, and possibly “some of the Southeast Woodland monarchies” waged true war.

The World War II era in anthropology also initiated critical appraisals of the Neo-Hobbes and Rousseau debate. Bronislaw Malinowski (1941) chided those who oversimplified the prehistoric past into either a peaceful utopia or a perpetually violent hell. He argued that anthropologists should, instead, engage in a cultural analysis that examined changes in war and peace through time and space. Although Malinowski ultimately constructed a linear evolutionary scheme comparing changes in warfare to social complexity, his argument for an empirical focus on synchronic and diachronic analysis was progressive. It was especially revolutionary when contrasted against the characterizations of non-state war as fanciful and infantile by some of his contemporaries.

Archaeologists and physical anthropologists during the 1940s also began amassing evidence of warfare and violent death through large systematic excavations. In
Great Britain, V. Gordon Childe (1941) compiled a list of archaeological evidence of prehistoric warfare throughout Europe and the Middle East. His compilation of warfare evidence was largely a reaction against British cultural diffusionists like Elliot-Smith who argued for a peaceful “primitive” past. In American archaeology, large New Deal era excavations began unearthing evidence of violent death in human skeletal remains. While not explicitly citing war as its cause, Georg Neumann (1940) documented the first case of prehistoric scalping in the Americas. Charles Snow (1941) found evidence that Native Americans also survived scalping injuries. Additionally, three prehistoric individuals from Irene Mounds, Georgia displayed skull trauma interpreted as resulting from violence (Hulse 1941).

The Post-WWII Period

By the 1960’s, many anthropologists, disillusioned with United States participation in the Vietnam War, reinvigorated sociocultural anthropological research on war. Morton Fried, Marvin Harris, and Robert Murphy, fueled by a political desire to combat outbreaks of war through an understanding of its sociocultural consequences, organized a symposium on warfare during the 1967 meeting of the American Association of Anthropology. The papers presented in this symposium resulted in the publication War: The Anthropology of Armed Conflict and Aggression (1968). Contributors addressed diverse war-related subjects, including functional hypotheses of war’s causes (Vayda 1968), warfare’s relationship to social organization (Chagnon 1968a), the biological impacts of war (Livingstone 1968), and exploration of social alternatives to war (Mead 1968). Despite this session’s success in highlighting anthropological
contributions to warfare studies, it largely perpetuated a Hobbesian message: that as long as there are resources to be competed for, war and conflict will permeate society.

This revival of anthropological interest in war was also stimulated by ethnographic research among unpacified small-scale groups. Intense warfare witnessed among the Tsembaga Maring (Rappaport 1967) and the Mae Enga (Meggitt 1977) of Papua New Guinea and the Yanomamö of Venezuela and Brazil (Chagnon 1968b) prompted reexamination of warfare in non-state cultures. Coinciding with these ethnographic observations, the development of new research orientations, including cultural materialism and sociobiology, prompted new scholarly interpretations of war. To cultural materialists, war is caused by ecological limitations, like reduced availability of animal protein (Carneiro 1964; Lathrap 1968; Ross 1971; Harris 1971) or of arable land (Carniero 1970). Warfare also plays a Malthusian role in society, reducing population sizes to ensure resources adequately sustained the population (Rappaport 1968; Divale and Harris 1976; Vayda 1976).

Circumscription theory, one of the more influential cultural materialist ideas regarding the origin of the state, argues that warfare resulted from the circumscription of agricultural land with an expanding population (Carneiro 1970). Physical barriers, including mountains, the sea, deserts, or neighboring villages, or increased population density create circumscription by impeding access to high quality arable land. Competition for this limited land and its resources caused war. The state later formed as a solution to population pressure in circumscribed areas by coordinating movement of resources between circumscribed lands and developing new agricultural technologies.
While cultural materialism links war’s causes to a limited ecology, sociobiology relates war accomplishments to increases in reproductive success. This anthropological research orientation, influenced by the Neo-Darwinian work of animal ethologists like Conrad Lorenz (1966), was promoted largely from Napoleon Chagnon’s (1968a, b; 1988) fieldwork among the warlike Yanomamö. In what would become known as the male-warrior hypothesis, Chagnon found that the most violent Yanomamö warriors had sexual relations with more women than other men. These aggressive warriors also produced more children than their less violent counterparts. Although the male-warrior hypothesis has courted controversy (e.g., Carman 1997; Thorpe 2003), research has continued testing the association between war and reproductive success. More recent studies designed to retest the male-warrior hypothesis have yielded inconsistent results. For example, Beckerman and colleagues (2009) interviewed Ecuadorian Waorani elders concerning genealogies and inquired about their and their relatives’ raid participation. The authors found lower reproductive success among the most aggressive Waorani warriors. In contrast, Glowacki and Wrangham (2015) found that elders included in their study group were who were identified as prolific raiders during their youth by elders not included in the study group had more wives and greater reproductive success over their life course than the other elders in the study group.

The post-World War II period in sociocultural anthropology reinvigorated research for studying war in contemporary non-state cultures, but archaeologists during this time were critical of evidence for warfare among prehistoric small-scale societies. As Keeley (1996) has argued, this “pacification of the past” emanated from a revival of Rousseauian visions of a peaceful prehistory. Bioarchaeological and archaeological
studies of warfare in prehistoric North America, in particular, were affected by the “pacification of the past,” resulting in few studies of precontact warfare for Native American cultures north of Mexico (Keeley 1996; see also Milner 1999; Kelly 2000; Lambert 2002; LeBlanc and Register 2003).

By the 1980s and 1990s, however, archaeological finds of violent deaths in the North American Plains, Midcontinent, and Southwest made it difficult to systematically deny or ignore warfare in North American prehistory. Excavations at Crow Creek, South Dakota, (Zimmerman, 1981, 1997; Willey, 1990) uncovered 486 men, women, and children interred in a mass grave within the site’s fortification ditch. These remains were likely buried after a raid resulted in a massacre of the community’s inhabitants, as many individuals presented evidence of violent death. At Norris Farms #36, Illinois, lethal skeletal injuries were found in approximately 17% of the 246 individuals excavated from the cemetery. Its Oneota inhabitants likely suffered from endemic high intensity ambush warfare that often targeted individuals outside of the community (Milner and Smith 1990; Milner et al. 1991). Patterns of skeletal pathologies suggest that attacks seemed to focus on diseased or disabled individuals whose reduced mobility limited their ability to flee (Milner et al., 1991).

In the American Southwest, Haas and Creamer (1993) examined changes in Kayenta Anasazi settlement patterns associated with periods of drought during the thirteenth century. They inferred that wars over declining resources caused Anasazi groups to move their habitations to more defensible areas. Finds of fragmentary modified human bone with processing trauma similar to animal butchery also prompted examinations of Southwest warfare. They have been suggested as evidence of warfare-
related cannibalism (Flinn et al. 1976; Turner and Turner 1992, 1999; White 1992; Billman et al. 2000), although this conclusion is highly controversial (e.g., Dongoske et al. 2000). Alternative explanations for these bone modification patterns include warfare-related death with secondary mortuary processing or corpse mutilation (Bullock 1991; Oglivie and Hilton 1993; Dongoske et al. 2000) and witch execution (Darling 1998).

Despite the accumulation of numerous examples of prehistoric and contemporary non-state warfare, a Neo-Rousseauian movement in anthropology renewed arguments for a more peaceful prehistoric past. Among the most vocal of the Neo-Rousseauians, R. Brian Ferguson (Ferguson 1990; Ferguson and Whitehead 1992) has questioned the ubiquity of warfare among prehistoric non-state societies. He has argued that the social pressures exerted by extant states on the “tribal zone,” the area affected by extant states but not under state control, have greatly exacerbated and changed the nature of conflict for non-state societies. Consequently, use of ethnographic analogy to understand warfare in the past obscures its reality, as the presence of the modern state has intensified militarization and conflict in non-state societies. Ferguson (2013) has also recently elaborated this critique, asserting that prehistoric warfare was not as deleterious to societies as archaeologists would lead us to believe. In a review of skeletal trauma research for prehistoric samples, he criticizes much of the bioarchaeological evidence for war. Ferguson concludes that war was exceptionally rare before the development of the state, precluding war from acting as a strong selective force throughout human history.

Despite this critique, recent cross-cultural ethnographic analyses of non-state war have also increased understanding of war’s causes and its associated social consequences (e.g., Ember and Ember 1992, 1997, 2007; Otterbein 2000; Sosis et al. 2007). Work
conducted by Carol and Melvin Ember has attempted to control for the influence of the state by only examining the war patterns for unpacified societies (meaning societies that did not have peace imposed by a colonial state). In a survey of the Human Relations Area Files (HRAF) of these unpacified societies, Melvin and Carol Ember found an association between the threat of natural disasters, socialization for mistrust of others, and warfare (Ember and Ember 1992). They infer that non-state societies wage war to protect themselves against unpredictable future losses by forcibly appropriating resources from their enemies. Furthermore, as discussed in the beginning of this chapter, Ember and Ember (1994, 1997) have also identified a cross-cultural association between warfare and other forms of intragroup violence. In sum, their work suggests that warfare was pervasive in non-state groups, and it inflicted serious social consequences on all those involved.

Throughout the last 350 years of scholarly attention to non-state warfare the unifying thread of the Hobbes-Rousseau debate has persisted. This debate has evidenced itself today in the Neo-Hobbesian portrayal of prehistoric war by Steven Pinker (2011) *The Better Angels of Our Nature* and Ferguson’s (2013) Neo-Rousseauian reaction to it. Although only a small portion of Pinker’s work was devoted to archaeological examples of war, he described prehistory as unceasingly violent. As he moved through time, he used history to bolster his argument that war was ubiquitous through time. He also found an association between warfare and other forms of intragroup violence. Ferguson, in contrast, downplayed or dismissed point-by-point Pinker’s archaeological evidence for violence. He argued that most of the archaeological cases of war discussed by Pinker
were not definitive. Homicides and other forms of non-warfare violence could not be excluded using more conservative archaeological interpretations.

Rather than asking axiomatic questions like “Was the past inherently warlike or peaceful?”, scholars should explore how violence affected past lifeways. Additionally, as Milner (1999) and Milner and colleagues (2013) has emphasized, archaeological cultures with long periods of peace and those with frequent war should be examined to find the cultural, environmental, and demographic correlates of those complex behaviors across space and time. In fact, by examining whether or not war was associated with intragroup violence, this research hopes to further move anthropology away from the Hobbes-Rousseau debate.

**Dissertation Organization**

In the following chapters, I examine how Mississippian warfare is associated with intragroup violence. This discussion is partitioned into eight chapters. Chapter Two presents an overview of the Mississippian Period. I begin by introducing the Mississippian archaeological culture and temporal period, followed by a description of maize production and political organization in Mississippian societies. Discussion turns to an overview of Mississippian warfare, including an assessment of the characteristics, causes, and goals of Mississippian war. The chapter concludes with a review of the archaeological and ethnohistoric evidence for Mississippian warfare.

Chapter Three begins by presenting the history of Mississippian Period research in the Central Illinois Valley (CIV) of west-central Illinois. Next, I critically assess the Mississippian temporal systematics in the region. The CIV’s Mississippian culture history is also explored, with a focus on cultural changes during each temporal subphase.
Archaeological and bioarchaeological evidence for Mississippian war in the CIV is then examined. Finally, I discuss the CIV sites from which skeletons were sampled for this dissertation.

The methods used to investigate this study’s research question are outlined in Chapter Four. This chapter is divided into two primary sections: 1) the methodological background and 2) the analytical methods. First, the methodological background for trauma analysis is presented. Here, I describe the biomechanics of fracture production in bone, review how time since traumatic insult is identified, and evaluate the osteological patterns that distinguish violent from accidental skeletal trauma. Next, I present a history of biological distance analysis methodologies, highlighting biodistance research in the Central Illinois Valley. This section also examines the method’s underlying theoretical assumptions. The mortuary analysis background reviews the theoretical history of the method, examining processual and postprocessual approaches in particular. The second section of this chapter details the analytical methods for the sample demography, trauma, biodistance, and mortuary analyses.

In Chapter Five, I discuss the models used to explore the research question. Two intergroup models and two intragroup models are assessed. Expectations for the intergroup violence models, including 1) warfare victims from the local community and 2) war captives from extralocal communities are examined first. Data patterns expected for the intragroup violence models, including 1) domestic violence and 2) male-male fights, are also offered.

Chapter Six presents the results of the demographic, trauma, biodistance, and mortuary analyses. It begins with demographic descriptions of the CIV sample, followed
by results of the trauma analysis. Trauma frequencies are presented by site, sex, and age-at-death. Trauma patterns at each site are also characterized using narrative descriptions. Next, I examine the results of the biodistance analysis. First, interobserver and intraobserver error in dental cervical measurements are assessed, followed by an analysis of the effects of fluctuating asymmetry. Discussion turns to the results of the principal components analysis where phenotypic variation within the sample is explored. Lastly, I outline the results of the mortuary analysis. Burial type and corpse position patterns are identified, and the chapter concludes with an examination of the accompanying funerary artifacts.

In Chapter Seven, I contextualize the results of the trauma, biodistance, and mortuary analysis with the behavioral models discussed in Chapter Five. Next, these results, coupled with data from previous studies by other researchers, are used to construct a temporal history of warfare and violence in the CIV. Alternative explanations for the data patterns identified in this research are also addressed. Finally, concluding remarks are presented in Chapter Eight. The results of this study are summarized, and suggestions for future research are offered.
CHAPTER 2 – MISSISSIPPIAN WARFARE

This chapter introduces the Mississippian Period, which dates to ca. AD 1000-1700) throughout the United States Midcontinent and Southeast. It explores how warfare and violence have been characterized for Mississippian peoples. First, the Mississippian Period and culture area are described, followed by a brief discussion of Mississippian maize agriculture and political economy. Next, the characteristics and causes of Mississippian warfare are examined. The chapter concludes with a review of the archaeological and ethnohistoric evidence for Mississippian warfare.

Description of Mississippian

The Mississippian is commonly considered both a temporal period and an archaeological culture located within the Eastern Woodlands (Figure 2.1). Both the immense cultural variability present in the eastern United States and the dramatic cultural transformations that occurred during the Mississippian Period have spawned debate regarding how to define the “Mississippian” archaeological culture. W.H. Holmes first used the term “Middle Mississippi” in 1903 as a ceramic tradition to describe the large quantities of shell-tempered pottery found in the Central Mississippi Valley. As these archaeological sites were excavated during the 20th century, researchers noted additional material traits in association with shell-tempered pottery, cataloguing them into trait lists. These trait lists were used to distinguish the Mississippian from other archaeological culture horizons. Using McKern’s (1939) Midwest Taxonomic Method, Thorne Deuel (1937) defined the “Middle Mississippi” phase by the presence of five traits found in mortuary contexts: 1) copper-covered wooden earspools and other copper-covered wooden objects; 2) shell and repoussé copper gorgets engraved with human, animal, and
Figure 2.1. Mississippian Culture Areas Contrasted against Oneota and Fort Ancient Cultures (adapted from Fagan 1995).
bird figures; 3) elaborate insignia or ornaments or depiction of these ornaments on
engraved gorgets; 4) textile-impressed pottery; and 5) long ceremonial swords. Likewise,
Willey and Phillips (1958) described the Mississippian as a complex of traits but focused
on archaeological evidence for agricultural village life rather than mortuary artifacts.
Their Mississippian traits included: agriculture, temple or town-house mounds, mounds
arranged around a central plaza, compact villages with structures composed of wattle-
and-dauber pole and thatch, and the presence of maize.

In concert with an increased interest in cultural materialism in anthropology
during the 1960s, Eastern Woodlands archaeologists defined Mississippian in terms of
cultural adaptations. James Griffin (1967:189) used Mississippian “to refer to the wide
variety of adaptations made by societies which developed a dependence upon agriculture
for their basic, storable food supply.” Griffin’s emphasis on agriculture in Mississippian
definitions was later expanded with sociopolitical formations. For instance, Peebles and
Kus (1977:435) explained the Mississippian as “both a mode of adaptation – maize
agriculture – plus a ranked form of organization.” Bruce Smith (1986) later added a
floodplains adaptation to the definitions of Mississippian formulated by Peebles and Kus
and Griffin. For Smith (1986:53) Mississippian, “implies a ranked level of sociocultural
integration … and a complex adaptation to river valley habitat situations that featured
maize-dominated field agriculture.”

Continuing the interpretation of the Mississippian as an adaptation, Muller and
Stephens (1991) critiqued the use of trait lists in definitions of archaeological cultures
finding them too restrictive. Rather than using a trait list, Muller and Stephens
considered the Mississippian as a set of adaptive responses to the daily experiences of living people. They defined the culture as an adaptation to “floodplain environments based on a combination of particular natural and sociocultural conditions. The conditions included sedentism, relatively high population density in critical floodplain environments, a degree of social and environmental circumscription, a localized mode of production, and the development of hierarchical sociopolitical organization” (Muller and Stephens 1991:300). The authors were also reticent to consider Mississippian a single archaeological culture, noting the variation among Mississippian subtraditions.

Similarly, recognition of cultural diversity among Late Prehistoric societies called Mississippian has created debate regarding the geographic extent of its culture area. These debates have largely derived from arguments regarding whether the spread of Mississippian culture was caused by a migration of Mississippian peoples out of a cultural heartland or whether they were in situ developments. Willey and Phillips (1958) identified a Mississippian “core” around the Central Mississippi Valley. This core region extended northernmost from Cahokia, Illinois and southeast into the Lower Ohio Valley and the Cumberland region of Tennessee. Selective sites in eastern Tennessee, central Georgia, and Alabama, including Moundville, Alabama and Etowah, Georgia, were included as Mississippian political centers. The authors, however, did not consider Late Prehistoric Ozark societies in Missouri west of Cahokia and into Arkansas as Mississippian.

In contrast, Phillips, Ford, and Griffin (1951:451) noted that Mississippian traits arose almost simultaneously throughout the eastern United States. As a result, they were dubious that any single Mississippian core existed and, thus, there existed multiple
variants of Mississippian. They also found that Mississippian cultures developed almost simultaneously and along similar trajectories throughout the eastern United States. Recent studies have supported the argument that mass migrations out of the Mississippian heartland did not cause the formation of Mississippian societies. Rather, Mississippianization throughout the Eastern Woodlands more likely resulted from local Late Woodland peoples choosing to adopt Mississippian culture and ideology (e.g., Smith 1984; Peebles 1990; Droessler 1981), rather than through a replacement of local peoples by Mississippian immigrants.

While it remains unlikely that the Mississippian culture was distributed geographically by mass migrations, regional distinctions among these Late Prehistoric societies form the basis of debates regarding what groups should be called Mississippian. For example, Willey (1966) and Griffin (1967) reclassified South Appalachian traditions through Georgia and South Carolina and Caddoan traditions inhabiting Missouri, Arkansas, and Oklahoma as regional variations of Mississippian. They each also considered Lower Mississippi Valley Plaquemine sites as representations of the Mississippian culture. Brain (1978), however, attempted to decouple Plaquemine sites (also known as Lower Mississippian) from this classification into the Mississippian culture horizon. Despite his reluctance to label Plaquemine societies as Mississippian, Brain recognized a profound Mississippian influence on Plaquemine sites after AD 1100. Similarly, disputes have persisted regarding the suitability of the Caddoan tradition as a Mississippian variant (e.g., Brown et al. 1978; Schambach 1990; Rogers 1991). Even today, little scholarly consensus regarding the taxonomy of Plaquemine and Caddoan
traditions has been achieved (e.g., Rees and Livingood 2007; Shuman 2007; Jeske 1999; Perttula 1992; Schambach 2000).

Although the Mississippian temporal period and archaeological culture exhibited tremendous variation, as Steponaitis (1986) has argued, intensified maize production and the development of hierarchical political organization were among its most important characteristics. The Mississippian subsistence economy is characterized, generally, by the cultivation of maize as a staple crop (e.g., Scarry 1993). Intensive maize production in the Eastern Woodlands began prior to the Mississippian Period, around AD 800 (Milner 2004), although at many sites its production was not intensified until much later (e.g., Kelly et al. 1984; Kidder 1992; Scarry 1993; Fritz 2000).

In the American Bottom, Mississippian cultivated a multicrop system, growing Eastern Agricultural Complex (EAC) starchy seeds alongside corn (Johannessen 1984; Lopinot 1992, 1997). Rindos and Johannessen (1991) identified maize cupules and kernels in 86% of feature flotation samples from nine American Bottom Mississippian sites. They also recovered high ubiquities of starchy seeds, including maygrass (*Phalaris caroliniana*) and goosefoot (*Chenopodium* sp.), in 44% and 28% of features, respectively. At Moundville and other Mississippian sites in Alabama, there is little evidence of EAC multicropping, and few wild starchy seeds have been recovered (Caddell 1983; Scarry 1986; Scarry and Steponaitis 1997). The relative importance of maize production at Moundville is evident when compared to temporal changes in nut exploitation. From early to later Mississippian phases in Moundville's history, a decline in the amount of nuts shells and an increase in the abundance of corn cupules and kernels has been observed (Scarry 1993).
Data from stable carbon isotopes support paleobotanical evidence that maize was an important component of Mississippian diets (Bender et al. 1981; Lynott et al. 1986; Buikstra and Milner 1991; Buikstra 1992; Buikstra et al. 1994; Schurr 1992; Schurr and Schoeninger 1995; Hedman et al. 2002; Ambrose et al. 2003). In an analysis of 55 American Bottom adults and late-adolescents, Hedman and colleagues (2002) estimated that 70% of their diet consisted of C_4 plants, most likely maize. Collagen $\delta^{13}$C values were high, averaging -11.4‰, although the values ranged between -8.52‰ and -19.70‰. Similarly, the carbon isotope values generated for Moundville suggest maize comprised between approximately 40% and 65% of all the calories in an individual's diet (Schoeninger and Schurr 1998).

The Mississippian subsistence economy potentially made communities more susceptible to warfare. In fact, reliance on cultivated crops may have led to food shortages during periods of drought or other causes of crop failure. Communities might have engaged in warfare in these circumstances to accumulate more food resources and avert food shortage risks (e.g., Vayda 1967; Rappaport 1967). Even the fear of potential food shortages, rather than an actual shortage itself, has most commonly motivated societies to war cross-culturally (Ember and Ember 1992). Similarly, the large populations composing Mississippian polities made averting the risk of shortages particularly important, as these populations may have outstripped the carrying capacity of the environment, preventing complete reliance on foraged foods. In fact, the need to manage food storage may be partially related to the development of hierarchical political organizations like the chiefdom (e.g., Netting, 1972; Peebles and Kus 1977; Anderson et al. 1995).
Mississippian political organizations are most commonly described as chiefdoms (Peebles and Kus 1977; Steponaitis 1978; Knight and Steponaitis 1998; Milner 1990, 1998; Anderson 1994a, 1994b, 1996a, 1996b; Blitz 1999), although some have argued the large Mississippian polity Cahokia represented an early state (e.g., Fowler 1974, 1975; Gibbon 1974; O'Brien 1990, 1991). In outdated classic cultural evolutionary typologies, populations numbering in the thousands, the presence of ranked status distinctions, and use of a redistributive economy were indicative of chiefdoms (Service 1962, 1975; Sahlins 1958, 1963; Fried 1967). In chiefdoms, political authority is vested in the inherited office of the chief, and ascribed ranks partition individuals and lineages throughout society (Fried 1967). These vertical status distinctions translate into differential access to resources, providing the elite with greater opportunities to increase their wealth or prestige. Service (1962, 1975) more specifically emphasized the use of a redistributive economy coordinated under a central authority as a defining feature of chiefdoms. The chief manages the redistribution of food and other resources, allowing individuals to participate in specialized tasks and craft production.

Little archaeological evidence, however, supports the classic redistributive economy model, while populations numbering over 1000 persons and the strict ranking distinctions described in these typologies were present only at the largest Mississippian sites. Rather, Mississippian political organizations varied in complexity from large, hierarchical complex chiefdoms to less hierarchical simple chiefdoms; or perhaps, many societies were not chiefdoms at all (Steponaitis 1978, 1986, 1991; Wright 1984; Smith 1986; Peebles 1987; Hally 1993; Anderson 1994a, 1994b, 1996a, 1996b). Two- or three-
tier political hierarchies characterized Mississippian complex chiefdoms (Steponaitis 1978, 1986; Wright 1984; Hally 1993).

The suitability of classic chiefdom definitions and the use of “chiefdom” as a socioevolutionary term have been regularly debated in anthropology and archaeology (Earle 1977, 1987; Emerson 1997; Muller 1997; Milner and Schroeder 1999; Yoffee 1993; Pauketat 2007). The term chiefdom has been applied to societies that vary considerably in their political, economic, and social diversity (Earle 1977; Peebles and Kus 1977; Steponaitis 1978; Muller 1984, 1997). Consequently, it may be more useful to explore this diversity though investigations of leadership, the basis of finance, political organization, and the strategies that permitted the naturalization of hierarchy using political economy models (e.g., Earle 1977, 1987, 1993, 1997; Blanton et al. 1996).

Two schools of thought characterize the Mississippian political economy literature. For Cahokia, by far the largest Mississippian polity, Milner (1998) divided this debate into what he termed “conventional” and “alternative” political models. The conventional perspective emphasizes almost state-like levels of regional consolidation and political hierarchy at Cahokia, while the alternative perspective argues that authority was far more contested and dispersed among individuals and regions. Expanding on Milner, Blitz (2010) has partitioned the political economy debate for Mississippian societies throughout the eastern United States into “centralized” and “decentralized” models.

Centralized models emphasize concentrated elite power and authority in pyramidal site hierarchies (e.g., O’Brien 1972, 1990, 1991; Fowler 1974; Griffin 1983; Knight and Steponaitis 1998; Dincauze and Hausenstab 1989; Welch 1991; Peregrine
Leadership was based on ascribed status with authority centralized in a chief or ruling lineage. Three-tier chiefdom hierarchies were common, with the apical polities extracting tribute and aggressively curbing the actions of lesser chiefdoms. Apical chiefdoms consolidated formerly dispersed individuals, thereby dramatically increasing the population sizes of the largest Mississippian sites.

Strategies used by centralized elites to obtain and naturalize their power and authority included control over economic resources (Steponaitis 1986; O’Brien 1991, 1992; Peregrine 1991; Pauketat 1992; Emerson 1997; Welch 1996), specialized craft production (Yerkes 1983), warfare (Dye 1995), community-building (Pauketat and Emerson 1997), and ideology (Pauketat and Emerson 1991; Pauketat 1997, 2007; Emerson and Pauketat 2002). Some centralized models emphasize that elite power was bolstered by the accumulation and control of precious goods circulated through a prestige goods economy (Friedman and Rowlands 1978; Cobb 1989; Brown et al. 1990; Peregrine 1992; Pauketat 1992; Trubitt 2003; Dye 1995). These prestige goods were concentrated with elites and amassed by controlling food production, expanding long distance trade, engaging in warfare, and participating in interpolity mate exchange.

In contrast, the proponents of decentralized models assert that decentralized political organization and modest hierarchy characterized Mississippian societies. Their arguments are supported by the absence of archaeological evidence supporting craft specialization, strong ranking, tribute mobilization, and administrative control over resource access (Milner 1990, 1998, 2006; Blitz 1993; Saitta 1994; Muller 1995, 1997; Cobb 2000, 2003; Byers 2006, 2013). They contend that elite control over the populace
was less authoritarian than centralized models depict. Rather, chiefs and their kin created loose alliance networks with other political factions within the polity. As a result, power was more dispersed and highly constrained within the chiefdom. Polities acted quasi-autonomously, with limited control exercised by the apical chief. These leaders held power tenuously, and polities were joined together in unstable coalitions (Milner 1998a; Cobb 2003). Consequently, direct administrative control of hinterland sites was rarely achieved. Evidence suggests great organizational diversity throughout the Midcontinent and Southeast, making large three-tier site hierarchies more the exception than the rule.

Decentralized perspectives also question the role of prestige goods in elite power accumulation strategies (Saitta 1994; Muller 1995). For instance, Muller (1995) has extensively critiqued the prestige goods model. He concluded that the model presents a logical tautology: the presence of elites was a necessary precursor for creation of an elite rank. Muller also contended that simpler economic models, such as down-the-line exchange, explain the spatial distribution of gorgets, a prestige item, better than prestige goods models.

Both centralists and decentralists have linked increases in war and violence to reduced elite authority and effectiveness. For some centralists, Mississippian political centralization suppressed war and violence of previous periods (Knight and Steponaitis 1998; Brown et al. 1990; Anderson 1996b). Strong, centralized elite power successfully curbed the aspirations of lesser chiefs. Only once the elite power structure weakened did violent conflicts erupt again. Some decentralists, in contrast, argue that Mississippian elite authority was insufficiently concentrated to ever truly quell violence (Muller 1997; Milner 1998a). Decentralization and limited control left greater numbers of political
rivals vying for power. Lesser chiefs maintained considerable autonomy and required significant coercion to check their ambitions. As Milner (1998a:13-14) asserted, violence was an ever-present threat used to compel compliance among political subordinates in the regional districts within Cahokia’s sphere of influence.

Regardless of the political model used for Mississippian societies, the importance of warfare in Mississippian research generally has increased over the last 15 years. As Milner (1999, 2004) has discussed, this renewed interest in war is a reaction to Keeley’s (1996) critique of the pacification of the past (Chapter One). Yet for many Mississippian sites, archaeological evidence for war is weak, as war is difficult to identify in the archaeological record. There also existed considerable diachronic and synchronic variability in warfare practices, as would be expected for a dynamic behavior, creating additional difficulties for understanding the practice in prehistory.

**Patterns of Mississippian War**

Mississippian war followed a greater pre-and postcontact Eastern Woodlands pattern consisting largely of periodic raids and ambushes (Milner 1995, 1999; Milner et al. 2013; Dye 2006, 2009). Raids varied from small-scale attacks on individuals distant from a settlement to large, well-organized forces assaulting fortified villages (Anderson 1994a, 1994b; DePratter 1991; Dickson 1981; Dye 1990, 2006; Gibson 1974; Hudson 1976; Larson 1972; Steinen 1992). Yet, disagreements have continued regarding the formality and scale of attacks. Drawing on contact era and historic European descriptions of southeastern warfare, some researchers have argued that large, formally organized armies composed of military specialists were deployed in Mississippian war (DePratter 1991; Hudson 1976; Pauketat 2007; Emerson 2007). Emerson (2007) has suggested that
two clay Mississippian Conquering Warrior statuettes represent archaeological evidence of these warrior specialists (Figure 2.2).

**Figure 2.2. Conquering Warrior Pipe Depicting an “Armored” Figure Clubbing an Adversary (from Emerson, 2007:142-143).**

The formal battles described by contact-era European explorers, however, were likely ethnocentric exaggerations and are not well supported by archaeological or bioarchaeological evidence (Milanich 1996; Milner 1995, 1999). As Steinen (1992:134) has suggested, well-organized southeastern Native American attacks “were not full-scale military operations in the modern sense but were what can be thought of as raids in force.” These “raids in force” were made possible by alliances formed between chiefs, enabling the participation of warriors from several polities (Dye 2009). Moreover, the
institutionalized status differences present in Mississippian chiefdoms likely enabled greater collaboration between raiding parties from different communities than was possible for bands and tribes (Dye 2009; Milner et al. 2013).

Threats of raids encouraged dispersed individuals to aggregate behind palisaded villages. Elites offered additional protection from the endemic warfare during the Mississippian period by allying with powerful neighboring polities (Milner 1999). The uninhabited frontiers between villages would have been dangerous places and presumably entrance into these zones for food procurement made individuals vulnerable to attack (Hickerson 1965; DePratter 1991; Anderson 1994b; Milner 1999, 2007; Milner et al. 2013). Consequently, Mississippian settlement locations were chosen in a compromise between natural resource access and site defensibility (Worne et al. 2012).

The Causes of Mississippian War

Multiple materialist and social theories have been offered to explain the causes of Mississippian war (e.g., Larson 1972; Gibson 1974; Dickson 1982; Anderson 1994a). Larson (1972) argued that Mississippian warfare was caused by competition over agricultural land. He also asserted that the fortifications surrounding many Mississippian settlements were effective deterrents against attacks, protecting control of the land. Larson did not believe that Native American attackers had the ability to penetrate the fortifications or to engage in prolonged sieges.

In contrast, Gibson (1974) contended that social factors, including accumulation of prestige through battle, revenge, defiling a chief’s property, and capturing prisoners, were primary causes of Mississippian war. He disagreed with Larson (1972) that control of land was the cause, as contact era accounts did not support such a claim. To support
his argument, Gibson (1974) quoted Garcilaso de la Vega’s account of war among the Native Americans encountered by Hernando de Soto’s expedition:

> But the hostility among these Indians amounted to no more than the harm they inflicted upon their persons with deaths, wounds, or shackles, for they made no attempt to seize estates … as soon as the conquerors had inflicted the desired damage, they regathered in their own lands without attempting to take possession of the land of others [Varner and Varner 1951:488-489].

Using de la Vega’s report as his only form of ethnohistoric evidence, Gibson argued that there was no indication that land was the cause of Mississippian war.

In an attempt to reconcile materialist and social explanations for Mississippian warfare, Dickson (1981) asserted that both competition for land and prestige were important. He contended that Mississippian riverine meander belt environments were highly circumscribed, creating intense resource competition. To reconcile these materialist concerns with the ethnohistoric record, Dickson distinguished between the proximate and ultimate causes of Mississippian warfare. He argued that social factors described Mississippian warfare “at the tactical level” but emphasized materialist explanations for the more essential “strategic level” (Dickson 1981:914).

Expanding the debate by coupling political economic models with materialism, Anderson (1994a, 1994b, 1996a, 1996b) has linked the inherent instability of chiefdom organization led to high levels of warfare in these societies. Warfare, factional competition, and environmental stresses caused mound centers to wax and wane in political complexity and prominence (Anderson 1994a, 1994b, 1996a, 1996b; see also Milner 1998a; Blitz 1999; c.f., Hally 1996). Cycles of violence and warfare could erupt to challenge a perceived weak complex chiefdom or to quell the aspirations of unruly subordinates. As one chiefdom enhanced its power and control over another, warfare
was reduced. Coercive threats were then used to preserve these relationships of political, social, and economic inequality.

Additionally, lasting periods of drought may have created resource instabilities that caused Mississippians to go to war. Although, Mississippians lived during the agriculturally favorable, warm, and wet Medieval Warm Period, its five centuries were not without drier years (Crowley 2000; Broecker 2001; Hughes and Diaz 1994). Benson and colleagues (2007, 2009) have identified persistent droughts throughout the Midwest between AD 1100-1245. Drought years were associated with social disruption, such as Cahokian population declines, the construction of a palisade around Cahokia’s central district, and abandonment of the American Bottom Richland farmsteads. Tree ring data have also been used to estimate crop yields and food storage for the South Appalachian region during the Mississippian Period (Anderson 1994a, 2001; Anderson et al. 1995). These estimates were compared to the corresponding years of political history in the region. A positive association was found between periods of relative peace and extended years of average early spring and summer rainfall. Intense warfare, in contrast, was associated with below average early spring and summer rainfall.

Droughts likely resulted in resource yield declines throughout the Eastern Woodland, stressed populations, and increased competition over remaining resources. Resource competition caused by declining resource availability is suggested by increased fortification construction throughout the Late Prehistoric Period during dry years (Milner 1998b, 1999; Milner et al. 2013). Eastern Woodlands fortifications peaked in frequency around AD 1300, coinciding with the shift from the Medieval Warm Period to the cooler, drier Little Ice Age (Milner 1999). Mississippian fortification construction, specifically,
was also associated with higher frequencies of lethal projectile injuries (Milner et al. 2013) and violent imagery on portable art objects (Milner 1998b), perhaps indicating resource and population stresses.

As the above discussion has shown, there was likely no single cause of Mississippian warfare. As Milner (2007:200) has stated, “Population size and distribution, environmental settings (including climatic change), technology (particularly as it pertains to subsistence practices), and society (such as the organization of labor) all played a part in determining whether warfare was common.” He has also suggested that researchers should investigate variation in warfare’s intensity across time and space, rather than seeking a single cause. This study responds to his critique by assessing synchronic and diachronic patterns of Mississippian warfare in the Central Illinois Valley.

**Evidence for Mississippian War**

Examinations of Mississippian warfare across time and space require accumulating evidence to infer the practice. Yet, warfare is difficult to identify in the archaeological record as it leaves few unambiguous physical traces. Archaeologists have used palisades, skeletal trauma, ethnohistoric reports, weaponry, and burned structures to infer Mississippian warfare practices. Skeletal trauma is the only direct evidence for warfare, while palisades, ethnohistoric reports, weaponry, and burned structures represent indirect evidence of warfare. Each of these forms of evidence is reviewed below.

**Palisades**

Palisades in the Mississippian world demarcated both important chiefly centers and small single mound sites. Mississippians erected palisades to inhibit enemy raids
their villages (e.g., Barrett 1933; Black 1941, 1967; Baerreis 1958; Larson 1972; Vogel and Allan 1985; Steinen 1992; Knight and Steponaitis 1998; Holley 1999; Milner 1999, 2000; Schroeder 2006; Pauketat 2007). At Moundville, for instance, a three-walled bastioned palisade protected most of the ceremonial and habitation area of the site from attack. All three walls, however, may not be contemporaneous. A riverside bluff protected the unpalisaded side (Knight and Steponaitis 1998; Scarry 1998).

Moundville’s palisade was first constructed around AD 1200 and was rebuilt six times (Scarry 1998:82). Its erection is associated with a change in settlement patterns from dispersed habitations to more nucleated habitations within the palisade’s walls (Scarry 1998; Knight and Steponaitis 1998; Wilson 2005, 2008; Wilson et al. 2006).

Large vertical posts anchored Mississippian palisade curtain walls. These stout posts measured from 15 to 25 centimeters in diameter (Milner 1999) and were set deeply within hoed-out trenches (Milner 1998b). Bark, branches, daub, or other material filled in the gaps between each pole (Barrett 1933; Black 1941; Baerreis 1958; Goldstein and Richards 1991; Demel and Hall 1998). A deep dry ditch was commonly dug around the palisade, enhancing defense. Mississippian palisades also incorporated bastions to increase tactical efficiency (Milner 1991, 2000). Bastions tended to be square-shaped and spaced regularly, at an average of 30 m apart (Milner 1999, 2000; Milner et al. 2013). Their position allowed defenders to shoot flanking arrow fire onto site attackers (Milner 1999; Milner et al. 2013). These features of Mississippian bastions conform to bastions found elsewhere in the world (Keeley et al. 2007).

While the function of fortifications was undoubtedly defensive, walls in the Mississippian world also served to divide a polity’s internal space. For instance, they
might serve as metaphorical markers, segregating elite from common contexts (Price and Griffin 1979; Demel and Hall 1998; Pauketat 2007; Bigman et al. 2011). Fortifications at Cahokia and Etowah differentiated the protected and sacred internal district from the mundane space (Demel and Hall 1998; Pauketat 2007; Bigman et al. 2011; c.f., Larson 1972). Cahokia’s palisade enclosed elite homes, burials, and mounds in the central precinct, while the homes of commoners were located outside of it (Anderson 1969; Fowler 1989; Iseminger et al. 1990; Demel and Hall 1998). Although the regularly spaced bastions of Cahokia’s palisade provided protection, Pauketat (2007) has suggested the elite contexts enclosed within the wall also restricted movement of nonelites through the site, heightening social stratification. At Etowah, unevenly spaced bastions and irregularities in its ditch caused Bigman and colleagues (2011) to question the exclusively defensive nature of the palisade. They, instead, infer that the palisade ideologically separated elite central space within from the secular space without. Yet, the palisade’s destruction demonstrates its primary purpose was defensive. Around AD 1375, Etowah’s palisade was burned and Etowah’s residents abandoned the site (King 1999, 2003).

**Skeletal Trauma**

Archaeological evidence for Mississippian palisades is not always associated with violent skeletal trauma and vice-versa. While palisades surrounded large mound centers throughout the United States Midcontinent and Southeast, skeletal trauma indicative of violence is rare at large multi-mound centers. Sampling bias may be the cause of this trend, yet few Mississippian skeletons excavated from the American Bottom, Moundville, and Spiro exhibit skeletal trauma. For instance, few individuals from Cahokia and sites throughout the American Bottom exhibit trauma indicative of
interpersonal violence, despite the large numbers of burials excavated from the region. Three of 265 individuals interred in Cahokia’s Mound 72 display unhealed injuries consistent with violent death (Rose 1999). Two individuals with scalping cuts and one individual with an unhealed blunt-force trauma to the cranium were excavated from Tract 15B located in a habitation area (Carbaugh et al. 2013). Trophy-taking has also been inferred for a small number of individuals recently excavated from the East St. Louis mound group (Eve Hargrave and Lenna Nash, personal communication 2014). In human remains from Moundville, violent trauma is rarely encountered. Powell (1988, 1991) did not find any blunt- or sharp-force cranial trauma in a sample of 564 individuals (Powell 1988, 1991). However, two cases of scalping with evidence of bone healing have been reported from Moundville (Snow 1941, 1942; Jacobi et al. 1996). No trauma attributable to interpersonal violence was present in samples of Caddoan Mississippians interred in mounded contexts at the unpalisaded Spiro site (Brues 1996; York 1996).

Warfare-related skeletal trauma is more frequently identified in skeletal samples from medium and small settlements in Illinois, Tennessee, and Alabama than large mound centers (Table 2.1). At Orendorf, Illinois, 9% of 268 individuals exhibit trauma consistent with warfare violence (Steadman 2008), while six of 52 individuals from Schild, Illinois displayed perimortem trauma (Spencer 2014). In skeletal remains from Averbuch, Tennessee, Berryman (1981) found evidence for scalping in six of 887 individuals. Additionally, Worne (2011) reanalyzed the Averbuch skeletal remains and 12 other Middle Cumberland Region (MCR) sites, reporting trauma only for individuals with at least 25% of the skull present. She included antemortem cranial blunt-force trauma,-scalping, decapitations, projectile point injuries, and sharp-force trauma in the
calculations. Worne (2011) reports 2.7% (47 cases) of 870 individuals from the MCR exhibit trauma indicative of warfare. The Cain’s Chapel site recorded the highest trauma frequency, with 10.5% of the sample displaying warfare trauma. Trauma was not observed in four of the MCR sites studied.

