A BIOCULTURAL PERSPECTIVE ON SEX AND GENDER IN LATE PREHISTORIC WEST CENTRAL ILLINOIS: GROWTH PATTERNS, MISSISSIPPIANIZATION, AND INTRACEMETERY SOCIAL DIFFERENTIATION

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ABSTRACT

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Uncontextualized sex-based analyses of stress and health provide simplistic, essentialized perspectives on trends among males and females in general, propagating the idea of a singular experience of "maleness" or "femaleness." A research design that incorporates multiple social units of analysis avoids essentialization of the experiences of men and women by providing a means of discovering the ways stress and growth might vary within each sex, related to social factors like status, kinship, and/or community/corporate membership. The research outlined here incorporates a traditional, sex-based perspective on growth patterns over the Late Woodland-Mississippian transition in West Central Illinois. However, detailed artifactual and spatial analyses of the Mississippian component of the Schild cemetery allows for further division of this portion of the sample into finer scale, socially meaningful units of analysis, which leads to a more engendered interpretation of biological patterns and contributes to reconstructions of gendered social identity.

Linear enamel hypoplasia (LEH) is used to isolate early childhood stress experiences, while femur length is used to assess cumulative growth, which continues into early adulthood. A less traditional method of growth assessment based on vertebral dimensions is also incorporated. Vertebral arch growth is complete by early childhood, and it has been hypothesized that neural canal diameter (NCD) can be used as indicator of early childhood growth corresponding roughly to the same period as LEH formation. Vertebral body height (VBH) increases until early

adulthood, corresponding closely with the timing of femoral growth. Comparison between these four indicators provides a detailed account of growth experience as well as a new test of the vertebral method. Diachronic analysis assesses differences in male and female growth trends over the Late Woodland-Mississippian transition, while more detailed analysis of the Schild Mississippian materials allows for an assessment of the ways that male and female growth patterns vary by burial treatment based on artifact assemblages, body positioning, burial areas, and charnel association.

Analysis of NCD suggest that the conditions of early childhood growth improved over the Late Woodland-Mississippian transition for females, while male growth patterns remained stable. Mississippian males experienced fewer LEH than their Late Woodland counterparts, with no corresponding change among females. Femur and VBH data indicate no change in cumulative growth patterns for either males or females over time. However, a closer examination of the Schild Mississippian component indicates intracemetery variation in these patterns among females, with those afforded certain burial treatments, those buried in particular areas, and those associated with charnel structures apparently experiencing better cumulative growth conditions than other females at the site. It is suggested that some women in the broader Schild Mississippian community experienced better biosocial circumstances of growth based on their association with certain status, kinship/community networks, and/or the timing of acculturation.

For Boomer-

You were not a *good* dog, but you were a *nice* dog.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE- INTRODUCTION

The Research Problem

The relationship between health status and social status has been noted by researchers studying both modern (Nguyen and Peschard 2003, Leatherman 1998) and past populations (Larsen 1997, Goodman 1998). Decreasing levels of community health and increasing status-related health differentials have been associated with transitions to agriculture and increased social complexity, in many cases involving concomitant increases in gender related health disparities (Ambrose and Buikstra 2003, Cohen and Bennett 1993, Cucina and Tiesler 2001, Lukacs 1992, White 2005). However, the particulars of the complex relationships between social complexity and heath disparities should not be simplified or generalized, especially when community or intracommunity perspectives are desired. For those with biocultural interests in the late prehistory of the Eastern United States, the spread of Mississippian culture/influence throughout the Midwest and its potential effects on social relations and health disparities in communities outside of the American Bottom provide a particularly fascinating case study.