Table 2.1. Mississippian Skeletal Trauma Frequencies for Sites in Alabama, Illinois, and Tennessee.*

<table>
<thead>
<tr>
<th>State</th>
<th>Site Name</th>
<th>Trauma Frequency</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>Tibbee Creek</td>
<td>11% inferred cases of warfare-related mortality</td>
<td>Bridges et al. (2000)</td>
</tr>
<tr>
<td></td>
<td>Moundville</td>
<td>0/564</td>
<td>Powell (1988, 1991)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 healed cases of scalping</td>
<td>Snow (1941, 1942); Jacobi et al. (1996)</td>
</tr>
<tr>
<td></td>
<td>Cahokia Mound 72</td>
<td>12% (6/52)</td>
<td>Spencer (2014)</td>
</tr>
<tr>
<td></td>
<td>Cahokia Tract 15B</td>
<td>1% (3/265)</td>
<td>Rose (1999)</td>
</tr>
<tr>
<td></td>
<td>East St. Louis</td>
<td>21% (3/14)</td>
<td>Carbaugh et al. (2013)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 cases of scalping</td>
<td>Hargrave and Nash, personal communication (2014)</td>
</tr>
<tr>
<td>Tennessee</td>
<td>Chickamauga Reservoir</td>
<td>1% (3/259)</td>
<td>Smith (2003)</td>
</tr>
<tr>
<td></td>
<td>Dallas Phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mouse Creek Phase</td>
<td>3% (9/272)</td>
<td>Smith (2003)</td>
</tr>
<tr>
<td></td>
<td>Middle Cumberland Region</td>
<td>2.7% (47/870)</td>
<td>Worne (2011)</td>
</tr>
</tbody>
</table>

*Each researcher uses different methods to calculate trauma frequencies, and these figures may not be directly comparable.

In the nearby region of the Chickamauga Basin of Tennessee, Dallas phase (AD 1300-1600) and Mouse Creek phase (AD 1400-1600) Mississippian skeletal samples exhibit low frequencies of warfare-related violence. Approximately 1% of Dallas phase (3/259) and 3% of Mouse Creek (9/272) skeletons sampled display scalping or projectile point trauma (Smith 2003). Frequencies of warfare-related trauma are particularly high for Mississippians in small and medium sites in Alabama. For instance, Bridges (1996)
identified six (5.6%) scalping victims in a sample of 108 individuals from Koger’s Island in northwest Alabama. In west-central Alabama, Bridges and colleagues (2000:44) have inferred that violence caused 11% mortality in skeletal samples from the Mississippian farmstead of Tibbee Creek and the single-mounded and palisaded Lubbub Creek site.

Mississippian warriors commonly targeted their victims opportunistically. As seen among the Oneota from Norris Farms #36, warfare victims were most often adult men and women engaging in subsistence tasks far from the village or inhibited from fleeing their attackers by pathological conditions that limited their mobility (Milner et al. 1990; Milner and Smith 1991; Milner 1995, 1999). These individuals would exhibit carnivore damage if a considerable time period had lapsed between the attack and their recovery (Milner et al. 1990; Milner and Smith 1991; Milner 1995, 1999; Steadman 2008). Subadults under the age of 15 were infrequently targeted as warfare victims.

Milner and colleagues (1990) have argued that Late Prehistoric warfare victims were most commonly male, but women and children were also affected. However, Bridges and colleagues (2000) have argued that the demographic profile of Mississippian warfare victims varied regionally. They infer that female-directed violence is more infrequent in the Southeast than Midwest. These regional disparities may result from lower access to female victims during raids in the Southeast, differences in the prestige conferred by killing men or women, or social sanctioning of violence toward women generally. More recent examinations of trauma in Mississippian skeletal collections from Tennessee, however, (e.g., Smith 2003; Worne 2011) do not support the male-biased trend in the Southeast. Women were affected by warfare trauma there, albeit in smaller frequencies than men.
Ethnohistory and Its Archaeological Evidence

Descriptions of warfare in Eastern Woodlands and Plains ethnohistories are discussed here and supplemented by archaeological evidence for the practices described. While upstreaming historical narratives is tempting, postcontact Native Americans were not static representations of precontact Mississippian peoples. These accounts must be critically reviewed for their conformity with archaeological evidence and examined for European ethnocentric exaggerations. The personal and political goals of cultural chroniclers may be a substantial source of bias in these accounts. Despite these concerns, ethnohistories remain powerful tools for interpreting Mississippian sites and peoples.

Garcilaso de la Vega, a chronicler of the Hernando de Soto expedition to Florida, described Southeastern Native American warfare practices as ambushes, without formal battles. He stated:

Since, as we have seen, almost all of the provinces that these Spaniards traversed were at war with each other, it will be appropriate to describe here the kind of warfare that was waged. One should know that this was not a conflict of force against force with an organized army or with pitched battles, except in rare instances, or a conflict instigated by the lust and ambition of some lords to seize the estates of others. Their struggle was one of ambushes and subtlety in which they attacked each other on fishing or hunting trips and in their fields and along their roads wherever they could find an enemy off guard. And those whom they seized on such occasions, they held as slaves, some in perpetual bondage with one foot maimed, as we have seen them in certain provinces, and some as prisoners to be ransomed and exchanged (Varner and Varner 1951:487-488).

His observation that southeastern Native Americans ambushed their enemy, accords with the prehistoric archaeological record of southeastern warfare practices (e.g., Milner 1999; Milner 2005).
De la Vega, in the above quotation, also discussed captive-taking practices among Native Americans at contact. Moreover, captive-taking was widely documented for Eastern Woodlands and Plains Native Americans engaged in warfare throughout the contact and historic periods (e.g., Thwaites 1899:49, 1900:62, 1901:71; Strachey 1849; Knowles 1940; Tooker 1962). Captors and their communities treated their prisoners in various ways, including adoption, enslavement, torturing, or killing them (Charlevoix 1851; Thwaites 1898:2, 23, 26, 36; Richter 1983; Tooker 1962; Knowles 1940). Adoption did not guarantee non-violent treatment, and some accounts recall beatings from members of the adoptive kin or tribe (e.g., Edwin 1830; Plummer 1973 [1839]; Swanton 2001 [1931]; Cole 2000). Captives, especially white adults, would sometimes resist their adoption, escaping and reintegrating with their former community members months or years later (Cole 2000). If taken as children, captives were far more likely to assimilate into their adoptive family and tribe (Seaver 1823; Edwin 1830; Plummer 1973 [1839]; Cole 2000).

War captives are uncommonly identified using Mississippian skeletal remains, although captive-taking practices have been inferred from the haphazardly placed female litter burials in Feature 229 of Cahokia’s Mound 72 (Fowler et al. 1999; Rose 1999; Koziol 2012). Haphazard burial treatment indicative of violent deaths, skeletal markers of poor health, and biodistance analyses have been cited by researchers as evidence the female litter burials represented sacrifices (Cohen 1974; Rose 1999). No skeletal trauma has been identified in these individuals. Koziol (2012) hypothesizes that these possible female sacrifices were war captives who were dispatched soon after their apprehension. Strontium isotope values generated from many of these remains, however, are consistent
with a local American Bottom residence throughout their lifetime (Hedman, personal communication 2014). Alternatively, the Mound 72 litter burials may represent intragroup sacrifices similar to other unusual early Mississippian burials. For example, researchers have suggested the four headless, handless males from Feature 106 in Mound 72 (Fowler et al. 1999; Rose 1999) and the four headless males buried at Dickson Mounds, Illinois (Harn n.d.[a]; Conrad 1989) were intragroup sacrifices.

In addition to captive-taking, Eastern Woodlands and Plains ethnohistories reported the practice of taking anatomical trophies from warfare victims (Thwaites 1899:70, 1900:68; De Lusser 1730; Adair 1775; Lorant 1946; Romans 1962; Strachey 1849; Knowles 1940; Tooker 1962; Swanton 1928, 1946; Axtell and Sturtevant 1980). Trophies removed from a slain enemy during battle, included scalps, arms, legs, hands, and feet (e.g., Thwaites 1899:70, 1900:68; De Lusser 1730; Adair 1775; Lorant 1946; Romans 1962; Varner and Varner 1951). Evidence for trophy-taking practices among Mississippian is most commonly identified archaeologically by the presence of scalping cuts on the cranium (e.g., Neumann 1940; Snow 1941, 1942; Berryman 1981; Steadman 2008; Hatch 2012). Cut marks indicative of head and limb trophy-taking have been encountered infrequently in Mississippian skeletal remains (Berryman 1981; Worne 2011).

Raids described in ethnographic reports were often conducted to undermine a chief’s authority through the desecration of a besieged town’s central temple (Varner and Varner 1951; Elvas 1993). Mississippian central temples contained ancestral human remains and statuary, sacred fires, and other symbolic materials (Knight 1986; Anderson 1994b; Brown 1985, 2001; Knight et al. 2001). Temple desecration dissolved the
ancestral links that formed the ideological basis for authority among southeastern Mississippian chiefs (Gibson 1974; Anderson 1994a, 1994b; DePratter 1983; Dye 1990, 1994; Hudson 1997; Milner 1999, 2004; Morse 1993; Sabo 1993; Dye and King, 2007).

In Mississippian societies, central temples were often placed atop pyramid mounds located at a site’s center. Consequently, palisade lines would have had to be infiltrated to access the temples and their symbolic items (Gibson 1974; DePratter 1983; Knight 1986; Holley 1999; Pauketat 2007; Anderson 1994b; Dye and King 2007). Dye and King (2007) have argued that five Mid-South Mississippian sites dated between AD 1200 and 1450, including Towosahgy, Missouri (Price and Fox 1990); Jonathan Creek, Kentucky (Shroeder 2003); Chucalissa, Tennessee (Childress and Wharey 1996; Brown and Dye 2007; Nash 1972); Etowah, Georgia (Larson 1971; King 2001, 2003); and Toqua, Tennessee (Polhemus 1987), display archaeological evidence of central temple desecration (Dye and King 2007). Scattered human remains around the central temple and burned towns and palisades at these sites support interpretations of temple destruction after raiders infiltrated the fortifications.

Ethnohistories also indicate that war also served economic functions. Steponaitis (1991) using ethnohistoric accounts from Southeast United States chiefdoms has inferred from the co-occurrence of non-local materials and war that war rituals were an important mechanism for circulating prestige goods. These elite-controlled prestige items were necessary to fund alliances, as tribute to terminate warfare antagonisms, or to offer reparations for aggrieved parties, including restitution for warrior deaths or injuries. As polities grew more powerful relative to their neighbors, prestige goods mobilized through warfare tribute would become tied into the most powerful polities, while lower
frequencies of prestige items would be found at less powerful sites. In fact, the height of trade of prestige items belonging to the Southeastern Ceremonial Complex is associated with the peak of palisade construction at Eastern Woodland sites between AD 1200-1400 (Milner 1998b, 1999; Milner et al. 2013).

**Weaponry**

The introduction of the bow and arrow in the Eastern Woodlands after the middle of the first millennium A.D. (Blitz 1988; Nassaney and Pyle 1999) revolutionized how warfare was conducted (Milner 1999). For the first time, individuals could engage in conflict from a distance, reducing the chance of mortality for the combatant. Archaeologically, arrow points alone are not direct evidence for warfare, as the same bow and arrow technology used for war was also used for hunting. Yet, Morse and Morse (1983:271) have suggested that the Nodena point was specially designed for war, as it penetrated deeply and was difficult to remove. Deep penetration of an arrow point, however, could be equally as useful for hunting large game, making the exclusive use of Nodena points in warfare doubtful.

Despite the bow and arrow’s ability to create distance between an attacker and danger, hand-to-hand combat was common during assaults, requiring close range weapons. Stone celts and wooden maces were effective shock weapons and were been used in war (Dye 2004; Van Horne 1993:231-232). Atlatls, spears, and knives constructed from stone, cane, shell, and bone could also have been used in war, but would be indistinguishable from hunting implements (Jones 2004:121-122; Swanton 1946:564).
Dye (2009) has argued that large bifacial knives, called Ramey knives, may have been used to scalp enemies, although he does not cite evidence to support this assertion. In contrast, Vermillion and colleagues (2003) identified copper- and iron-based pigments on Ramey knives from the Loyd site in the American Bottom. They concluded that these knives were used exclusively in ceremony and did not have a utilitarian function. Similar to Ramey knives, monolithic axes and stone maces, being fragile, were almost certainly ceremonial weapons and not used in war. In archaeological contexts, these weapons are primarily recovered in high status burial accompaniments and ritual displays (Webb and DeJarnette 1942, Plate 242 No. 2; Larson 1971; Brown 1976, 1996). The ceremonial importance of these weapons resulted in their exchange across large distances (Brown 1996; Cobb and Giles 2009).

**Mississippian Iconography**

The Southeastern Ceremonial Complex (SECC) was a regionally diverse thematic and artistic style that was used to create Mississippian ceremonial and exchange objects (e.g., Waring and Holder 1945; Brain and Phillips 1996; Phillips and Brown 1978; Larson 1971; Knight 1986; Galloway 1989; Knight et al. 2001; Dye 2004; King 2007). War motifs prevalent in SECC artwork included figures of warriors, captives, weapons, and limbs taken as trophies (Phillips and Brown 1978; Knight 1986; Brown 2004, 2007; Brown and Dye 2007). They were created on rock, copper, and shell (Waring and Holder 1945; Phillips and Brown 1978, 1984; Muller 1995; Brain and Phillips 1996; Diaz-Granados 2004; Dye 2004, n.d.; King 2004; Cobb and Giles 2009).

A prominent SECC war motif depicts warriors holding maces or war clubs above their heads. These warriors are often depicted with raptorial eyes, creating a mythical
figure called the birdman. One of the more notable images of the birdman was crafted in
the Rogan repoussé copper plate (Figure 2.3) recovered from Etowah’s Mound C
(Thomas 1894; Willoughby 1932; Waring and Holder 1945; King 2004; Brown and Dye
2007). The Rogan plate depicts a dancing birdman holding a mace in his right hand and a
decapitated head in his left hand. A bellows-shaped apron, a stylistic representation of a

**Figure 2.3 Rogan Plate Depicting Morning Star Holding A Severed Head (from
Brown and Dye 2007).**

scalp, also hangs prominently from the Rogan birdman’s belt (Phillips and Brown 1978;
King 2004; Brown 2007a). The birdman figure has been associated with a mythical
falcon-like being called Red Horn or Morning Star in historic eastern Plains cosmologies
(La Flesche 1995; Radin 1950; Hall 1977, 1997; Brown 2007a). These stories relate the
exploits of Morning Star and his family in raids and mystical battles. Cahokia’s Mound
72 Sub 1 burials, which include the burial lying atop a falcon-shaped bed of shell beads, have been interpreted by Brown (2003, 2006) as a collective representation reenacting Morning Star’s battle with death.

Acts of trophy- and captive-taking have been depicted in SECC art. Severed heads, scalps, and isolated hands, forearm bones, femurs, and skulls are found in Mississippian iconography (Phillips and Brown 1978, 1984; Morse and Morse 1983, 1998; O’Brien 1994; Dye 2004; Dye 2007; Brown and Dye 2007). Figurines of kneeling and bound captives were also modeled into ceramic effigy pipes (Dye 2004). A clay effigy from Spiro, Oklahoma represented a supernatural warrior decapitating a crouched adversary (Burnett 1945; Hamilton 1952; Fundaburk and Foreman 1957; Brown 1996; Emerson et al. 2003; Dye 2004; Brown and Dye 2007).

Mississippian SECC art did not record the exploits of living warriors but rather, recreated mythical scenes of supernatural beings in combat (King 2004; Brown and Dye 2007). These supernatural scenes, however, were grounded in familiar activities for Mississippians. Furthermore, Brown and Dye (2007:278-279) have cautioned against making direct inferences about Mississippian warfare practices from art objects:

It is seductively easy to slip into direct conflation of images and physical evidence, and in so doing perceive artistic imagery here and elsewhere as a contemporary pictorial document. That is, it is primarily a pictorial confirmation of biological and physical reality … this perspective fails to recognize the active role that religious beliefs have in selecting those images deemed appropriate for honoring the sacred, particularly on objects engaged in sacred activities.

SECC iconography must be evaluated critically when examining Mississippian warfare practices, although certain images, such as weaponry, were probably based on those used
by Mississippians (Fontana 2007). War rituals using SECC icons, however, could have invoked supernatural warriors to impart their power into living warriors (Cobb and Giles 2009).

**Burned Structures**

Fontana (2007:52) and Dye (2009) have asserted that intentionally burned houses or settlements are direct evidence for warfare. They argue that structures burned in a warfare raid would be distinguishable archaeologically from ritual or accidental fires by examining the types of structures burned. Raiders were most likely to target the palisade, chiefly residences, storage structures, and the temple complex for destruction.

Excavations at the East St. Louis Mound group in the American Bottom uncovered evidence for a fire that burned approximately 25 Late Stirling phase (AD 1150-1200) structures that were part of a walled elite compound or precinct (Pauketat et al. 2013). Pauketat and colleagues estimate (2013) that as many as 100 huts were incinerated when unexcavated areas are considered. They infer that this fire was most likely an act of “ritual burning,” but also offer alternative explanations, such as a “politically motivated assault” or an accident, for the fire’s cause (Pauketat 2013:218). Their argument that the fire was a ritual burning is consistent with interpretations from other prehistoric North American sites.

Burned structures littered with complete artifacts on the floors are commonly found throughout the Central Illinois Valley and American Bottom during the Mississippian Period (McConaughy 1991, 2007; Harn 1994). It is unclear, however, whether these fires were burned intentionally or purposefully. Steadman and Wilson (2007) concluded that warfare was the cause of domestic assemblages on burned house
floors in Illinois. Pauketat (1989), however, has argued that burned Mississippian houses with complete ceramic vessels on the floors in the American Bottom resulted from an accidental fire, an intentional fire to clean the area, or ritual abandonment. Warfare is suggested as a cause of a burned house, when it is associated with evidence of a contemporaneously burned ancestor temple, charnel house, or palisade (Dye and King 2007; Cook 2012).

When palisades, skeletal trauma, ethnohistories, SECC iconography, and burned structures are examined, archaeological evidence indicates that Mississippian war was characterized by numerous strategies. The diversity of Mississippian warfare strategies could include small-scale ambushes and raids on the outskirts of a community to large-scale “raids-in-force” designed to penetrate defensive palisades and destroy symbols of chiefly authority. In fact, by AD 1200, intensified palisade construction coinciding with increases in skeletal trauma and violent art suggest war became endemic throughout the Midcontinent and Southeast (Milner 1998b, 1999; Milner et al. 2013). Some of the most compelling evidence for Mississippian war has been amassed from sites in the Central Illinois Valley (CIV) of west-central Illinois. The following chapter introduces the CIV, presents its culture history, and reviews the archaeological evidence for war in the region.
CHAPTER 3 – THE CENTRAL ILLINOIS VALLEY

This chapter reviews the archaeological and bioarchaeological literature for the Mississippian Period in the Central Illinois Valley. Major research themes are summarized, followed by an examination of problems with the region’s Mississippian chronology and culture history. Central Illinois Valley culture history from the Mississippian Eveland through Crable phases is reviewed, followed by a review of temporal changes in warfare and violence during the Mississippian Period. This chapter concludes with a brief summary of the five Central Illinois Valley sites from which skeletons were sampled for this dissertation.

**Mississippians in the Central Illinois Valley**

The Central Illinois Valley (CIV) of west-central Illinois (Figure 3.1) extends for approximately 210 kilometers along the Illinois River from the contemporary village of Hennepin southwards to Meredosia (Harn 1978, 1994). Precontact Native Americans inhabited the region continuously from Paleoindian through Late Prehistoric times (e.g., Santure et al. 1990; Conrad 1991; Wiant 1993; Holt 2000; Esarey 2000; Nolan and Fishel 2009). The Mississippian Period occupation of the CIV extends from ca. AD 1050-1450. After ca. AD 1450, the region was abandoned, following a generalized pattern of depopulation throughout the Midwest (Cobb and Butler 2002; Milner and Chaplin 2010). The CIV was not recolonized until the arrival of the Illinois tribes approximately a century later (Green 1993; Harn 1994; Esarey and Conrad 1998; Emerson 2012). This Large settlements and populations make the Mississippian one of the more archaeological visible (e.g., Cole and Deuel 1937) and therefore better-studied temporal periods in the region.
Although Mississippian chiefdom sociopolitical models have not been systematically applied to CIV Mississippian polities, settlement data do suggest relatively small and ephemeral regional site hierarchies. By the Late Mississippian Period, CIV settlements were organized with central temple towns surrounded by smaller hamlets and extractive sites (Harn 1994). Platform mounds, central plazas, and large village habitation areas characterized the largest sites in the CIV settlement system, temple towns (Harn 1978, 1994). Some of the largest settlements (e.g., Larson) in the CIV show evidence of shifts in occupations, with cycles of habitation, abandonment, and rehabilitation (Harn 1994).
Some of the earliest reports of Mississippian scalping (Neumann 1940) and anecdotal notations of violent death (Morse et al. 1961; Morse 1978) were described from CIV Mississippian burials. Yet, systematic regional studies of warfare and violence were initiated only during the 1990s by George Milner and colleagues (Milner and Smith 1990; Milner et al. 1991; Milner 1995). The low intensity raiding experienced by Oneota occupants at the Norris Farms #36 cemetery has shaped scholarly understandings of Native North American warfare. Milner and colleague’s findings have also encouraged new bioarchaeological and archaeological research on CIV Mississippian warfare (Steadman 2008; Hatch 2012; G. Wilson 2012; Vanderwarker and G. Wilson n.d.).

More visible in the literature, however, are two other CIV research themes that have considerable historical depth. The first focuses upon the relationships of CIV polities and peoples to the nearby Mississippian center of Cahokia, which lies approximately 200 river km to the south. Research has examined hypotheses that Cahokian migrations caused the spread of Mississippian culture into the CIV (e.g., Goodman and Armelagos 1985; Conrad 1991; Harn 1991a). The preponderance of bioarchaeological and archaeological evidence, however, does not support any direct Mississippianization of the CIV by Cahokian immigrants nor direct Cahokian control. Rather, the Mississippian cultural horizon was likely initiated as an in situ adoption of Mississippian cultural practices by local Late Woodland peoples (Steadman 1997, 1998, 2001; Bardolph 2014).

While a large migration of Cahokians did not take place, Cahokian influence is visible at sites throughout the CIV. Cahokian material culture and stylistic motifs, whether imported or emulated, are found in Ramey Incised and Powell Plain ceramic
wares (Simpson 1952; Perkins 1965; Caldwell 1967a; Conrad 1972; Harn n.d.[a], 1980),
Mill Creek chert hoes and Ramey knives (McDonald 1950; H. Smith 1951; Morse 1960;
Harn, n.d.[a]), and long nosed god masks (Morse et al. 1961; Griffin and Morse 1961;
Sampson and Esarey 1993). Cahokian interactions with CIV polities appear to be
unidirectional, however. Goods and ideology flowed outward from Cahokia, with little
evidence of goods directed from the CIV to Cahokia (Kelly 1991; Harn 1991a; Milner 1991).

A second, related theme involves arguments emphasizing the harmful effects of
both Mississippianization and Cahokia on CIV individuals. In the 1970s and 1980s,
George Armelagos and his students at the University of Massachusetts (UMass) Amherst
instituted a research program studying the health of individuals interred at the Dickson
Mounds site. Their research found that the Middle Mississippians were physically
stressed, with high subadult mortality, low mean age-at-death, and high frequencies of
nutritional and infectious illnesses as well as trauma (Lallo 1973; Lallo et al. 1977, 1978,
mean age-at-death found in these studies, however, was likely due to age estimation
techniques that typically underestimated adult age-at-death. Nevertheless, CIV
Mississippian health was deleteriously affected by the poor nutrition associated with the
shift to maize agriculture and increased population densities, which facilitated disease
transmission.

Goodman and Armelagos (1985), consistent with the time’s emphasis on world
system models (e.g., Wallerstein 1974; Dincauze and Hasenstab 1989), have suggested
that the significant nutritional stress suffered by CIV individuals was possibly caused by
that the CIV’s role as a maize-provisioning outpost. Archaeological evidence has not been marshaled to support this conclusion. First, the political and population apex at Cahokia during which maize demands would have been highest occurred during the CIV Eveland phase (ca. AD 1050 and 1200), prior to any large political or organizational changes in the region. Moreover, the high maize composition of CIV Mississippian diets during a period of severe drought (Benson et al. 2007, 2009) argues against deleterious Cahokian maize demands. Isotopic studies of δ^{13}C values demonstrate a high CIV Mississippian dietary reliance on maize (Buikstra and Milner 1991; Buikstra 1992; Strange 2006; Tubbs 2013). Significantly, maize comprised nearly 50% of CIV Mississippian diets throughout all Mississippian subphases (Buikstra 1992). High maize dietary reliance is also revealed in high maize cupule and kernel ubiquity from CIV domestic features and middens (VanDerwarker et al. 2013).

More recent theoretical and methodological advances in paleodemography and paleopathology have contributed to the reevaluation of the health trends identified by the UMass Amherst research program (e.g., Wood et al. 1992; Boldsen et al. 2002; Konigsberg and Frankenberg 2002; Milner and Boldsen 2012). Jeremy Wilson (2010, 2014) found that while early childhood mortality was high among Mississippians, it had remained constant since Late Woodland times and thus was not caused by cultural changes. Wilson’s work also showed that higher mortality and greater susceptibility to illness, or frailty, affected Mississippian women more than men. He argued that sociopolitical changes, like population nucleation and increased warfare, beginning in the Orendorf phase drove Mississippian demographic and health patterns, rather than transitions to maize agriculture or Cahokian tributary demands.
Although the CIV’s role in interregional sociopolitical relationships and their effects on health have been explored, these questions persist. More work is necessary to better frame these preexisting questions through improvement of CIV Mississippian culture history. Increasing understanding of temporal-systematics also lends insight into diachronic changes in war. To frame this diachronic approach to CIV warfare, the following section reviews the literature on CIV Mississippian subphases.

Temporal Systematics

The Mississippian occupation of the CIV persisted for almost 400 years, but identifying the precise dates of the CIV Mississippian cultural horizon and its subphase chronologies requires continued scholarly attention. Various archaeological and skeletal chronologies and subphases have been devised for the Mississippian period and have been reviewed elsewhere (Buikstra and Milner 1989). Conrad (1991), Harn (1994), and Esarey and Conrad (1998) have developed more recent revisions to these chronologies. As Esarey and Conrad’s (1998) subphase chronology was based on Method B calibrated radiocarbon dates (Stuiver and Reimer 1993), it is preferred in this analysis.

Four archaeological subphases and a unified Mississippian occupation of the CIV have generally characterized CIV temporal systematics. In contrast, Conrad (1991) initially divided the CIV into a northern Spoon River and southern La Moine River traditions. This regional division was based on hypotheses regarding geographic differences in Late Woodland progenitor populations, interactions with Cahokian migrants, and Bold Counselor Oneota occupation densities. Reevaluation of ceramic horizon markers and calibrated radiometric dates, however, revealed continuity in
cultural elements throughout the region, negating the need to separate the CIV into two traditions (Esarey and Conrad 1998).

Esarey and Conrad’s (1998) calibrated radiocarbon dates revealed problematic overlaps in the ceramic horizon markers used to differentiate subphases. For instance, dates from the temporally “sequential” Orendorf and Larson sites, dating to the Orendorf and Larson subphase horizons, show considerable overlap. As these two sites provide the bulk of information regarding their respectively named phases, such overlap is particularly problematic. Difficulties with the ceramics-based archaeological chronologies, however, were recognized before the date recalibration. Artifacts that define each Mississippian cultural phase exhibit considerable stylistic diversity when compared between sites (Harn 1994:25), making relative chronologies problematic. Fishel (1985) has argued that elongation in ceramic jar rim heights through time may prove useful in marking a CIV intraregional chronology. His analysis inverted the dates for the Larson and Orendorf sites (Orendorf is earlier than Larson but was assessed as later than Larson), complicating the temporal trend.

More work should be focused on continued chronology refinements, especially using calibrated radiocarbon dating. The majority of radiocarbon dates collected from CIV Mississippian sites derived from laboratory analyses at the University of Michigan and the University of Wisconsin (Table 3.1) and were published in the middle of the twentieth century (e.g., Crane and Griffin 1959, 1963; Bender et al. 1975). These dates represent early archaeological applications of absolute dating. Since these dates were collected, few new Mississippian dates have been generated. Additional carbon-14 dates, especially direct dates of human skeletal remains, need to be collected and published to
<table>
<thead>
<tr>
<th>Site</th>
<th>Sample ID</th>
<th>Context</th>
<th>Date BP</th>
<th>Uncorrected Date</th>
<th>Calibrated Date</th>
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</thead>
<tbody>
<tr>
<td>Eveland</td>
<td>WIS-652</td>
<td>Charred wood from log in house</td>
<td>865 ± 50</td>
<td>AD 1085</td>
<td>AD 1040 – 1260</td>
</tr>
<tr>
<td>Eveland</td>
<td>WIS-653</td>
<td>Charcoal from log in house</td>
<td>895 ± 55</td>
<td>AD 1055</td>
<td>AD 1025 – 1245</td>
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<tr>
<td>Eveland</td>
<td>WIS-654</td>
<td>Charcoal, hickory nuts from cross-shaped building floor</td>
<td>820 ± 50</td>
<td>AD 1130</td>
<td>AD 1048 – 1281</td>
</tr>
<tr>
<td>Orendorf</td>
<td>WIS-649</td>
<td>Charcoal from logs of mortuary structure</td>
<td>800 ± 55</td>
<td>AD 1150</td>
<td>AD 1050 – 1290</td>
</tr>
<tr>
<td>Orendorf</td>
<td>WIS-683</td>
<td>Charcoal from feature</td>
<td>865 ± 55</td>
<td>AD 1085</td>
<td>AD 1039 – 1260</td>
</tr>
<tr>
<td>Orendorf</td>
<td>WIS-692</td>
<td>Charcoal from log outside structure</td>
<td>845 ± 65</td>
<td>AD 1105</td>
<td>AD 1039 – 1274</td>
</tr>
<tr>
<td>Orendorf</td>
<td>WIS-693</td>
<td>Same as WIS-692, acid pretreatment only</td>
<td>810 ± 45</td>
<td>AD 1140</td>
<td>AD 1058 – 1281</td>
</tr>
<tr>
<td>Orendorf</td>
<td>WIS-695</td>
<td>Maize from pit</td>
<td>770 ± 55</td>
<td>AD 1180</td>
<td>AD 1156 – 1383</td>
</tr>
<tr>
<td>Larson</td>
<td>WIS-655</td>
<td>Charcoal from feature</td>
<td>765 ± 55</td>
<td>AD 1185</td>
<td>AD 1158 – 1384</td>
</tr>
<tr>
<td>Larson</td>
<td>WIS-689</td>
<td>Charcoal from feature</td>
<td>760 ± 55</td>
<td>AD 1185</td>
<td>AD 1160 – 1384</td>
</tr>
<tr>
<td>Larson</td>
<td>WIS-659</td>
<td>Charcoal from storage pit</td>
<td>835 ± 60</td>
<td>AD 1115</td>
<td>AD 1043 – 1277</td>
</tr>
<tr>
<td>Larson</td>
<td>WIS-688</td>
<td>Charcoal from house floor</td>
<td>815 ± 55</td>
<td>AD 1135</td>
<td>AD 1047 – 1284</td>
</tr>
<tr>
<td>Berry</td>
<td>M-549</td>
<td>Charcoal from village</td>
<td>810 ± 125</td>
<td>AD 1140</td>
<td>AD 995 – 1399</td>
</tr>
<tr>
<td>Crable</td>
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<td>Wooden pole from house</td>
<td>565 ± 65</td>
<td>AD 1385</td>
<td>AD 1291 – 1440</td>
</tr>
<tr>
<td>Crable</td>
<td>WIS-644</td>
<td>Carbonized pole from house</td>
<td>515 ± 60</td>
<td>AD 1435</td>
<td>AD 1296 – 1474</td>
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<tr>
<td>Crable</td>
<td>M-550</td>
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<td>600 ± 100</td>
<td>AD 1350</td>
<td>AD 1217 – 1486</td>
</tr>
<tr>
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<td>Charcoal from pit feature</td>
<td>620 ± 100</td>
<td>AD 1330</td>
<td>AD 1207 – 1467</td>
</tr>
<tr>
<td>Crable</td>
<td>M-554</td>
<td>Charcoal from pit feature</td>
<td>530 ± 100</td>
<td>AD 1420</td>
<td>AD 1274 – 1524</td>
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</tbody>
</table>

*a* WIS samples from Bender et al. (1975); M samples from Crane and Griffin (1959), deviations revised in Crane and Griffin (1963).

*b* Dates calibrated with CALIB version 7.0.1 (Stuiver and Reimer 1993).
improve diachronic analyses in the CIV. Direct radiocarbon dating of one Mississippian burial from the Luthy Alps (Hedman and Emerson 2008) and 11 dates from Mississippian and Late Woodland burials from Dickson Mounds (Harn 2011), however, are positive steps for strengthening CIV chronologies. Alan Harn plans to publish the new Dickson Mounds radiocarbon dates in a forthcoming Dickson Mounds monograph.

Central Illinois Valley Culture History

The culture history of the four CIV Mississippian subphases (Eveland, Orendorf, Larson, and Crable) has been summarized in great detail by Lawrence Conrad (1991). Consequently, much of the following discussion expands upon his work. Because Mississippian chronologies in the region are inconsistent across researchers and suffer from the dating problems discussed above, a nuanced Mississippian culture history has yet to be developed for the CIV. Rather, the literature describes settlements, diet, and burial accompaniments for each Mississippian subphase. As a result, each subphase will be summarized through an introduction to the phase and descriptions of pottery, diet, and typical burial accompaniments following Conrad (1991). Due to researchers’ increased interest in changes to CIV warfare practices through time, a more synthetic diachronic history is possible for this topic. It will be discussed in a subsequent section. While there may have been temporal overlap in Mississippian subphases, they remain the best method to investigate changes over time in the region until additional radiocarbon dates are generated.

Eveland Phase

The Eveland phase of the CIV dates to ca. AD 1050-1200 (Esarey and Conrad 1998), although slight differences between researchers exist (Conrad 1991, Harn 1994;
Esarey and Conrad 1998). For instance, Conrad (1991) subdivided the Eveland phase into the Waterford (AD 1050–1100) and Wolf (AD 1100-1150) subphases, but material culture dating to the Wolf subphase is uncommonly recovered and restricted geographically. Harn (1991, 1994) found evidence for Eveland phase occupations in at least 13 CIV sites. No temple town centers date to this phase and settlements are small (less than one hectare), widely dispersed, and occupied only for short durations (Harn 1991, 1994; Conrad 1991).

Pottery typically dated to the Eveland phase includes shell-, sand-, and grit-tempered replications of Cahokian pottery (Conrad 1991). The most ubiquitous Eveland phase ceramics are Powell Plain wares (Conner 1985). Ramey Incised pots, like those produced at Cahokia, are also found in the CIV during the Eveland phase. While both Conrad (1991) and Harn (1991a) have questioned the idea that local CIV Mississippians would have the technology and knowledge to reproduce these wares, thin-section analyses have indicated a local sourcing of the clays (Harn 1991a; Stoltman cited in Conrad 1991). As a result, Harn (1991a:142) argues that Cahokian immigrants or second-generation potters created such fine wares. It is equally likely, however, that they were local imitations – a point also argued for Eveland phase ceramics from the Lamb site (Bardolph, 2014).

Maize enriched the diet of Eveland phase Mississippians relative to the preceding Late Woodland period ($\delta^{13}C$ -12.6 Mississippian, $\delta^{13}C$ -13.4 Late Woodland), composing approximately 50% of the diet (Milner and Buikstra 1991; Buikstra 1992). In archaeobotanical assemblages from the Eveland phase Lamb site, maize cupules and kernels and hickory nutshells were the most abundant plant remains recovered.
(VanDerwarker et al. 2013). At the C.W. Cooper site, maize cupules, hickory nut shells, and chenopod seeds were the most abundant charred plant remains recovered from features dating between AD 1150 and 1200 (VanDerwarker et al. 2013). Eveland phase diets were also supplemented with other wild and domesticated plants (Conrad 1991; Harn 1991a). A number of terrestrial and faunal resources were consumed, especially fish and deer (Kuehn and Blewitt 2013).

The Dickson Mounds cemetery provides the most information regarding Eveland phase burials. Mounds A-E (2-6) contain a mixture of Late Woodland and Eveland phase burials (Harn n.d.[a], 1991b). Individuals were generally interred as extended supine or semiflexed inhumations, although bundle burials were also common (Harn n.d.[a], 1991b). Grave goods associated with Eveland phase burials included: triangular and notched triangular arrow points, potter’s trowels, sandstone slot abraders, marine shell bead jewelry, clothing, and hair decorations, Busycon pendants, copper-covered earspools composed of wood or stone, cougar canine ear pendants, discoidals, Ramey knives, rattles, shell spoons, ceramic vessels, and tattooing equipment (Harn n.d.[a], 1991b).

**Orendorf Phase**

The Orendorf phase dates to approximately AD 1150-1250 (Esarey and Conrad 1998), with excavations from the Orendorf site supplying most of the available information regarding the Orendorf phase in the CIV (Santure 1981). By constructing the site on a 30 m high bluff top that overlooks a backwater lake, Orendorf inhabitants were protected by a natural defensive location (Santure 1981; Conrad et al. 1981). Santure (1981) postulates that a sequence of four settlements comprised the site, expanding from east to west through time. Orendorf Settlement B was associated with a platform mound,
and Settlement C contained a large plaza faced by public buildings, three of which underwent a minimum of six construction phases (Santure 1981).

Ceramic wares during the Orendorf phase are not as finely made as those from the preceding Eveland phase (Conrad 1991). Ramey Incised and Sepo wares became relatively infrequent. Cord marked ceramics comprised approximately three percent of Orendorf Settlement C pottery (Conrad et al. 1981). Powell Plain jars are present in Orendorf assemblages in reduced frequencies relative to the Eveland phase. Curvilinear and pseudo-scroll designs typify the Orendorf archaeological ceramic phase (Conrad 1991).

Maize consumption increased among Mississippians during the Orendorf phase, with \( \delta^{13}C \) values averaging -10.2 at Dickson Mounds and -9.4 at the Orendorf site (Buikstra and Milner 1991; Buikstra 1992). Additional \( \delta^{13}C \) values, all relatively consistent with Buikstra and colleagues’ mean, have been generated (Strange 2006; Tubbs 2013). At the Orendorf site, deer, fish from oxbows, sloughs, and lakes, turkey, and waterfowl are among the most prevalent animal resources extracted (Emerson 1981; Paloumpis 1983; Speth 1981). Average \( \delta^{15}N \) values from Orendorf are relatively high (e.g., 10.5‰), perhaps indicating greater consumption of maize-fed animal protein (Tubbs 2013) relative to American Bottom Mississippians (Hedman et al. 2002). The high \( \delta^{15}N \) values are less likely to be caused by diminished reliance on legumes, as beans were recovered in low abundance during the Orendorf phase and during the previous Eveland phase (Vanderwarker and Wilson n.d.). In fact, corn cupules and hickory nuts were the most ubiquitous plants recovered from the Orendorf site (Blake n.d., cited in Conrad 1991).
Mortuary behavior during the Orendorf phase is known principally from Dickson Mounds, Orendorf, and Weaver-Betts site burials (Conrad 1972, 1991; Wray and MacNeish 1958, cited in Conrad 1991). Most Orendorf phase burials were interred as extended supine inhumations, but disarticulated bundles were also relatively common. Conrad (1991) found a mutually exclusive relationship between marine shell and ceramics in his 1967 excavation of Orendorf phase burials at Dickson Mounds and in burials from Weaver-Betts. Yet at the Orendorf cemetery, marine shell artifacts and ceramic wares were recovered in association. Conrad (1972, 1991) also emphasized the presence of ascribed status in Orendorf phase burials, evident in subadults buried with “badges of offices” like shell necklaces and bracelets.

Larson Phase

The Larson phase of the CIV (ca. AD 1250-1300) continued the town and mound four-tiered settlement system evident during the Orendorf phase. By the Larson phase, settlements exhibited greater nucleation (Harn 1994). It is unclear whether Larson phase central towns and primary villages were continuously occupied or habitations rotated seasonally. Harn (1994) contended the Larson site was part of a seasonally shifting settlement system. While acknowledging the tenuous nature of his seasonality evidence, he argued the Larson site was primarily inhabited during fall and winter months. He cited the presence of fall and winter resources (e.g., fall-ripening nut seeds and shells) in middens, deer remains with shed antlers, migratory birds, and house structures with internal hearths in support of his argument. Harn also maintained that these combinations of features were uncommon or absent from other Larson phase settlements. These data, however, do not demonstrate that the site was used exclusively in the fall and winter.
The Larson phase is characterized by shell-tempered Dickson series ceramics including: Dickson trailed, Dickson cordmarked, and Dickson plain (Harn 1994:26). During the Larson phase, cordmarked ceramics comprise a higher frequency of sherds than in the preceding Orendorf period. Using cordmarking as a horizon marker is problematic, as the cordmarked vessel counts are limited to three structures and their respective features at Fouts Village (Cole and Deuel 1937:118-119; Conrad 1991) and 34 vessels from the Morton site (Santure 1990). Effigy bowls, Spoon River beakers, water bottles, lobed jars, and Wells Incised plates may also be recovered from Larson phase assemblages (Conrad 1991). A detailed regional ceramic analysis, however, has yet to be conducted for this subphase.

Larson phase maize consumption was slightly reduced relative to the Orendorf phase at Dickson mounds ($\delta^{13}$C -11.2) (Buikstra and Milner 1991; Buikstra 1992). Recent analysis by Vanderwarker and Wilson (n.d.) of flotation samples from Myer-Dickson site Larson phase features found lower frequencies of native plants and increased abundance of beans relative to previous periods. The site’s inhabitants, therefore, may have reduced their foraging range and relied on the consumption of cultigens as a response to warfare threats. While Larson phase faunal assemblages analyses have not been completed, Harn (1991b:161) listed deer, fish, small terrestrial animals and migratory birds among the animals exploited. A small sample of macrofaunal remains recovered from Larson phase features at Norris Farms #36 evidence substantial exploitation of fresh water fauna, especially mussels, fish, and aquatic turtles and birds. Deer, however, was not recovered in high frequencies, representing only five
percent of the sample (Styles 1990). More detailed investigations of resource
exploitation during the Larson phase, however, have yet to be conducted.

Burials outside of primary village cemeteries and mounds were infrequent during
the Larson phase but, when they did occur, were likely limited to sites remote from a
primary village (Harn 1994). Larson phase burials have been excavated from several
sites, including Dickson Mounds, (Harn n.d.[a], 1980; Conrad 1972), Larson (Harn
n.d.[b]), Berry (Conrad 1970), and Emmons (Morse et al. 1961). Unlike the Orendorf
phase, burial accompaniments could include marine shell and ceramics together rather
than separately (Conrad 1991). Nonperishable burial artifacts, however, were recovered
less frequently from Larson phase contexts than from previous periods (Harn n.d.[b]). By
the Larson phase, however, burial goods in village cemetery and mound contexts
exhibited Southeast Ceremonial Complex (SECC) symbolism (Conrad 1989; Harn
n.d.[a]; Morse et al. 1961; Griffin and Morse 1961). Copper covered long-nosed god
masks (Morse et al. 1961; Griffin and Morse 1961), copper gorgets with cross and circle
design (Harn n.d.[a]), fenestrated cross incised marine shell gorgets, serpents engraved on
beakers, and frog and human effigy pipes (Conrad 1989) were among these SECC burial
artifacts excavated from Larson phase components.

Crable Phase

The Crable phase extends from approximately AD 1300-1450. During this phase,
v Violent ethnic population interactions following a movement of tribal Oneota peoples into
Mississippian-occupied CIV occurred. Mississippian and Oneota habitations and features
are located alongside one another or features with a mixture of Oneota and Mississippian
ceramics are found at sites like Morton Village (Santure 1990; Conner and O’Gorman
At the nearby Norris Farms #36 site, however, endemic raiding threatened the Oneota residents. Sixteen percent of the 264 individuals of all ages, or one-third of all adults, interred in the Norris Farms #36 cemetery display trauma indicative of warfare (Milner et al. 1991; Milner and Smith 1990; Milner 1995). Mississippians, who had once inhabited both the northern and southern portions of the CIV, abandoned the Oneota-occupied north and retreated southward (Esarey and Conrad 1998). Mississippian populations nucleated into fortified settlements at Crable, Lawrenz Gun Club, and Walsh, perhaps in response to conflict with the Oneota.

As Oneota peoples inhabited a large proportion of the CIV, more intensive research has been focused on Oneota, rather than Mississippian sites dating to the Crable phase. Consequently, more work is required to define the phase’s Mississippian horizon markers, and inconsistent chronologies are used among researchers. For instance, Conrad (1991) distinguished between three phases beginning at approximately AD 1300: a Spoon River Marbletown Complex (ca. AD 1300-1400) and La Moine Mississippian Crabtree (ca. AD 1300-1375) and a subsequent Crable phase (ca. AD 1375-1450). While not including the distinction between an upper valley Marbletown Complex and a southern valley La Moine variant, Harn (1994) also subdivided the period between AD 1300 and 1450 into Crabtree and Crable phases. Esarey and Conrad (1998), in contrast, did not include either the Marbletown complex or Crabtree phases in their chronology, which is limited to a Crable phase extending from ca. AD 1300-1425. As Esarey and Conrad’s (1998) chronology was based on recalibrated radiocarbon dates (Stuiver and Reimer 1993) from several Late Mississippian samples, their Crable phase and date...
estimates are preferred in this research. Ceramics typical of the Crable phase include effigy bowls, plain and cordmarked large bowls, painted, negative painted, and plain water bottles, plain small bowls, and decorated broad-rimmed plates (Conrad 1991; Esarey and Conrad 1998). Cordmarked jars and plates are especially common during this period (Conrad 1991; Esarey and Conrad 1998).

Little is known regarding Mississippian diets during this phase, and information is limited to an unpublished report of “unfloated” fauna (it is not specified whether samples were screened, but this work likely occurred before flotation techniques) from Crable by Paul Parmalee (n.d., cited in Conrad 1991:149) and Parmalee’s observations of fauna collected from the Sleeth site reported in Conrad (1991:149). These analyses identified deer, fish, mussels, turtles, elk, and birds. Macroscopic examinations also found maize kernels in Crable pit features (Conrad 1991). While more subsistence data are available for Oneota peoples, it is unlikely that Oneota subsistence data from the Crable phase would characterize their Mississippian contemporaries. Norris Farms #36 Oneota δ^{13}C values reflect a slightly lower maize reliance than for Mississippians from previous periods (Buikstra and Milner 1991; Buikstra 1992; Tubbs 2013). As Oneota work parties were often targeted in raids at Norris Farms #36 (Milner et al. 1991), warfare threats may have limited expansion of agricultural fields and thereby reduced Oneota maize consumption. Tubbs (2013) has argued from Norris Farms #36 and Orendorf stable carbon isotope analyses, instead, that maize was not as ideologically important to Oneota peoples as it was to Mississippians. Mean Norris Farms #36 δ^{13}C values more closely resemble those from other Upper Mississippian Oneota sites (e.g., Vradenburg 1993;
Vradenburg and Hollinger 1994; Emerson et al. 2005) than those generated for CIV Middle Mississippians.

Crable phase burials were largely interred within village cemeteries but mound, storage pit, and house pit burials also occurred (MacDonald 1950; H. Smith 1951; Morse 1960). Unfortunately, information regarding Crable phase mortuary programs is limited primarily to excavations from the first half of the twentieth century at the Crable site (McDonald 1950; H. Smith 1951). Further research is required to provide a more complete understanding of the mortuary program at Crable phase sites throughout the region. Burial accompaniments were largely consistent with those found in previous periods, with SECC artifacts and imported Mill Creek chert long knives (Ramey knives) especially prominent (McDonald 1950; H. Smith 1951; Morse 1960). Shell gorgets incised with spiders, an eagle, crosses and a “stepped-cloud” motif are among the SECC artifacts recovered from the site (Smith 1951; Morse 1960).

Over approximately 400 years of Mississippian occupation, the peoples of the CIV experienced shifts in settlement location, diet, and mortuary traditions. From the relatively small and dispersed Eveland settlements to the increasing population sizes and settlement nucleation of the Orendorf, Larson, and Crable phases, Mississippianization had significant effects on the region’s inhabitants. Temporal shifts in CIV violence and warfare are also evident through examination of each subphase.

**Warfare in the Central Illinois Valley**

Traditionally, bioarchaeological studies of Mississippian violence have largely focused on noting interesting trauma cases (e.g., Neumann 1940; Poehls 1944; Morse 1978), although more recent work has assessed site and population distributions of
trauma. As Cook (2007) argued, more local and regional paleopathological syntheses are required to enhance our understandings of past lifeways. Dawnie Steadman (2008) has created such a regional synthesis for warfare in the CIV. Her work supplied a thorough summary of available trauma case reports, but was limited by the paucity of CIV population-level trauma studies. While violence in the CIV has been inferred from bioarchaeological case reports since the 1940s (e.g., Neumann 1940; Poehls 1944), more research at the population-level is necessary to assess temporal patterns, as large samples of skeletal remains from the region remain understudied.

Steadman (2008) argued that bioarchaeological analyses of trauma show temporal shifts from "ritual" violence to high intensity warfare to low intensity warfare through time. During the Eveland phase (ca. AD 1050-1200), symbolic tableaus of "ritual" sacrifices are prominent. These ritualized contexts are argued to be human offerings of community members (Conrad 1991, 1993; Cobb and Harn 2002), which reenact Siouxan Morningstar fertility and world renewal myths (Hall 1997). Eveland phase violence has been identified in two "ritual" contexts, Kingston Lake and Dickson Mounds (Cobb and Harn 2002). At the Kingston Lake site, a commingled grave containing two adults with missing crania without cut marks on their remaining skeletal elements and a child with more than 100 cut marks on the skull was excavated (Poehls 1944; Conrad 1993; Cobb and Harn 2002). At Dickson Mounds, four headless individuals with pots placed in the position of the head have been studied (Conrad 1993; Cobb and Harn 2002). No cut marks have been identified on any of the skeletal elements recovered from these four headless burials.
By the Orendorf phase (ca. AD 1200-1250), the intensity of violent conflict escalated. At the Orendorf site, two of the five sequentially built settlements were constructed within palisades (Santure 1981). Steadman's (2008) analysis of skeletal remains from Orendorf found evidence for skeletal trauma indicative of warfare in nine percent of 268 individuals excavated. Clear evidence for warfare-related trauma, however, is limited to 15 individuals who exhibit cranial cut marks, often in concert with embedded projectile points, chop wounds, or blunt-force trauma. Adult males and females were affected in approximately equal frequencies.

During the subsequent Larson phase (ca. AD 1250-1300) of the CIV, the number of palisaded towns increased with a rise in population density (Harn 1994). Settlements exhibited greater nucleation and were often placed in defensive locations (Harn 1994). Further studies of interpersonal violence skeletal trauma are necessary to elucidate violence patterns from this period. Analyses of Larson phase samples have focused on counts of elements with traumatic lesions and have reported cases of individuals who display embedded arrow points or cut marks to the cranium at the Dickson Mounds and Emmons cemeteries (Lallo 1973; Morse et al. 1961; Morse 1978; J. Wilson 2010). At the palisaded Larson site, Hatch (n.d.) examined 10 commingled, burned, and fragmentary individuals salvaged from a midden pit (Harn n.d.[b]). Four of these individuals display perimortem sharp-force trauma to the cranium suggestive of mutilation or scalping. Drawing ethnographic analogy from Iroquois sacrifices, Hatch (2012) has interpreted this context as possible evidence of captive sacrifice from the scalping, mutilation, burning found in these remains – an interpretation contested by Schurr and Cook (2014). Hatch has acknowledged, however, that further research is necessary to test this interpretation.
Syntheses of violence within Crable phase (ca. AD 1300-1425) Mississippian communities have yet to be conducted. At the Crable site, Neumann (1940) described one of the first cases of prehistoric scalping, while Morse (1978) reported the presence of another individual with an embedded arrow point in a vertebra. The presence of endemic violence during this phase has caused Esarey and Conrad (1998:43-54) to speculate that the presence of some Oneota ceramics in all Crable Mississippian household assemblages could be evidence of Mississippian and Oneota domestic cohabitation. These culturally mixed assemblages could have formed from a number of scenarios including: Mississippian-Oneota intermarriage and the presence of Oneota refugees and/or Oneota war captives in Mississippian households (Esarey and Conrad 1998). Although interesting, Esarey and Conrad’s arguments for Mississippian-Oneota cohabitation require further evaluation using Crable phase site assemblages and phenotypic and genetic analyses from the individuals buried at Crable. The complexity of Mississippian-Oneota interactions deserves greater attention to resolve questions about inter- and intragroup violence during the Crable phase.

The highest frequencies of violence recorded in the CIV were not identified in a Mississippian society, but instead, in the Bold Counselor Oneota occupation of the valley during the Crable phase. At Norris Farms #36, sixteen percent of 264 individuals had perimortem trauma indicative of interpersonal violence (Milner and Smith 1990; Milner et al. 1991; Milner 1995). Perimortem blunt-force, sharp-force, and projectile trauma were observed in this sample. Scalping and decapitation provided prominent evidence of trophy-taking. In addition, as both males and females were killed in equivalent proportions, it is unlikely that those who perpetrated the attacks at Norris Farms #36
sought to obtain female captives (Milner 1995). This high frequency of violent conflict evident at Norris Farms #36 has been hypothesized to be the result of Oneota entry into the central Illinois valley around AD 1300 (Santure et al. 1990). Although many of the Mississippian peoples living in the CIV had dispersed this time, pockets of Mississippian peoples remained (Conrad 1991; Jackson et al. 1992; Esarey and Conrad 1998).

While bioarchaeological investigations of intergroup violence in the CIV suggest an oscillating pattern from low to high intensity war over time, archaeological evidence of nucleated settlements and fortifications displays a linear increase in war’s frequency through time (Santure 1981; Conrad 1991; Harn 1994; G. Wilson, personal communication 2012). Gregory Wilson (2012) argued that by the Late Eveland phase, settlements became more nucleated and defensively positioned on bluff tops. No evidence of fortifications, however, has been documented from this time period. By approximately AD 1200, many settlements were both nucleated and fortified. Throughout the Mississippian period, however, burned structures with large and heavy domestic items remaining in situ were common (Harn 1994). It is unclear whether warfare or non-violent site abandonments caused these burning episodes. Improved site histories would help reveal the cause of these razed domestic structures.

Sites with Skeletal Remains Studied in this Analysis

The final section of this chapter describes the site provenances for skeletal collections analyzed in this research. Five Mississippian sites, Dickson Mounds, Larson, Crable, Berry, and Emmons, will each be discussed with brief reviews of associated habitation sites and cemeteries when possible. Some sites (e.g., Dickson Mounds) are
better studied than others (e.g., Berry) prohibiting comprehensive comparisons across sites. Table 3.2 reports the number of individuals in the sample from each site.

**Dickson Mounds**

Early work at the Dickson Mounds cemetery identified a burial mound complex (labeled A-K), a pyramidal mound with a charnel house substructure, and a premound cemetery (Harn n.d.[a], 1994). Subsequent analysis by Alan Harn (personal communication 2014) has revised the Dickson Mounds mound identifications to include 11 burial mounds with a premound charnel structure (labeled 1-12) and four unmounded cemeteries. While making comparison between previous studies more difficult, Harn’s updated mound assignments are used in the present research. They will become the standard upon publication of Harn’s revised Dickson Mounds synthesis currently scheduled for late 2015.

<table>
<thead>
<tr>
<th>Site</th>
<th>Phase</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds</td>
<td>Eveland Phase</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Orendorf Phase</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Larson Phase</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>Unassigned</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>503</td>
</tr>
<tr>
<td>Emmons</td>
<td>Larson Phase</td>
<td>43</td>
</tr>
<tr>
<td>Larson</td>
<td>Larson Phase</td>
<td>21</td>
</tr>
<tr>
<td>Berry</td>
<td>Larson Phase</td>
<td>16</td>
</tr>
<tr>
<td>Crable</td>
<td>Crable Phase</td>
<td>197</td>
</tr>
<tr>
<td>CIV Total</td>
<td></td>
<td>780</td>
</tr>
</tbody>
</table>

Substantial numbers of Late Woodland and Mississippian burials were interred in these mounds. In fact, Harn (1980) has estimated that approximately 3000 individuals were buried at Dickson Mounds, despite the excavation of just over 1000 individuals.
Burial goods were used to assign the burials in each mound to archaeological cultural horizons. Mounds A-E (2-6) contain both Late Woodland and Eveland phase Mississippian interments. Mounds F-K (7-12) contain primarily Mississippian Orendorf and Larson phase burials. Recently these assignments were supported and further refined by a series of eleven direct radiocarbon dates sampled from individuals throughout the mounds (Harn 2011). Median dates begin at cal. AD 1100 with Late Woodland burials and include both Late Woodland and Mississippian burials, evidencing concurrent cemetery use by both Late Woodland and Mississippian cultures (Harn, 2011, personal communication 2014).

The Dickson Mounds cemetery has fueled most Mississippian period CIV bioarchaeological research. Studies throughout the 1970s and 1980s directed by George Armelagos at University of Massachusetts Amherst (e.g., Lallo 1973; Lallo et al. 1977, 1978, 1980; Rose et al. 1978; Goodman et al. 1980, 1984; Goodman and Clark 1981; Goodman and Armelagos 1985; summarized in Buikstra and Milner 1989) produced a large compendium of information regarding health and disease with the transition to agriculture among precontact Eastern Native Americans. Unfortunately, the original data and any information regarding the temporal assignments of each burial have been lost, preventing comparison of present research on Dickson Mounds samples with the work of Armelagos and colleagues.

The Dickson Mounds cemetery was not associated directly with a habitation site. Rather these accretional burial mounds appear to have been used first by residents of the Eveland site and subsequently by inhabitants of Myer-Dickson. The Eveland phase Eveland site contains domestic dwellings, sweat lodges, two council houses, an earth
lodge, and what is described as a “cross-shaped” building (Caldwell 1967a, b). No fortifications or signs of population nucleation are evident in this early habitation area. Myer-Dickson is a Larson phase hamlet that includes a central plaza bordered by a ceremonial building. The site was internally well-organized with rows of habitation structures surrounding the ceremonial building (Harn 1994). Myer-Dickson House 23 was burnt with many large and difficult to transport domestic artifacts remaining on the house floor (Harn 1994:35). While the nearby Eveland and Myer-Dickson populations likely contributed many of the Dickson Mound burials, Harn (2011) has acknowledged that these small habitations could not have been the only sites interring the thousands of burials into Dickson Mounds. Other CIV Mississippians must have used the cemetery complex as well.

**Larson**

The Larson site is located on a bluff top with a view of the Spoon River and represents the primary town in the Larson phase settlement system (Harn 1994). Its primary village area covers approximately six hectares, but habitation and use areas associated with the site likely extended for 50 ha (Harn 1994). Harn (1994:33) argues “Larson is the largest and most strategically positioned site in the settlement system.” The site’s primary habitation area is placed in a defensible position on the bluff top and is enclosed by an bastioned palisade without bastions set in a shallow trench.

Larson site cemeteries are located along the bluff edge outside the fortification wall to the site’s southeast. Some burials were also excavated in the village area within the fortification wall. The vast majority of Larson’s burials were not excavated, however, due to the presence of a modern cemetery among the precontact burials (Harn 1994).
Twelve burials containing a minimum of 21 individuals were excavated. A single piece of unmodified jasper associated with Burial 12 was the only nonperishable object found associated with any of the excavated burials (Harn n.d.[b]). Burials 1-11 were single inhumations, while Burial 12 was a midden pit that held the commingled remains of a minimum of ten individuals. Some burning and possible evidence of scalping are evident among the Burial 12 remains (Hatch 2012).

**Crable**

Crable’s location west of the Illinois River on a bluff top above Anderson Lake provided convenient access to both riverine and lacustrine resources. The approximately ten-acre mound field contained four burial mounds, a cemetery, a platform mound, and a plaza (McDonald 1950; H. Smith 1951). Village debris was scattered across approximately 30 ha (Conrad 1991; Harn 1994). Crable served as a central temple town in the southern portion of the CIV (Harn 1994). Very little is known regarding the village habitations and the burial mounds have suffered from extensive looting (e.g., McDonald 1950). Two burned house structures excavated by Robert Hall in 1969 and 1970 have assemblages of broken but reconstructable ceramic vessels on the floor (Esarey and Conrad 1998). Conrad and Esarey (1983) argued that a palisade wall likely enclosed the site, although the evidence cited is limited to a deep midden in a circumscribed area. No postholes, trenches, or other building features indicative of a palisade have been identified.

Occupation dates from Crable primarily to the Mississippian period (Crane and Griffin 1959; Bender et al. 1975; Morse 1969; Conrad 1991; Esarey and Conrad 1998), although Morse (1960, 1978) concluded that the site was occupied periodically from
Paleoindian to Late Woodland times. A Crable phase temporal designation is supported by recalibration of five radiocarbon dates from the site (Crane and Griffin 1959; Bender et al. 1975; Esarey and Conrad 1998). The mixture of Late Mississippian and Oneota ceramics in surface collections and middens at Crable also supports the Crable phase temporal designation (Morse 1969; Conrad 1991; Esarey and Conrad 1998).

The skeletal remains from Crable curated by the Illinois State Museum is composed primarily of skulls donated by collectors and pathological specimens and is, therefore, highly biased. Most Crable site skeletal remains curated by the Illinois State Museum came from the unsystematic excavations of Glen McGir and Edgar and Charles McDonald (Morse 1978). McGir and the McDonalds sent pathological individuals from Crable to Dr. Don Dickson for analysis. A small fraction of the sample probably also came from Robert Hall’s excavations in 1969 and 1970 and from a recent collector’s donation (Wilson 2010). Many of the remains from the excavations by McGir and the McDonalds, and other collectors were retained because they display trauma and other forms of infectious and developmental diseases. Often only the pathological skeletal element was retained and the rest of the skeleton was reburied. As the Crable collection is primarily composed of isolated specimens, full skeletal analysis is generally precluded. No associated burial information is included with these samples, although reports from site excavations describe a number of abundantly accompanied burials, many with SECC artifacts (McDonald 1950; H. Smith 1951; Morse 1960). Decorated shell gorgets with incised designs (including spiders, raptorial birds, incised circles and crosses, and a “step” motif), shell and turtle bone rattles, copper-covered wooden ear spools, effigy ceramics and bone pins, and negative painted pottery are among the many classes of
artifacts described from Crable (see also the discussion of Crable phase mortuary remains in the discussion above).

**Berry**

Berry, also known as Ester Berry, is a multicomponent site, although the Mississippian Larson phase habitation dominated excavated contexts (Conrad 1991; Harn 1994). The Mississippian burials from Berry are typically extended supine or interred as disarticulated bundles (Conrad 1991). Harn (1994) classifies Berry as a subsidiary hamlet in the Larson site settlement system. Burned house structures with ceramic assemblages on the floor dating to the Larson phase have been recorded (Harn 1994). Most information regarding Berry’s settlement structure, however, is “too fragmentary to be of much value” (Conrad 1991:142). In fact, little has been reported regarding the Mississippian occupation at Berry, and the burials curated at the Illinois State Museum analyzed in this research lack any detailed provenience information. The ISM site records, however, do classify them as belonging to the Larson phase.

**Emmons**

The Emmons site is positioned on the west side of the Illinois River on a bluff slope above Anderson Lake. While there is evidence the Emmons site was inhabited during the Late Archaic period, most of the artifacts and features recovered date to the Mississippian period (Morse et al. 1961). At least two mounds, a borrow pit, a cemetery and three overlapping village habitations comprised the site (Morse et al. 1961; Strezewski 2003). Ceramics, marine shell, copper-covered wood headdress and earplugs, beads, arrow points, knives, shell spoons, among other artifacts were found associated with the burials (Morse et al. 1961). A long-nosed god maskette composed of red cedar
and covered in copper foil was associated with Burial 31 in the Emmons cemetery (Morse et al. 1961; Griffin and Morse 1961; Sampson and Esarey 1993).

Temporal classifications of the Emmons site conflict with Conrad’s (1991:144) assignment to a Marbletown complex phase (ca. post AD 1300) for the cemetery, based on the presence of what he identifies as post-Dickson Trailed cordmarked jars and more Oneota-like high jar rims. Conrad (1991:132), however, also stated, “Orendorf phase material is abundant at the Emmons village site.” Harn (1994:10) argued that the long-nosed god masks (including the Emmons mask and another shell mask found near the Emmons cemetery) date to between ca. AD 1100-1200 (late Eveland phase). Harn (1994) also tellingly did not list Emmons among the CIV sites occupied in the Larson phase settlement system. Yet, ceramics interred with the Emmons mask (a smoothed-over cordmarked bowl and red filmed animal effigy bowl) are more indicative of a Late Mississippian assignation (Griffin and Morse 1961). Sampson and Esarey (1993:464-465) disagreed with all of the preceding temporal assessments for Emmons and assigned the cemetery to the Larson phase, with a village occupation not post-dating AD 1250 using the presence of unspecified ceramics. Jeremy Wilson (2011) concurred with their Larson phase assignment for the cemetery. Referencing Emmons’s proximity to the Mississippian-Oneota composite assemblages found 1.5 miles away at Crable, he notes the lack of Oneota material from the Emmons cemetery, which would indicate an earlier, Larson phase assignment. Following the arguments of Sampson and Esarey (1993) and Wilson (2010), the skeletal remains from the Emmons cemetery are assigned to the Larson phase in this analysis. It is acknowledged, however, that Emmons may be a
multicomponent site. Direct radiocarbon dating on burials from Emmons would improve the chronological resolution for this site and should be conducted in the future.

The Mississippian Period of the Central Illinois Valley represents a culturally rich period to investigate warfare and violence. Much more work on habitation sites and chronology in the CIV is necessary to contextualize research on Mississippian warfare. Yet the region’s large Mississippian cemeteries and good skeletal preservation facilitate systematic studies of skeletal remains. The following chapter reviews the background and analytical methods for the trauma, biodistance, and mortuary analyses used in this research.
CHAPTER 4 – METHODS

This chapter discusses the methods used in trauma, biodistance, and mortuary analysis. All three of these methods form the basis for the evaluation of the different models of violence discussed in Chapter Five. The chapter has two sections. The first provides the background review for each method. The trauma background section reviews the biomechanics of fracture production, estimates of time since insult, and how the behavioral etiologies that cause trauma may be distinguished. The biodistance background reviews the history of biodistance research with particular emphasis on central Illinois valley studies. It also discusses the theoretical assumptions of its methods. The mortuary analysis background provides a history of processual and postprocessual theoretical approaches. It ends by emphasizing use of context in mortuary analysis. The second major section of this chapter details the analytical methodologies used to assess trauma, biodistance, and mortuary data respectively. The statistical techniques used to investigate each data type are examined.

Methods Background

Trauma Analysis

The identification of trauma in this study is limited to its expression on hard tissue. Traumatic lesions are expressed differentially depending on the type of weapon used, the force and velocity applied, and the skeletal element affected (Gurdjian et al. 1950; Polson et al. 1985; Leestma and Kirkpatrick 1988; Merbs 1989). Here, I review the biomechanics of fracture production, the three primary types of trauma: blunt force, sharp force and projectile, methods for estimation of time since injury, and this project’s rationale for distinguishing between trauma caused by intergroup and intragroup
violence. Understanding how fractures are created and appear in skeletal remains is important for distinguishing between violent and non-violent causes of fractures. This background also forms the basis for distinguishing violent trauma from other pathological or taphonomic causes.

Bone Biomechanics

Biomechanical properties influence fracture production in bone. These properties include load, resistance of bone to a force, stress, and strain. A load is created by the combination of an applied force to a material (e.g., bone) and the material’s resistance to that force. Whether a bone rebounds to its original shape, becomes permanently deformed, or ultimately fractures is explained through its stress-strain characteristics. Stress (\(\sigma\)) is the applied force and is calculated as \(\sigma = \text{Force/Area}\); whereas strain (\(\varepsilon\)) is the resultant change or deformation in the shape of the material and is described as the ratio of the change in dimension over the original dimension (\(\varepsilon = \frac{\text{Deformation}}{\text{Dimension}}\)).

The relationship between stress and strain can be described as a graphical plot (Currey 1970; Evans 1976; Saha and Hayes 1976) with stress as the y-axis and strain as the x-axis (Figure 4.1). When stress is applied in small amounts, the relationship between stress and strain remains proportional (Sedlin 1965; McElhaney 1966; Burstein and Frankel 1968; Sammarco et al. 1970; Katz 1971). This proportional relationship between stress and strain at low levels is called elastic deformation. During the elastic phase, the graphed line is straight – indicative of the proportionality between stress and strain – with the area underneath the straight line referred to as the zone of elastic
deformation. Bone that has been subjected to a load and bent in the elastic phase will rebound to its original dimension once the load is removed (Sedlin 1965; Katz 1971).

At higher levels of stress and strain, bone is unable to regain its original shape and remains permanently deformed once the load is removed (Chamay 1970; Chamay and Tschantz 1972; Fondrk et al. 1988). The point at which a material is unable to recover once a stress is released is called the yield point. After the yield point, the bone enters its plastic phase, and the stress-strain relationship ceases to be proportional. Graphically, the relationship between stress and strain begins to curve, and the area beneath the curved segment of the line is known as the zone of plastic deformation (Figure 4.1). In this zone, small increases in stress will cause larger increases in strain (Nalla et al. 2003; Yan et al. 2007). But once a bone can no longer withstand the higher degree of strain, the bone will reach its failure point and fracture (McElhaney 1966; Burstein and Frankel 1968; Sammarco et al. 1970; Catanese et al. 1999; Nalla et al. 2003; Yan et al. 2007).

Fracture Etiology

There are three primary stresses that create loads on bone: tension, compression, and shear (Einhorn 1992) (Figure 4.2). Tension loads pull apart or stretch bone. Compression loads compact the material. Sheer force, in contrast, places opposing forces at a 90-degree angle to the material, resulting in one portion sliding over the other (Reilly and Burstein 1975). When two or more types of forces are applied to bone, they may act in concert to create torsion or bending loads. Torsion is a variation of shear stress that is combined with tension and compression, which twists a bone about its axis (Wescott 2013). Bending is caused by the application of tension and compression forces to different sides of a bone (Carter and Hayes 1977) (Figure 4.2).
Figure 4.1. Idealized Stress-Strain Curve (adapted from Harkess et al. 1994).

The composition of bone influences its ability to withstand different stresses and strains (Wolff 1892; Yeni et al. 1998; Burr 2002; Tal et al. 2006). Bone is a heterogeneous and viscoelastic material composed of inorganic calcium hydroxyapatite crystals (Ca$_{10}$(PO$_4$)$_6$(OH)$_2$) and organic structures including, collagen, non-collagenous proteins, proteoglycans, water, blood vessels, and cells (Rogers 1949; Rogers et al. 1952; Robinson and Elliott 1957; Eastoe and Eastoe 1954; Gong et al. 1964; Martin et al. 1998). The organic portion of bone allows it to resist tension forces, while the inorganic portion withstands compression (Burstein et al. 1975; Kaplan et al. 1985; Mammone and Hudson 1993). Bone is strongest under compression, weakest in shear, and exhibits
intermediate strength in tension (Smith and Walmsley 1959; Currey 1970; Reilly and Burstein 1975; Yeni et al. 2004). The viscoelastic nature of bone provides it with two

Figure 4.2. Fracture Production Forces.
properties: First, a higher tolerance to stress, resulting in only small increases in strain. Second, energy dissipates from the material after the stress is removed (Sedlin 1965; Currey 1970; Fondrk et al. 1988).

Fractures are categorized here into three types: blunt force, sharp force, or projectile trauma. Any blunt implement, including hammers, clubs, fists, and baseball bats, causes blunt force trauma. Momentum opposed against a stationary surface, like a fall to the ground, also creates blunt force wounds. Sharp force trauma is caused by sharp-edged or pointed objects, like knives, saws, or axes. Projectiles are high velocity weapons that result in penetrating injuries. Among precontact North Americans, most projectile injuries were inflicted using a bow and arrow. Characteristics of blunt force, sharp force and projectile trauma are reviewed in the following discussion.

**Blunt Force Trauma**

Perkins (1958) classifies fractures according to the degree and pattern or shape of a break. If a fracture maintains some continuity with surrounding bone, that fracture is classified as incomplete. Incomplete fractures should be more common in children than adults, as the bones of children are more plastic (Chamay 1970; Chamay et al. 1972; Currey and Butler 1975; Swischuk 2002). This plasticity offers improved resistance to tension forces. Complete fractures, in contrast, cause a total discontinuity between two or more bones fragments. Fracture shapes are determined by the direct or indirect application of force. Direct trauma applies localizes trauma at a point of impact. Indirect trauma, in contrast, results when forces operate distant from the point of impact.

As the geometric shapes and biomechanical properties of the postcranium and cranium are different, postcranial and cranial trauma are discussed separately. In the
postcranial, direct trauma consists of tapping and crushing fractures, while indirect postcranial trauma is classified as traction/tension, angulation, spiral, oblique, and compression fractures (Perkins 1958; Harkess et al. 1994; Lovell 1997; Galloway 1999a; Rogers 2002).

**Postcranial Direct Trauma**

Tapping fractures, also called transverse fractures, are caused by the application of a small force to a localized area. The force generally impacts with a decreasing momentum, producing a transverse fracture line (Galloway 1999a). Clubs, hard kicks to the shin, and other blunt-force objects, may produce tapping fractures. Crushing fractures, in contrast, are created by a large force applied directly to a large area. Depending on the velocity and force of the implement, injuries ranging from a simple transverse fracture line to a high level of bone fragmentation with associated soft tissue damage may result (e.g., Thompson and Mormino 2003).

**Postcranial Indirect Trauma**

Opposing forces cause traction, or avulsion, fractures. They result from the tensile force of a ligament or tendon acting on a bony attachment site (Noyes et al. 1974; Wren et al. 2001). Angulation fractures are visible as transverse fracture lines created when the bone is bent. A compressive stress is placed on the concave side, while a tensile stress is placed on the convex side. Between the convex and concave sides is a stable, neutral plane. Bone distant from the neutral plane experiences greater magnitudes of stress. The bone will fail first on the convex side under tension. The fracture will then propagate through the bone, as the adjoining fibers experience greater stress after the first failure (Carter and Hayes 1977; Harkess et al. 1994).
Spiral fractures are axially loaded by torsion forces and are typically located in the long bones (Vashishth et al. 2001). The fracture is observed as a line spiraling downward around the complete circumference of a bone’s longitudinal axis. Failure generally first occurs from tension loads (Reilly and Burstein 1975; Netz et al. 1979). A vertical component joins the origin and terminus of the fracture line, and this vertical fracture component may also exhibit splintering (Reilly and Burstein 1975). If torque (twisting) is applied to the long bone, a spiral fracture develops from the shear stress (Reilly and Burstein 1975; Netz et al. 1979).

Compression fractures rarely result from compressive loads alone. During the rare occasions when pure compressive forces operate on bone, the diaphysis of a long bone impacts into its epiphysis (Alms 1961). More commonly, however, compression fractures form through a combination of compression and shear, with failure beginning under either tension or shear stress (Alms 1961; Currey 1970).

Because juvenile bones possess greater ductility due to the high elastic components of immature bone, bone failure often results in incomplete fractures (Chamay 1970; Chamay et al. 1972; Currey and Butler 1975). Incomplete fractures found in juveniles include greenstick fractures, bow fractures, and torus or buckling fractures (Rogers et al. 1978). Angulation or bending forces produce greenstick fractures with compression acting on the concave side and tension acting on the convex side of a bone’s long axis. As the bone fails first under tension, a fracture line propagates from the convex cortex under tension and moves horizontally toward the concave side of the cortex only reach the middle half of the shaft. From the shaft midpoint, the fracture may turn at a 90-degree angle, resulting in a vertical split in the bone. The fracture, however,
remains incomplete as the concave side of the cortex only bends or bows (Rixford 1913; Kittleson and Whitehouse 1966; Currey and Butler 1975). An analogous process akin to greenstick fracture production is bending and snapping a green twig.

Classified as a “cousin” of the greenstick fracture, the bow fracture is a type of plastic deformation and not a true discontinuity. It is observed as a broad curvature along the full length of a bone (Borden 1974, 1975; Crowe and Swischuk 1977; Swischuk 2002). Angulation and compressive forces cause the bone to enter the plastic deformation region of the stress-strain curve. While the stress placed on the bone exceeds the yield point and prevents the bone from returning to its normal shape, it does not reach the failure point (Chamay 1970; Chamay et al. 1972). Bow fractures most commonly affect the radius, ulna, clavicle, and fibula (Borden 1974; Cail et al. 1978; Swischuk 2002). When axial loading causes buckling of a bone’s cortex, torus fractures are produced. If pure compressive forces act on the bone, the metaphyseal trabeculae are crushed and the cortical bone buckles (bulges) outward (Rixford 1913; Swischuk 2002; Hernandez et al. 2003). Such torus or buckling fractures commonly result from an outstretched hand bracing a fall and, therefore, are most frequent in the forearm (Swischuk 2002).

**Cranial Blunt-Force Fractures**

A blunt-force blow to the head creates compression forces to the outer table and tension forces to the inner table (Berryman and Haun 1996). Blunt force fractures to the cranium manifest as two primary lesions: depression fractures and linear fractures (Figure 4.3). Depression fractures result from a blunt instrument causing the cranial vault to bend and the force to be distributed over a large area (Rogers et al. 2002; Lovell 1997).
A depression fracture is more likely to result from high velocity blunt forces of small mass applied directly to a localized area (Rogers et al. 2002). The characteristic depression appearance forms from compression of the ectocranium at the point of impact. As a result, the ectocranium “depresses” inwards. The diploë also compresses due to the opposing resistance of the endocranium, brain, and dura mater (Merbs 1989). The endocranium remains intact unless a high amount of force is applied (Berryman and Haun 1996).

Clinically, linear fractures are observed more frequently than depression fractures (Gurdjian 1975). Linear fractures are created from a low level of force with a large amount of mass (Cox et al. 1987). They may propagate through the “path of least resistance,” often resulting in the fracture forces radiating toward and releasing through a suture. The consequent sutural break is termed a diastatic fracture (Gurdjian et al. 1975). The most common linear fracture, however, is the radiating fracture. Tensile forces at the impact site initiate the fracture endocranially. The radiating fracture may be limited to the internal table, but if the force is great enough, it may extend through the ectocranial surface. Force increases cause multiple radiating fractures that extend outward from the impact site. With even greater force, radiating fractures may be joined by concentric fractures that encircle the impact site (Kroman et al. 2011; Rogers et al. 2002; Davidson et al. 2011; Berryman and Haun 1996). While radiating fractures initiate endocranially, concentric fractures begin at the ectocranium in areas under tension from outbending (Gurdjian et al. 1947, 1950a, b). More recent work, however, has questioned Gurdjian’s model of fracture propagation, finding that radiating fractures initiate instead at the point of impact (e.g., Kroman et al. 2011).
Figure 4.3. Depression, Linear and Diastatic Cranial Fractures (adapted from Galloway 1999b:69 and Berryman and Haun 1996:3).

**Sharp Force Trauma**

Bladed or pointed implements, such as a knife, axe, or cleaver, create sharp force trauma (DiMaio and DiMaio 2001). Cut marks, punctures, and chops represent forms of sharp-force trauma. Cut marks are thin, linear incisions drawn across a bone’s surface
(Byers 2005). When the sharp implement contacts bone, it causes a v-shaped groove called a kerf (de Gruchy 2002). As the implement is pulled out of the bone, it produces beveling, or a chipped, irregular edge (Reichs 1998; Humphrey and Hutchinson 2000; Kimmerle and Baraybar 2008). Cuts created by stone tools are identifiable through the following characteristics: fine, parallel striations within a thin v-shaped kerf, however, they can appear ragged when viewed from above with an open cross-section; these cut marks are grouped in sub-parallel orientations; and flaking or crushing of the surrounding bone should be minimal (e.g., Binford 1981; Shipman 1981; Shipman and Rose 1983; Olsen and Shipman 1994; Blumenschine et al. 1996).

Punctures penetrate bone and are caused by instruments directed perpendicular to the bone’s surface (Kimmerle and Baraybar 2008; Byers 2005). Stab wounds are classified as punctures only when a knife’s bladed tip is inserted (Tennick 2012). Typically, punctures are deeper than they are wide (Kimmerle and Baraybar 2008). They can, however, be superficial if the force is low. Microscopically, they appear as circular to oblong pits with pointed grooves (Byers 2005). Triangular, elongated, or v-shaped cross-sections may also be observed in punctures (Thali et al. 2003).

Chops are injuries created from hacking trauma (Kimmerle and Baraybar 2008; Byers 2005). Long or thick-bladed implements strike bone, causing lesions with visible entrance and exit wounds (Humphrey and Hutchinson 2001). Depending on the instrument type and sharpness, the entry wounds range in appearance from clean cuts to crushed bone (Humphrey and Hutchinson 2001; Tucker et al. 2001; Lynn and Fairgrieve 2009). Chattering, bone flakes broken away during the traumatic event, is often viewed at the fracture margins (Humphrey and Hutchinson 2001; Lynn and Fairgrieve 2009).
Exit wounds may be discernable as fractured bone caused by an implement’s removal from bone (Humphrey and Hutchison 2001).

Stone tool created cut marks are differentiated from taphonomic processes, including animal tooth marks or trampling, using both microscopic and macroscopic methods. Shipman and colleagues (Shipman 1981, Shipman and Rose 1983, Olsen and Shipman 1988, 1994) have demonstrated that scanning electron microscopy of casted cuts allows cut marks to be discerned from taphonomic agents. While microscopy has commonly been employed in cut mark documentation, a number of authors argue macroscopic methods reliably enable cut mark identification (e.g., Bunn 1981, 1991; Bunn and Kroll 1986; Cappaldo 1995; Blumenschine et al. 1996). In this study, cut mark identification will be conducted using macroscopic methods, as high inter- and intra-observer reliability in effector determination has been achieved using these methods (e.g., Blumenschine et al. 1996).

**Projectile Trauma**

Penetrating implements create projectile trauma. Bows and arrows were common types of projectile weapons used in precontact North America (e.g., Jones 2004). Archaeologically, arrowheads are infrequently found lodged in bone (e.g., Lambert 1997; Milner 2005). Flint arrowhead projectile wounds may resemble stabbing wounds as deep v-shaped notches (Olsen and Shipman 1994; Smith et al. 2007) or gunshot wounds with internal beveling (Bill 1862; Boylston 2000; Smith et al. 2007). An arrowhead entry manifests as a smooth walled lesion on the outer table of bone, while the inner table exhibits beveling (Smith et al. 2007). Flint projectiles may leave fragments of the tip embedded in the bone, which can be detected macroscopically (Smith et al. 2007).
Although projectile points embedded in bone leave an easily identifiable signature of conflict, most projectile points hit soft tissue, rather than bone (Jurmain 1999; Milner 1995; Jurmain et al. 2009). From an analysis of historic Indian Wars medical descriptions, Milner (2005) estimated that only 30% of arrows hit bone. Thus, projectile points within or beneath the thorax cavity could indicate that the projectile entered into the chest or abdomen (Lambert 1997). Careful contextualization of any traumatic lesion with or without associated projectiles must occur to infer projectile trauma these cases.

*Time Since Insult*

Trauma analysis requires that time since insult be estimated. Antemortem injuries, or those occurring well before death, are identified by the presence of bone healing (Aufderheide and Rodriguez-Martin 1998; Sauer 1998; Galloway et al. 1999; Ortner 2003). The mechanisms of bone healing follow a set of cellular and molecular events (Udupa and Prasad 1963; Kalfas 2001; Schindeler et al. 2008). While these events occur in discrete stages, there is considerable overlap between them. The first stage of bone healing after fracture is inflammation. During this stage, vascular damage at the injury site causes a hematoma to form over a fractured bone's cortical surface. Lack of blood supply to the fractured bone edges causes necrosis within the first 24 hours after injury. Osteoclasts resorb the fractured bone ends, and other inflammatory cells (e.g., granulocytes, lymphocytes, and monocytes) invade the area to combat infection. Granulation tissue will then form around the injury from capillary growth into the hematoma. Phagocytic cells also remove debris and damaged soft tissue cells during this time.
Next, a soft callus is created by chondrocytes and fibroblasts. The resulting cartilaginous matrix serves as a template for endochondral ossification to proceed. This fiber callus is not necessary to promote ossification in all fractures, yet it is generally present in most cases (Schindeler et al. 2008). Hard callus formation occurs in the peripheral areas of the soft callus to aid in mechanical stability. In the case of tubular long bones, osteoid will be deposited by osteoblasts in the periosteum and endosteum (Udupa and Prasad 1963; Kalfas 2001; Schindeler et al. 2008). Woven bone matrix will eventually bridge across the fracture. As the bone heals, woven bone is resorbed and more mature lamellar bone is deposited in its place. The lamellar hard callus will finish its formation from approximately a few weeks to months after injury, depending on the skeletal element affected (Udupa and Prasad 1963; Kalfas 2001; Schindeler et al. 2008).

During the remodeling stage, the bony callus will be integrated further into the unaffected bone. At the end of healing, the bone will often return to its original shape, structure, and mechanical strength (Kalfas 2001). Mechanical loading stresses are essential to the remodeling process, which completes anywhere from months to years.

While signs of osteogenic reaction are the hallmark of antemortem wounds, perimortem wounds are distinguished by a lack of healing. A perimortem insult to bone may be identified when wounds occur up to three weeks in advance of death - before any identifiable osteogenic reaction. Moreover, a fractured bone may be identified as perimortem after a fracture occurring well into the postmortem interval (up to five months after death). This identification will be made as long as the bone's moisture content and organic components are not significantly lost (Weiberg and Wescott 2008).
In perimortem fractures, those occurring around the time of death, the fracture margin usually has a clean, smooth edge. A large window of time is encapsulated by the term perimortem, as it is difficult to identify if a fracture occurred shortly before death or and any osteogenic reaction or even months after death occurred. Additionally, bone patina is consistent with the color of the surrounding unfractured bone (Ubelaker and Adams 1995; Lovell 1997). Certain fracture orientations may also help to identify perimortem trauma. Spiral fractures (those that radially circle the bone shaft), greenstick (jagged, v-shaped edges), and butterfly fractures (triangular fragments) typify the shapes of perimortem fractures visible in postcrania (e.g., Johnson 1985; Weiberg and Wescott 2008). Butterfly fractures, however, have also been observed in dry bone (Ubelaker and Adams 1995; Wheatley 2008) and are not considered sufficient evidence for perimortem injury. Additionally, the angle between the fracture and cortical bone surface tends to be obtuse or acute in perimortem fractures (Johnson 1985).

 Discriminating between perimortem and postmortem wounds is often difficult (Ubelaker and Adams 1995; Sauer 1998). Postmortem fractures are usually smaller, exhibit a bone patina on the fracture margin that differs from the patina of surrounding bones, and tend to be more irregular and flaked (Lovell 1997). The brittleness of dry bone causes it to shatter into small, consistently shaped fragments (Maples 1986). Postmortem fractures form right angles with the cortical bone’s surface (Morlan 1980; Johnson 1985).

*Trauma Etiology: Distinguishing between Violence and Accidents*

The previous discussion outlines the basic principles of fracture production. This section uses the identifications of trauma type and time since insult to infer either an
intergroup or intragroup violence etiology. Table 4.1 reports the types of trauma used in this analysis to identify interpersonal violence. As Willey (1990:93) argued, definitively linking a skeletal lesion to its corresponding behavioral etiology is a problematic exercise. This difficulty is especially true of interpersonal aggression. For instance, while lethal traumatic lesions could indicate warfare, it is also possible they could be exhibited in an individual who was the victim of homicide. The former is caused by intergroup violence, while the latter is a consequence of intragroup violence.

Table 4.1. Forms of Interpersonal Violence and Possible Trauma Correlates.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Trauma Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalloping</td>
<td>Few (&lt; 20), small cuts partly circling area of scalp on the cranium – cuts should be infrequent on postcrania</td>
</tr>
<tr>
<td>Trophy Taking</td>
<td>Few cuts to the cervical vertebrae to remove the head; isolated cuts or chops at joints to remove limbs; isolated cuts to attachment sites for muscles of mastication to remove the mandible – cuts should not be distributed throughout body</td>
</tr>
<tr>
<td>Other Warfare Injuries</td>
<td>Unhealed trauma, including embedded projectiles, chop marks, stabbing injuries, and large elliptical BFTs to skull</td>
</tr>
<tr>
<td>Intragroup Violence</td>
<td>Healed BFTs to skull; parry fractures of the ulna are only considered when associated with a skull BFT – Other postcranial fractures are not included.</td>
</tr>
</tbody>
</table>

In fact, homicide and warfare may be best distinguished by observing scalping wounds or trophy taking. Native American ethnohistories have documented scalping and trophy taking as widespread warfare practices (e.g., De Lusser 1730; du Pratz 1758; Adair 1775; Grant 1890; Swanton 1946; Lorant 1946; Romans 1962; Thwaites 1897:68, 70). Scalps and trophies were important not only for a warrior’s social prestige, but also were a necessary component for a variety of rituals (e.g., Grant 1890; Swanton 1946). Since scalping and trophy taking are warfare practices, their identification provides a strong indication that a death may be attributed to warfare, rather than to intragroup homicide or accidents.
Scalping is identified through the presence of short, parallel transverse or oblique cut marks distributed at the crown of the head (Hamperl 1967; Milner et al. 1991; Olsen and Shipman 1994). Typically, scalping cuts concentrate on the frontal bone near the hairline. They can also be located on the side of the head above the ears and on the posterior cranium (e.g., Milner et al. 1991; Owsley and Berryman 1975; Owsley et al. 1977; Pollack et al. 1987; Zimmerman et al. 1981). Cuts indicative of scalping, however, may range in location around the cranial vault and are not fixed to precise areas of each cranial element (e.g., Allen et al. 1985). For instance, on the frontal bone cut marks indicative of scalping may be incised as inferior as the supraorbital ridges to as superior as the coronal suture. Cut marks are common laterally throughout the parietals and can extend as low as the suprameatal crest on the temporal bones. They may even be prominent as inferiorly as the nuchal crest of the occipital (Allen et al. 1985; Olsen and Shipman 1994).

Cut marks to one or more of the upper cervical vertebrae, but especially the first cervical vertebra, may indicate decapitation (e.g., Milner et al. 1991; Smith 1993), and cut or chop marks near the joints may identify limb trophies. Such trophy-taking behaviors must be distinguished from cuts used to deflesh bones for secondary burial (e.g., Olsen and Shipman 1994; Mensforth 2001; Hatch 2012). Olsen and Shipman (1994) distinguished among seven different signatures that allow cuts resulting from conflict to be differentiated from cuts caused by secondary burial processing. Those signatures are presented in Table 4.2.

Perimortem projectile injuries are strong indicators of violent death, rather than accidental injury. Yet, arguments persist about distinguishing warfare violence from
homicide. For instance, Jurmain (1999) and Jurmain and colleagues (2009) have argued that projectiles are the only unequivocal evidence of warfare. In contrast, Ferguson (2013) and Lambert (1997) asserted that projectile wounds can only demonstrate violent intent due to the amount of effort and concentration required to aim and successfully shoot a target. Such intentionality, however, is unable to discriminate between intragroup homicide and intergroup warfare. The burial context, victim demography, and any co-associated trauma must be considered in ruling out homicide as the cause of an embedded projectile (e.g., Rogers 2004).

Table 4.2. Cut Mark Signatures that Distinguish Conflict from Secondary Burial
(modified from Olsen and Shipman 1994:380).

<table>
<thead>
<tr>
<th>Signature Type</th>
<th>Conflict</th>
<th>Secondary Burial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal Representation</td>
<td>Complete skeleton</td>
<td>Partial skeleton</td>
</tr>
<tr>
<td>Cut Mark Frequency</td>
<td>Few cuts marks - often less than 20</td>
<td>High cut mark frequencies - can be hundreds per element</td>
</tr>
<tr>
<td>Cut Marks on:</td>
<td>Scalloping marks</td>
<td>Defleshing marks</td>
</tr>
<tr>
<td>Cranium</td>
<td>Usually absent</td>
<td>Common</td>
</tr>
<tr>
<td>Mandible</td>
<td>Infrequent</td>
<td>Abundant</td>
</tr>
<tr>
<td>Postcrania</td>
<td>Variable and restricted</td>
<td>Patterned and clustered</td>
</tr>
<tr>
<td>Cut Mark Orientation and Distribution</td>
<td>Cut marks, chop marks, ax injuries, blows, embedded lithics, stabbing, or projectile point wounds</td>
<td>Cut marks, scraping, enlargement of foramen magnum</td>
</tr>
</tbody>
</table>

Blunt-force trauma may also result from violent or accidental causes. Differentiating between these two trauma etiologies is accomplished through the location of injury. In clinical studies, blunt-force injuries to the head and face are more likely to have been caused during violent events, rather than accidents (e.g., Paaske and Madsen 1987; Davidoff et al. 1988; Shepherd et al. 1988; Ström et al. 1992; Hussain et al. 1994;
Brink et al. 1998; Novak 1999; 2006; Brink 2009; Saddki et al. 2010). If they disproportionately affect one age group, it is likely that the injuries are from a violent cause (Wilkinson 1997). Furthermore, a blunt-force wound to the cranium may specifically indicate intergroup violence if it is observed as a point of impact with multiple linear and concentric fractures (Merbs 1989). The great amount of force necessary to create this extensive fracture pattern is generally accomplished through swinging a mace, club, or celt (e.g., Steinbock 1976; Merbs 1989; Walker 1989; Smith 1996; Ortner 2002).

Postcranial blunt-force wounds are less likely to have been caused by physical violence and are more likely from an accidental or occupational etiology (e.g., Lovejoy and Heiple 1981; Grauer and Roberts 1996; Judd and Roberts 1999; Neves et al. 1999; Judd 2002a; Glencross 2003; Smith 2003; Djurić et al. 2006), although transverse fractures to rib shafts are created by a direct blow and often associated with interpersonal violence (e.g., Galloway 1999a; Novak 1999, 2006). Rib fractures, when they co-occur with a cranial blunt-force injury, provide more convincing evidence for violent conflict than when they are present alone (Novak 1999, 2006). Ulna “parry” fractures, blunt-force wounds to the distal one-third of the ulna diaphysis, are a particularly contentious postcranial injury. They have long been associated with a forearm parry of a blow (e.g., Smith and Wood Jones 1910; Du Toit and Gräbe 1979; Lahren and Berryman 1984; London 1991; Rogers 2002; Schultz 1990; Seligson and Voos 1997; Jurmain 1999; Kilgore et al. 1998; Lambert 1997; Walker 1997; Smith 1996; Lovell 1997; Judd 2004, 2008). Many researchers, however, (e.g., Loder and Mayhew 1988; Richter et al. 1996; Smith 1996; Lovell 1997; Rogers 2002; Judd 2004, 2008) have cautioned against the use
of parry fractures as an indicator of physical violence, because an outstretched hand bracing from a fall may also cause a similar pattern. Sex-specific patterns of parry fractures should be carefully evaluated to ensure the higher parry fracture frequencies were not caused by increased risk of injury sex-specific occupations. In this research, unless the parry fracture is co-associated with cranial trauma (following Smith 1996), they are considered to have resulted from accidental injury.

In males, trauma resulting from male-male “ritual” fights or contact sports may display injury patterns that closely resemble those expected from physical assaults. Trauma caused during “ritual” fights or physical sports should be non-lethal (e.g., Tung 2007; Walker 1989, 1997; Alvrus 1999; Scott and Buckley 2014) and can take the form of blunt-force trauma, especially if a club or stick is used. For instance, Walker (1989, 1997) and Tung (2007) have argued that “ritual” club fighting in archaeological Native Americans populations from the Santa Barbara Channel area and the Wari from the Andes, respectively, resulted in high frequencies of nonlethal blunt-force lesions to the cranial vault in men. Such trauma is discussed as possibly being caused by the “ritualized” club battles described ethnographically in North and South America (e.g., Priestly 1937; Hartman 1972; Chagnon 1992; Schuller and Petermann 1992; Orlove 1994; Conklin 2001).

Furthermore, Alvrus (1999) hypothesizes that wrestling, a contact sport, practiced by ancient Nubian males could be a possible cause of craniofacial trauma (e.g., Carroll 1988). Since the males who participate in these “ritual” fights and contact sports are most often members of the communities in which they are buried, it is expected that these individuals with trauma would be phenotypically similar to the other members of the
cemetery sample. If the participants were community members, they should also be
buried in accordance with the regular cemetery program and with artifacts within the
normal range of variation for the sample. An injury that actually resulted from a “ritual”
fight or contact sport identified as a male intragroup assault would not present a problem
for this research, as “ritual” fights, physical sports, and assaults are all forms of
intragroup violence. Consequently, if the patterns expected for a male intragroup assault
is identified, it is likely that some form of intragroup violence was the cause.

The variables expected to identify war captives might also reflect domestic
violence directed at migrant wives. There are, however, three reasons that make non-
local wife abuse less likely than the physical assault of female war captives. First,
Konigsberg (1988) and Konigsberg and Buikstra (1995), using biological distance
analysis, have found evidence for matrilocality among Mississippian populations living
south of the CIV in the neighboring Lower Illinois Valley of west-central Illinois.
Therefore, if the residence pattern among CIV Mississippian was also matrilocal,
smaller numbers of women likely entered the community from distant settlements.
Second, Steadman (2001) has also used biodistance to ascertain that while migrants did
enter the CIV, they did not do so in large enough numbers to change the valley
population structure, which reduces the likelihood that women would be migrating in
high numbers into the valley. Third, even if an abused wife is from a distant community,
there is no reason to assume she would be either physically or materially isolated in the
cemetery. In contrast, captive women who do not achieve full integration into their new
community may be isolated after death.
**Biological Distance Analysis**

Biological distance analysis (biodistance) uses heritable epigenetic traits of the cranium and dentition to assess phenotypic variability within and among populations (Buikstra et al. 1990; Larsen 1997; Schillaci 2003; Stojanowski 2003a, 2005a; Stojanowski and Schillaci 2006; Stojanowski et al. 2007; Pietrusewsky 2008; Pilloud and Larsen 2011). Biodistance analyses rely on the premise that mate exchange results in an increase in phenotypic similarities between populations, while those populations that do not exchange mates exhibit greater differences through time (Stojanowski and Schillaci 2006; Larsen 1997). In microevolutionary terms, gene flow causes greater phenotypic similarities between populations, while genetic drift creates greater phenotypic dissimilarities. These underlying genetic patterns are assessed using phenotypic traits of the skeleton (most commonly the skull) and dentition as their proxies. Cranial and dental measurements and epigenetic traits are used most commonly. This study conducts an intracemetery biodistance analysis to test whether or not individuals with trauma exhibit phenotypic variation statistically consistent with their cemetery sample or greater than that of their cemetery sample. Individuals identified as phenotypic outliers, which are greater than the five percent confidence interval for the population, provide one line of evidence to identify potential war captives as described by the models in Chapter Four.

Biodistance studies are classified as either model free or model bound (Relethford and Lees 1982; Relethford and Blangero 1990). Model free analyses statistically compare phenotypic similarity and dissimilarity in a sample. Population genetics models are not employed in examining the data, but rather their statistical analogues are used. Model bound approaches, in contrast, examine microevolutionary patterns by fitting data
to genetic models. In this study, a model free approach is used, as the focus is on identifying single phenotypic outliers, rather than population-level microevolutionary forces. This section provides a brief history of biodistance analysis, focusing on levels of analysis and the method’s application in west-central Illinois. The discussion turns to an outline of the theoretical and methodological assumptions of biodistance, focusing particularly on heredity. Finally, the dental measurements examined in this research are described.

**Brief History of the Method**

Greater understanding of population genetics along with statistical techniques aided by the development of improved computing systems influenced the shift from typology to the population and variability approaches emphasized in contemporary biodistance analysis (Cook 2006; Konigsberg 2006). These biodistance studies examine populations with the goal of understanding population history or microevolutionary processes at differing levels of analysis, including interregional, intragional, and intracemetery scales. Interregional biodistance analyses have been particularly focused on phenotypic variation within and among populations at the global scale (e.g., Howells 1969, 1973, 1989, 1995; Relethford 1994, 2002, 2009, 2010; Keita 2004; Hanihara et al. 2003; Roseman and Weaver 2004; Hanihara and Ishida 2005; Strauss and Hubbe 2010; Irish 2013). They have also been used to examine numerous population origin and migration questions at the continental scale or across large regional expanses, such as the peopling of the Pacific (e.g., Brace and Hunt 1990; Brace et al. 1990; Howells 1973, 1989; Pietrusewsky 1971, 1984, 1990, 1994, 1996, 2005; Turner 1990), the Bantu expansion in sub-Saharan Africa (e.g., L’Abbé et al. 2006; Ribot 2004), the peopling of
the Americas (e.g., Turner 1983, 1985; Turner and Bird 1981; Neves and Pucciarelli 1991; Ishida 1993; Ross et al. 2002; González-José et al. 2003, 2008; Segushi et al. 2011), and population histories of central and eastern Asia (e.g., Hanihara 1992; Hanihara and Ishida 2009; Pietrusewsky 1999, 2006; Hemphill et al. 2004; Matsumura and Hudson 2005; Kozintsev 2009).

Prior to the development of modern statistical approaches to biological distance analysis, early phenotypic studies of prehistoric CIV Native Americans were largely concerned with documenting racial types. For instance, Georg Neumann (1950, 1952a,b) analyzed 45 unmodified male skulls excavated from the CIV to serve as the type description for the Walcolid variant. He equivocated, however, regarding the likelihood that he successfully eliminated all individuals with artificial cranial modification from his sample of 45 individuals. Groups assigned to the Walcolid type were found in pockets in the Northwest, Great Basin, and eastern United States. In the east, Walconids were believed to have intruded into the region by the Middle Archaic period. They were described as large skulled, primarily brachycephalic individuals with a large to medium sized face. Neumann’s students used his CIV type skulls to further refine Native American variant typologies, making the region an early research epicenter for studying interregional population histories (e.g., H. W. Neumann 1960; Johnston 1956).

While interregional comparisons have produced a great library of information regarding phenetic similarity and dissimilarity, Armelagos and Van Gerven (2003) have critiqued them as remaining implicitly racial, descriptive, and typological – differing little from the biological anthropology practiced at the onset of the twentieth century. Stojanowski and colleagues (Stojanowski and Buikstra 2004; Stojanowski and Schillaci
have offered rejoinders to this interpretation, arguing that such studies are not inherently typological in their approach. Instead, the contemporary emphasis on variability in interregional biodistance studies moves them further from typology. Even if many of these studies retain primarily descriptive orientations to understanding population variation, these authors assert that this issue is not a fatal flaw of interregional biodistance research.

Intraregional biodistance analyses, when couched in an explanatory and analytical framework, have greater potential for addressing larger anthropological questions concerning population composition, movement, and identity than interregional approaches (e.g., Heathcote 1994; Blom et al. 1998; Sutter and Mertz 2004; Weston 2005; Irish 2006; Pinhasi and von Cramon-Taubadel 2009; Torres-Rouff et al. 2013; Serafin et al. 2015). Most importantly for this dissertation, however, a strong foundation for intraregional biodistance has been constructed for populations that inhabited west-central Illinois. This research has been primarily employed to understand population genetic parameters, particularly gene flow and drift, which influence the region’s biological variability from Middle Woodland to Mississippian time periods (e.g., Droessler 1981; Konigsberg 1987; Konigsberg and Buikstra 1995; Steadman 1998, 2001). Specifically, questions regarding postmarital residence patterns (Konigsberg 1988), population movement and mating networks (Buikstra 1972, 1976, 1980; Droessler 1981; Conner 1984, 1990; Konigsberg 1990a; Steadman 1997, 1998, 2001), and biological lineage social organization through burial mound use (Buikstra 1972, 1976; Kongsberg 1990b) have been explored. Additionally, maps of genetic boundaries between west-central Illinois populations have been constructed (Konigsberg and
The breadth of regional biodistance analyses makes west-central Illinois an ideal place to build upon this research foundation.

Intracemetery biodistance studies provide insight into patterns of biological relationships within a sample. The questions that can be addressed through intracemetery biodistance methodologies are diverse and include: kinship analysis (e.g., Acsadi and Nemeskéri 1957; Alt and Vach 1998; Spence 1996; Velemínský and Dobisíková 2005; Stojanowski 2005a), temporal microchronology (e.g., Owsley and Jantz 1978; Konigsberg 1987, 1990b), postmarital residence (e.g., Lane and Sublett 1972; Spence 1971, 1974a, b; Corrucini 1972; Konigsberg 1988; Stefan 1999; Schillaci and Stojanowski 2003, 2005), age-structured phenotypic variation (Perzigian 1975; Sciulli et al. 1988; Simpson et al. 1990; Stojanowski 2005b), and variance comparison analyses that assess the genetic heterogeneity of the population (e.g., Key and Jantz 1990a, b; Petersen 2000; Stojanowski 2001, 2003b) For a detailed and seminal overview of intracemetery biodistance methodologies and applications, see Stojanowski and Schillaci (2006). Despite the strength of intraregional work, few intracemetery biodistance studies have been conducted in the region (c.f., Buikstra 1972, 1976; Blakely 1973; Konigsberg 1987, 1990b; Stone 1996 for aDNA).

In an intracemetery biodistance comparison of the Dickson Mounds CIV Late Woodland and Mississippian skeletons, Blakely (1973) found that the Mississippian component sampled was statistically distinct from the Late Woodland component. Using craniometrics, he suggested that the Mississippians were intrusive migrants into the CIV, possibly originating from Cahokia. Nonmetric cranial traits, however, did not display significant differences between the two groups. Similarly, when examining differences
within early and late subsamples within the Mississippian sequence, Blakely found considerable genetic similarity. Blakely’s (1973) study is complicated due to its reliance on adult males and unequal sample sizes – the latter being an unfortunate common consequence of cemetery samples.

To test Blakely’s (1973) hypothesis that Mississippian migrants from Cahokia settled the CIV, Steadman (1997, 1998, 2001) performed a Relethford and Blangero analysis (1996). This method is a model-bound approach that uses both intracemetery and intraregional analysis scales. Results indicated genetic continuity between Late Woodland and Mississippian populations in the CIV. Throughout the three Mississippian subphases (Eveland, Orendorf, and Larson), there was little extraregional gene flow, while intraregional gene flow is more extensive. These results were consistent with those identified by Droessler (1981) between Lower Illinois Valley Mississippian and Late Woodland samples. Both Steadman (1997, 1998, 2001) and Droessler (1981) strongly support an in situ Mississippianization of west-central Illinois and the CIV, which directly contradict the Cahokia migration model.

Theoretical Assumptions of Biodistance

According to Stojanowski and Schillaci (2006:51), biodistance analysis is dependent on five assumptions. First, allele frequencies within and between populations inhabiting similar environments and in geographic proximity are affected by genetic drift and gene flow, as long as natural selection and mutation are constant. Second, measurable and mathematically tractable phenotypic changes, to the extent the morphology of interest is under genetic control, result from alterations in allele frequencies. Third, environmental effects should have a negligible impact on phenotypic
variation, or their impact should be randomly distributed throughout the populations analyzed. Fourth, as primarily continuous traits are used in these analyses, multiple alleles at multiple different loci contribute additive genetic effects to the phenotype. These effects are heritable, resulting in phenotypic similarities among biological relatives; and fifth, the samples used do not represent living populations, but rather biological lineages, reflecting accumulation over time.

This fifth assumption is particularly problematic for bioarchaeological research generally and use of population genetics in biodistance particularly. As Cadien and colleagues (1974) argued, cemetery samples are not equivalent to biological populations. Because biological populations are defined by their ability to interbreed (sensu Mayr 1963), individuals interred in cemeteries formed over hundreds of years of skeletal accumulation may never have lived contemporaneously. Rather, the cemetery samples used in bioarchaeology reflect skeletal lineages – that is a “temporally ordered sequence of populations, presumably with genetic continuity” (Cadien et al. 1974:196). As the cemetery catchment neither reflects a biological population nor prevents error in assigning age grades to each lineage, cemetery skeletal samples represent an estimated average of a lineage’s gene pool. This important critique, however, does not prohibit either phenetic or population genetic comparisons across cemetery samples, yet requires recognition of the error involved in such comparisons. Furthermore, intracemetery biodistance analyses may allow for the nature of any sampling bias to be identified (Stojanowski and Schillaci 2006).
**Heritability**

Because biodistance studies use phenotypic traits, a genetic contribution to the traits of interest must be established. In fact, phenotypes do not directly reflect their corresponding alleles. They result, instead, from combinations of genetic and environmental effects (Fisher 1918; Wright 1934; Falconer 1960; Cheverud 1988; Vitzthum 2003). While genetic effects include dominance and additive effects, only additive genetic effects contribute to similarities in phenotypes between biological kin. Dominance effects are not transmissible to offspring (Carson 2006; Konigsberg 2000).

To understand the relationships between genes, environment, and phenotype, quantitative genetics developed the heritability statistic. Heritability is the proportion of phenotypic variance that may be ascribed to genetic effects in a particular environment (Fisher 1918; Falconer and MacKay 1996; Konigsberg 2000; Vitzthum 2003). To assess the sum of genetic contributions to a trait, broad sense heritability may be examined. It is represented by the equation:

\[ H^2 = \frac{V_g}{V_p}, \]

where \( V_g \) is the total genetic variance and \( V_p \) is the total phenotypic variance (Fisher 1918; Falconer and MacKay 1996).

Broad sense heritability includes the non-transmissible dominance effects but does give a general impression of the role of genes on trait expression.

As this research is concerned only with heritable genetic effects, narrow sense heritability (\( h^2 \)) is used. Narrow sense heritability is calculated as:

\[ h^2 = \frac{V_a}{V_p}, \]

where \( V_a \) is the additive genetic variance and \( V_p \) is the phenotypic variance (Fisher 1918; Falconer and MacKay 1996).
Because heritabilities are calculated as proportions, their values range between $h^2 = 0.00$ to $h^2 = 1.0$. Heritabilities of zero do not necessarily imply a trait has no genetic contribution. Similarly, heritabilities of one do not imply that a phenotype is under complete genetic control. For instance, factors such as directional selection, a sample’s environmental heterogeneity, or a lack of genotypic and phenotypic variance may drive down heritability estimates regardless of genetic contribution to the phenotype (Falconer 1960; Vitzthum 2003). Heritabilities for discrete and metric traits have been estimated using various species, particularly mice (e.g., Grüneberg 1952; Deol et al. 1957; Leamy 1974; Berry and Berry 1967; Self and Leamy 1978) and rhesus macaques (e.g., Cheverud and Buikstra 1981a, b, 1982; Cheverud et al. 1990; McGrath et al. 1984). They have also been measured in human twins (Dahlberg 1926; Von Verschuer 1954; Corruccini and Potter 1980; Townsend et al. 1986; Sharma et al. 1985; Dempsey et al. 1995) and families (e.g., Alvesalo and Tigerstedt 1974; Susanne 1977; Sjøvold 1984; Townsend and Brown 1978; Harris and Smith 1980, 1982; Kolakowski and Bailit 1981; Potter et al. 1983; Hu et al. 1991).

Traits used in biodistance analyses are generally moderately heritable. Narrow sense heritabilities for phenotypic traits average near $h^2 = 0.55$ (Stojanowski and Schilaci 2006; c.f., Carson 2006). There may be considerable variation in heritability, however, depending on the trait type, population, and life stage (e.g., Falconer 1965, 1967; Sjøvold 1984; Vitzthum 2003; Towne et al. 1993; Cheverud and Buikstra 1981a, b, 1982; Cheverud 1988; Konigsberg and Ousley 1995; Carson 2006). In a model bound analysis, while a change in absolute values of genetic distances occurs, the relative patterns of genetic distances between populations are usually not significantly different when the
narrow sense heritability is greater than 0.2 (Relethford and Blangero 1990). Other researchers, however, have found significant differences caused by using variable heritability rates, especially investigations of microevolutionary processes (e.g., Sciulli and Mahaney 1991; Carson 2003). As this study uses a model free approach to biodistance, precise heritability estimates for traits is less of a concern. Rather, at least moderate trait heritability is necessary to statistically estimate biological relationships.

Description of Biodistance Data

In this study, biodistance analysis is conducted using dental cervical measurements for all individuals from each of the five CIV sites. Dental metrics are continuously distributed traits that are examined through measurements. Following standards developed by Hillson and colleagues (2005), buccolingual and mesiodistal cervical diameters are measured using Paleo-Tech Hillson-Fitzgerald dental calipers (Hillson et al. 2005) at the cementoenamel junction (Figure 4.4). Because dental wear often obliterates tooth crown maximum dimensions and adult Mississippian CIV individuals experience heavy tooth wear, dental crowns were not measured. Furthermore, as researchers have found a high degree of correlation between dental cervical and crown measurements (Hillson et al. 2005; Stojanowski 2007b; Fitzgerald and Hillson 2008), using both dental measurement types may result in intertrait correlation problems. Such redundant data would have to be removed during statistical analysis.

The analytical methods employed here are from an intracemetery variability analysis employed by Stojanowski (2005a). His research is novel, as it is one of the few analyses to employ statistical techniques to assess the phenetic variability among
individuals afforded atypical mortuary treatment. His methods allow hypotheses about whether or not individuals had principal component factor loading scores within or exceeding the 95% confidence interval from dental cervical measurements. These
methods are described in more detail below in the analytical methods section of this chapter.

**Summary**

Biodistance analysis has a long history in west-central Illinois bioarchaeology. From typological interregional analyses to discussions of population history and movement within a region to intracemetery studies examining sample phenotypic variability, the method provides a nondestructive path to understanding biological relationships within and among samples. Yet, when employing a model free approach as in this research, biodistance analysis requires numerous assumptions regarding the underlying genetic mechanisms that produce phenotypes, trait heritability, sample representation of the biological population, and statistical limitations. Nevertheless, it remains a robust line of evidence for investigating biological relationships among individuals.

**Mortuary Analysis**

The history of mortuary studies in archaeology serves as the basis for understanding the mortuary methodologies used by this dissertation. A review of the history of mortuary analysis is needed, as data analysis is not conducted in a theoretical vacuum. This section begins with a brief history of processual approaches to mortuary archaeology. Discussion then turns to the postprocessualist critique’s influence in mortuary analysis. A note on the importance of cultural context on the mortuary analysis conducted in this study concludes this section.
Processual Mortuary Archaeology

Processualist approaches in mortuary analysis emphasize empirical research based on cross-cultural generalizations that relate mortuary traditions to social structures. This research program was stimulated by translation of the French structuralist works of Robert Hertz (1960 [1907]) and Arnold Van Gennep (1960 [1908]) during the 1960s (Chapman 2003; Rakita and Buikstra 2005). These works emphasized the universality of mortuary rituals among cultures, also linking them to social relationships among the living. For example, Hertz (1960[1907]) linked burial rituals to political, economic, and kinship obligations among the living (Bartel 1982), while Van Gennep (1960[1908]) argued that life cycle rituals, although variable on the surface, functioned consistently across societies.

Processualist approaches to mortuary archaeology were stimulated by Lewis Binford’s (1971) publication of “Mortuary Practices: Their Study and Their Potential” and Saxe’s (1970) dissertation “The Social Dimensions of Mortuary Practice.” Both works expanded French social anthropology’s observations that social relationships are expressed through mortuary ritual cross-culturally (Chapman 2003). Saxe (1970) advanced the idea that sociopolitical complexity was reflected in mortuary contexts using a cross-cultural ethnographic analysis. Extending Binford’s “New Archaeology” (1962) focus on formal hypothesis testing, Saxe developed and tested eight hypotheses that related mortuary ritual to social organization. His most seminal contribution, Hypothesis 8, linked the presence of formal disposal of the dead to the legitimation of corporate group resource control. Hypothesis 8 states:
To the degree that corporate group rights to use and/or control crucial but restricted resources are attained and/or legitimized by means of lineal descent from the dead (i.e., lineal ties to ancestors), such groups will maintain formal disposal areas for their exclusive disposal of their dead, and conversely (Saxe 1970:119).

This hypothesis predicts that corporate groups will symbolically link their dead’s placement within designated territorial areas to limited resource access or control.

In James Brown’s edited volume *The Social Dimensions of Mortuary Practice* (1971a), Binford applied social role theory (Goodenough 1965) to assess whether there were cross-cultural relationships between a society’s sociopolitical complexity and its mortuary practices. His review found that with greater degrees of sociopolitical complexity, mortuary treatment increases in its variability. For instance, more social dimensions were expressed in the mortuary rituals of agriculturalists than of the hunter-gather societies examined. Binford’s method for assessing sociopolitical complexity, however, was problematic, as it was measured by proxy using subsistence systems (Tainter 1978; Precourt 1984; Rakita and Buikstra 2005).

Published alongside Binford’s (1971) contribution in *The Social Dimensions of Mortuary Practice*, James Brown’s chapter (1971b) investigated burial programs at Spiro, Oklahoma. In this piece, Brown explored the use of formal analysis to examine ethnohistoric reports of Natchez-Taensa and Choctaw burial complexes and compared them to the mortuary practices of the Mississippians at Spiro. He found a greater preponderance of vertical status dimensions among the dead at Spiro than among the ethnohistoric cases he examined. Consequently, his findings related greater social complexity with greater mortuary program diversity.
Following the initial research orientation established by Saxe (1970), Binford (1971), and Brown (1971b), processually oriented studies became a predominant approach to mortuary analysis. Among the most intense loci of processualist mortuary analysis were the cemeteries from the Lower Illinois Valley (LIV) of west-central Illinois and the Mississippian Period of the Midcontinent and Southeast. Work in these regions by scholars like Lynne Goldstein (1976, 1980, 1981), Christopher Peebles and Susan Kus (1977), and Joseph Tainter (1975a,b, 1977a,b, 1978) contributed substantially to the establishment of processualism in mortuary archaeology.

In a reanalysis of the ethnographic literature explored by Saxe (1970), Goldstein (1976) tested Hypothesis 8’s cross-cultural generalizability. Her work showed that this hypothesis did not work reciprocally. Corporate groups that controlled restricted resource access through lineal descent did not always maintain formal exclusive mortuary disposal areas. Additionally, she critiqued Saxe’s law-like proposition that cultural variation in mortuary practice would make it unlikely that all societies would ritualize their death ceremonies in the same ways.

From her cross-cultural ethnographic study, Goldstein then clarified Saxe’s Hypothesis 8, reformulating it into what would become known as the Saxe-Goldstein Hypothesis (e.g., Morris 1991). This predictive model (Whitley 2013) explained how burial rituals functioned to ease property transfers among the living, finding that the more formal a permanent disposal area, the more likely social organization could explain the burial program. Goldstein (1976, 1980, 1981) tested her revision of Hypothesis 8 using Mississippian and Late Woodland components of the LIV Moss and Schild cemeteries. She found, in a visual inspection of cemetery spatial structure, evidence for corporate or
lineal descent groups in spatially clustered groups. Support for this hypothesis has also been garnered in studies conducted by other researchers (e.g., Buikstra and Charles 1983; Morris 1991; Charles 2005).

Influenced by the presence of ranking identified by Brown (1971b) in Mississippian mortuary programs at Spiro, Peebles and Kus (1977) hypothesized that mortuary analysis might be one line of evidence of identifying chiefdoms in the archaeological record. They tested this hypothesis using burial programs from Mississippians interred at Moundville, Alabama. Ascribed and achieved status dimensions were examined to identify the aspects of social personae represented among the Moundville burials. They identified elements of ascribed status in these burials, and argued that these mortuary markers of status also could be used to infer a chiefdom-level social organization.

Also influenced by Brown’s work at Spiro, Joseph Tainter (1975a, b, 1977a, b, 1978) tested the relationship between burial program energy expenditure and the deceased’s relative social rank. Greater amounts of effort expended in a burial program translated to higher status of the deceased, so paramount individuals with the greatest ascribed status would have the most energy expenditure. This energy expenditure approach has been applied by a number of researchers (e.g., Shennan 1975; Rothschild 1979; Hohmann 1982; Shyrock 1987; Mitchell 1994; Crown and Fish 1996; Whittlesey and Reid 2001) and greatly influenced archaeological investigations of status. Yet, Tainter’s arguments were roundly critiqued for the arbitrary and sometimes erroneous energy values he assigned to burial programs and the lack of middle range theory connecting how these energy values corresponded to vertical and horizontal status in the

O’Shea’s (1981) study of Plains Native Americans mortuary patterns created a model to examine how vertical and horizontal elements social distinctions may be identified in each society’s burial program. He used data from both ethnohistoric accounts and archaeological excavations, finding vertical distinctions easily identified in the burial programs of both data sources. In contrast, examination of Pawnee and Arikara mortuary programs did not distinguish horizontal dimensions in either data source. For the Omaha, however, horizontal distinctions were identified in both ethnographic and archaeological observations. Horizontal differentiations in mortuary programs may be difficult to recognize, as they were primarily expressed through pre-interment rituals or in organic inclusions. In sum, O’Shea’s work demonstrated that not all elements of social organization are equally expressed in a society’s burial program.

Postprocessual Mortuary Archaeology

Problems with the law-like generalizations developed in processualism led to extensive critiques and a revision in the types of questions answerable in mortuary archaeology. These critiques and their research orientations would form a research program labeled postprocessualist approach or the “radical critique” (Earle and Preucel 1987). Postprocessualism is a broad umbrella term that captures a variety of critical theoretical paradigms, including structuralism, semiotics, Marxism, phenomenology, post-modernism, and archaeological emphasis on marginalized groups (Kus 2013). In mortuary archaeology, postprocessualists prominently refuted the Binford-Saxe paradigm (Hodder 1980, 1982; McGuire 1992; Miller and Tilley 1984; Parker Pearson 1982;
Shanks and Tilley 1982; Tilley 1984; Cannon 1989). Foremost among its early critiques was processual archaeology’s narrow focus on social organization, while issues of symbolism (e.g., Hodder 1980; 1982; Cannon 1989) and ideology (Parker Pearson 1982) in mortuary rituals were ignored.

Hodder (1980, 1982) criticized processualism’s emphasis on social systems and argued that changes in the ideology and social organization of the living may obscure burial patterns in archaeological record. To illustrate this premise, he compared generational changes in Sudanese Mesakin Nuba burial practices. The relationship between the Nuba and their cemeteries could be superficially interpreted as corresponding to the Saxe-Goldstein Hypothesis. As described ethnographically during the 1940s (Nadel 1947), deceased Nuba were buried in cemeteries adjacent to settlements, creating a link between the ancestors in the cemeteries and claims for corporate land rights. By the 1970s, Nuba burial practices remained unchanged; yet changing socioeconomics caused Nuba to migrate away from their villages and integrate into the larger Sudanese economy. These migrations caused burial patterns to reflect a symbolic ideal, rather than the actual patterns of land ownership and social relationships.

Expanding on Hodder’s criticisms, Parker Pearson (1982) argued that the living often have a significant interest in distorting the power relationships expressed in mortuary ritual. Furthermore, the symbolism used to communicate meaning through mortuary rituals expresses the ideal, rather than actual, power relationships. Parker Pearson’s critique was illustrated using changes in funeral program competitive displays according to social status. The poor elevated their status through competitive displays, while the rich responded by favoring less ostentatious funerals. Power relationships
among the living altered economic investment patterns in mortuary rituals, masking dominance through social practices.

The influence of postprocessualism extended beyond its critiques of processual archaeology. Its genesis ushered in other postmodern theoretical approaches, including investigations of the personhood of cultural agents, whether individuals or collectives (Gillespie 2001; Brück 2004; Williams 2004); and the identities of the dead, especially gender, age, and sexual identities (McCafferty and McCafferty 1994; Knüsel and Ripley 2000; Sofaer Deverenski 2000; Joyce 2001b; Meskell 2001; Cannon 2005; Perry 2006; Holliman 2011). Embodiment approaches also analyzed how a person’s physical body functioned in the creation of social memory or group identity (Joyce 2001a, 2003, 2005; Blom 2005; Nystrom 2011; Geller 2012). Insights gained from these new approaches allowed for investigations of how individuals and their societies understood or symbolized themselves.

By the 1990s, researchers like Kamp (1998) and Carr (1995) recognized the importance of incorporating insights from postprocessualist critiques, but maintained an emphasis on empirically sound investigations of mortuary ritual. Kamp (1998) reconfirmed a rough cross-cultural relationship between burial wealth and status. However, she found that energy expenditure in mortuary rituals is better explained by the relative amount of social competition in a society. Carr (1995), using the HRAF database, found that ideology (what he called “philosophical-religious” principles) was equally as important as social structure in the determination of funerary rituals. His work blended Binford’s empirical focus on social organization with Hodder’s emphasis on ideology. Additionally, Carr’s work provides an almost “middle-range” framework in
mortuary study designs. Archaeologists should use this work to identify mortuary variables that exhibit cross-cultural patterns in the social or ideological dimensions of interest. Researchers may then engage in a culturally contextualized study to understand the nuances expressed in the mortuary program.

Attempts to synthesize processual and postprocessual approaches were also made during the 1990s. Morris (1991) and Charles (1995) emphasized that while processualist and postprocessualist explanations have historically been divisive, a combination of the approaches can offer improved interpretations. The theoretical foundation Morris (1991) provided for the Saxe-Goldstein Hypothesis illustrated the hypothesis’s continued utility. However, Morris cautioned that the Saxe-Goldstein Hypothesis should not be used as a universal principle. Instead, it represents one possible way people may communicate through mortuary practices.

While the postprocessual critique has been instrumental in highlighting how non-social phenomena influence mortuary customs, ultimately, the ideological was merely substituted for the social by postprocessualists (Brown 2007b:304). Furthermore, these early postprocessualist paradigms were not easily applied to a prehistoric archaeological record (Rakita and Buikstra 2005; but see Carr 1995). Without historical descriptions of mortuary ideologies and customs, archaeologists were left with uncertainty regarding their mortuary analyses. Critiques of postprocessualism, however, do not dismiss the approach’s importance. They illustrate, instead, that both postprocessualism and processualism have interpretative problems that require theoretical grounding and greater contextualization.
Ultimately, one of postprocessualism’s greatest contributions to mortuary theory is its emphasis on context (Miller 1982; Hodder 1987; Cannon 1989). Context requires full consideration of cultural practices and a more thorough analysis of the archaeological record. It reorients mortuary studies, improving the interpretive quality of data. As Carr (1995:193-194) has summarized:

“When interpreting the cultural meaning(s) of a mortuary practice as a symbol, it is essential to use a broad contextual approach (Emerson, 1989:46; Hodder, 1982a, 1982b; Taylor, 1948), which considers the synchronic and historical patterns of association and contrast of the practice with other mortuary practices and broader circumstances. Taking into consideration cross-cultural, statistical regularities in the meaning(s) of the practice can be helpful but need not be sufficient. This is so for three reasons. First, it is the place of a mortuary practice within such synchronic and historical patterns that the practice may take on and be constrained in its symbolic meaning(s) of the practice, be they social, philosophical-religious, or other. Turner (1967:50-51) labeled such meanings of symbols their ‘positional meanings.’ Second, it is through synchronic and historical patterns of association and contrast among mortuary and other practices that cultural bundles of meaning are revealed – what have been termed the ‘logical fabric’ of a culture (Rosenthal, 1995; Toelken, 1979), ‘configurations’ (Kroeber, 1963), ‘patterns’ (Benedict, 1934), and ‘themes’ (Emerson, 1989:47). Importantly, such bundles of meaning(s) can comprise the basic tenets of a society’s world view . . . Finally, because a mortuary practice is a complex mix of social, philosophical-religious, and other factors, using a contextual approach in conjunction with cross-cultural regularities in the meaning(s) of that practice can facilitate the teasing out of those meaning(s).”

By contextualizing mortuary data, researchers can reconstruct both social relationships and ideology with scientific data, rather than relying on the problematic assumptions of universal generalizability in processualist studies.
To explore the models discussed in Chapter Five, this research relies on information from the mortuary context. Burial practices at each cemetery are contextualized with reference to common and atypical mortuary patterns. Common burial practices refer broadly to frequent mortuary customs at both the individual site level and throughout the Mississippian Period of the Central Illinois Valley broadly. Atypical mortuary treatment denotes rare mortuary practices. This study seeks to identify individuals buried atypically, evidencing social or ideological marginalization. In a cultural context, this mortuary marginalization may serve as evidence of war captives. However, the mortuary evidence must be combined with trauma and biodistance data to conform to the model for war captives, for instance. Previous work has suggested that socially marginalized individuals (e.g., war captives or slaves) are also materially and/or spatially isolated from the normative cemetery burial pattern (O'Gorman 2001; Wilkinson 1997; Martin et al. 2001; Martin et al. 2010). Extra-local war captives should be buried on the edges of the cemetery with few or no grave goods.

It is necessary to caution that the interpretation of mortuary data is not straightforward. Differential preservation of organic grave inclusions may bias burial treatment reconstructions. Confounding meanings signaled in the material culture of graves have contributed to what Sofaer (2006) described as a reluctance of researchers to use both biological and material data in mortuary analyses. I argue, instead, that combining biological and material data reduces the encumbrance of conflicting meanings and preservation biases on mortuary studies.

The history of mortuary analysis reviewed above provides the theoretical backdrop for this dissertation’s methods. Both social and ideological factors may
influence the burial patterns observed in the archaeological record, yet archaeological and cultural contexts are necessary to investigate the patterns observed in mortuary remains. The biological contexts of mortuary remains, like skeletal trauma and phenotypic affinities, also represent additional lines of evidence to investigate violence archaeologically. Biological and mortuary contexts are used in this research to discriminate between intragroup and intergroup violence.

Analytical Methods

Demography

Data collection was conducted at the Illinois State Museum, Springfield, IL for 780 individuals from five Mississippian sites: Dickson Mounds, Crable, Emmons, Berry, and Larson. Each bone and tooth was observed for completeness and given an inventory code according to standards developed by Buikstra and Ubelaker (1994). Such inventories provide baseline counts of skeletal elements and teeth for comparisons across individuals and sites. In addition, demographic categories of sex and age were estimated. Sex was estimated using morphological markers of the cranium and hip bones and metric assessments of the skeleton that display sexual dimorphism, while age-at-death was estimated using patterns of growth and degeneration in the skeleton (see Buikstra and Ubelaker 1994). Individuals were assigned to age cohorts based on their age range. These categories included: infant (0-3 years), child (3-12 years), adolescent (12-20 years), young adult (20-35 years), middle adult (35-50 years), and old adult (>50 years).

Trauma Analysis

A trauma analysis was conducted for 776 individuals in the CIV sample. Each skeletal element was assessed for the presence of antemortem or perimortem traumatic
wounds. These lesions were further differentiated by trauma type (projectile, blunt force, or sharp force trauma) and time since insult (antemortem, perimortem, or postmortem). As postcranial blunt-force trauma is less likely to have been caused by interpersonal violence, it is only reported when in association with blunt-force trauma to the skull. Comprehensive records of the size, distribution, extent of healing of trauma were made using schematics and standardized data collection forms, along with narrative descriptions of the injury. Capitol Illini Veterinary Clinic and St John’s Hospital, both in Springfield, IL, x-rayed each traumatic injury. Radiographs were examined to ensure a lesion originated from a fracture and not another pathological condition. Discrimination between violent and accidental fracture etiologies was made using the criteria described in the theoretical trauma methods section of this chapter.

Frequencies of violent trauma for individuals and violent trauma type were calculated by site, sex, age-at-death, and temporal subphase. Significant differences in trauma frequencies between the sexes were tested using independent samples t-test in SPSS v. 21. Classical hypothesis testing was not used to test for significant differences in trauma between sites as many of the skeletal collections analyzed in this study suffered from substantial sampling bias. Skeletal collections from Emmons, Crable, and Berry were formed primarily through collector activities or retained during archaeological excavations only because they exhibited significant pathologies.

**Biological Distance Analysis**

In this study, the biodistance analysis used dental cervical measurements data from 214 CIV individuals. Buccolingual cervical diameter and mesiodistal cervical diameter measurements were taken using Paleo-Tech Hillson-Fitzgerald dental calipers at
the cementoenamel junction (Hillson et al. 2005). Both the left and right side of the polar tooth for each tooth class (M\textsuperscript{1}, P\textsuperscript{1}, C, I\textsuperscript{1}; M\textsubscript{1}, P\textsubscript{1}, C, I\textsubscript{2}) were measured (following Stojanowski 2003a). Methodologies for analysis of metric data were adapted from Stojanowski (2005a).

Variables affected by inter- or intraobserver error, fluctuating asymmetry, and age and sex correlations were identified and removed from the data set. Interobserver error was tested using left polar tooth measurements of 25 individuals from the Semna South collection at Arizona State University. Tests of interobserver error are necessary to ensure the accuracy and precision of measurements made by an observer, regardless of whether or not all data were measured by that one observer. Paired t-tests assessed significant differences between the author’s measurements and measurements taken by Anna Novotny for the same teeth. Intraobserver error was tested using a sample of fifty individuals sampled randomly from the study’s CIV sample. Measurements taken throughout data collection were compared to measurements taken at the conclusion of data collection using paired-samples t-tests.

To reduce the effects of fluctuating asymmetry and environmental plasticity, only the left polar tooth was analyzed. The right polar tooth was substituted when the corresponding left tooth was missing, unless asymmetry between the right and left measurements for a polar tooth was statistically significant. To test the appropriateness of this method, the significance of fluctuating asymmetry on antimere measurements was assessed using Pearson’s r correlation coefficients for each antimere measurement. Results are reported in Chapter Six; however, measurements were highly correlated allowing for antimere substitution to reduce missing data in the data set.
The effects of age and intertrait correlations on dental measurements were examined using Pearson’s R correlation coefficients. Variables affected by significant intertrait and age correlations were removed from the data set. Additionally, to mitigate for the effects of intertrait correlations in dental traits, only traits of the key tooth for each tooth class were used in this analysis. As the multivariate statistics necessary to conduct biodistance analysis require complete data sets, 25% of the missing data were imputed using an expectation-maximization algorithm (Wilkinson et al. 1996).

Analysis of metric phenotypic variance follows the methods described in Stojanowski (2005a). A principal components analysis (PCA) transformed the data matrix into loading scores. Each principal component load represents an uncorrelated variable used to estimate biological affinity among the individuals in this analysis. Scatter plot matrices displaying the principal component loading scores for each individual were generated to graphically represent the transformed data. Individuals were also labeled in this plot for presence or absence of trauma. To determine whether there were patterns of relationships among individuals, bivariate plots of the principal component loadings were produced. Using Systat v. 13, a bivariate 95% confidence ellipse of means was calculated and graphed on the PC loadings plot. This confidence ellipse was used to define individuals who exhibited phenotypic variation greater than 2σ from the mean. These variable individuals were identified as outliers, lying on or outside of the confidence ellipse. Plots were produced for the total sample and separately for each sex.
Mortuary Analysis

In order to contextualize the biological data from the CIV skeletal samples, data on treatment at death, accumulated from analyses by other researchers, were examined. The mortuary data of interest in this research included burial treatment and material accompaniments. Unfortunately, this information was only available for 532 individuals from three sites. Information regarding burial treatments, their locations, and artifact types and materials was obtained for Dickson Mounds (Harn n.d.[a]; Conrad 1972), Larson (Harn n.d.[b]), and Emmons (Morse et al. 1961). Burial treatments were classified by interment type and corpse position (e.g., supine, extended, flexed, or prone). Positioning of specific body parts, including the trunk, right and left arms, and legs were also examined. These variations were reported for each site.

Associated artifacts were categorized according to artifact class (e.g., ceramic bowl, arrowhead, awl) and material composition (e.g., obsidian, chert, bone, ceramic). Differences in artifact counts, class, and material composition variables between individuals with and without violent trauma were examined using histograms, chi-square tests, and independent samples t-tests. For nominal-level variables, a Fisher’s Exact Test was also employed when cell counts were less than five. Scale variables were also assessed for equality of variance using a Levene’s test. If equal variance could not be assumed, a modified Levene’s t-test was conducted (These tables are reported in Appendix B).

The following chapter presents the behavioral models used to explore this study’s research question. Two models of intragroup violence and two models of intragroup violence are examined. First, data expectations for community members killed in warfare
are discussed. These patterns are then contrasted against data expected for war captives brought in from a non-local biological community. Finally, expectations for victims of domestic violence and male-male intragroup assaults are discussed.
CHAPTER 5 – MODELS AND TEST EXPECTATIONS

To evaluate the results of the trauma, biodistance, and mortuary analyses, behavioral models are explored to discriminate between patterns of intergroup and intragroup violence and their expected outcomes. Two intergroup violence models, ambush warfare and war captives, and two intragroup violence models, domestic violence and male intragroup fights, are contrasted here. Each model relies on expectations from multiple categories of evidence, including skeletal trauma, age-at-death and sex estimates of each individual, biodistance relationships and mortuary variables, such as grave location and burial artifact assemblages (Table 5.1). None of these models are mutually exclusive. As a result, each pattern of physical violence may be present within a single site or during a particular Mississippian subphase. Furthermore, these models are constructed primarily from both ethnohistoric reports of violence among Eastern Woodlands and Plains Native Americans and bioarchaeological data patterns from prehistoric North American sites. Consequently, they are not cross-culturally applicable.

**Intergroup Models**

While each intergroup model reflects test expectations due to warfare, the ambush outcomes differ considerably from those for war captives. The ambush warfare model evaluates the variables associated with war combat, while the war captive model identifies individuals who were forcibly removed by another bellicose group. These models are differentiated through time following the traumatic insult, victim demographics, levels of phenotypic variance, and mortuary patterns.
Table 5.1. Intergroup and Intragroup Models with Expected Variable Patterns.*

<table>
<thead>
<tr>
<th>Insult</th>
<th>Victim</th>
<th>Implement</th>
<th>Biodistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>shealed</td>
<td>Male</td>
<td>Female</td>
<td>Child</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>X</td>
<td>Y</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 potential patterns for each model or all possible alternative behavioral models.
Model 1 - Ambush Warfare - Victims from Cemetery Community

As described by Milner and colleagues at Norris Farms #36 (Milner and Smith 1990; Milner et al. 1991; Milner 1995), intergroup raids result in primarily lethal blunt-force, sharp-force, and projectile trauma. Evidence of trophy taking, such as scalping, decapitation, and limb removal, should be present, considering prehistoric and historic Woodland and Plains Native American practices. As observed among many small-scale ethnographic societies cross-culturally (e.g., Divale and Harris 1976; Chagnon 1974, 1988; Glasse 1968; Heider 1970, 1979; Meggitt 1977), adult males are most frequently the targets of warfare. Adult males and females, however, may also be affected in equal proportions (Milner and Smith 1990; Milner et al. 1991; Milner 1995; Kuckelman et al. 2002).

As these war victims were members of the local community, it is expected that they will have biodistance principal component loading scores within the 95% confidence interval of the sample and would be buried within their community’s cemetery. Multiple burials of small numbers of individuals with lethal trauma may be indicative of warfare-related deaths (e.g., Milner and Smith 1990; Milner et al. 1991; Milner 1995; Steadman 2008). If the individuals with trauma were buried as single inhumations, their burial positions, cemetery locations, and grave inclusions will be within the normal range of variation for the sample.

Model 2 - Captives - Victims from Extra-Local Communities

Intergroup conflict often resulted in intergroup raiding to obtain captives. Among historic Eastern Woodland tribes, captive taking could often be a primary motivator for raiding (e.g., Thwaites 1888:6, 1899:49, 53; De Lusser 1730; du Pratz 1758; Adair 1775;
Strachey 1849; Knowles 1940; Tooker 1962; Swanton 1928, 1946, 2001[1931]). While men were reported to have been taken as captives, children and, especially, women were also taken into captivity (e.g., du Pratz 1758; Swanton 1946, 2001[1931]; Thwaites 1899:49). War captives could be tortured and sacrificed once the raiding party returned to the village (e.g., Thwaites 1899:53; Knowles 1940; Swanton 1946, 2001[1931]; Hudson 1976). Knowles (1940) summarizes the great variety of torture and sacrifice methods practiced by historic Eastern Woodland Native Americans. This diversity of practices could result in perimortem blunt-force, sharp-force, and/or projectile injuries to tortured or sacrificed war captives. Alternatively, if a captive was allowed to live, they could be forced into slavery (e.g., Tooker 1962; Hudson 1976; Thwaites 1901:71) or adopted into the tribe of their abductors (e.g., Thwaites 1898:18; 1899:69; Swanton 2001[1931]; Edwin 1830; Tooker 1962).

From a careful reading of the Jesuit Relations, Starna and Watkins (1991) conclude that adult male captives are more likely to be sacrificed or killed, while adult female and child captives are more likely to be adopted. For those individuals who survived and were adopted or enslaved, as Martin and colleagues (2010) argue, sub-lethal blunt-force trauma will be evident. Because captive individuals were often of lower social status and may have lacked strong kin ties regardless of adoption or slavery (e.g., Edwin 1830; Swanton 2001[1931]), they were more likely to experience beatings (e.g., Wilkinson 1997). Consequently, these captives may exhibit multiple blunt-force wounds in various stages of healing, due to “battering” from beatings sustained at different times (Maples 1986; Wilkinson and Van Wagenen 1993; Walker et al. 1997; Walker 2001).
War captives are less likely to be closely biologically related to the captor community and generally exhibit more phenotypic differences from its members (Martin and Akins 2001; Martin et al. 2010; Sutter and Verano 2007). These captive individuals will be identified in the biodistance analysis as individuals with principal component factors scores greater than the 95% confidence interval of the sample. Previous work has suggested that socially marginalized individuals (e.g., war captives or slaves) are also materially and/or spatially isolated from the normative cemetery burial pattern (O'Gorman 2001; Wilkinson 1997; Martin et al. 2001; Martin et al. 2010). Extra-local war captives should therefore be buried haphazardly or placed in expedient holes like barrow or midden pits.

**Intragroup Models**

Unlike the intergroup models, intragroup models focus on within-group conflict. In this research, two models of intragroup violence were explored. The first model addresses trauma, demographic, biodistance, and mortuary patterns expected from domestic violence. The second model, in contrast, assesses data patterns for individuals with trauma caused by intracommunity male-male combat.

While often referred to as intimate partner violence, use of the term domestic violence is preferred here, as intimate partner violence implies that the perpetrator and victim of violence have engaged in a sexual or emotional relationship (e.g., Coker et al. 2000; Jewkes 2002; Garcia-Moreno et al. 2006; Catalano 2006). In contrast, domestic violence allows for the inclusion of other household or familial relationships, such as a mother-in-law’s abuse of a daughter-in-law, a husband’s abuse of a wife, etc. (e.g., Leung et al. 2002; Shiu-Thornton et al. 2005; Chan et al. 2008). As it is extraordinarily rare to
have information about sexual or emotional relationships in the archaeological record, a broad definition of domestic violence patterns is used here.

Similarly, although it is unsafe to assume that a male caused the traumatic wounds displayed by other males, neither the ethnographic record nor clinical or forensic studies provide strong documentation that women cause nonlethal blunt-force trauma in men. In fact, these studies find that men assault other men and women with higher frequency than women assault men or other women (e.g., Mock et al. 1999; Shepherd et al. 1990; Ambade and Godbole 2006; Au and Beh 2011; Komar and Lathrop; see Walker 2001 for a review). One notable exception to this trend, however, is observed in Burbank’s (1994) study of violence among Australian Aboriginal women at a settlement given the pseudonym “Mangrove.” In this society, women were not only the recipients of most violence, but they also initiated violence in most cases. While women fought men, attacking a man presented more risk to the women and was conducted more sparingly. Women were more likely to assault other women because they were less likely to become injured themselves.

Contemporary studies of domestic violence have also identified a strong association between wife battering and child abuse. Children who grow up in households where their mother is abused are likely to be abused themselves (Hughes et al. 1989; O’Keefe 1994; Farmer and Owen 1995; Connolly et al. 2006; Holt et al. 2008). Similarly, when these children grow up, they are also likely to both perpetrate domestic violence against their partners and/or be victims of violence in their own relationships (Wekerle and Wolfe 1999; Levendosky et al. 2002; Ehrensaft et al. 2003; Cunningham

Model 1 - Domestic Violence

Although domestic violence can be perpetrated against males, the frequency of this occurrence is lower than rates of female victimization (e.g., Crowell and Burgess 1996; Daly and Wilson 1988, 1990). Children may also be the focus of domestic violence, but trauma attributable to child abuse is rare in the archaeological record (e.g., Walker 2001; Bloniaux et al. 2002; Wheeler et al. 2013). As a result, domestic violence is generally identified through the presence of high frequencies of antemortem blunt-force wounds to adult females (Elliot-Smith and Wood-Jones 1910; Webb 1995; Lambert 1997; Alvrus 1999; Novak 1999, 2006). While domestic violence is rarely reported ethnohistorically among Eastern Woodland tribes, Adair (1775:143) reported that Chickasaw wives were beaten and disfigured for adultery. Such punishments were commonly socially sanctioned for immoral acts, however, and may not be true evidence of battering expected in chronic domestic violence.

As a result of repeated beatings, multiple wounds in various stages of healing are expected (Maples 1986; Wilkinson and Van Wagenen 1993; Walker et al. 1997; Walker 2001). These repeated beatings would pattern as battering - resulting in a trauma pattern similar to that expected for captive women. Because of the close correspondence in trauma patterns expected in both war captives and victims of domestic violence, use of biological distance analysis has been suggested to further discriminate between them (e.g., Martin 1997; Martin and Akins 1991). As these women will be closely biologically related to the community (Martin 1997; Martin and Akins 2001) and, thus, have
biodistance principal component factor loading scores within the 95% confidence ellipse of the sample. No correlation between grave inclusions and presence or absence of traumatic wounds will be identified. Burial position and location of each individual with trauma will be within the pattern of normal variation (Lambert 1997:89-90)

*Model 2 - Male Intragroup Violence*

As clinical studies attest, most assault victims within a society are male (e.g., Kraus 1987; Aalund et al. 1990; Allan and Daly 1990; Hussain et al. 1994), and the face and the head are the preferred target areas (Ström et al. 1992; Hussain et al. 1994; Paaske and Madsen 1987; Shepherd et al. 1990). In nonlethal assaults, blunt objects, hitting with fists, and kicking are most common (e.g., Scherer et al. 1989; Shepard et al. 1990). Consequently, high frequencies of nonlethal blunt-force injuries to the head and face will be observed among adult males. These individuals will have principal component loading scores within the 95% confidence ellipse, as these individuals will be members of the burial community. Grave good type, material, or frequency is not expected to pattern with the presence of traumatic wounds. Additionally, burial position and location of each individual with trauma will be within the pattern of normal variation of the cemetery sample.

The two models of intergroup violence and two models of intragroup violence cannot possibly include the full range of behaviors that may cause injuries in past populations. In fact, bioarchaeologists are often caught between their desire to be conservative and their desire to push boundaries when reconstructing behavior from skeletal remains. Yet, without pushing the analytical capability of bioarchaeological data, advances in reconstructions of past lifeways are difficult to achieve. These models
provide a framework for distinguishing among physical violence etiologies and should be
adapted for different cultural practices in any future work. The following chapter
presents the results of trauma, biodistance, and mortuary analyses.
CHAPTER 6 – RESULTS

This chapter presents the results of trauma, biodistance, and mortuary analyses. It first reports the results of the demographic analyses for site sample sizes, sex, and age-at-death. Analysis then turns to examination of osteological trauma. Frequencies of skeletal trauma are reported by site, sex, age-at-death, and temporal phase (Detailed intrasite demographic frequency data and trauma descriptions are also presented in Appendix A). Dental cervical measurements and their biodistance results are then discussed, along with an assessment of interobserver and inraobserver error and fluctuating asymmetry. A principal components analysis of dental cervical measurements is presented, and individuals with trauma are described in relation to their position within or outside of the bivariate 95% confidence ellipse of means. The chapter concludes with the results of the mortuary analysis. Burial types and corpse positions are described for Dickson Mounds, Larson, and Emmons. Artifact association counts, classes, and materials interred with individuals from Dickson Mounds, Larson, and Emmons are also examined.

Demography of the CIV Sample

A total of 780 individuals from five sites were studied. Four individuals were removed from demographic and trauma analyses, as they could not be osteologically examined for skeletal trauma. Three of these individuals (an infant, a child, and an adolescent) originated from a commingled grave and were identified only by the presence of teeth. An adult of indeterminate sex, represented only by a skull, was also removed from analysis because a plaster soft tissue reconstruction placed sometime after excavation covered its skull, precluding osteological observations. After removing these
four individuals, the total sample studied, Sample A, consists of 776 individuals. For some analyses, results are also reported for a subsample of these individuals who have at least 25% of the bones of the skull present. No preference was given to any combination of bones within this 25%. In most cases, bones present were not limited to either the face or calvarium, making this a robust approach for examining skull trauma. In fact, this subsample of 379 individuals, Sample B, better approximates trauma frequencies, as violent trauma is identified primarily on the skull and eliminates individuals represented only by postcranial elements in the analysis.

Table 6.1 displays the sample sizes from each site. Dickson Mounds comprised approximately two-thirds of Sample A, totaling 503 individuals. Remains from Crable compose approximately one-quarter of the sample. Individuals from Emmons, Larson, and Berry, cumulatively represent approximately 10% of the sample. While site sample sizes are reduced in Sample B, proportions of skeletal remains from each site approximate those of Sample A (Table 6.1).

<table>
<thead>
<tr>
<th>Site</th>
<th>Sample A</th>
<th>Sample B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds</td>
<td>502 (64.7%)</td>
<td>217 (57.4%)</td>
</tr>
<tr>
<td>Crable</td>
<td>197 (25.4%)</td>
<td>110 (29.1%)</td>
</tr>
<tr>
<td>Emmons</td>
<td>42 (5.4%)</td>
<td>35 (9.3%)</td>
</tr>
<tr>
<td>Larson</td>
<td>19 (2.4%)</td>
<td>13 (3.4%)</td>
</tr>
<tr>
<td>Berry</td>
<td>16 (2.1%)</td>
<td>3 (0.8%)</td>
</tr>
<tr>
<td>Total</td>
<td>776 (100%)</td>
<td>378 (100%)</td>
</tr>
</tbody>
</table>

The dramatically reduced sample sizes of Sample B are caused primarily by three sampling problems. First, grave digging by prehistoric Native Americans at Dickson Mounds disturbed a large number of burials, disassociating skeletal elements. Second, amateur archaeologists dug CIV sites intensively, further disturbing remains. Third,
particularly in the cases of Berry, Crable, and Emmons, many individuals were reburied immediately after excavation. The excavators often retained select individuals and pathological examples for curation and study, along with more representative samples. As a result, caution should be applied in interpretations from these sites.

Sex could not be estimated for half the individuals in Sample A. Males were present in higher frequencies than females (Tables 6.2), although the difference was not statistically significant ($\chi^2 = 1.934$, df = 1, p = 0.164). In Sample B, sex frequencies are approximately equivalent, although sex could not be estimated for nearly 40% of the sample (Table 6.2) due to the high frequency of juvenile remains. Individuals under the age of 18 years at death comprised approximately 40% of the sample (Table 6.3). Adults, for whom an age-at-death range could not be estimated, composed a quarter of the sample. These adults were largely represented by isolated postcranial elements and also contributed to the high frequency of indeterminate sex estimates. Old adults, those 50 years and over, represented only approximately 5% of the sample, while young and middle adults combined to represent about one-third of the sample. The low frequency of old adults may be attributed to the tendency of the age estimation methods used in this analysis to underestimate age-at-death.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Sample A</th>
<th>Sample B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>175 (22.6%)</td>
<td>117 (31.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>202 (26.0%)</td>
<td>114 (30.2%)</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>399 (51.4%)</td>
<td>147 (38.9%)</td>
</tr>
<tr>
<td>Total</td>
<td>776 (100%)</td>
<td>378 (100%)</td>
</tr>
</tbody>
</table>
Table 6.3. Age-at-Death Demographics.

<table>
<thead>
<tr>
<th>Age-at-Death</th>
<th>Sample A</th>
<th>Sample B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant</td>
<td>177 (22.8%)</td>
<td>92 (24.3%)</td>
</tr>
<tr>
<td>Child</td>
<td>86 (11.1%)</td>
<td>38 (10.1%)</td>
</tr>
<tr>
<td>Adolescent</td>
<td>51 (6.7%)</td>
<td>24 (6.3%)</td>
</tr>
<tr>
<td>Young Adult</td>
<td>152 (20%)</td>
<td>105 (27.8%)</td>
</tr>
<tr>
<td>Middle Adult</td>
<td>104 (13.4%)</td>
<td>73 (19.3%)</td>
</tr>
<tr>
<td>Old Adult</td>
<td>29 (3.7%)</td>
<td>17 (4.5%)</td>
</tr>
<tr>
<td>Adult</td>
<td>177 (22.8%)</td>
<td>29 (7.7%)</td>
</tr>
<tr>
<td>Total</td>
<td>776 (100%)</td>
<td>378 (100%)</td>
</tr>
</tbody>
</table>

Trauma Analysis

Each of the four models discussed in Chapter 6 requires identification of traumatic lesions indicative of interpersonal violence. As used subsequently, “trauma” refers specifically to injuries caused by interpersonal violence, as defined in Chapter Four (e.g., sharp-force trauma, scalping and dismemberment, antemortem and perimortem blunt-force wounds to the skull, and projectile injuries), unless otherwise stated. Trauma from possible accidental or occupational etiologies is discussed only if they co-occur with interpersonal violence trauma.

Site Comparisons

Interpersonal violence trauma was identified infrequently (7%) in Sample A (Table 6.4). When the sites within Sample A are examined alone, individuals from Larson and Emmons have the highest percentages of violent trauma, 42% and 38% respectively (Table 6.4). In contrast, violent trauma is relatively infrequent at Dickson Mounds, present in 2% of the 502 individuals assessed. Individuals examined from Crable and Berry display intermediate trauma rates. In Sample B, trauma percentages increase for all five sites (Table 6.4). These higher frequencies are expected, as violent
trauma is most commonly found on the cranium; isolated postcranial remains are common from each site.

### Table 6.4. Frequencies of Trauma Presence by Site.

<table>
<thead>
<tr>
<th>Site</th>
<th>Sample A (n=776)</th>
<th>Sample B (n=378)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds</td>
<td>7 (1.4%)</td>
<td>7 (3.2%)</td>
</tr>
<tr>
<td>Crable</td>
<td>21 (10.7%)</td>
<td>19 (17%)</td>
</tr>
<tr>
<td>Emmons</td>
<td>16 (38.1%)</td>
<td>16 (46%)</td>
</tr>
<tr>
<td>Larson</td>
<td>8 (42.1%)</td>
<td>7 (54%)</td>
</tr>
<tr>
<td>Berry</td>
<td>3 (18.8%)</td>
<td>1 (33%)</td>
</tr>
<tr>
<td>Total</td>
<td>55 (7.1%)</td>
<td>50 (13.2%)</td>
</tr>
</tbody>
</table>

Table 6.5 reports frequencies of violent trauma type by site. Types of violent trauma found included: scalping, projectile trauma, healed and unhealed blunt force trauma to the skull, and sharp force trauma. Healed cranial blunt force trauma, by far the most common injury, was identified in 44 individuals from Sample A. The high frequency of healed blunt-force trauma in samples from Crable and Emmons (18 and 16 individuals respectively), however, likely biases the overall sample totals. In contrast, scalping, projectile, unhealed skull blunt-force, and sharp-force injuries were rare in the sample. Three individuals exhibited cut marks consistent with scalping; two individuals display projectile trauma, and three individuals had unhealed blunt-force trauma to the skull. With the exception of one case of unhealed skull blunt-force trauma at Crable, all scalping, projectile, and unhealed skull blunt force injuries are found in individuals from Dickson Mounds and Larson. Sharp force trauma was also identified infrequently in Sample A and presents only as short cuts. Only individuals from Larson and Crable displayed sharp-force injuries.

Few differences in trauma type frequencies distinguish Sample A from Sample B (Table 6.6). Four individuals with trauma in Sample A were not included in Sample B’s
frequencies. Two individuals from Berry with healed blunt-force trauma to the skull were eliminated from Sample B, as their skulls are relatively incomplete. Additionally, a mandible with cut marks from Larson was also removed from analysis, as less than 25% of that individual’s skull was present. The adult of indeterminate sex from Crable with unhealed blunt-force trauma to the right parietal was also excluded, as that bone was the only element retained by excavators.

<table>
<thead>
<tr>
<th>Site</th>
<th>Scalping</th>
<th>Projectile Trauma</th>
<th>Healed BFT to Skull</th>
<th>Unhealed BFT to Skull</th>
<th>SFT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>8^a</td>
</tr>
<tr>
<td>Crable</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>1</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>Emmons</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Larson</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>10^b</td>
</tr>
<tr>
<td>Berry</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>2</td>
<td>44</td>
<td>3</td>
<td>6</td>
<td>58</td>
</tr>
</tbody>
</table>

a. 1 individual exhibited both projectile trauma and scalping.
b. 1 individual exhibited scalping, unhealed skull blunt-force trauma, and sharp-force trauma to the mandible.

<table>
<thead>
<tr>
<th>Site</th>
<th>Scalping</th>
<th>Projectile Trauma</th>
<th>Healed BFT to Skull</th>
<th>Unhealed BFT to Skull</th>
<th>SFT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>8^a</td>
</tr>
<tr>
<td>Crable</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>0</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Emmons</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Larson</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>9^b</td>
</tr>
<tr>
<td>Berry</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>2</td>
<td>42</td>
<td>2</td>
<td>4</td>
<td>53</td>
</tr>
</tbody>
</table>

a. 1 individual exhibited both projectile trauma and scalping.
b. 1 individual exhibited scalping, unhealed skull blunt-force trauma, and sharp-force trauma to the mandible.
Table 6.7 presents sex-based differences in trauma frequencies. Approximately 15% of males and 10% of females in Sample A exhibited trauma, although the difference is not statistically significant (Table 6.8). In Sample B, male and female trauma frequencies increase to over 25% and 15%, respectively. This difference in violent trauma by sex is also insignificant (Table 6.8).

**Table 6.7. Trauma Frequencies by Sex. Percentages reflect frequencies of individuals with trauma out of number of individuals of that sex.**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Sample A</th>
<th>Sample B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>18 (10.3%)</td>
<td>18 (15.4%)</td>
</tr>
<tr>
<td>Male</td>
<td>31 (15.3%)</td>
<td>29 (25.4%)</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>6 (1.5%)</td>
<td>2 (2.0%)</td>
</tr>
</tbody>
</table>

**Table 6.8. Pearson’s Chi-Square Test of Trauma by Sex (males and females only).**

<table>
<thead>
<tr>
<th>Sample</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.124</td>
<td>1</td>
<td>0.145</td>
</tr>
<tr>
<td>B</td>
<td>3.601</td>
<td>1</td>
<td>0.058</td>
</tr>
</tbody>
</table>

Differences in violent trauma types are not predicted by sex (Table 6.9). Both males and females exhibited scalping, healed blunt-force trauma, and sharp-force trauma. Some differences between males and females were found for projectile trauma and unhealed blunt-force trauma to the skull. Only males presented evidence of projectile trauma, while only females and an adult of indeterminate sex displayed unhealed blunt-force trauma to the skull. As these sample sizes are low, it is unclear if this pattern is meaningful. Results for Sample B are not presented, as its results are nearly identical to those for Sample A.
Table 6.9. Trauma Frequencies by Type and Sex for Sample A - Total Sample.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Scalping</th>
<th>Projectile Trauma</th>
<th>Healed BFT to Skull</th>
<th>Unhealed BFT to Skull</th>
<th>SFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female*a</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Male*b</td>
<td>2</td>
<td>2</td>
<td>27</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

a. 1 individual exhibited scalping, unhealed cranial blunt-force trauma, and sharp-force trauma.
b. 1 individual exhibited both projectile trauma and scalping.

Trauma by Age-at-Death

Table 6.10 reports the frequencies of trauma by age-at-death in the total CIV sample. CIV adults were most likely to be affected by skeletal trauma. Fifty adults, two adolescents, and three children exhibited violent lesions. No violent trauma was observed on infants. These patterns pertain to individuals from Sample B. Presence of trauma did not increase with age-at-death. Percentages of trauma among adults, across all age groups, were similar. Young, middle, and old adult trauma frequencies ranged between 13.2-15.4% of the total sample. Trauma frequencies increase slightly (19-23.5%) when only individuals with at least 25% of the skull are considered. These results run counter to observations that skeletal trauma in archaeological samples tends to be distributed in an age progressive pattern. Having one injury did not make subsequent injuries more likely in the CIV sample.

Differences in type of violent trauma were observed by age-at-death category (Table 6.11). Trauma affected adults much more frequently than children, although subadults were not immune from experiencing trauma. Scalping, projectile wounds, and unhealed cranial blunt-force trauma were found only among adults. Additionally, adults displayed healed blunt-force trauma in the highest frequencies. Children also exhibited...
healed blunt-force trauma and sharp-force trauma, while only healed cranial blunt-force lesions were observed on adolescents. We must recognize, however, that healed trauma observed in adults may have occurred during childhood. Again, results from Sample B are not reported, as few differences distinguish it from Sample A.

<table>
<thead>
<tr>
<th>Table 6.10. CIV Trauma Frequencies by Age-at-Death.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Infant</td>
</tr>
<tr>
<td>Child</td>
</tr>
<tr>
<td>Adolescent</td>
</tr>
<tr>
<td>Young Adult</td>
</tr>
<tr>
<td>Middle Adult</td>
</tr>
<tr>
<td>Old Adult</td>
</tr>
<tr>
<td>Adult</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 6.11. CIV Trauma Type Frequencies by Age-at-Death – Sample A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Infant</td>
</tr>
<tr>
<td>Child</td>
</tr>
<tr>
<td>Adolescent</td>
</tr>
<tr>
<td>Young Adult</td>
</tr>
<tr>
<td>Middle Adult</td>
</tr>
<tr>
<td>Old Adult</td>
</tr>
<tr>
<td>Adult</td>
</tr>
</tbody>
</table>

**Trauma by Phase**

Trauma frequencies are analyzed separately for each of the four temporal phases of the CIV Mississippian Period and reported only for Sample A. Sample B is not included in the following analyses, as its results are similar to Sample A’s. These frequencies are likely highly biased by skeletal completeness, as complete skeletons were rarely recovered from any time period. Dickson Mounds and Larson had the most
complete skeletons out of the sample, although many individuals were still poorly represented and fragmentary.

Remains were dated to the Eveland (ca. AD 1050-1200), Orendorf (ca. AD 1200-1250), Larson (ca. AD 1250-1300), and Crable (ca. AD 1300-1425) phases. Skeletal trauma was rare in the Central Illinois Valley between AD 1050-1250. In fact, no skeletal trauma was observed for the 160 Eveland phase (ca. AD 1050-1200) skeletons from Dickson Mounds. The four headless males interred in Dickson Mounds during the Eveland phase were included in these results. While no trauma was identified on any of their skeletal elements, these four individuals were poorly preserved and highly fragmented at the time of analysis. If sharp-force trauma, for instance, had been present on the vertebrae of the headless males, the extreme cortical exfoliation and fragmentation of these elements would have obscured these injuries.

Violent trauma was also infrequent during the Orendorf phase at Dickson Mounds. Only one individual of 93 examined exhibited skeletal trauma. A projectile point penetrated into this a young male’s left first rib. At the time of archaeological recovery, the point had dislodged and shattered within the chest cavity. It is unclear whether the point was dislodged when Mississippian peoples moved the body during burial or during the body’s decomposition.

Trauma was observed most commonly in the Larson (ca. AD 1250-1300) and Crable (ca. AD 1300-1425) phase skeletons. Four of the sites sampled in this study date to the Larson phase (AD 1250-1300), allowing conclusions to be drawn across space for this time period. During the Larson phase, healed trauma is high throughout the region, with the exception of the individuals buried at Dickson Mounds (Table 6.12). Healed
trauma frequencies observed in remains from the Larson, Emmons, and Berry sites range between 9.2-37.2%, but individuals from Dickson Mounds (2.5%) rarely display trauma. Unhealed trauma, while infrequent, was observed on individuals from Dickson Mounds and Larson. One Dickson Mounds and six Larson individuals displayed unhealed traumatic lesions.

<table>
<thead>
<tr>
<th>Site</th>
<th>Unhealed Trauma</th>
<th>Healed Trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds</td>
<td>1/202 (0.5%)</td>
<td>5/202 (2.5%)</td>
</tr>
<tr>
<td>Larson</td>
<td>6/21 (28.6%)</td>
<td>2/21 (9.5%)</td>
</tr>
<tr>
<td>Emmons</td>
<td>0/43 (0%)</td>
<td>16/43 (37.2%)</td>
</tr>
<tr>
<td>Berry</td>
<td>0/16 (0%)</td>
<td>3/16 (18.8%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7/282 (2.5%)</td>
<td>26/282 (9.2%)</td>
</tr>
</tbody>
</table>

Table 6.13 reports the trauma type frequencies for Larson phase individuals. Healed blunt-force trauma to the skull is the most common type of injury during this phase. Scalping and projectile trauma are infrequent, found only four times in three individuals. Unhealed blunt-force trauma to the skull and sharp-force trauma are also infrequently identified. Two individuals from Larson display unhealed blunt-force trauma to the skull, while four individuals also from Larson exhibited sharp-force trauma.

Skeletal remains from the Crable site were the only individuals sampled from the Crable phase (AD 1300-1425). Healed trauma is present for 9.1% (18/197) of individuals and unhealed trauma for 1.5% (3/197) of Crable phase remains. Healed cranial blunt-force injuries are the most common, found in 18 individuals. Unhealed cranial blunt-force trauma and sharp-force trauma are infrequently identified, present in one and two Crable phase individuals, respectively.
Table 6.13. Larson Phase Trauma Type Frequencies.

<table>
<thead>
<tr>
<th>Site</th>
<th>Scalping</th>
<th>Projectile Trauma</th>
<th>Healed BFT to Skull</th>
<th>Unhealed BFT to Skull</th>
<th>SFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Emmons</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Larson&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Berry</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

a. 1 individual exhibited scalping, unhealed cranial blunt-force trauma, and sharp-force trauma.
b. 1 individual exhibited both projectile trauma and scalping.

**Biological Distance Analysis**

This section reports the results of the biological distance analysis of dental cervical measurements. First, I test for interobserver error and intraobserver error in these measurements. These tests are necessary to assess the accuracy and precision of measurements used in this analysis and to ensure other researchers may use them. They are also needed to ensure the reliability of measurements taken at the beginning of data collection with those at the end. To ensure that substitutions between right and left measurements are not significantly affected by fluctuating asymmetry, correlations between antimere measurements are also assessed. Results of the biodistance analysis are presented next. The principle components eigenvalues and percent of variance explained are presented. Finally, biological variability in the sample is assessed using bivariate plots of the orthogonally rotated principle component factor loading scores for Principle Components 1 and 2. Calculation of a 95% confidence ellipse allows individuals with biological variability distinct from the CIV sample to be identified.
Interobserver Error, Intraobserver Error, and Effects of Fluctuating Asymmetry

Prior to the biodistance analysis, potential sources of error in the data were examined. Interobserver error was tested using 28 individuals from the Semna South, Sudan Nubian collection curated at Arizona State University. Buccolingual (BL) and mesiodistal (MD) dental cervical measurements for the left polar teeth of the maxillary (I\textsuperscript{1}, C\textsuperscript{1}, P\textsuperscript{1}, M\textsuperscript{1}) and mandibular (I\textsubscript{2}, C\textsubscript{1}, P\textsubscript{1}, M\textsubscript{1}) arcades were taken. As teeth were missing or exhibited carious damage in many individuals, the number of observations for each measurement differs. The maximum number of observations for a variable was 19, while the minimum number was 12. These measurements were compared to the corresponding measurements taken by Anna Novotny. Table 6.14 presents the results of the interobserver analysis. No statistically significant differences were calculated between observers. Hatch’s mean differences between measurements, however, tended to be smaller than Novotny’s, potentially indicating bias between the researchers for some measurements. These measurement differences may have been caused by use of different calipers by the each of the observers. Nevertheless, this trend is not of concern, as the mean differences are quite similar with most differences less than or equal to 0.01 mm.

Intraobserver error was evaluated using both right and left dental cervical measurements from 50 individuals sampled randomly from in the CIV individuals analyzed in this study. The first set of measurements was taken throughout the seven months of data collection, while the second set was taken at the completion of data collection in December 2012. As some data may be missing for each individual (due to tooth loss, carious lesions, wear, or skeletal element absence), the number of observations
differs for each measurement. No statistically significant differences between first and second observations were found for any measurement using paired sample t-tests (Table 6.15). Additionally, measurement bias was not identified in this analysis. Mean differences alternate between positive and negative values, demonstrating consistency in the data; the teeth were neither regularly over nor under measured.


<table>
<thead>
<tr>
<th>Measurement</th>
<th>N</th>
<th>(t\ (p &gt; 0.05 \text{ for all tests}))</th>
<th>df</th>
<th>Mean difference</th>
<th>Mean absolute difference</th>
<th>Standard deviation of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>I(^1) MD</td>
<td>12</td>
<td>1.144</td>
<td>11</td>
<td>0.032</td>
<td>0.07</td>
<td>0.098</td>
</tr>
<tr>
<td>C(^1) MD</td>
<td>14</td>
<td>-0.351</td>
<td>13</td>
<td>-0.005</td>
<td>0.04</td>
<td>0.053</td>
</tr>
<tr>
<td>P(^1) MD</td>
<td>15</td>
<td>0</td>
<td>14</td>
<td>0</td>
<td>0.04</td>
<td>0.058</td>
</tr>
<tr>
<td>M(^1) MD</td>
<td>18</td>
<td>1.199</td>
<td>17</td>
<td>0.021</td>
<td>0.05</td>
<td>0.073</td>
</tr>
<tr>
<td>I(^1) BL</td>
<td>11</td>
<td>1.074</td>
<td>10</td>
<td>0.023</td>
<td>0.06</td>
<td>0.07</td>
</tr>
<tr>
<td>C(^1) BL</td>
<td>12</td>
<td>1.016</td>
<td>11</td>
<td>0.01</td>
<td>0.02</td>
<td>0.034</td>
</tr>
<tr>
<td>P(^1) BL</td>
<td>14</td>
<td>1.302</td>
<td>13</td>
<td>0.022</td>
<td>0.04</td>
<td>0.064</td>
</tr>
<tr>
<td>M(^1) BL</td>
<td>16</td>
<td>0.027</td>
<td>15</td>
<td>0.001</td>
<td>0.07</td>
<td>0.092</td>
</tr>
<tr>
<td>I(^2) MD</td>
<td>18</td>
<td>0.175</td>
<td>17</td>
<td>0.002</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>C(^1) MD</td>
<td>19</td>
<td>-0.377</td>
<td>18</td>
<td>-0.005</td>
<td>0.04</td>
<td>0.055</td>
</tr>
<tr>
<td>P(^1) MD</td>
<td>19</td>
<td>1.085</td>
<td>18</td>
<td>0.014</td>
<td>0.04</td>
<td>0.055</td>
</tr>
<tr>
<td>M(^1) MD</td>
<td>18</td>
<td>0.501</td>
<td>17</td>
<td>0.01</td>
<td>0.05</td>
<td>0.085</td>
</tr>
<tr>
<td>I(^1) BL</td>
<td>17</td>
<td>0.987</td>
<td>16</td>
<td>0.019</td>
<td>0.06</td>
<td>0.079</td>
</tr>
<tr>
<td>C(^1) BL</td>
<td>19</td>
<td>0.54</td>
<td>18</td>
<td>0.005</td>
<td>0.03</td>
<td>0.042</td>
</tr>
<tr>
<td>P(^1) BL</td>
<td>18</td>
<td>0.249</td>
<td>17</td>
<td>0.004</td>
<td>0.04</td>
<td>0.066</td>
</tr>
<tr>
<td>M(^1) BL</td>
<td>15</td>
<td>-1.102</td>
<td>14</td>
<td>-0.013</td>
<td>0.04</td>
<td>0.047</td>
</tr>
</tbody>
</table>
### Table 6.15. Dental Cervical Metrics Intraobserver Error.

Abbreviations: MD=Mesiodistal, BL=Buccolingual

<table>
<thead>
<tr>
<th>Measurement</th>
<th>n</th>
<th>t (p &gt; 0.05 for all tests)</th>
<th>df</th>
<th>Mean difference</th>
<th>Mean absolute difference</th>
<th>Standard deviation of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI₁ MD</td>
<td>24</td>
<td>0.685</td>
<td>23</td>
<td>0.010</td>
<td>0.039</td>
<td>0.069</td>
</tr>
<tr>
<td>LI₁ MD</td>
<td>21</td>
<td>0.667</td>
<td>20</td>
<td>0.016</td>
<td>0.061</td>
<td>0.108</td>
</tr>
<tr>
<td>RC₁ MD</td>
<td>25</td>
<td>-1.707</td>
<td>24</td>
<td>-0.017</td>
<td>0.042</td>
<td>0.050</td>
</tr>
<tr>
<td>LC₁ MD</td>
<td>26</td>
<td>-1.490</td>
<td>25</td>
<td>-0.177</td>
<td>0.037</td>
<td>0.061</td>
</tr>
<tr>
<td>RP₁ MD</td>
<td>21</td>
<td>-1.921</td>
<td>20</td>
<td>-0.012</td>
<td>0.023</td>
<td>0.028</td>
</tr>
<tr>
<td>LP₁ MD</td>
<td>28</td>
<td>0.293</td>
<td>27</td>
<td>0.005</td>
<td>0.055</td>
<td>0.090</td>
</tr>
<tr>
<td>RM₁ MD</td>
<td>25</td>
<td>0.598</td>
<td>24</td>
<td>0.009</td>
<td>0.053</td>
<td>0.077</td>
</tr>
<tr>
<td>LM₁ MD</td>
<td>29</td>
<td>0.729</td>
<td>28</td>
<td>0.010</td>
<td>0.048</td>
<td>0.074</td>
</tr>
<tr>
<td>RI₁ BL</td>
<td>21</td>
<td>0.405</td>
<td>20</td>
<td>0.005</td>
<td>0.039</td>
<td>0.054</td>
</tr>
<tr>
<td>LI₁ BL</td>
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<td>-1.746</td>
<td>19</td>
<td>-0.018</td>
<td>0.031</td>
<td>0.045</td>
</tr>
<tr>
<td>RC₁ BL</td>
<td>24</td>
<td>-1.444</td>
<td>23</td>
<td>-0.022</td>
<td>0.045</td>
<td>0.076</td>
</tr>
<tr>
<td>LC₁ BL</td>
<td>27</td>
<td>-0.555</td>
<td>26</td>
<td>-0.004</td>
<td>0.032</td>
<td>0.042</td>
</tr>
<tr>
<td>RP₁ BL</td>
<td>20</td>
<td>1.087</td>
<td>19</td>
<td>0.020</td>
<td>0.047</td>
<td>0.082</td>
</tr>
<tr>
<td>LP₁ BL</td>
<td>28</td>
<td>-1.172</td>
<td>27</td>
<td>-0.027</td>
<td>0.067</td>
<td>0.116</td>
</tr>
<tr>
<td>RM₁ BL</td>
<td>23</td>
<td>-1.861</td>
<td>22</td>
<td>-0.051</td>
<td>0.078</td>
<td>0.131</td>
</tr>
<tr>
<td>LM₁ BL</td>
<td>30</td>
<td>-1.075</td>
<td>29</td>
<td>-0.011</td>
<td>0.043</td>
<td>0.058</td>
</tr>
<tr>
<td>RI₂ MD</td>
<td>23</td>
<td>1.752</td>
<td>22</td>
<td>0.036</td>
<td>0.053</td>
<td>0.100</td>
</tr>
<tr>
<td>LI₂ MD</td>
<td>24</td>
<td>0.972</td>
<td>23</td>
<td>0.010</td>
<td>0.042</td>
<td>0.050</td>
</tr>
<tr>
<td>RC₁ MD</td>
<td>31</td>
<td>0.786</td>
<td>30</td>
<td>0.033</td>
<td>0.072</td>
<td>0.231</td>
</tr>
<tr>
<td>LC₁ MD</td>
<td>21</td>
<td>-0.137</td>
<td>20</td>
<td>-0.002</td>
<td>0.045</td>
<td>0.080</td>
</tr>
<tr>
<td>RP₁ MD</td>
<td>31</td>
<td>0.660</td>
<td>30</td>
<td>0.005</td>
<td>0.031</td>
<td>0.038</td>
</tr>
<tr>
<td>LP₁ MD</td>
<td>29</td>
<td>0.785</td>
<td>28</td>
<td>0.009</td>
<td>0.043</td>
<td>0.062</td>
</tr>
<tr>
<td>RM₁ MD</td>
<td>27</td>
<td>0.925</td>
<td>26</td>
<td>0.013</td>
<td>0.050</td>
<td>0.075</td>
</tr>
<tr>
<td>LM₁ MD</td>
<td>30</td>
<td>0.458</td>
<td>29</td>
<td>0.008</td>
<td>0.058</td>
<td>0.092</td>
</tr>
<tr>
<td>RI₁ BL</td>
<td>25</td>
<td>-0.375</td>
<td>24</td>
<td>-0.004</td>
<td>0.045</td>
<td>0.053</td>
</tr>
<tr>
<td>LI₁ BL</td>
<td>23</td>
<td>-0.517</td>
<td>22</td>
<td>-0.005</td>
<td>0.035</td>
<td>0.044</td>
</tr>
<tr>
<td>RC₁ BL</td>
<td>25</td>
<td>0.000</td>
<td>24</td>
<td>0.000</td>
<td>0.032</td>
<td>0.046</td>
</tr>
<tr>
<td>LC₁ BL</td>
<td>21</td>
<td>-1.857</td>
<td>20</td>
<td>-0.019</td>
<td>0.044</td>
<td>0.047</td>
</tr>
<tr>
<td>RP₁ BL</td>
<td>23</td>
<td>-0.395</td>
<td>22</td>
<td>-0.006</td>
<td>0.064</td>
<td>0.074</td>
</tr>
<tr>
<td>LP₁ BL</td>
<td>28</td>
<td>1.193</td>
<td>27</td>
<td>0.017</td>
<td>0.052</td>
<td>0.076</td>
</tr>
<tr>
<td>RM₁ BL</td>
<td>27</td>
<td>-1.572</td>
<td>26</td>
<td>-0.014</td>
<td>0.038</td>
<td>0.047</td>
</tr>
<tr>
<td>LM₁ BL</td>
<td>23</td>
<td>0.640</td>
<td>22</td>
<td>0.007</td>
<td>0.041</td>
<td>0.055</td>
</tr>
</tbody>
</table>


Table 6.16 presents the results of the fluctuating asymmetry test. All CIV individuals with dental cervical measurements of polar teeth available were included in this analysis. Results indicate that left and right measurements are highly correlated. All Pearson’s r correlation coefficients but one equaled over 0.9. Additionally, all antimere correlations were statistically significant at the 0.05 $\alpha$-level (Table 6.16). These results indicate that antimere measurement substitutions are appropriate for this study.
Table 6.16. Right and Left Dental Cervical Measurement Correlations.

Abbreviations: MD=Mesiodistal, BL=Buccolingual

<table>
<thead>
<tr>
<th>Measurement</th>
<th>n</th>
<th>Mean</th>
<th>s.d.</th>
<th>Pearson's $r$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>105</td>
<td>6.160</td>
<td>0.495</td>
<td>0.985</td>
<td>0.000*</td>
</tr>
<tr>
<td>LI&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>100</td>
<td>6.154</td>
<td>0.499</td>
<td>0.971</td>
<td>0.000*</td>
</tr>
<tr>
<td>RC&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>111</td>
<td>5.689</td>
<td>0.434</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LC&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>120</td>
<td>4.703</td>
<td>0.326</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LP&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>128</td>
<td>7.675</td>
<td>0.453</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RM&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>135</td>
<td>7.728</td>
<td>0.457</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RI&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>99</td>
<td>6.399</td>
<td>0.422</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LI&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>104</td>
<td>6.409</td>
<td>0.412</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RC&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>112</td>
<td>7.790</td>
<td>0.620</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LC&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>116</td>
<td>7.708</td>
<td>0.589</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RP&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>115</td>
<td>8.305</td>
<td>0.596</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LP&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>114</td>
<td>8.203</td>
<td>0.585</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RM&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>135</td>
<td>10.702</td>
<td>0.541</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LM&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>136</td>
<td>10.709</td>
<td>0.555</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RI&lt;sub&gt;2&lt;/sub&gt; MD</td>
<td>124</td>
<td>3.815</td>
<td>0.478</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LI&lt;sub&gt;2&lt;/sub&gt; MD</td>
<td>137</td>
<td>3.783</td>
<td>0.554</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RC&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>140</td>
<td>5.295</td>
<td>0.466</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LC&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>137</td>
<td>5.294</td>
<td>0.483</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RP&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>156</td>
<td>4.753</td>
<td>0.324</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LP&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>154</td>
<td>4.750</td>
<td>0.340</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RM&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>140</td>
<td>9.096</td>
<td>0.520</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LM&lt;sub&gt;1&lt;/sub&gt; MD</td>
<td>134</td>
<td>9.136</td>
<td>0.568</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RI&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>117</td>
<td>5.805</td>
<td>0.651</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LI&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>134</td>
<td>5.690</td>
<td>0.806</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RC&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>123</td>
<td>7.492</td>
<td>0.570</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LC&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>140</td>
<td>7.457</td>
<td>0.603</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RP&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>145</td>
<td>6.719</td>
<td>0.468</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LP&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>162</td>
<td>6.639</td>
<td>0.485</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>RM&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>137</td>
<td>8.771</td>
<td>0.435</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
<tr>
<td>LM&lt;sub&gt;1&lt;/sub&gt; BL</td>
<td>123</td>
<td>8.846</td>
<td>0.461</td>
<td>0.869</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

*Denotes statistical significance.
Principal Components Analysis

Once potential sources of error were eliminated, the biodistance analysis was conducted using a principal components analysis (PCA) on a sample of 214 CIV individuals. The dental cervical metric data were assessed through the PCA to compare uncorrelated phenotypic variables between individuals with trauma and the remaining CIV sample. As discussed in Chapter Four, the raw dental cervical measurements were first imputed to eliminate missing data. Next, the PCA orthogonally transformed the dental measurements into four principal components (PC) that explain 81.5% of the variance (Figure 6.1, Table 6.17). PC 1 accounts for 58.8% of the variance in the data and likely represents a relative measure of tooth size. Males more commonly have positive PC 1 loading scores, and females tend toward negative values, although this association is imperfect. PC 2, in contrast, explains 9.2% of the variance and likely reflects individual measurement proportions and tooth shapes (e.g., Stojanowski 2005a). Although PCs 3 and 4 have eigenvalues less than one, they are also included in the analysis to examine the phenotypic relationships expressed by additional shape components. PC 3 explains 6.9% of the variance, and PC 4, explains 6.6% of the sample variance.

Figure 6.2 shows the individual loadings of PC 1 and PC 2 graphed on a bivariate plot (Plot 1); an ellipse is drawn around the bivariate 95% confidence interval of means. Fourteen statistical outliers lie on or outside the ellipse. (Figure 6.2, Table 6.18). These individuals display phenotypic variation exceeding 2σ of the CIV bivariate mean. No trauma is present for eight of the individuals outside of the 95% confidence ellipse.
Figure 6.1. Scree Plot of PCA Eigenvalues.

Table 6.17. Principal Components Percent of Variance Explained.

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.649</td>
<td>58.842</td>
<td>58.842</td>
</tr>
<tr>
<td>2</td>
<td>1.200</td>
<td>9.230</td>
<td>68.072</td>
</tr>
<tr>
<td>3</td>
<td>0.890</td>
<td>6.848</td>
<td>74.921</td>
</tr>
<tr>
<td>4</td>
<td>0.854</td>
<td>6.570</td>
<td>81.491</td>
</tr>
<tr>
<td>5</td>
<td>0.535</td>
<td>4.118</td>
<td>85.609</td>
</tr>
<tr>
<td>6</td>
<td>0.397</td>
<td>3.055</td>
<td>88.664</td>
</tr>
<tr>
<td>7</td>
<td>0.307</td>
<td>2.364</td>
<td>91.029</td>
</tr>
<tr>
<td>8</td>
<td>0.273</td>
<td>2.103</td>
<td>93.132</td>
</tr>
<tr>
<td>9</td>
<td>0.242</td>
<td>1.859</td>
<td>94.990</td>
</tr>
<tr>
<td>10</td>
<td>0.186</td>
<td>1.431</td>
<td>96.421</td>
</tr>
<tr>
<td>11</td>
<td>0.176</td>
<td>1.353</td>
<td>97.774</td>
</tr>
<tr>
<td>12</td>
<td>0.163</td>
<td>1.254</td>
<td>99.028</td>
</tr>
<tr>
<td>13</td>
<td>0.126</td>
<td>0.972</td>
<td>100.000</td>
</tr>
</tbody>
</table>
Trauma was present, however, in six of the outliers (15% of all individuals with trauma in this analysis), three adult females and three adult males. Antemortem nasal fractures were identified on all three females and one male. The two remaining males, Berry Inventory #5111 and Larson Burial #4, had healed fractures of the right mandibular condyle and right parietal, respectively. Only Larson Burial #4 had mortuary data in association.

The factor loading scores for 33 individuals with violent trauma (85% of all individuals with trauma included in this analysis) plotted within the 95% confidence ellipse. Twelve of these individuals have associated mortuary data available and are labeled in Figure 6.3. Table 6.19 presents summary data for these individuals, including principal component factor loadings, sex, age-at-death, and trauma description. Dickson Burial 1000, a young adult male with the highest count of artifacts in the sample lies near the center of the 95% confidence ellipse, indicating scores that approximate the bivariate mean.

Individuals with violent trauma that plotted as outliers in Plot 1 (PCs 1 and 2) were also consistently identified as outliers in plots of other combinations of the four principal component factors extracted in this analysis (Table 6.20). In fact, bivariate plots for PCs 1 and 3 (Figure 6.4); PCs 1 and 4 (Figure 6.5); PCs 2 and 3 (Figure 6.6); PCs 2 and 4 (Figure 6.7); and PCs 3 and 4 (Figure 6.8) did not identify any additional individuals with trauma as outliers. Only one individual with trauma identified as an outlier in Plot 1, Crable Burial #4703, was not calculated as an outlier in these additional analyses.
Similarly, plotting principal components separately by sex did not find any new outliers representing individuals with trauma. Reducing the sample sizes, instead, reduced the number of outliers identified in the analysis. Individuals with trauma who plotted as outliers were largely consistent across all combinations of PCs 1-4. Crable #4703 is the only Plot 1 outlier that is not also an outlier in the sex-separated plots. Table 6.21 reports the individuals with trauma identified as outliers in the sex separated PC plots, and Figure 6.9 displays the factor loadings plots for PCs 1 and 2 separated by sex.

**Figure 6.2. Plot 1 - Principal Components 1 & 2 Loadings of Dental Metrics for Total CIV Sample.** Individuals with trauma represented by the red triangle. Individuals on or outside the 95% confidence ellipse are labeled by burial number.
Table 6.18. Principal Component Factor Scores of 95% Confidence Ellipse Outliers.

<table>
<thead>
<tr>
<th>Age</th>
<th>Phase</th>
<th>PC 1</th>
<th>PC 2</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>Larson</td>
<td>-1.68745</td>
<td>2.30077</td>
<td>Healed BFT r</td>
</tr>
<tr>
<td>Adult</td>
<td>Crable</td>
<td>0.74608</td>
<td>2.28603</td>
<td>Healed BFT r</td>
</tr>
<tr>
<td>YA</td>
<td>Larson</td>
<td>2.78203</td>
<td>1.53649</td>
<td>No</td>
</tr>
<tr>
<td>YA</td>
<td>Larson</td>
<td>0.37740</td>
<td>2.73918</td>
<td>No</td>
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<tr>
<td>YA</td>
<td>Orendorf</td>
<td>2.81948</td>
<td>0.29509</td>
<td>No</td>
</tr>
<tr>
<td>YA</td>
<td></td>
<td>-1.84503</td>
<td>1.76290</td>
<td>No</td>
</tr>
<tr>
<td>MA</td>
<td>Eveland</td>
<td>1.68050</td>
<td>-2.06496</td>
<td>No</td>
</tr>
<tr>
<td>Adult</td>
<td>Eveland</td>
<td>2.18631</td>
<td>-2.35657</td>
<td>No</td>
</tr>
<tr>
<td>OA</td>
<td>Larson</td>
<td>-0.56704</td>
<td>-2.74009</td>
<td>Healed BFT r</td>
</tr>
<tr>
<td>MA</td>
<td>Larson</td>
<td>-0.39772</td>
<td>-3.10028</td>
<td>Healed BFT r</td>
</tr>
<tr>
<td>Adult</td>
<td>Larson</td>
<td>-1.08228</td>
<td>-4.96452</td>
<td>Healed BFT l</td>
</tr>
<tr>
<td>YA</td>
<td>Larson</td>
<td>2.01696</td>
<td>-1.52988</td>
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</tr>
<tr>
<td>YA</td>
<td>Larson</td>
<td>3.27885</td>
<td>2.42218</td>
<td>Healed BFT ri</td>
</tr>
<tr>
<td>MA</td>
<td>Larson</td>
<td>1.21070</td>
<td>3.53101</td>
<td>No</td>
</tr>
</tbody>
</table>
Table 6.19. Principal Component Factor Scores for Individuals within the 95% Confidence Ellipse with Violent Trauma and Associated Mortuary Data.

<table>
<thead>
<tr>
<th>Site</th>
<th>Burial</th>
<th>Sex</th>
<th>Age</th>
<th>Phase</th>
<th>PC 1</th>
<th>PC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson</td>
<td>287</td>
<td>M</td>
<td>YA</td>
<td>Orendorf</td>
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<td>1.07641</td>
</tr>
<tr>
<td>Dickson</td>
<td>380</td>
<td>M</td>
<td>YA</td>
<td>Larson</td>
<td>0.65688</td>
<td>-0.88228</td>
</tr>
<tr>
<td>Dickson</td>
<td>432</td>
<td>M</td>
<td>YA</td>
<td>Larson</td>
<td>-1.00076</td>
<td>-0.14738</td>
</tr>
<tr>
<td>Dickson</td>
<td>443</td>
<td>M</td>
<td>Ado</td>
<td>Larson</td>
<td>0.38574</td>
<td>-0.14738</td>
</tr>
<tr>
<td>Dickson</td>
<td>560</td>
<td>M</td>
<td>YA</td>
<td>Larson</td>
<td>0.43397</td>
<td>-0.08622</td>
</tr>
<tr>
<td>Dickson</td>
<td>1000</td>
<td>M</td>
<td>YA</td>
<td>Larson</td>
<td>-0.11420</td>
<td>0.02136</td>
</tr>
<tr>
<td>Emmons</td>
<td>EE12, 4381</td>
<td>M</td>
<td>YA</td>
<td>Larson</td>
<td>0.87055</td>
<td>-1.48650</td>
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<tr>
<td>Emmons</td>
<td>2822, 3C</td>
<td>F</td>
<td>YA</td>
<td>Larson</td>
<td>-1.41372</td>
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<tr>
<td>Larson</td>
<td>L6</td>
<td>M</td>
<td>YA</td>
<td>Larson</td>
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<td>0.60490</td>
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<td>F</td>
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</tr>
<tr>
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<td>F</td>
<td>YA</td>
<td>Larson</td>
<td>-1.16355</td>
<td>-0.21665</td>
</tr>
<tr>
<td>Larson</td>
<td>12H</td>
<td>I</td>
<td>Child</td>
<td>Larson</td>
<td>0.14422</td>
<td>-1.33942</td>
</tr>
</tbody>
</table>

Figure 6.3. Principal Component Loadings Plot for Total CIV Sample.
Site associations are denoted by color. Burial numbers indicate individuals with trauma who also have mortuary data available.
Table 6.20. Summary of Individuals with Trauma Calculated as Outliers in All PC Plots.

<table>
<thead>
<tr>
<th>Sex</th>
<th>PCs 1 &amp; 2</th>
<th>PCs 1 &amp; 3</th>
<th>PCs 1 &amp; 4</th>
<th>PCs 2 &amp; 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Male</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Female</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Female</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Male</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Table 6.21. Summary of Individuals with Trauma Calculated as Outliers in PC Plots Separated by Sex.

<table>
<thead>
<tr>
<th>Sex</th>
<th>PCs 1 &amp; 2</th>
<th>PCs 1 &amp; 3</th>
<th>PCs 1 &amp; 4</th>
<th>PCs 2 &amp; 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Male</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>male</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>male</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>male</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>fale</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>
Figure 6.4. Plot of Principal Components 1 & 3 for Total CIV Sample. Individuals with trauma represented by the red triangle. Individuals on or outside the 95% confidence ellipse are labeled by burial number.
Figure 6.5. Plot of Principal Components 1 & 4 for Total CIV Sample.
Individuals with trauma represented by the red triangle. Individuals on or outside the 95% confidence ellipse are labeled by burial number.
Figure 6.6. Plot of Principal Components 2 & 3 for Total CIV Sample.
Individuals with trauma represented by the red triangle. Individuals on or outside the 95% confidence ellipse are labeled by burial number.
Figure 6.7. Plot of Principal Components 2 & 4 for Total CIV Sample. Individuals with trauma represented by the red triangle. Individuals on or outside the 95% confidence ellipse are labeled by burial number.
Figure 6.8. Plot of Principal Components 3 & 4 for Total CIV Sample. Individuals with trauma represented by the red triangle. Individuals on or outside the 95% confidence ellipse are labeled by burial number.
Figure 6.9. Plot of Principal Components 1 & 2 Separated by Sex. Individuals with trauma represented by the red triangle. Individuals on or outside the 95% confidence ellipse are labeled by burial number.
Mortuary Analysis

The mortuary analysis examines whether or not individuals with trauma were treated differently in mortuary rituals than individuals without trauma. Burial treatment and associated artifacts were assessed to test for these differences. Mortuary data were only available for individuals from Dickson Mounds, Larson, and six individuals from Emmons. These six individuals are contextualized using mortuary data from 74 other individuals excavated by Morse and colleagues (1961) from Emmons. These individuals were not curated by ISM and, thus, not available for trauma analysis. No mortuary data were available for individuals from Berry or Crable. Analyses begin with descriptions of burial type and corpse position frequencies by site and then turn to burial treatments of individuals with trauma. As material artifacts did not prove useful for differentiating individuals with trauma from the rest of the cemetery sample, these results are given a short summary here. A more detailed discussion is available in Appendix B.

Burial Types and Positions

Dickson

Table 6.22 displays the individual frequencies of burial types and body positions for all individuals from Dickson Mounds. Most Dickson individuals (62.6%) were interred as primary inhumations. Most primary inhumations (306 individuals) were buried in an extended supine position. Semiflexed, flexed, and extended prone burials, in contrast, comprised less than 2% of the sample. Secondary bundle burials composed 18.5% of the sample, while burial type and position could not be determined for 18.9% of cases. Intensive prehistoric and historic disturbances, along with amateur excavations at the site, obscured identification of burial type and position for these individuals.
Table 6.22 Dickson Mounds Frequencies of Burial Types and Corpse Positions.

<table>
<thead>
<tr>
<th>Burial Type</th>
<th>Body Position</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Inhumations</td>
<td>Extended Supine</td>
<td>306</td>
<td>61.0%</td>
</tr>
<tr>
<td></td>
<td>Semiflexed</td>
<td>4</td>
<td>0.8%</td>
</tr>
<tr>
<td></td>
<td>Flexed</td>
<td>1</td>
<td>0.2%</td>
</tr>
<tr>
<td></td>
<td>Extended Prone</td>
<td>3</td>
<td>0.6%</td>
</tr>
<tr>
<td><strong>Primary Total</strong></td>
<td></td>
<td><strong>314</strong></td>
<td><strong>62.6%</strong></td>
</tr>
<tr>
<td>Secondary Inhumations</td>
<td>Bundle</td>
<td>93</td>
<td>18.5%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>95</td>
<td>18.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>502</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Corpse positions of the torso, right and left arms, and legs were also examined individually. These results report torso and limb positions for primary and secondary burials when available. Some bundle burials had additional information on body segment corpse positions. Table 6.23 displays the frequencies of each torso position. Over 97% of all torsos were interred extended supine. Extended prone, extended right side, and extended left side burials cumulatively accounted for less than 2.5% of torso positions. Arms, whether from the right or left side, were most commonly buried extended to the side (Tables 6.24, 6.25). Variations on arm position included: flexed, semiflexed, hands or arms over the torso, akimbo, or underneath the body. These variations were present in less than 10% of all individuals for each arm. Legs were also predominantly in an extended supine position (Table 6.26). Leg position variations, including knees bent, knees bent or flexed upward, both legs semiflexed, both legs flexed, one leg flexed, and legs extended prone, were infrequent and totaled approximately 10% of the sample.
Table 6.23. Dickson Mounds Torso Position Frequencies.

<table>
<thead>
<tr>
<th>Torso Position</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended Supine</td>
<td>217</td>
<td>97.7%</td>
</tr>
<tr>
<td>Extended Right Side</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Extended Left Side</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Extended Prone</td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td>Total</td>
<td>222</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 6.24. Dickson Mounds Left Arm Position Frequencies.

<table>
<thead>
<tr>
<th>Left Arm Position</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended to Side</td>
<td>170</td>
<td>91.9%</td>
</tr>
<tr>
<td>Flexed</td>
<td>3</td>
<td>1.6%</td>
</tr>
<tr>
<td>Arms/Hands over Torso</td>
<td>11</td>
<td>5.9%</td>
</tr>
<tr>
<td>Akimbo</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Total</td>
<td>185</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 6.25. Dickson Mounds Right Arm Position Frequencies.

<table>
<thead>
<tr>
<th>Right Arm Position</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended to Side</td>
<td>176</td>
<td>91.7%</td>
</tr>
<tr>
<td>Flexed</td>
<td>2</td>
<td>1.0%</td>
</tr>
<tr>
<td>Semiflexed</td>
<td>12</td>
<td>6.3%</td>
</tr>
<tr>
<td>Arms/Hands over Torso</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Under body</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Total</td>
<td>192</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 6.26. Dickson Mounds Leg Position Frequencies.

<table>
<thead>
<tr>
<th>Leg Position</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended</td>
<td>242</td>
<td>88.6%</td>
</tr>
<tr>
<td>Knees bent</td>
<td>13</td>
<td>4.8%</td>
</tr>
<tr>
<td>Semiflexed</td>
<td>3</td>
<td>1.1%</td>
</tr>
<tr>
<td>Flexed</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>One leg flexed only</td>
<td>2</td>
<td>0.7%</td>
</tr>
<tr>
<td>Left leg crossed over right</td>
<td>5</td>
<td>1.8%</td>
</tr>
<tr>
<td>Right leg crossed over left</td>
<td>3</td>
<td>1.1%</td>
</tr>
<tr>
<td>Knees flexed or bent upwards</td>
<td>2</td>
<td>0.7%</td>
</tr>
<tr>
<td>Extended prone</td>
<td>2</td>
<td>0.7%</td>
</tr>
<tr>
<td>Total</td>
<td>273</td>
<td>100%</td>
</tr>
</tbody>
</table>
Little diversity in burial types and positions was observed among the seven males with trauma at Dickson Mounds. Six of these males are buried as primary inhumations in an extended supine position and one was interred as a secondary bundle burial (Table 6.27). Extended supine positions were the most common form of interment at Dickson Mounds, found for 61% of individuals (Table 6.22). Torso, arm, and leg positions for primary inhumations, were predominantly extended. The only exception was Burial 432’s right arm, which was bent up to his chest. Most primary inhumations exhibited antemortem blunt-force wounds to the cranium (Table 6.28).

A perimortem projectile injury to the right first rib, however, was identified in a male positioned extended supine. The other male with perimortem trauma was interred as a secondary inhumation (Table 6.28). Burial 380, a young adult male who had evidence of scalping and an embedded projectile point, was recovered as a bundle (Table 6.28). Unusually, his torso was positioned within the bundle positioned extended prone. Bundle interment may have been necessitated by a prolonged period between death and recovery of the body, evidenced by carnivore punctures on the femora. This bundle with a torso positioned prone is an uncommon form of interment in the Dickson Mounds cemetery.

<table>
<thead>
<tr>
<th>Burial #</th>
<th>Burial Position</th>
<th>Left Arm Position</th>
<th>Right Arm Position</th>
<th>Leg Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>287</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Extended to Side</td>
<td>Extended</td>
</tr>
<tr>
<td>380</td>
<td>Bundle, Torso</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>432</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Bent up to chest</td>
<td>Extended</td>
</tr>
<tr>
<td>443</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Extended to Side</td>
<td>Extended</td>
</tr>
<tr>
<td>451</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Extended to Side</td>
<td>Extended</td>
</tr>
<tr>
<td>560</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Extended to Side</td>
<td>Extended</td>
</tr>
<tr>
<td>1000</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Extended to Side</td>
<td>Extended</td>
</tr>
</tbody>
</table>
Table 6.28. Description of Trauma and Demographics of Dickson Individuals.

<table>
<thead>
<tr>
<th>Burial #</th>
<th>Sex</th>
<th>Age</th>
<th>Trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td>287</td>
<td>M</td>
<td>YA</td>
<td>Perimortem projectile wound left first rib, nerve damage to right ankle</td>
</tr>
<tr>
<td>380</td>
<td>M</td>
<td>YA</td>
<td>Scalping, embedded projectile in lower thoracic vertebra, carnivore puncture wounds to femora</td>
</tr>
<tr>
<td>432</td>
<td>M</td>
<td>YA</td>
<td>Healing left nasal fracture, right ulna parry fracture</td>
</tr>
<tr>
<td>443</td>
<td>M</td>
<td>Ado</td>
<td>Healed BFT right posterior parietal</td>
</tr>
<tr>
<td>451</td>
<td>M</td>
<td>MA</td>
<td>2 Healed BFT to left aspect of frontal</td>
</tr>
<tr>
<td>560</td>
<td>M</td>
<td>YA</td>
<td>Healed BFT to left parietal bone, possible celt wound</td>
</tr>
<tr>
<td>1000</td>
<td>M</td>
<td>YA</td>
<td>Healed BFT to right nasal bone, malunited</td>
</tr>
</tbody>
</table>

*Larson*

Over half of the individuals (52.4%) buried at Larson were interred as primary inhumations in extended supine (38.1%) and semiflexed (14.3%) corpse positions (Table 6.29). No secondary inhumations were recovered. These individuals were buried both in the east borrow pit cemetery and between houses within the village. The remaining half (47.6%) of the Larson burial sample is composed of a single commingled burial pit that contained a minimum number of ten individuals. Located at the northeastern edge of the Larson village excavation, this circular-shaped refuse pit (Feature 270) contained over 650 bone fragments. Few of these fragments could be assigned to a discrete individual (Carter et al. n.d.). Scorching and burning was also identified on a small proportion of fragments. Due to the small sample of individuals excavated from the Larson salvage excavation, the relatively large number of individuals from Feature 270 biases the sample.

Tables 6.30-6.33 report the torso and limb positions found at Larson. The torsos of the primary inhumations were interred in two positions: supine and prone. Eight individuals were placed in an extended supine position. Two individuals were buried in
semiflexed supine torso position, while one individual was interred with the torso 
semiflexed prone. Tables 6.31 and 6.32 report the frequencies of left and right arm burial 
positions, respectively. Larson primary inhumation left and right arms were most 
frequently extended to the side. Few other position variations were found for the left 
arm. Only two (18.2%) individuals displayed arms or hands crossed over the torso. In 
contrast, right arm positions exhibited greater variation, but these position variations were 
infrequent. Right arms were also flexed, across the torso, or under the chest. Over 72% 
of legs (eight individuals) were extended (Table 6.33). The remaining three (27.3%) 
individuals had legs positioned semiflexed to the right, flexed to the right, and flexed 
upward.

### Table 6.29. Larson Burial Type and Corpse Position Frequencies by Individual for Total Sample.

<table>
<thead>
<tr>
<th>Burial Type</th>
<th>Burial Position</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Inhumations</td>
<td>Extended Supine</td>
<td>8</td>
<td>38.1%</td>
</tr>
<tr>
<td></td>
<td>Semiflexed</td>
<td>3</td>
<td>14.3%</td>
</tr>
<tr>
<td><strong>Primary Total</strong></td>
<td><strong>11 (52.4%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Commingled Pit Interment with Some Cremation</td>
<td>10</td>
<td>47.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21 (100%)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Violent trauma was observed in three individuals interred as primary inhumations and five individuals from the Feature 270 refuse pit. Tables 6.34 and 6.35 present the corpse positions and trauma descriptions for the primary inhumations. Two males with healed cranial trauma, Larson Burials 4 and 6, were buried extended supine, the most common corpse position for primary inhumations in the sample (Table 6.29). Larson Burial 4 exhibited one healed blunt-force fracture to the right parietal. Larson Burial 6 displayed three injuries: a healed fracture to the right and left nasal bones, a healed fracture to the acromial end of the left clavicle, and L-5 bilateral spondylolyis.

In contrast, Larson Burial 8, a middle adult female, was positioned in a semiflexed position with a prone torso. Her left arm was extended to her side, her right arm was under her chest, and her legs were flexed to the right. She exhibited multiple injuries, including a perimortem fracture to the right mandibular ascending ramus, and a healing fracture to the right ulna diaphysis. As with the individuals with perimortem trauma at Dickson Mounds, her corpse position is uncommon in the cemetery sample.
Only one other individual from the site, who did not exhibit trauma, was buried in a semiflexed prone position.

Table 6.36 displays the age-at-death, sex, and trauma descriptions for remains interred in Burial 12. Vertical and horizontal provenience data were not available for the five individuals with violent trauma interred in Feature 270 had perimortem wounds. Individual 12A, an adult male, and Individual 12B, a young adult female, exhibited scalping cuts. Individual 12B also had perimortem cuts to the mandible and a perimortem fracture to the right mandibular corpus. Individuals 12C, 12D, and 12H displayed perimortem cut marks on the skull. This mortuary feature and the commingled, fragmentary, and burnt remains within it are unusual forms of interment in the CIV.

*Emmons*

Table 6.37 reports the variations of burial types and corpse position for burials from the Emmons site reported by Morse and colleagues (1961). Primary inhumations composed over three-quarters of the sample, while secondary inhumations are infrequent and represented by only two bundled individuals. Most individuals (70.2%) from Emmons were interred in extended supine corpse positions. Semiflexed and flexed positions were infrequent, however, totaling a combined 7.2% of the sample. Seven individuals, however, were disturbed and burial type and corpse position could not be evaluated. The excavators also described a “mass grave” of ten burials. Burial treatment and corpse positions within the mass grave were not reported, as little of the grave was excavated.
Table 6.34. Burial Positions of Larson Inhumations with Trauma.

<table>
<thead>
<tr>
<th>Location</th>
<th>Burial Position</th>
<th>Left Arm Position</th>
<th>Right Arm Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrow Cemetery</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Extended to Side</td>
</tr>
<tr>
<td>arrow Cemetery</td>
<td>Extended Supine</td>
<td>Extended to Side</td>
<td>Flexed on Chest</td>
</tr>
<tr>
<td>arrow Cemetery</td>
<td>Semiflexed Prone</td>
<td>Extended to Side</td>
<td>Under Chest</td>
</tr>
</tbody>
</table>

Table 6.35. Description of Trauma and Demographics of Larson Inhumations with Trauma.

<table>
<thead>
<tr>
<th>Age</th>
<th>Trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA</td>
<td>Healed BFT superior aspect of right parietal</td>
</tr>
<tr>
<td>OA</td>
<td>Healed BFT right and left nasals, healed fracture at acromial end of left clavicle, bilateral spondylosis</td>
</tr>
<tr>
<td>MA</td>
<td>Perimortem BFT right mandibular ascending ramus, healing fracture to diaphysis</td>
</tr>
</tbody>
</table>

Table 6.36. Description of Trauma and Demographics of Larson Individuals from Feature 270.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Adult</td>
<td>Scalping</td>
</tr>
<tr>
<td>F</td>
<td>YA</td>
<td>Scalping, perimortem cuts to mandible, fracture to right mandible</td>
</tr>
<tr>
<td>F</td>
<td>YA</td>
<td>Perimortem cuts to cranium and right ilium</td>
</tr>
<tr>
<td>I</td>
<td>Adult</td>
<td>Perimortem cuts to cranium</td>
</tr>
<tr>
<td>I</td>
<td>Child</td>
<td>Perimortem cuts to left mandible</td>
</tr>
</tbody>
</table>
Table 6.37. Counts of Emmons Burial Type and Position Frequencies by Individual.

<table>
<thead>
<tr>
<th>Burial Type</th>
<th>Burial Position</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Inhumations</td>
<td>Extended Supine</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Semiflexed</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Flexed</td>
<td>4</td>
</tr>
<tr>
<td><strong>Primary Total</strong></td>
<td></td>
<td><strong>65</strong> (77.4%)</td>
</tr>
<tr>
<td>Secondary Inhumations</td>
<td>Bundle</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Disturbed/Indeterminate</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>“Mass Grave”</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>84</strong> (100%)</td>
</tr>
</tbody>
</table>

Morse and colleagues (1961) did not consistently record arm, leg, and torso positions. Among the extended inhumations, they note that four individuals were positioned with their legs crossed at the ankles. Left arms folded over the chest were also documented for two individuals. It is likely that the legs and arms of most of the extended inhumations were extended straight and, thus, not specified further. Burial photographs that show extended inhumations with extended arms and legs (Morse et al. 1961:127) support this assumption.

The burial type and corpse positions of only three individuals from the Emmons collection who exhibited traumatic injuries are known. The remaining 13 individuals with violent trauma lacked internal site provenience and association data. Morse and colleagues (1961) described Emmons Burial 8 as exhibiting a projectile embedded in the tenth thoracic vertebra (Morse et al. 1961). This individual is treated in this analysis as displaying violent trauma, even though I did not independently evaluate the veracity of the reported injury. Burial 8 is not curated at ISM. As a result, this analysis blends results of osteological analysis with Emmons field report to contextualize the relationship between corpse treatment and positioning with violent trauma.
Three adult males buried in extended supine positions and a child from the “mass grave” context displayed violent trauma (Table 6.38). Emmons Burials 12 and 57 displayed healed cranial blunt-force wounds, and as previously stated, Emmons Burial 8 displayed a projectile injury (Table 6.39). Over 70% of individuals interred at Emmons were buried in an extended supine position (Table 6.37). Thus, presence of trauma did not differentiate the mortuary treatment of these three individuals from Emmons. The child interred within the mass grave, however, was the only burial recovered from the mass grave. Consequently, it is unknown if other individuals from within this context also present violent trauma. The child exhibited a partly healed blunt-force wound to the right frontal squama (Table 6.39).

Table 6.38. Burial Positions of Emmons Inhumations with Trauma.

<table>
<thead>
<tr>
<th>Burial #</th>
<th>Burial Position/Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE12, 4381</td>
<td>Extended Supine</td>
</tr>
<tr>
<td>E57, 3615</td>
<td>Extended Supine</td>
</tr>
<tr>
<td>E3616</td>
<td>&quot;Mass Grave&quot;</td>
</tr>
<tr>
<td>E8*</td>
<td>Extended Supine</td>
</tr>
</tbody>
</table>

*Not present for analysis.

Table 6.39. Description of Trauma and Demographics of Emmons Individuals.

<table>
<thead>
<tr>
<th>Burial #</th>
<th>Sex</th>
<th>Age</th>
<th>Trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE12, 4381</td>
<td>M</td>
<td>YA</td>
<td>Healed malunited zygomatic arch fracture</td>
</tr>
<tr>
<td>E57, 3615</td>
<td>M</td>
<td>MA</td>
<td>Healed BFT to left frontal, healed BFT left parietal</td>
</tr>
<tr>
<td>E3616</td>
<td>I</td>
<td>Child</td>
<td>Healing BFT right frontal squama</td>
</tr>
<tr>
<td>E8*</td>
<td>M</td>
<td>Adult</td>
<td>Perimortem projectile embedded in T-10</td>
</tr>
</tbody>
</table>

*Not present for analysis. Demographics and trauma identified in field by Morse and colleagues (1961)
**Associated Burial Artifacts**

Associated burial artifacts were analyzed according to counts of artifacts within a grave, number and type of artifact class, and counts of artifact material types for Dickson Mounds, Larson, and Emmons. These analyses were compared between individuals with and without violent trauma. The Emmons artifact associations are reported in Morse and colleagues (1961). Only nine individuals recovered from that excavation were available for osteological analysis at the Illinois State Museum. As a result, artifact associations for individuals with trauma are compared against those for whom trauma was absent. No hypothesis testing was conducted, as trauma presence could not be evaluated for 75 individuals recovered from the 1961 excavation. Additionally, only one individual interred at Larson was associated with artifacts, so the results from the site are limited. Artifact associations, however, did not differentiate individuals with trauma from the rest of the cemetery sample in any variable assessed. Consequently, detailed results of the artifact analysis, including summary tables, are reported in Appendix B, but some general artifact association trends are discussed here.

Individuals with trauma interred at Dickson Mounds tended to be interred with more artifacts than individuals with trauma. This difference was not statistically significant when Burial 1000, an individual with trauma interred with the most artifacts at the site, was removed from the analysis. The males with trauma at Dickson Mounds tended to be buried with higher percentages of copper covered ear spools, chert scrapers, and bone pins than males without trauma. The cell counts for these variables are low, however, and statistical significance could not be assessed. The material composition of
associated artifacts interred with individuals with trauma did not display any statistically significant differences from those placed with individuals without trauma.

As at Dickson Mounds, individuals with trauma at Emmons tended to be interred with higher frequencies of objects than individuals without trauma. Again, this difference was not statistically significant. Individuals with trauma from Emmons were associated with artifact classes that were infrequently recovered in the remainder of the sample. For instance, sheet copper, hair rings, scarifiers, bone pins, and chert scrapers were present in the graves of individuals with trauma, but rarely in burials without trauma. Statistically significant differences between the presence of these artifact classes in graves of individuals with and without trauma could not be examined. Similarly, individuals with trauma from Emmons were not buried with different materials than individuals without. In sum, artifact accompaniments did not differentiate between individuals with and without trauma buried at Dickson Mounds, Larson, or Emmons. It does not appear that individuals with trauma were treated differently than the rest of the community through material objects.

The following chapter examines these results in detail. It begins with assignment of individuals with trauma to one of the four violence models discussed in Chapter Five. After exploration of the models, I evaluate the research question presented in Chapter One. I then present a revised history of warfare and intragroup violence for the Mississippian Period of the CIV using the results of this study. Finally, alternative explanations for observed data patterns are assessed.
CHAPTER 7 – DISCUSSION

This chapter examines the behavioral models proposed in Chapter Five in order to explore the research question: Did intragroup violence increase in association with warfare during the Mississippian Period of the Central Illinois Valley? First, each individual’s trauma, biodistance, and mortuary data are assessed against each intergroup and intragroup violence model’s expectations. Each individual is then fit to a model, allowing the estimation of intergroup and intragroup violence frequencies to evaluate the research question. Next, these results are contextualized with other osteological and archaeological studies to refine the diachronic history of warfare in the CIV. Finally, alternative explanations for data patterns are discussed.

Model Exploration and Research Question Evaluation

This section evaluates the trauma, biodistance analysis, and mortuary results against expectations for the two models of intergroup violence and two models of intragroup violence discussed in Chapter Five. Missing data precluded detailed evaluation of biodistance and mortuary variables for some individuals. In these cases, both time since insult and trauma type were used to classify individuals into an intergroup or intragroup violence model.

Intergroup Model 1 – Victims of Ambush Warfare from the Local Community

When the results of this study are assessed against expectations of all four violence models, data patterns for 12 individuals (21.8%) are consistent with ambush warfare victims from the local community. Eleven of these individuals displayed unhealed traumatic lesions, including scalping, projectile wounds, cut marks, and unhealed cranial blunt-force trauma. One healed lesion, the large elliptical depression on
Dickson Burial 560 is also assigned to this model, as the shape, size, and severity of his depression suggests a blow from a celt or club. These weapons were likely employed during hand-to-hand combat in war.

Individuals assigned to this model all had principal components loading scores that plotted within the 95% confidence ellipse. Thus, these individuals exhibited tooth size and shape measurements within the normal range of variation for the sample (Table 7.1). Although not expected for Intergroup Model 1, uncommon burial types or corpse positions were most frequently associated with individuals whose burial patterns corresponded best to Intergroup Model 1 (Table 7.1). Among these unusual burial programs were two inhumations with prone torsos. One of these individuals, Dickson Mounds Burial #380, was bundled, while the other, Larson Burial #8, was a primary inhumation. Two individuals assigned to Model 1 were interred in common burial types and corpse positions. Dickson Mounds Burials #287 and #560 were placed in extended supine corpse positions with associated funerary artifacts.
Table 7.1 Intergroup Model 1 – Victims from the Local Community.\(^a\)

<table>
<thead>
<tr>
<th>Site</th>
<th>Burial/Inventory#</th>
<th>Trauma Time Since Injury</th>
<th>Within 95% Confidence Interval of Biodistance PC Plot</th>
<th>Uncommon or Common Burial Type and Corpse Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson</td>
<td>287</td>
<td>Perimortem</td>
<td>Yes</td>
<td>Common</td>
</tr>
<tr>
<td>Dickson</td>
<td>380</td>
<td>Perimortem</td>
<td>Yes</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Dickson</td>
<td>560</td>
<td>Antemortem</td>
<td>Yes</td>
<td>Common</td>
</tr>
<tr>
<td>Larson</td>
<td>12A</td>
<td>Perimortem</td>
<td>–</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Larson</td>
<td>12B</td>
<td>Perimortem</td>
<td>Yes</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Larson</td>
<td>12C</td>
<td>Perimortem</td>
<td>–</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Larson</td>
<td>12D</td>
<td>Perimortem</td>
<td>–</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Larson</td>
<td>12H</td>
<td>Perimortem</td>
<td>Yes</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Larson</td>
<td>8</td>
<td>Perimortem</td>
<td>Yes</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Crable</td>
<td>#2684</td>
<td>Perimortem</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Crable</td>
<td>#4791</td>
<td>Perimortem</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Crable</td>
<td>#2366</td>
<td>Perimortem</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

\(^a\) – indicates missing data.

Intergroup Model 2 & Intragroup Model 1 – War Captives from an Extra-Local Community & Domestic Violence

This research did not find evidence for either war captives or victims of domestic violence. Battering, diagnosed by multiple injuries in different states of healing, was not apparent. This form of chronic abuse was required in by both behavioral models to identify war captives adopted into the community or domestic violence victims. Without this evidence, no individuals had data patterns that satisfied the expectations of either Intergroup Model 2 or Intragroup Model 1. Incomplete skeletal remains and dentitions and the absence of mortuary data for many females may also have impeded recognition of adopted war captives with trauma in the CIV sample. Furthermore, the data in this analysis did not support the presence of tortured or killed war captives. All individuals who exhibited perimortem warfare trauma exhibited phenotypic patterns consistent with the rest of the CIV sample.

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**Intragroup Model 2 – Male-Male Assaults**

Twenty-six males, comprising 47% of individuals who exhibited violent trauma, were assigned to the intragroup male fights model (Table 7.2). These males displayed healed blunt-force trauma to the face and cranial vault. All seven individuals with associated mortuary records were interred in common burial types or corpse positions. Although associated funerary objects did not predict model categorization in this sample, two of the individuals best corresponding to the male-male assault model (Dickson Burial #1000 and Emmons Burial #E12) had mortuary artifact counts among the highest in the sample.

When the principal component loading scores from each individual’s dental cervical measurements were plotted, all but three individuals had phenotypic patterns consistent with the CIV sample. Of these three biodistance outliers, only one individual presented a violent traumatic lesion. This individual, Larson Burial #4, was interred as an extended supine primary inhumation, the most common burial mode in the CIV. While his biodistance principal component loadings were outside the 95% confidence ellipse for the CIV sample, his treatment at death was not indicative of an outsider status. Use of common mortuary treatments for individuals with high biological variability, like Larson Burial #4, may denote the presence of migrants to the CIV who were integrated into their adopted community. Alternatively, these data patterns may also be indicative of a captive individuals who were well-integrated or adopted into the community at death. Further work, however, is necessary to test these hypotheses.
Table 7.2 Intragroup Model 2 – Male-Male Assaults.\(^a\)

<table>
<thead>
<tr>
<th>Site</th>
<th>Burial/Inventory#</th>
<th># of Traumatic Injuries*</th>
<th>Within 95% Confidence Interval of Biodistance PC Plot</th>
<th>Uncommon or Common Burial Type and Corpse Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson Mounds</td>
<td>443</td>
<td>1</td>
<td>Yes</td>
<td>Common</td>
</tr>
<tr>
<td>Dickson Mounds</td>
<td>451</td>
<td>2</td>
<td>–</td>
<td>Common</td>
</tr>
<tr>
<td>Dickson Mounds</td>
<td>1000</td>
<td>1</td>
<td>Yes</td>
<td>Common</td>
</tr>
<tr>
<td>Crable #2, #9918</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4676</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4681</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4693</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4698</td>
<td></td>
<td>2</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4701</td>
<td></td>
<td>2</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4703</td>
<td></td>
<td>1</td>
<td>No</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4724</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4737</td>
<td></td>
<td>3</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4745</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4767</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #4785</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Crable #8066</td>
<td></td>
<td>2</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Berry Be4376</td>
<td></td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Berry Be5111</td>
<td></td>
<td>1</td>
<td>No</td>
<td>–</td>
</tr>
<tr>
<td>Emmons E1, #2854</td>
<td></td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Emmons E2174</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Emmons E2176</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>Emmons E57, 3615</td>
<td></td>
<td>2</td>
<td>–</td>
<td>Common</td>
</tr>
<tr>
<td>Emmons EE12, 4381</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>Common</td>
</tr>
<tr>
<td>Larson L4</td>
<td></td>
<td>1</td>
<td>No</td>
<td>Common</td>
</tr>
<tr>
<td>Larson L6</td>
<td></td>
<td>3</td>
<td>Yes</td>
<td>Common</td>
</tr>
</tbody>
</table>

\(^a\) – indicates missing data.

**Alternative Intragroup Model – Assaults to Women and Children**

Because battering in the warfare captives and domestic violence models was not identified in this research, an alternative model called intragroup assaults to women and children is proposed to assign the remaining 16 individuals with trauma (Table 7.3). Nonlethal trauma to women and children could be attributed to infrequent beatings or
assaults of women and children by others in the household, rather than as evidence of chronic severe battering or child abuse (e.g., Walker 2001; Novak and Rodseth 2009). Wife-beating, rather than wife-battering, may have been experienced by Mississippian women in the CIV after AD 1200. Women also could have participated in fights with other women (e.g., Webb 1995). Little information from ethnohistoric accounts concerning the role of women in intragroup violence is available, however, hindering contextualization of healed trauma to the heads of women and children in this research.

Approximately 31% of the individuals with violent trauma, 15 females and two subadults, were assigned to this model. All but three of these individuals were located within the 95% bivariate confidence ellipse of means. For the individuals whose biodistance results placed them outside the 95% confidence ellipse, none exhibited more than one traumatic lesion nor did they have associated mortuary data to contextualize these results. Intragroup assaults are the most likely cause of their injuries. Alternatively, domestic violence, particularly the socially sanctioned beating of wives and children, rather than the more severe and chronic battering, may also explain these patterns.

Mortuary data were absent for all but one individual assigned to this model. This individual, Emmons Catalog #3616, was commingled in a grave with nine other unexcavated individuals. No additional burial type or corpse position details were recorded, preventing further examination of data patterns in the only large commingled grave recorded at Emmons. Emmons Catalog #3616 also did not have a sufficient number of permanent polar teeth erupted for inclusion in the biodistance analysis. The absence of biodistance and detailed mortuary data makes classification of this child
difficult, but its trauma patterns alone accord best with expectations of an intragroup assault.

Emmons Catalog #2184 was another individual with unusual data patterns. This old adult female had seven healed large ovoid depression fractures to the top and sides of her cranium. The number and size of her injuries are among the most severe in the sample. As all seven traumatic lesions were in a single healed state, there was no direct evidence of battering. It is, therefore, unclear whether these injuries were sustained in a single attack or in a pattern of chronic abuse. The biodistance analysis supports a phenotypic similarity to the CIV sample. Her dental cervical measurement factor loading scores plotted inside the 95% confidence interval. Her biological variability, however, may have been reduced due to a number of her dental measurements being imputed because of missing teeth. As she was not associated with any mortuary data, her treatment at death could not be used to contextualize these results.

The results in this research met proposed expectations for both intergroup violence and intragroup violence in Mississippian samples from the Central Illinois Valley. Although expectations for two models were not met, results suggest that intergroup and intragroup violence can be differentiated using behavioral models that include multiple lines of evidence. Approximately 22% of CIV individuals who exhibited violent trauma had data patterns consistent with injuries from warfare, while an intragroup violence cause is supported for the remaining nearly 78% of individuals with trauma. With the skeletal trauma partitioned into intergroup and intragroup violence models, the research question can be assessed.
### Table 7.3. Alternative Intrigroup Model – Assaults to Women and Children.\(^a\)

<table>
<thead>
<tr>
<th>Site</th>
<th>Burial/Inventory#</th>
<th># of Injuries</th>
<th>Within 95% Confidence Interval of Biodistance PC Plot</th>
<th>Uncommon or Common Burial Type and Corpse Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crable</td>
<td>#4721</td>
<td>1</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Crable</td>
<td>#4733</td>
<td>1</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Crable</td>
<td>#8062</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Crable</td>
<td>#8081</td>
<td>1</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Berry</td>
<td>Be4298</td>
<td>1</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Emmons</td>
<td>E2178</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Emmons</td>
<td>E2184</td>
<td>7</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Emmons</td>
<td>E2818</td>
<td>1</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Emmons</td>
<td>E2822</td>
<td>1</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Emmons</td>
<td>E3690</td>
<td>2</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Emmons</td>
<td>E4299</td>
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<td>No</td>
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</tr>
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<td>Emmons</td>
<td>E6, 2859</td>
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<td>E7, 2860</td>
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<td>-</td>
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<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Emmons</td>
<td>E8215(^b)</td>
<td>1</td>
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</tr>
<tr>
<td>Emmons</td>
<td>E3616(^b)</td>
<td>1</td>
<td>-</td>
<td>Uncommon</td>
</tr>
</tbody>
</table>

\(^a\) – indicates missing data.
\(^b\) Subadults

### Evaluation of the Research Question

This study examined the research question: *Was there an association between intergroup and intragroup physical violence during the Mississippian Period (ca. AD 1050-1425) in the Central Illinois Valley?* Results suggest that increases in warfare and intragroup violence were related during the Mississippian Period of the CIV.

Osteological and archaeological evidence suggest that intragroup violence is found only after warfare has become endemic in the CIV. None of the CIV human remains dated to the Eveland phase presented skeletal trauma from either intergroup or intragroup violence, and only one Orendorf phase (ca. AD 1200-1250) individual exhibited trauma from intergroup violence. Although archaeological and osteological evidence of warfare...
increased during the Orendorf phase, this research did not find corresponding intragroup violence for this subphase.

Intragroup violence, in contrast, is only found during the Larson and Crable phases in this research, both periods with high levels of warfare indicated by skeletal trauma and archaeological evidence. Eight Larson phase (ca. AD 1250-1300) individuals had warfare-related skeletal trauma, while 24 individuals had injuries consistent with intragroup assaults. Similarly, during the later Crable phase (ca. AD 1300-1425), evidence for intragroup assaults was found for 17 individuals, and intergroup violence was found in three individuals. These temporal patterns of violence support the hypothesis that intragroup violence was associated with warfare during the Mississippian Period of the CIV.

**Contextualization with Previous CIV Warfare Research**

In this section, I compare to the temporal history of CIV Mississippian warfare constructed by Dawnie Steadman (2008) to the results of this analysis. Her work included an exhaustive synthesis of the bioarchaeological and archaeological literature on warfare during the Mississippian Period of the CIV available at that time. By contributing an examination of an additional 780 individuals from five CIV sites, I am able to supplement and refine Steadman’s diachronic analysis.

According to Steadman (2008), Eveland phase (ca. AD 1050-1200) violence was primarily limited to “rituals” that incorporated symbolic mortuary tableaus suggestive of violent death. Little archaeological and bioarchaeological evidence for interpersonal physical violence has been documented from this era. During the Orendorf phase (ca. AD 1200-1250), high intensity warfare became endemic throughout the valley, as
evidenced by increased palisade construction and violent trauma dated to this phase. Warfare ebbed during the subsequent Larson phase (ca. AD 1250-1300). Fortifications continued to be constructed during this time, but findings for only a handful of individuals with skeletal trauma indicated more sporadic Larson phase raiding. Movement of Bold Counselor Oneota peoples into the region around AD 1300, however, caused high intensity conflict until depopulation of the valley after AD 1425. This local abandonment was part of a larger pattern of population movements out of the Midwest after AD 1400 (Cobb and Butler 2002; Milner and Chaplin 2010; Milner et al. 2013).

Results of this research support Steadman’s (2008) reconstruction of violence during the Eveland phase. I did not identify evidence of violent trauma on skeletal remains dating to the phase, including the headless males buried in the “violent tableau” at Dickson Mounds. Similarly, no skeletal trauma was present on the four headless males from Dickson Mounds analyzed in this study interred in what has been called a ritually violent mortuary display. Poor preservation of the skeletal elements composing these males, however, made examination for violent trauma difficult. Also, most of the upper cervical vertebrae were either missing or too fragmentary to retain any evidence of trauma, if present. Evidence of violent trauma during the Eveland phase is limited to a single CIV context from Kingston Lake not analyzed in this work. Buried commingled with two headless adults in a mound context, the cranium of a child displayed over 100 cut marks concentrated predominantly on the frontal bone (Cobb and Harn 2002). Comparable to the headless Dickson Mounds males, these three individuals at Kingston Lake have also been interpreted as a violently ritualized mortuary tableau (Cobb and Harn 2002).
During the roughly coeval Stirling phase (ca. AD 1100-1200) at Cahokia, violent trauma was similarly rare (Rose 1999; Carbaugh et al. 2013). Much of the available evidence for violence has, instead, been inferred from mortuary tableaus like the headless males at Dickson Mounds and Kingston Lake in the CIV. Rose (1999) identified cut marks consistent with decapitation on the atlas of one of four headless, handless males interred in Mound 72. No additional skeletal trauma was identified on these skeletal remains, although poor preservation could have obscured any trauma if present. Consequently, violence during the twelfth century in the CIV and American Bottom of Illinois was associated with mortuary symbolism, rather than warfare.

Like Steadman’s (2008) study, this research found high frequencies of intergroup and intragroup violence during the Crable phase (ca. AD 1300-1425) at the Crable site. Approximately 11% of the sample from the Crable site analyzed here had evidence of violent trauma. Three individuals in this analysis displayed warfare trauma, and 18 had injuries consistent with intragroup violence. Two individuals with violent injuries, who were not included in these counts, were reported in published cases studies. Neumann (1940) presented a case of scalping on a Mississippian individual interred at Crable. This individual is curated at Indiana University and was not analyzed in this research. Morse (1978) also presented a Crable burial with an embedded projectile point that was not available for examination in this research. Taken in sum, this evidence supports an interpretation that warfare and intragroup violence were associated during the Crable phase.

Also supporting an interpretation of high intensity warfare during the Mississippian Crable phase is the contemporaneous movement of Bold Counselor Oneota
peoples into the CIV around AD 1300. George Milner and colleagues’ (Milner and Smith 1990; Milner et al. 1991; Milner 1995) analysis of Oneota skeletal remains from the Norris Farms #36 cemetery found some of the highest frequencies (16.2%) of violent death recorded from a prehistoric North American site. High frequencies of trauma identified in skeletons from both Norris Farms #36 and Crable indicate that warfare was a substantial threat to CIV Mississippians and Oneota alike after AD 1300.

While results of this analysis and Steadman’s (2008) work are consistent for the Eveland and Crable phases, differences in warfare interpretations between researchers were identified for the Orendorf (ca. AD 1200-1250) and Larson (ca. AD 1250-1300) phases. Steadman’s trauma analysis of remains from the Orendorf site recorded high frequencies of healed and unhealed skeletal trauma during the Orendorf phase. When only cases of skeletal trauma from interpersonal violence are considered, over 7% of individuals from Orendorf displayed violent trauma.

Results of this study suggest, instead, that warfare may not have been widespread in the CIV between AD 1200-1250. Warfare trauma was identified in only one Orendorf phase individual (of 93 observable) interred at Dickson Mounds. Because skeletal remains from only two sites (Dickson Mounds and Orendorf) with Orendorf phase components have been studied at this time, it is difficult to draw region-wide conclusions regarding patterns of violence from this small site sample. Similarly, archaeological evidence for warfare during the Orendorf phase has only been recovered from the Orendorf site palisade (e.g., Santure 1981; Vanderwarker and Wilson n.d.), further impeding regional comparisons. It is possible, however, that only a few sites in the region, like Orendorf, experienced war during this time.
Although Steadman (2008) concluded that warfare decreased in frequency during the Larson phase of the CIV, the highest frequencies of both intergroup and intragroup violence found in this research date between AD 1250-1300. Over 11% of Larson phase individuals exhibited violent trauma, including eight individuals with warfare trauma and 24 who displayed trauma consistent with intragroup violence. Archaeological evidence, including settlement nucleation, construction of sites in defendable locations, erection of fortifications, and diet breadth reduction, also support this study’s finding of high rates of war during the Larson phase (e.g., Conrad 1991; Harn 1994; Wilson 2012; Vanderwarker and Wilson n.d.).

Differences in the temporal patterns of violence found between this research and Steadman (2008) may have also resulted from the use of Dickson Mounds skeletal samples in this research. Low frequencies of trauma throughout the Eveland, Orendorf, and Larson phases were found for Dickson Mounds. These low frequencies, especially when compared to trauma frequencies for other Orendorf and Larson phase sites, may have resulted from Dickson Mounds perhaps acting as a larger regional cemetery, rather than a site-specific cemetery. Harn (1994) has hypothesized that Dickson Mounds may have acted as the site cemetery for the Eveland and/or Myer-Dickson sites. The small populations of these sites, however, were not likely to have been the sole contributors of the thousands of burials interred in these mounds. It is more probable that Dickson Mounds was a regional cemetery. Thus, those interred in Dickson Mounds may have been selected using criteria that differed from that of burials in site cemeteries or informal village areas. Consequently, the trauma frequencies of individuals from Dickson may be biased, as the cemetery includes an unrepresentative sample of the population.
Results of this study provide a revised history of Mississippian Period war. Although warfare and violence are presented as persistent threats after AD 1200, the resolution of archaeological and bioarchaeological data prevents fine-grained temporal assessments. Consequently, warfare and violence may better be described as punctuated events. Mississippian warfare does not appear Hobbesian; it likely did not endure perpetually without periods of peace. Warfare during the Eveland phase was infrequent, with violence limited predominantly to symbolic mortuary contexts at Dickson Mounds and Kingston Lake. By the Orendorf phase, warfare was a significant cause of death at the Orendorf site, while individuals from Dickson Mounds were left relatively unscathed. It is unclear how frequent warfare and violence were, however, at other Orendorf sites. During the Larson phase, warfare and violence were experienced in high frequencies at sites throughout the valley. Evidence for war and violence remained infrequent for those interred at Dickson Mounds. Movement of Bold Counselor Oneota into the CIV during the Mississippian Crable phase likely exacerbated rates of warfare in the region. Remains from both the Crable site and Norris Farms #36 present evidence of high intensity war during this time.

**Alternative Explanations for Data Patterns**

The behavioral models explored in this research were limited, as numerous alternative explanations for the data patterns present in this research were not fully examined. For instance, female-female assaults and female initiated domestic violence towards males were not considered. These behavioral patterns were not modeled, as they are either uncommon or less commonly discussed in cross-cultural studies of violence (c.f., Burbank 1994) or the ethnohistories of Eastern Woodland Native Americans. The
lack of ethnographic findings and the concomitant bioarchaeological difficulty in modeling these behaviors appropriately stems from what Wobst (1978:303) has termed the tyranny of the ethnographic record, stating:

The archaeological record does not consist of behavior but, at best, of the precedents and products of behavior. Even ethnographers lack access to certain behavioral realms. For example, they cannot observe behavior in private (e.g., infanticide); behavior distorted by observers (e.g., hunting); and variability in behavior in large units of space and time.

As domestic violence is often experienced privately, it is particularly difficult to observe ethnographically. Similarly, female-female violence is also a domain likely to be distorted by observers, often considered less serious than violence perpetrated by men on other men or women.

This difficulty in modeling domestic violence also extends to the models for female victims of domestic violence discussed in this research, as their expectations were not met. Battering, the presence of multiple injuries in different stages of healing, was not present in the CIV sample. Yet, the 16 women and children with healed blunt-force injuries suggest that a less chronic form of domestic violence than proposed in the models occurred in Mississippian societies. This less chronic form of violence, “wife-beating” is often socially sanctioned and sometimes even encouraged. As Novak and Rodseth (2009) have asserted from a cross-cultural review of contemporary studies on intimate partner violence, “wife-beating” is often situationally appropriate and encouraged. They argue either mothers-in-law or husbands may beat wives as a form of physical rebuke. In contrast, “wife-battering,” the form of domestic violence expected to leave signs of battering in the skeleton, is never socially acceptable and is characterized by intense feelings of sexual jealousy. Performed by intimate partners to limit their counterparts’
autonomy, it is a more severe and chronic form of abuse than wife-beating. Wife-battering may be distinguished archaeologically from wife-beating by the presence of injury recidivism or multiple wounds in various states of healing. Archaeological evidence of wife-beating, in contrast, would be more difficult to identify due to the infrequent nature of the assaults. In fact, the lack of findings for battering in this research may have resulted from social sanctioning of wife-batterers preventing severe and chronic abuse of Mississippian women.

Societal attitudes toward women have a profound influence on the likelihood a woman will experience wife-beating during her lifetime. In a non-Western cross-cultural ethnographic analysis, Levinson (1989) identified social characteristics in societies without domestic violence. Among the most important characteristics is the placing authority in the hands of women and a lack of social disparagement of women. When domestic violence was present in a society, Levinson (1989) found that community interventions and socially integrating women lessened the frequency and severity of abuse. Empowerment and external support of women are essential to reducing domestic violence. Matrilineal and matrilocal societies are more likely to empower women and allow frequent contact with consanguinal relatives. Patrilineal and patrilocal societies tend to restrict women and, consequently, have higher rates of domestic violence (Warner et al. 1986).

According to the contemporary women of the Oglala Lakota Sacred Shawl Women’s Society (n.d.), prior to the reservation system, women had the socially sanctioned ability to severely punish abusers. A woman abused could remove her abuser from their shared relative living arrangements (tiyospaye), and her brothers were also
expected to retaliate against the abuser and his family. Furthermore, the community perceived wife-beaters as irrational and prevented these irrational men from leading war parties, owning a pipe, or hunting. Men who abused their wives had limited opportunities to gain leadership or prestige within their communities.

Similarly, the lack of findings for the captive models may also be because repeated physical violence toward war captives was infrequent in Mississippian societies. Alternatively, violence may have been used selectively captives adopted into the tribe or severely abused captives may not have been buried in the community cemetery. Historic reports of forced white captivity among Eastern Woodland Native Americans frequently document both cases of kindly and chronically violent treatment after adoption by their captors (e.g., Seaver 1824; Edwin 1830; Plummer 1973 [1839]). Ethnohistoric reports also discuss the practice of torture and sacrifice among Eastern Woodlands Native Americans (Charlevoix 1851; Thwaites 1898:2, 23, 26, 36; Richter 1983; Tooker 1962; Knowles 1940). No evidence of captive torture or sacrifice was found. Tortured or sacrificed individuals were not buried within CIV site cemeteries, and thus, they would seldom be recovered from the archaeological record. It is more likely these individuals would have been placed outside of formal disposal areas. Larson Burial #4 was the only individual found in this analysis that may represent an adopted war captive as he had multiple well-healed injuries, biodistance principal component scores outside of the 95% confidence ellipse, and burial within the normal pattern at Larson. He could also represent an extralocal male who married into the CIV. These hypotheses, however, should be tested in future work.
Contrary to expectations from some clinicians (e.g., Buhr and Cook 1959; Zylke 1990), this research did not find evidence that injury frequencies accumulated as age increased. This analysis also did not find differences in the distribution of trauma frequencies by adult age category (e.g., Judd 2002b). Trauma frequencies for the CIV individuals studied were similar for young adults (aged 20-34), middle adults (aged 35-49), and old adults (aged 50+). This result may be attributed to the sample’s mortality distribution, so improved age estimation methods would help to better evaluate this trend. Additionally, this expectation may not have been met, as bioarchaeologists only view injuries after an individual’s death. Individuals who are more predisposed to injury may also have greater risks of death. These individuals may, therefore, have entered the mortality cohort prior to experiencing multiple traumatic injuries.

The association between perimortem injuries and uncommon burial types or corpse positions was an unanticipated finding in this research. Of the nine individuals who exhibited perimortem trauma with associated mortuary data, seven were interred with body positions or burial types found infrequently in the CIV sample. While the proposed models argued that individuals killed in warfare would be treated the same as any other community member, it seems that individuals who died violently may have been subject to a different set of mortuary rituals. In fact, as Weiss-Krejci (2013:70) has noted, mortuary rituals for “bad deaths” often create the “deviant mortuary behavior” identified archaeologically (see also Binford 1971; Carr 1995). For Native American cultures, Hultkrantz (1979:136) explained, “in many American religions a separate realm of the dead is assigned to women who have died in childbirth, to people struck by lightning, to suicides, drowning victims, and others whose death is unexpected or
violent.” While, cross-culturally, mortuary rituals may treat individuals who died in warfare or in other forms of “bad death” differently (Bloch and Parry 1982; Straus 1978), “bad” or violent deaths are rarely expressed in mortuary ritual using body position (Carr 1995:133, 136, 137). These deviations may have been necessitated by the decomposition and dearticulation of the body prior to prehistoric discovery of the body. For instance, Dickson Burial #380 had evidence of carnivore punctures, perhaps indicating an extended period between death and recovery. This individual was also interred unusually, as a bundle with a prone torso. The results in this study are interesting, as they suggest a deviation from cross-cultural patterns in how CIV Mississippians treated individuals who experienced violence at death.

Evidence of difficulty recovering ambushed community members is abundant at Norris Farms #36. Carnivore scavenging was exhibited on skeletal remains with unhealed trauma buried at Norris Farms #36. Milner and colleagues (Milner and Smith 1989; Milner and Smith 1990; Milner et al. 1991; Milner 1995) inferred that these taphonomic signatures suggest individuals died violently at a large distance from the safety of the community. Their bodies were exposed to a prolonged period between death and discovery, which allowed scavengers access to the remains. While individuals killed in warfare were eventually recovered and interred in a cemetery at Norris Farms #36, it is equally conceivable that other individuals killed far from the community were not, although their absence is not indicated in the mortality profile. When considering the frequencies of warfare and violence in the archaeological record, issues of body recovery should be considered.
Among the individuals with perimortem trauma interred in uncommon burials are the individuals commingled in Larson Burial 12. Eleven individuals were interred in a refuse pit with animal bones. These men, women, and children were highly fragmented at the time of recovery and evidence of burning was found on some remains. Although this disposal type was unusual in the CIV, Cole and Deuel identified a similar Larson phase interment at the nearby Morton site (Strezewski 2003a). This feature was only mentioned briefly in Cole and Deuel’s field notes, and the skeletal remains were not collected. As a result, the two features cannot be compared further.

In previous research, I interpreted Larson Burial 12 as possible evidence of war captives (Hatch 2012), but the biodistance analysis in this study placed all of these burials within the local sample. Consequently, it is more likely that these individuals were warfare victims from the local community. My 2012 interpretation that the cut marks found in Larson Burial 12 and three additional individuals are evidence of violence is also supported by the absence of perimortem cut marks on secondary burials. This dearth of mortuary processing was unexpected, given that Strezewski (2003b) interpreted cut marks on a group of loosely articulated Mississippian skeletons from the Morton site as evidence that these individuals were interred as secondary burials, rather than disturbed primary inhumations. These results demonstrate that trauma must be contextualized with site-specific mortuary patterns to discriminate between potential causes of violence.

Moreover, the frequency of violent deaths in a sample may be underestimated due to differential recovery of dead killed at a distance from their town of residence. For instance, the Iroquois at European contact reportedly raided into Maryland and Illinois from their home in New York State (Thwaites 1900:62). It is unlikely that when wars
were being fought at a distance that fallen group members would be transported home. Captives were also transported back to New York from Illinois and Maryland, and some likely perished on the journey. Again, it is unlikely these individuals would have been recovered for burial in either their resident cemeteries or those of their captors. Consequently, these individuals are unlikely to be recovered for bioarchaeological analysis.

The low frequencies of warfare-related trauma identified in this research could be argued as evidence of homicide or accidents, rather than war. Ferguson (2013) has asserted that the presence of only one violent death in a mortuary sample is not sufficient evidence that warfare took place and may, instead, be better explained as homicides or accidents. While Ferguson makes a compelling argument, the nature of small scale raiding makes it likely that only a single victim might be killed in an attack (e.g., Milner 1995). Alternatively, as discussed above, the distance of a raid from the village may prevent warfare victims from being buried in the community cemetery, further obscuring the prevalence of warfare-related mortalities. Indirect evidence of warfare threats or participation (e.g., palisades and settlement nucleation and defensibility), therefore, is essential to identifying war in the past. No single form of evidence should be used alone.

Results of this analysis support a general pattern of low intensity raiding for Mississippian populations in the CIV. Evidence for warfare-related death is relatively infrequent, but becomes more common in the skeletal samples studied in this analysis after AD 1250.

Nearly half of all violent injuries present in the CIV sample were attributed to male-male intragroup assaults. It is also possible that some of these injuries may have
been blunt-force traumas sustained during warfare participation. Many of these injuries, however, were small and circumscribed on the facial bones. Such localized injuries to the fragile facial bones were more likely to have been caused by an implement with a smaller area of impact, like a punch with a fist, than by the large impact area of a war club. The two individuals with trauma and large number of funerary artifact accompaniments, Dickson Burial #1000 and Emmons Burial #12, each experienced fractures to the facial bones. Intragroup violence, rather than warfare, is a more likely cause for each of their injuries. Thus, there is no direct evidence that the frequency of artifacts interred in their graves is associated with warfare participation.

While absence of mortuary information and loss of dentition in many burials precluded detailed evaluation of the models for some individuals, results suggest an association between intergroup and intragroup violence during the Mississippian Period of the Central Illinois Valley. Evidence for warfare-related skeletal trauma in this research is strengthened by archaeological evidence of increased fortification construction and defensive site positioning after AD 1200. These two lines of evidence indicate that warfare was endemic in the CIV during this time, and considerable effort was placed into community protection. Intragroup violence was only found during periods with bioarchaeological and archaeological evidence for warfare. When war was absent, intragroup violence was also absent.

Most importantly, this study applies Ember and Ember’s (1994, 1995, 1997) findings for the association between warfare and violence longitudinally into prehistoric non-Western cultures. Much work has evidenced this association cross-culturally in contemporary and historic Western societies (Russell 1972; Eckhardt 1973; Sipes 1973;
Levinson 1989; Erchak and Rosenfeld 1994; Chick et al. 1997; Chick and Loy 2001; Pinker 2011), as well as unpacified, Western-contacted societies (Ember 1994). From the sum of these works, it appears that warfare and intragroup violence have disastrous societal consequences across time, space, and culture. Combatants and noncombatants alike do not escape their society’s decisions to engage in war, even when they are far from the conflict zone. The following chapter concludes this work and presents potential directions for future research.
CHAPTER 8 – CONCLUSIONS

This study tested whether or not the positive association between warfare and intragroup violence found cross-culturally by Ember and Ember (1994) for contemporary societies was also present in a prehistoric non-state culture. Results support Ember and Ember’s work, finding a positive relationship between intergroup and intragroup violence during the Mississippian Period of the Central Illinois Valley. High frequencies of intragroup violence were related to concomitant increases in warfare after AD 1250. Similarly, intragroup violence was absent during periods when no warfare-related trauma was identified in the sample (e.g., ca. AD 1050-1200). It remains unclear whether participation in war caused higher rates of intragroup violence or whether higher rates of intragroup violence caused war. Yet, this research has demonstrated that war and intragroup violence in combination created a hostile social climate for Mississippians living in the CIV that resulted in greater frequencies of injury and mortality.

War also likely had profound effects on non-warriors. As combatant/noncombatant status appears to have had little influence on who was killed, war affected individuals regardless of their age or sex during the Mississippian Period of the CIV. While adult males displayed violent skeletal trauma most commonly, women and children were also victims of both forms of violence. These demographic patterns of trauma victims accord with Raymond Kelly’s (2000) argument that social substitution, where one group member may take the place of another in the eyes of an external group, allowed all group members to be an appropriate target for violence in segmented societies.
Although more individuals became exposed to war after AD 1200, war did not necessarily affect every habitation site. For example, individuals interred in both Orendorf and Larson phase components at Dickson Mounds displayed violent trauma in low frequencies. In contrast, high frequencies of violent trauma were found in remains from Larson and Emmons dated to the Larson phase in this research. Steadman’s (2008) work also found high frequencies of violent trauma in skeletal remains dating to the Orendorf phase of the Orendorf site. These findings indicate that warfare, while a substantial social pressure during the Late Mississippian, was not ubiquitous. A few communities may have warred, while others were left unmolested.

This point has substantial implications for the Neo-Hobbes and Rousseau debate of Steven Pinker (2011) and R. Brian Ferguson (2013) concerning the ubiquity of prehistoric warfare. Pinker’s Hobbesian depictions of the ubiquity of prehistoric war and violence oversimplify the past, while Ferguson’s (2013) characterization of world prehistory before the state as predominantly peaceful is equally facile. Instead, as this research and Milner and colleagues (2013) have demonstrated, prehistoric war varied considerably throughout time and space and was a more dynamic and punctuated process than the more simplistic characterizations of Pinker and Ferguson. War was serious among prehistoric societies, and scholars should consider variations in its practice through time and space with equal gravity.

**Future Directions**

While this study identified a relationship between warfare and intragroup violence in a precontact chiefdom, additional work should be conducted to assess if this association also holds in small-scale societies. Future research should examine
prehistoric hunter-forager and tribal societies to determine the effects of varied levels of social and political complexity on the relationship between warfare and intragroup violence. Positive results from a single society are not robust enough to assert a cross-cultural relationship between war and intragroup violence in prehistory. Societies of varied social and political complexity should be investigated to assess whether or not exceptions to this association existed. Additionally, studies of societies where sufficient temporal control is available to assess the causes of the association between war and intragroup violence should be conducted.

As George Milner and colleagues (2013) have demonstrated, bioarchaeologists must accumulate evidence from throughout the precontact Eastern Woodland to investigate how war affected the social life of these past peoples. Small regional samples, like those used in this study, are important for asking local questions about who was subjected to violence and how those patterns change over time. However, a single region is not adequate for addressing large questions about the diverse ways Eastern Woodland societies used war in the development of social complexity. Instead, numerous regional samples must be accumulated. Problems with sampling bias in cemeteries further obscure the behavioral and social patterns identifiable using skeletal remains. Cemeteries are not a random sample of the population at any given time; they are, rather, a selectively sampled collection of biological lineages (e.g., Cadien et al. 1974). Consequently, subsequent research should compile site reports, dissertations, and published and unpublished studies to accumulate sufficient data to address such questions.
Social science and public health research has suggested that maternal experiences of war and violence, along with their indirect consequences (e.g., malnutrition, infection, mental health complications), caused significant intergenerational health and social problems (e.g., Devakumar et al. 2014). Such intergenerational health risks may include higher risks of infection, low birth rates, reduction of completed adult height, and greater adiposity (Lumey 1992; Clarkin 2008; Tegethoff et al. 2011). To assess whether or not these health effects manifested differently in prehistory, archaeological data should be compared against findings from contemporary societies. This resource orientation represents a fertile opportunity for subsequent bioarchaeological work interested in the intersections between war and health. Skeletal samples with evidence for high frequencies of war and violence should be examined for changes in growth and development, physical stress markers, and other pathologies over time.

Comparisons of prehistoric and contemporary data are also vital for understanding the intersections between the threat of war, warfare socialization, and any associated increases in intragroup violence rates. These comparisons are also necessary for exploring whether increases in war or increases in intragroup violence create the association between these two variables. For example, Ember and Ember (1994) argued that socialization for warfare participation was the cause of the greater frequencies of intragroup violence found in their research. Socialization for warfare violence, therefore, socializes individuals for violence in other aspects of life. But it is not clear that this socialization pattern also hold for prehistoric societies where noncombatants are subjected to attacks. For instance, a general increase in social stress from perceived resource shortages (e.g., Ember and Ember 1992) or the threat of attack on all individuals.
within the community could also have caused the high frequencies of intragroup violence during the Mississippian Period of the CIV. This hypothesis should be tested in subsequent work using a cross-cultural ethnographic analysis and further archaeological samples that have better temporal control.

This research’s major deficit originated from problems identifying biologically distinct individuals. Application of a principal components analysis in a model-free biodistance methodology suffered from several impediments. First, this model-free approach requires that phenotypic relationships be defined by the sample studied. This sample may not be a reflection of the actual population, skewing identification of biologically distinct individuals. Second, assignment of a 95% confidence interval defining those who phenotypically resemble the sample and those who do not is arbitrary. It is a statistical definition, rather than a biological one. Finally, low frequencies of complete dentitions severely limited the sample sizes of this study and its ability to examine biological variability in the sample.

Use of a model-bound biodistance methodology would have provided more sensitive estimates of phenotypic variation than the model-free approach used here. However, model-bound approaches would not have been ideal solutions either, because they would require individuals with trauma to be treated as a unified biological population. The point of this project, however, was to estimate whether individuals with trauma were from within our outside the local population. Men and women with trauma could belong to the local biological community or be brought in as war captives from extralocal sources. Thus, lumping this diversity into a “trauma group” for comparison
against the remainder of the sample in this study would have inhibited behavioral model exploration.

Unfortunately, bioarchaeology’s current overemphasis on frequency reporting, admittedly a problem in this study as well, has perhaps limited identification of warfare patterns. While trauma frequencies are useful for making comparisons across studies and sites in a population approach, they are not true population-level estimates of violence in a population. The frequencies of violent injuries on skeletons interred at Norris Farms #36 are some of the highest reported from prehistoric North America. These high frequencies are not what constitute the substance of Milner and colleagues’ (Milner and Smith 1989, 1990, Milner et al. 1991; Milner 1995) seminal studies. Rather, their work found evidence to address problems like: who was killed; where were people killed; and how was warfare practiced at Norris Farms #36? Shifting bioarchaeology away from its focus on frequency in future work may aid in understanding broader societal, demographic, and behavioral correlates of war through empirical research.

Similarly, an overemphasis on frequency reporting has not promoted sufficient theorizing on archaeological studies of prehistoric peace. This emphasis on the presence of violent trauma, particularly in publications, has limited assessments of societies where violent trauma is absent or present in low frequencies. Once large-scale baseline studies have been conducted documenting prehistoric societies with high frequencies of war or existing during long periods of peace, attention can turn to understanding societal differences leading to these sociopolitical outcomes. Such studies have great potential for understanding the correlates of war and peace in contemporary society and may help decrease warfare participation in the future.
Results also demonstrated that behavioral models explored using multiple lines of evidence are promising ways to distinguish between causes of violence. These models should not be applied cross-culturally, but developed uniquely for each culture with consideration of appropriate behavioral variations. Moreover, placing ethnocentric and contemporary behavioral expectations on past peoples inhibits the explanatory power of bioarchaeological models. For instance, an ethnocentric understanding of domestic violence as battering and a lack of modeling for female-male domestic violence may have limited the domestic violence model in this study. Yet, Eastern Woodlands and Plains ethnohistoric accounts did not speak to this practice so developing a more culturally specific model was not possible for this research. It appears that the types of domestic violence experienced by CIV Mississippians occurred more situationally and better follows a model of wife-beating than wife-battering.

Similarly, the patterns expected for war captives were not evident in the data. The expectations for war captives may have been overly reliant on physical signs of violent maltreatment. As captivity may have included forced labor, additional lines of evidence, such as musculoskeletal markers indicative of repetitive activities or pathologies associated with stress, may improve bioarchaeological detection of war captives (e.g., Martin et al. 2010). The biodistance analysis used to distinguish war captives also may not have been sufficiently sensitive when biological variability was low for these individuals. Isotopic analyses of residential mobility should be conducted in the future to identify non-local war captives.

The results presented here may also have underestimated skeletal trauma from Dickson Mounds. Alan Harn’s excavation notes may have information regarding
additional cases of trauma in Dickson Mounds skeletons that could not be assessed in this research, although his data are still being analyzed. These individuals reportedly had projectile points embedded in bone, but the relevant skeletal elements and their points are now missing from ISM collections in the years since the excavation (Dawn Cobb, personal communication 2015). Confirmation of this information, however, will have to wait until the planned publication of Alan Harn’s Dickson Mounds report.

This research’s findings support an association between war and intragroup violence during the Mississippian Period of the Central Illinois Valley. It also demonstrated, however, that studying the past does not just inform humanity about prehistoric and historic events. Rather, a rich understanding of the past generates insight into the causes and the solutions to contemporary problems. Perhaps by recognizing that the high rate of intragroup violence participated in by contemporary soldiers has some of its roots in millennia old warfare practices, research may then turn to examining the methods utilized in both western and nonwestern societies to socialize soldiers for warfare violence and identifying ways to change the violence inducing behaviors. In this manner, bioarchaeological research promotes the contextualization of contemporary problems through an understanding of history and addresses problems relevant to both the past and the present.
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Verschuer, Otmar

Vitzthum, Virginia J.

Vogel, Joseph O., and Jean Allan

Vradenburg, Joseph A.

Vradenburg, Joseph A., and Eric Hollinger

Walker, Phillip L.

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—
Walker, Phillip L., Della C. Cook, and Patricia M. Lambert

Wallerstein, Immanuel

Waring, Antonio J., and Preston Holder

Wason, Paul K.

Webb, Stephen

Webb, William S., and David L. DeJarnette

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Weiss-Krejci, Estella

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Wescott, Daniel J.

Weston, Theresia Christine

Wheatley, Bruce P.

Wheeler, Sandra M., Lana Williams, Patrick Beauchesne, and Tosha L. Dupras

White, Tim D.

Whitehead, Neil L.

Whitley, James

Whittlesey, Stephanie, and J. Jefferson Reid

Wiant, Michael D.
Wieberg, Danielle A. M., and Daniel J. Wescott

Wilkinson, Leland, Grant Blank, and Chris Gruber

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Zylke, Jody W.  
APPENDIX A

TRAUMA WITHIN-SITE SUMMARIES
This appendix summarizes the within-site age, sex, and trauma patterns for individuals from Dickson Mounds, Crable, Emmons, Berry, and Larson. Descriptions of individual traumatic lesions are presented. Additionally, skeletal element distributions of skull blunt-force trauma are also reported in the text.

**Dickson Mounds**

Seven Dickson Mounds individuals, all males, exhibited violent injuries (Table A.1). Six were adults at the time of death and one was an adolescent. Healed blunt-force wounds to the skull were most common. Cut marks consistent with scalping were present on the frontal bone of Dickson Burial 380. Site reports also list an embedded projectile a lower thoracic vertebra of Burial 380. The vertebra was not present, however, at the time of analysis, and it therefore could not be independently evaluated. Dickson Burial 287, a young adult male, exhibited a slicing wound from a projectile point to the left first rib (Figure A.1). The projectile point was found shattered with his chest cavity. Dickson Burials 432 and 1000 exhibited nasal fractures. Burial 432 also had a healing fracture of the distal diaphysis of the right ulna. Dickson Burials 443 and 451 exhibited healed depression fractures to the cranial vault. Burial 443, an adolescent male, displayed a healed depression fracture to the right parietal bone, while Burial 451 had two depressions to the left aspect of the frontal squama. Burial 560 displayed the largest cranial blunt-force wound (Figure A.2), a healed elliptical wound located on the right parietal. The concavity, consistent with a blow from a club or celt, extended several millimeters into the calvarium.
Table A.1. Dickson Mounds Demographic Frequencies by Trauma Type.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age-at-Death</th>
<th>Scalping</th>
<th>Projectile Injury</th>
<th>Healed CBFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescent</td>
<td>0/4</td>
<td>0/4</td>
<td></td>
<td>0/4</td>
</tr>
<tr>
<td>Adult</td>
<td>0/87</td>
<td>0/87</td>
<td></td>
<td>0/87</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescent</td>
<td>0/4</td>
<td>0/4</td>
<td></td>
<td>25% (1/4)</td>
</tr>
<tr>
<td>Adult</td>
<td>1% (1/110)</td>
<td>1.8% (2/110)</td>
<td></td>
<td>2.7% (3/110)</td>
</tr>
<tr>
<td>Indeterminate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult</td>
<td>0/241</td>
<td>0/241</td>
<td></td>
<td>0/241</td>
</tr>
<tr>
<td>Adult</td>
<td>0/56</td>
<td>0/56</td>
<td></td>
<td>0/56</td>
</tr>
</tbody>
</table>

Figure A.1. Projectile Wound to the Left Rib of Dickson Mounds Burial 287.
Crable

Consistent with the other CIV sites, healed cranial blunt-force wounds are the most frequent injuries to individuals from Crable (Table A.2). Over nine percent of adult females and approximately 20% of adult males exhibited at least one healed cranial blunt-force injury. Most cranial blunt-force injuries at Crable are directed to the face, and few appear to have been caused by blows to the back of the head. Two females exhibited healed nasal fractures, and three presented one healed depression fracture to the cranial vault (two to the right frontal squama, one to the left parietal bone). No female displayed
more than one injury at Crable. Four Crable males suffered healed nasal fractures, one of whom, Inventory #4701, also had a healed depression fracture to the left frontal bone. The nine other males presented cranial vault trauma. The frontal bone was the most common element affected, identified in seven individuals. Three depression fractures to the frontal bone were found on Individual #4737. Only two adult males exhibited parietal injuries. Crable Inventory #9918 presented one healed wound to the right parietal bone, while Inventory #8066 showed two healed depressions to the left parietal.

Perimortem trauma was identified in three individuals buried at Crable (Table A.2). A middle adult male and a child of indeterminate sex exhibited cut marks on their skulls. The adult male exhibited perimortem cut marks to the right zygomatic bone, while the child, displayed more than 50 cut marks to the distal humeral diaphysis. Carnivore gnawing was evident on the bone’s distal-most margin, while a perimortem spiral fracture was present on the proximal end. Additionally, an adult of indeterminate sex displayed a perimortem depression fracture with a radiating fracture line on the right parietal (Figure A.3).

<table>
<thead>
<tr>
<th>Table A.2. Crable Demographic Frequencies by Trauma Type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Indeterminate</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Emmons

Table A.3 reports the frequencies of trauma type by demographic category for individuals from the Emmons site. Healed blunt-force wounds to the skull were the only trauma identified on Emmons skeletal remains. Fifty percent of adult females and over 38% of adult males displayed healed blunt-force to the skull. Nasal fractures were the most common of these skull injuries, found in six individuals (four adult females and two adult males). A young adult male also exhibited a healed malunion of the zygomatic
arch. Five individuals presented only one blunt-force trauma to the skull. Emmons Inventory #4299, a middle adult female, had a healed depression fracture on the right and left parietal bones. Healed frontal depression fractures were also found for an adolescent of indeterminate sex, a child, and two middle adult females. Additionally, three individuals interred at Emmons exhibited more than one cranial vault blunt-force injury.

Emmons Inventory #2184, an old adult female, exhibited seven depressions distributed around the top and back of the cranium (Figure A.4). The depressions were severe and deeply impressed into the skull. A middle adult male and a middle adult female each displayed healed blunt-force depressions to the frontal and left parietal bones. The female may have also suffered from a possible fracture of the right fibula at midshaft.

Healed blunt-force injuries were also found on two subadults, an adolescent and a child.

<table>
<thead>
<tr>
<th>Table A.3. Emmons Demographic Frequencies by Trauma Type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Indeterminate</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Berry

Table A.4 reports the demographic frequencies and trauma types for individuals from the Berry site. Only three of the sixteen individuals sampled from Berry exhibited trauma, and blunt-force trauma to the skull was the only trauma documented. Berry Inventory #4298, a young adult female, presented with a healed depression fracture to the frontal squama, while a young adult male (Berry Inventory #4376) fractured his right nasal bone. Additionally, Berry Inventory #5111, an adult male, displayed a healed blunt-force wound to the right mandibular condyle. As most individuals recovered from Berry are represented by a single postcranial element, trauma frequencies are likely underenumerated.
Table A.4. Berry Demographic Frequencies by Trauma Type.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age-at-Death</th>
<th>Healed SBFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Adolescent</td>
<td>0/1</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>100% (1/1)</td>
</tr>
<tr>
<td>Male</td>
<td>Adolescent</td>
<td>0/0</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>66.7% (2/3)</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>Subadult</td>
<td>0/4</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>0/7</td>
</tr>
</tbody>
</table>

**Larson**

Scalping, healed and unhealed blunt-force trauma to the skull, and sharp-force trauma were identified in remains from Larson (Table A.5). One adult male and one adult female (Figure A.5) exhibited scalping cuts. The female, Burial #12B, also displayed an unhealed blunt-force trauma to the right mandibular corpus and ramus, and cut marks inferior to the right mandible mandibular condyle, and cut marks surrounding the mandibular notch. Perimortem cut marks to the skull were also found on Larson Burials 12C, 12D, and 12H, although they were too numerous and diffusely spread across muscle attachment sites to be convincing evidence of scalping. Larson Burial #12C, a young adult female, presented cut marks on the frontal, right and left parietal bones, the left mandibular ascending ramus, and the left ilium. Burning on Larson #12C’s skull is evidenced by areas of black and brown discolorations. Larson #12D, an adult of indeterminate sex, exhibited numerous cut marks distributed across the lateral walls of the right and left parietal bones. The cut marks clustered near the temporal line, the origin of the *temporalis* muscle, and are consistent with attempts to remove the mandible. The mandible was not recovered. Larson #12H, a child, exhibited seven cut marks to the left mandibular ascending ramus.
Healed cranial blunt-force trauma was relatively infrequent at Larson, present in only three individuals. Two adult males showed healed blunt-force head injuries. One male exhibited a depression fracture to the right parietal bone. The other male, displayed a healed nasal fracture, a healed fracture to the acromial end of the left clavicle, and spondylolysis of the fifth lumbar vertebra. Additionally, Larson Burial 8, a middle adult female, presented an unhealed blunt-force trauma to the mandible. This female also exhibited a healed transverse fracture to the sternal end of right rib #8 and a healing fracture to the right ulna diaphysis.

Table A.5. Larson Demographic Frequencies by Trauma Type.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age-at-Death</th>
<th>Scalping</th>
<th>Healed SBFT</th>
<th>Unhealed SBFT</th>
<th>SFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Adolescent</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>14.3% (1/7)</td>
<td>0/7</td>
<td>28.6% (2/7)</td>
<td>28.6% (2/7)</td>
</tr>
<tr>
<td>Male</td>
<td>Adolescent</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>16.7% (1/6)</td>
<td>33.3% (2/6)</td>
<td>0/6</td>
<td>0/6</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>Subadult</td>
<td>0/5</td>
<td>0/5</td>
<td>0/5</td>
<td>20.0% (1/5)</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>0/1</td>
<td>0/1</td>
<td>0/1</td>
<td>100% (1/1)</td>
</tr>
</tbody>
</table>
Figure A.5. Larson Burial 12B Scalping Cuts.
APPENDIX B

ASSOCIATED ARTIFACT ANALYSIS
Results for the artifact analyses summarized in Chapter Six are presented here. Comparisons of artifact counts, classes, and material composition are compared between individuals with and without trauma interred at Dickson Mounds, Larson, and Emmons.

**Dickson Mounds**

Associated artifacts were infrequently recovered from Dickson Mounds burials. Nearly three-quarters of Mississippian individuals were interred without grave goods (Table B.1), while over one-quarter of Mississippian individuals were buried with associated artifacts. Individuals with trauma from Dickson Mounds are more likely to be interred with associated artifacts than the individuals without trauma (Table B.2), and a Fisher’s Exact Test found a statistically significant difference \((p = 0.018)\) between these males. Extensive looting and disturbance of Dickson Mounds graves, however, likely disproportionately influence these statistics. It is assumed that graves contained greater frequencies of artifacts than were recovered from the contemporary Dickson excavations.

**Table B.1. Frequencies of Artifact Presence or Absence in Dickson Mounds Graves.**

<table>
<thead>
<tr>
<th>Grave Artifacts</th>
<th>n of Graves</th>
<th>% of Graves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>365</td>
<td>72.7%</td>
</tr>
<tr>
<td>Present</td>
<td>137</td>
<td>27.3%</td>
</tr>
</tbody>
</table>

**Table B.2. Frequencies of Artifact Presence or Absence in Dickson Mounds Graves by Trauma Presence.**

<table>
<thead>
<tr>
<th>Trauma</th>
<th>Artifacts Present</th>
<th>Artifacts Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>5 (71.4%)</td>
<td>2 (28.6%)</td>
</tr>
<tr>
<td>Absent</td>
<td>132 (26.7%)</td>
<td>363 (73.3%)</td>
</tr>
</tbody>
</table>

As only Dickson Mounds males displayed osteological trauma indicative of interpersonal violence, the following analyses assess artifact presence for males alone.

Seventy-one percent of males with trauma were interred with at least one artifact (Table
B.3). In contrast, only 31.4% of male graves without trauma were buried with an artifact. A statistically significant difference in presence of associated artifacts in the grave was calculated between males with trauma and males without trauma using a Fisher’s Exact Test (p = 0.034). The strength of this significance, however, is weaker than that for Table B.2, which compares individuals with trauma and the total Dickson Mounds cemetery sample and includes females and subadults.

Table B.3. Frequencies of Artifact Presence or Absence in Dickson Mounds Male Graves by Trauma Presence

<table>
<thead>
<tr>
<th>Trauma</th>
<th>Artifacts Present</th>
<th>Artifacts Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>5 (71.4%)</td>
<td>2 (28.6%)</td>
</tr>
<tr>
<td>Absent</td>
<td>34 (31.4%)</td>
<td>74 (68.5%)</td>
</tr>
</tbody>
</table>

Table B.4 reports the descriptive statistics for the artifact counts among males with and without violent at Dickson Mounds who were buried with at least one funerary accompaniment. An average number of 3.07 and median of two artifacts were calculated for individuals who do not display trauma. Approximately 43% of Dickson Mounds males without trauma had only one grave good in association. The high standard deviation in this sample (43.517) indicates a large range of variability in grave good frequencies. The finding for high variability is supported by the large skewness and kurtosis statistics. The data is non-normally distribution with a large left skew in the data for individuals with trauma. Taken in sum, artifact frequencies between males who exhibit trauma and those without trauma are not inconsistent when outliers are not considered. Consequently, other measures of central tendency, like the median value, may better describe the sample than the mean. In fact, differences in median values...
between males with trauma and males without trauma, four and two respectively, are more similar than their means (Table B.4).

**Table B.4. Dickson Mounds Artifact Count Univariate Statistics for All Individuals by Trauma Presence.**

At Least One Artifact Must Be Present In Grave for Inclusion in Analysis.

<table>
<thead>
<tr>
<th>Trauma</th>
<th>mean</th>
<th>s.d.</th>
<th>mode</th>
<th>median</th>
<th>range</th>
<th>skewness</th>
<th>kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>23.20</td>
<td>43.517</td>
<td>N/A*</td>
<td>4</td>
<td>1 - 101</td>
<td>2.230</td>
<td>4.977</td>
</tr>
<tr>
<td>Absent</td>
<td>3.07</td>
<td>3.811</td>
<td>1</td>
<td>2</td>
<td>1 - 27</td>
<td>3.476</td>
<td>14.896</td>
</tr>
</tbody>
</table>

*N*No mode is present as each value is unique.

Univariate statistics comparing total artifact counts for males with and without trauma are reported in Table B.5. Individuals must have at least one artifact present for inclusion in the analysis. Male graves with trauma have a higher mean number of artifacts ($\bar{x} = 23.20$) than male graves without trauma ($\bar{x} = 3.07$). The large standard deviation for total artifact counts for males with trauma indicates large variation in the data. The unusually high number of objects (101) interred with Burial 1000 causes most of this variation. For comparison, an individual buried with six objects has the next highest number of total artifacts. This high degree of variation in the data is confirmed by the statistically significant result of the Levene’s Test for Equality of Variances ($F = 33.212$, $p = 0.000$). However, a t-test with equal variance not assumed does not reveal significant differences in total artifact count mean values ($t = -0.952$, $df = 4.023$, $p = 0.395$). Additionally, removing Burial 1000 from the analysis returns a nonsignificant Levene’s test F-value, allowing equal variances to be assumed ($F = 1.314$, $p = 0.260$). A t-test with Burial 1000 removed also confirms the finding that no significant difference in total artifacts is present between males with and without trauma ($t = -0.724$, $df = 109$, $p = 0.471$).
Table B.5. Univariate Statistics for Dickson Mounds Male Total Artifact Count.
At Least One Artifact Must Be Present for Inclusion in Analysis.

<table>
<thead>
<tr>
<th>Male Trauma</th>
<th>n</th>
<th>mean</th>
<th>s.d.</th>
<th>mode</th>
<th>median</th>
<th>range</th>
<th>skewness</th>
<th>kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>5</td>
<td>23.20</td>
<td>43.517</td>
<td>N/A*</td>
<td>4</td>
<td>2 - 101</td>
<td>2.230</td>
<td>4.977</td>
</tr>
<tr>
<td>Absent</td>
<td>31</td>
<td>3.07</td>
<td>5.788</td>
<td>1</td>
<td>3</td>
<td>1 - 27</td>
<td>2.573</td>
<td>7.056</td>
</tr>
</tbody>
</table>

*No mode is present as each value is unique.

Artifact Classes

Dickson Mounds male graves were interred with a variety of artifact classes, including rattles, projectile points, shell pendants, chert scrapers. Table B.6 displays the grave good class frequencies differentiated by males with and without skeletal trauma who have at least one artifact in association. Males with trauma were interred with higher percentages of copper ear spools, bone pins, and chert scrapers, while males without skeletal trauma were buried with higher percentages of pottery, shell spoons, and chert projectile points. Males with and without violent trauma were interred with high percentages of chert projectile points. As cells for most variables have less than five artifacts, significance testing was not conducted.
Table B.6. Grave Good Class Frequency in Dickson Mounds Male Graves by Trauma Presence.

<table>
<thead>
<tr>
<th>Artifact Class</th>
<th>Trauma Present</th>
<th>Trauma Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=5</td>
<td>n=36</td>
</tr>
<tr>
<td>n of Individuals with Artifacts Present</td>
<td>%</td>
<td>n of Individuals with Artifacts Present</td>
</tr>
<tr>
<td>Rattle/Clacker</td>
<td>1 20%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Paint Palette</td>
<td>1 20%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Stone Celts</td>
<td>1 20%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Beaver Incisor Chisel</td>
<td>1 20%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Animal Burial</td>
<td>1 20%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Antler Artifact</td>
<td>1 20%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Shell Bead Ornament</td>
<td>1 20%</td>
<td>3 9.7%</td>
</tr>
<tr>
<td>Bone Needle</td>
<td>0 0%</td>
<td>2 6.5%</td>
</tr>
<tr>
<td>Cut Bird Bone</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Bird Wing Fan</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Bone Artifact</td>
<td>1 20%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Bone Fishhook</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Bone Awl</td>
<td>1 20%</td>
<td>2 6.5%</td>
</tr>
<tr>
<td>Bone Pin</td>
<td>2 40%</td>
<td>3 9.7%</td>
</tr>
<tr>
<td>Chert Object</td>
<td>1 20%</td>
<td>3 9.7%</td>
</tr>
<tr>
<td>Chert Debitage</td>
<td>1 20%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Chert Knife</td>
<td>1 20%</td>
<td>4 12.9%</td>
</tr>
<tr>
<td>Chert Projectile Point</td>
<td>4 80%</td>
<td>10 32.3%</td>
</tr>
<tr>
<td>Chert Scraper</td>
<td>3 60%</td>
<td>4 12.9%</td>
</tr>
<tr>
<td>Chert Utilized Flake</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Stone Abrader</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Stone Artifact</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Stone Plummet</td>
<td>1 20%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Copper Ear Spool</td>
<td>2 40%</td>
<td>2 6.5%</td>
</tr>
<tr>
<td>Shell Pendant</td>
<td>1 20%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Pigment</td>
<td>1 20%</td>
<td>6 19.4%</td>
</tr>
<tr>
<td>Pipe</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Pottery</td>
<td>1 20%</td>
<td>12 38.7%</td>
</tr>
<tr>
<td>Shell Artifact</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Shell Spoon</td>
<td>0 0%</td>
<td>11 35.5%</td>
</tr>
<tr>
<td>Unmodified Shell</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Unmodified Stone</td>
<td>0 0%</td>
<td>1 3.2%</td>
</tr>
<tr>
<td>Textile</td>
<td>1 20%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>
When all males are included in the analysis, regardless whether or not they have at least one artifact in association, statistically significant differences are found between males with and without skeletal trauma for four variables: bone pins, chert projectile points, chert scrapers, and copper ear spools (Table B.7). In a comparison between males with and without trauma interred with at least one artifact, only bone pin presence remains statistically significant (Table B.8).
Table B.7. Fisher’s Exact Tests of Artifact Class Frequencies in Graves of Dickson Mounds Males by Trauma Presence.  
All Males were Included in the Analysis.

<table>
<thead>
<tr>
<th>Artifact Class</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rattle/Clacker</td>
<td>0.122</td>
</tr>
<tr>
<td>Paint Palette</td>
<td>0.122</td>
</tr>
<tr>
<td>Stone Celts</td>
<td>0.062</td>
</tr>
<tr>
<td>Beaver Incisor Chisel</td>
<td>0.122</td>
</tr>
<tr>
<td>Animal Burial</td>
<td>0.122</td>
</tr>
<tr>
<td>Antler Artifact</td>
<td>0.062</td>
</tr>
<tr>
<td>Shell Bead Ornament</td>
<td>0.230</td>
</tr>
<tr>
<td>Bone Needle</td>
<td>1.000</td>
</tr>
<tr>
<td>Cut Bird Bone</td>
<td>1.000</td>
</tr>
<tr>
<td>Bird Wing Fan</td>
<td>1.000</td>
</tr>
<tr>
<td>Bone Artifact</td>
<td>0.062</td>
</tr>
<tr>
<td>Bone Fishhook</td>
<td>1.000</td>
</tr>
<tr>
<td>Bone Awl</td>
<td>0.178</td>
</tr>
<tr>
<td>Bone Pin</td>
<td>0.031*</td>
</tr>
<tr>
<td>Chert Object</td>
<td>0.115</td>
</tr>
<tr>
<td>Chert Debitage</td>
<td>0.122</td>
</tr>
<tr>
<td>Chert Knife</td>
<td>0.280</td>
</tr>
<tr>
<td>Chert Projectile Point</td>
<td>0.004*</td>
</tr>
<tr>
<td>Chert Scraper</td>
<td>0.005*</td>
</tr>
<tr>
<td>Chert Utilized Flake</td>
<td>1.000</td>
</tr>
<tr>
<td>Stone Abrader</td>
<td>1.000</td>
</tr>
<tr>
<td>Stone Artifact</td>
<td>1.000</td>
</tr>
<tr>
<td>Stone Plummets</td>
<td>0.062</td>
</tr>
<tr>
<td>Copper Ear Spool</td>
<td>0.019*</td>
</tr>
<tr>
<td>Shell Pendant</td>
<td>0.062</td>
</tr>
<tr>
<td>Pigment</td>
<td>0.372</td>
</tr>
<tr>
<td>Pipe</td>
<td>1.000</td>
</tr>
<tr>
<td>Pottery</td>
<td>0.589</td>
</tr>
<tr>
<td>Shell Artifact</td>
<td>1.000</td>
</tr>
<tr>
<td>Shell Spoon</td>
<td>1.000</td>
</tr>
<tr>
<td>Unmodified Shell</td>
<td>1.000</td>
</tr>
<tr>
<td>Unmodified Stone</td>
<td>1.000</td>
</tr>
<tr>
<td>Textile</td>
<td>0.062</td>
</tr>
</tbody>
</table>

*Denotes statistical significance
Table B.8. Fisher’s Exact Tests of Artifact Class Frequencies in Male Graves by Trauma Presence.
At Least One Artifact Must Be Present in Grave for Inclusion in Analysis.

<table>
<thead>
<tr>
<th>Artifact Class</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone Pin</td>
<td>0.132</td>
</tr>
<tr>
<td>Chert Projectile Point</td>
<td>0.064</td>
</tr>
<tr>
<td>Chert Scraper</td>
<td>0.040*</td>
</tr>
<tr>
<td>Copper Ear Spool</td>
<td>0.084</td>
</tr>
</tbody>
</table>

*Denotes statistical significance

Univariate statistics of number artifact classes recovered from male graves containing at least one artifact do not suggest large differences between males with and without trauma from Dickson Mounds (Table B.9). Comparison of artifact class frequencies using a traditional t-test, however, is precluded by high variance in the sample identified in a Levene’s Test for Equality of Variances (f = 12.436, p = 0.001). As a result, the independent samples t-test was run with calculated variances assumed. No statistically significant differences in counts of discrete artifact classes were calculated (t = -0.990, df = 4.122, p = 0.377).

Table B.9. Dickson Mounds Artifact Class Count Univariate Statistics for All Individuals with Trauma Present or Absent.
At Least One Artifact Must Be Present In Grave for Inclusion in Analysis.

<table>
<thead>
<tr>
<th>Male Trauma</th>
<th>mean</th>
<th>s.d.</th>
<th>mode</th>
<th>median</th>
<th>range</th>
<th>skewness</th>
<th>kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>5.60</td>
<td>6.986</td>
<td>3</td>
<td>3</td>
<td>1–18</td>
<td>2.147</td>
<td>4.717</td>
</tr>
<tr>
<td>Absent</td>
<td>2.06</td>
<td>2.143</td>
<td>N/A*</td>
<td>2</td>
<td>1–10</td>
<td>2.36</td>
<td>5.547</td>
</tr>
</tbody>
</table>

*Multiple modes exist.

Artifact Materials

Items composed of copper, shell, stone, minerals, bone, tooth, antler, pearl, and ceramic were recovered from Dickson Mounds Mississippian burial contexts. Two textile fragments were found adhering to the thoracic vertebrae of Burial 1000 were the only perishable items recovered. Males at Dickson Mounds were interred most often
with bone, chert, ceramic and shell objects. Antler, tooth, and textile materials were recovered infrequently from male graves.

Table B.10 reports the artifact material frequencies between males who exhibit violent trauma to those without trauma. At least one artifact must be present for inclusion in the analysis. Dickson Mounds male graves included: antler, bone, chert, copper, sandstone, other stone or minerals, ceramics, shell, tooth, and textile artifacts. Chert artifacts were recovered among male burials with and without trauma in high frequencies. Bone materials were also commonly recovered for both variables. No male grave artifact inclusions material compositions distinguish males with trauma and males without trauma. Results of a Fisher’s Exact Test of artifact material types found with males with and without trauma are reported Table B.11. No statistically significant differences were identified for any variable.

### Table B.10. Grave Good Material Frequencies in Dickson Mounds Male Graves with Trauma Compared to Males without Trauma.

<table>
<thead>
<tr>
<th>Artifact Material</th>
<th>Trauma Present n=5</th>
<th>Trauma Absent n=36</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Antler</td>
<td>1</td>
<td>20%</td>
</tr>
<tr>
<td>Bone</td>
<td>3</td>
<td>60%</td>
</tr>
<tr>
<td>Chert</td>
<td>4</td>
<td>80%</td>
</tr>
<tr>
<td>Copper</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>Sandstone</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>Stone-Other</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>Ceramic</td>
<td>1</td>
<td>20%</td>
</tr>
<tr>
<td>Shell</td>
<td>1</td>
<td>20%</td>
</tr>
<tr>
<td>Tooth</td>
<td>1</td>
<td>20%</td>
</tr>
<tr>
<td>Textile</td>
<td>1</td>
<td>20%</td>
</tr>
</tbody>
</table>
Table B.11. Fisher’s Exact Tests of Artifact Material Frequencies in Dickson Mounds Male Graves by Trauma Presence

<table>
<thead>
<tr>
<th>Artifact Material</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antler</td>
<td>0.139</td>
</tr>
<tr>
<td>Bone</td>
<td>0.119</td>
</tr>
<tr>
<td>Chert</td>
<td>0.342</td>
</tr>
<tr>
<td>Copper</td>
<td>0.084</td>
</tr>
<tr>
<td>Sandstone</td>
<td>0.132</td>
</tr>
<tr>
<td>Stone-Other</td>
<td>0.603</td>
</tr>
<tr>
<td>Ceramic</td>
<td>0.634</td>
</tr>
<tr>
<td>Shell</td>
<td>0.342</td>
</tr>
<tr>
<td>Tooth</td>
<td>0.262</td>
</tr>
<tr>
<td>Textile</td>
<td>0.139</td>
</tr>
</tbody>
</table>

Males with and without violent trauma cannot be distinguished using counts of discrete grave good materials. While males who exhibit violent trauma have higher average discreet material counts, these numbers are inflated by Burial 1000’s high artifact class counts. Median values, which likely better represent the sample characteristics, are equal for both variables (Table B.12). These conclusions are supported by the results of a Levene’s Test for Equality of Variances ($F = 9.325, p = 0.004$) and an independent samples t-test ($t = -0.932, df = 4.156, p = 0.402$). The statistically significant p-value for the Levene’s Test identified unequal variances between the variables. With unequal sample variances are assumed, the t-test for equality of discreet male grave good counts between males with trauma present and absent is not statistically significant.

Table B.12. Dickson Mounds Artifact Material Count Univariate Statistics for All Individuals with Trauma Present or Absent.

<table>
<thead>
<tr>
<th>Male Trauma</th>
<th>mean</th>
<th>s.d.</th>
<th>mode</th>
<th>median</th>
<th>range</th>
<th>skewness</th>
<th>kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>3.60</td>
<td>3.647</td>
<td>2</td>
<td>2</td>
<td>1-10</td>
<td>2.029</td>
<td>4.272</td>
</tr>
<tr>
<td>Absent</td>
<td>2.06</td>
<td>1.263</td>
<td>N/A*</td>
<td>2</td>
<td>1-6</td>
<td>1.568</td>
<td>2.431</td>
</tr>
</tbody>
</table>

*Multiple modes exist.
Larson

Table B.13 shows the frequencies of presence and absence of associated artifacts interred with individuals from Larson. Only one individual, a middle adult male, had any artifacts in association. A piece of jasper was recovered beneath his left hand. This individual, Burial 11, did not exhibit violent trauma. The paucity of associated burial goods at Larson precludes any further analysis of mortuary artifact associations.

<table>
<thead>
<tr>
<th>Associated Mortuary Artifacts</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>1</td>
<td>4.8%</td>
</tr>
<tr>
<td>Absent</td>
<td>20</td>
<td>95.2%</td>
</tr>
</tbody>
</table>

Emmons

Analysis of mortuary artifact associations originates from Morse and colleague’s (1961) excavation of 84 individuals. Seventy-five of these individuals were not available for analysis. Only three individuals with trauma and six individuals without trauma were assessed in this research. Additionally, Morse and colleague’s (1961) report an individual with an embedded arrow point in a tenth vertebra that was not present in the ISM collection. This individual, Burial 8, was included as exhibiting trauma for all Emmons artifact association tables, even though it was not subject to osteological examination.

Over 63% of Emmons individuals excavated by Morse and colleagues (1961) had funerary artifacts in association, while no artifacts were recovered for the remaining 36.9% of the cemetery (Table B.14). Additionally, three of the four individuals with violent trauma were interred with mortuary artifacts (Table B.15). All three were adult
males. A child with trauma, buried in a commingled “mass” grave context, did not have any artifacts in association.

Table B.14. Frequency of Associated Artifacts for All Emmons Individuals Excavated by Morse et al. (1961).

<table>
<thead>
<tr>
<th>Grave artifacts</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>31</td>
<td>36.9%</td>
</tr>
<tr>
<td>Present</td>
<td>53</td>
<td>63.1%</td>
</tr>
</tbody>
</table>

Table B.15. Frequency of Associated Artifacts for Emmons Individuals with Trauma Excavated by Emmons Morse et al. (1961).

<table>
<thead>
<tr>
<th>Grave artifacts</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Present</td>
<td>3</td>
<td>75%</td>
</tr>
</tbody>
</table>

Table B.16 presents the univariate statistics comparing the mortuary artifact associations for individuals with at least one artifact in association. Individuals with trauma were interred with a mean of nine artifacts, while those for whom trauma was absent or unobservable had a mean of two objects. Although the three individuals with trauma had artifacts counts in the upper 12% of all interments, the highest count in the sample (18) was associated with an individual without trauma. These results suggest that individuals with trauma were accompanied overall with greater frequencies of artifacts than the rest of the cemetery. The small sample size of individuals available for osteological examination, however, precluded hypothesis testing.

Table B.16. Univariate Statistics for Emmons Total Associated Artifact Counts.

<table>
<thead>
<tr>
<th>Trauma</th>
<th>n</th>
<th>mean</th>
<th>s.d.</th>
<th>mode</th>
<th>median</th>
<th>range</th>
<th>skewness</th>
<th>kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>51</td>
<td>9</td>
<td>5.196</td>
<td>6</td>
<td>6</td>
<td>6 - 15</td>
<td>1.732</td>
<td>N/A†</td>
</tr>
<tr>
<td>Absent</td>
<td>2</td>
<td>3.2</td>
<td>3.393</td>
<td>1</td>
<td>2</td>
<td>1 - 18</td>
<td>2.454</td>
<td>7.219</td>
</tr>
</tbody>
</table>

†Small sample size precluded calculation.
Artifact Classes

Twenty-one artifact classes were interred with the individuals buried at Emmons (Table B.17). Pottery was the most ubiquitous artifact class in the sample, present in 42.5% of individuals without trauma and 66.7% of individuals with trauma. Shell spoons, chert knives, and projectile points were also common in both individuals with and without trauma. While infrequently recovered, sheet copper, hair rings, scarifiers, bone pins, and chert scrapers were also present with individuals who exhibit trauma.

<table>
<thead>
<tr>
<th>Artifact Class Present</th>
<th>Trauma Present n=3</th>
<th>Trauma Absent/Unobservable n=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pottery</td>
<td>2 66.7%</td>
<td>34 42.5%</td>
</tr>
<tr>
<td>Effigy Pottery</td>
<td>0 0%</td>
<td>6 7.5%</td>
</tr>
<tr>
<td>Shell Spoon</td>
<td>1 33.3%</td>
<td>17 21.3%</td>
</tr>
<tr>
<td>Copper Ear Spool</td>
<td>0 0%</td>
<td>2 2.5%</td>
</tr>
<tr>
<td>Sheet Copper</td>
<td>1 33.3%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Human Face Effigy Mask</td>
<td>0 0%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Hair Ring</td>
<td>1 33.3%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Rattle/Clacker</td>
<td>0 0%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Scarifier</td>
<td>1 33.3%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Animal Burial</td>
<td>0 0%</td>
<td>2 2.5%</td>
</tr>
<tr>
<td>Bead Adornment</td>
<td>0 0%</td>
<td>6 7.5%</td>
</tr>
<tr>
<td>Bone Needle</td>
<td>0 0%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Bone Ring</td>
<td>0 0%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Bone Pin</td>
<td>1 33.3%</td>
<td>3 3.8%</td>
</tr>
<tr>
<td>Chert Graver</td>
<td>0 0%</td>
<td>2 2.5%</td>
</tr>
<tr>
<td>Chert Knife</td>
<td>2 66.7%</td>
<td>15 18.8%</td>
</tr>
<tr>
<td>Chert Projectile Point</td>
<td>2 66.7%</td>
<td>7 8.8%</td>
</tr>
<tr>
<td>Chert Scraper</td>
<td>1 33.3%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Pendant</td>
<td>0 0%</td>
<td>2 2.5%</td>
</tr>
<tr>
<td>Unmodified Stone</td>
<td>0 0%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Copper Covered Wood</td>
<td>0 0%</td>
<td>1 1.3%</td>
</tr>
<tr>
<td>Object</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Artifact Materials

Table B.18 reports the artifact materials in graves of individuals with trauma and individuals without trauma. Materials interred with individuals at Emmons include: bone, chert, other stone or mineral, ceramic, shell, wood, copper, and pearl. Ceramic and shell materials were the most ubiquitous materials placed in Emmons graves. Items composed of wood, pearl, copper, and non-chert stones or minerals were infrequently recovered. Bone and chert materials were included with three individuals with trauma who had at least one grave artifact present, although bone and chert was also found in high frequencies in graves of individuals without trauma. While rare, ceramic, shell, and copper composed items were also recovered from graves of individuals with trauma.

<table>
<thead>
<tr>
<th>Artifact Material</th>
<th>Trauma Present n=3</th>
<th>Trauma Absent/Unobservable n=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone</td>
<td>3 100%</td>
<td>7 14%</td>
</tr>
<tr>
<td>Chert</td>
<td>3 100%</td>
<td>17 34%</td>
</tr>
<tr>
<td>Stone-Other</td>
<td>0 0%</td>
<td>3 6%</td>
</tr>
<tr>
<td>Ceramic</td>
<td>1 33.3%</td>
<td>39 78%</td>
</tr>
<tr>
<td>Shell</td>
<td>1 33.3%</td>
<td>23 46%</td>
</tr>
<tr>
<td>Wood</td>
<td>0 0%</td>
<td>1 2%</td>
</tr>
<tr>
<td>Copper</td>
<td>1 33.3%</td>
<td>2 4%</td>
</tr>
<tr>
<td>Pearl</td>
<td>0 0%</td>
<td>1 2%</td>
</tr>
</tbody>
</table>