This dissertation investigates the interrelationships between growth patterns, social identity, and social complexity through time on the Mississippian periphery using skeletal remains from the Late Woodland and Mississippian components of the Schild and Yokem sites in West Central Illinois. Changes in age-sensitive patterns of stress and growth between males and females are investigated through an analysis of enamel defects, long bone growth, and vertebral growth. Data is analyzed within a framework of existing mortuary data and interpreted with reference to contemporary gender scholarship and ideas regarding the specific nature of Mississippianization in West Central Illinois. This chapter will introduce the problems to be

investigated, make an argument for the suitability of a biocultural perspective for approaching these questions, outline general hypotheses, and briefly summarize results and interpretations.

Conceptual Framework

Late prehistoric West Central Illinois was occupied by a Late Woodland population that eventually became Mississippianized via acculturation and limited colonization (Delaney-Rivera 2004, 2007, Schroeder 2004). Consequently, by Mississippian times, these communities began to display mortuary patterns and material culture in keeping with the Mississippian phenomenon elsewhere in the region. By analyzing the skeletal series from the Schild and Yokem sites, the first consideration of this dissertation is a further investigation of the extent to which, in becoming Mississippianized, traditional social relations were transformed in these communities. It is clear that the nature of mortuary ritual was altered, but did these changes reflect concomitant changes in the lived experiences of people? Did changes in intracommunity social relations also occur or was the basic structure of daily life part of some body of social relations that was either maintained from the previous period or otherwise differentially incorporated? Can changing gender relations be detected osteologically as changes in relative stress, particularly insofar as differential occurrence of stress in males and females, as interpreted within the context of diachronic and intracommunity archaeological research? Is this type of phenomenon expressed similarly across the Mississippian world?

This study can be broken down into the following four areas:

1. **Diachronic Change**- Between the Late Woodland and Mississippian skeletal series at Schild and Yokem, are there changes in the overall frequency of osteological indicators of biological stress and growth? Do differences in these patterns correspond with sex and,

if so, how are these patterns similar or different between the Late Woodland and Mississippian components?

2. **Relating observed osteological patterns to gender transformations-** Can the observed stress and growth patterns in the Late Woodland and Mississippian series be interpreted in regard to possible gender-related health disparities and in terms of changing social structure and life ways at this time and place? Because gender, as a cultural construct, cannot be observed directly from skeletal remains, how does the explicit incorporation of mortuary analysis and age-sensitive osteological data clarify the sex-specific patterns of growth and stress observed in these skeletal series?
3. **Regional comparisons**- How do the observed patterns of gender-related health disparities and changes over time differ from what we see at other Mississippian villages and centers (i.e. Dickson mounds and American Bottom sites)? What does this mean as far as differential affects of Mississippianization between peripherally versus centrally located sites?
4. **Broader applications**- Given the results of this investigation, what can this study contribute to the broader body of knowledge regarding the relationship between health, gender/social identity, and cultural transitions? To what extent do outlying communities who are culturally/ethnically affiliated with core sites continue to exhibit traditional gender relations and patterns of community health in spite of having become part of a larger, more complex system? How can the answers to these questions contribute to a discussion of the extent of influence of centers over peripheral peoples or of the ability of peripheral peoples to selectively incorporate or resist certain aspects of the prevailing cultural pattern?

A combined osteological and archaeological approach allows for a biocultural exploration of these questions. Multiple indicators of early childhood and late adolescent growth were evaluated within a temporal and cultural framework and compared to published reports regarding local and regional health patterns. Linear enamel hypoplasia (LEH) and long bone length are frequently used measures of growth patterns and disruptions in bioarchaeological studies, but although several authors have noted the potential sensitivity of vertebral growth to stress related disruptions (Clark et al 1986, Larsen 1998, Hoppa and Fitzgerald 1999, Tatarek 1999, Porter 1985), few have applied this knowledge to bioarchaeological situations. Clark's (1985, 1988) vertebral morphometric method for growth assessment is intended to go beyond traditional methods of evaluating sexual dimorphism by distinguishing between chronic and acute growth disruptions, the recognition of which has culturally significant implications. The method is based on the observation that vertebral arch growth ceases before vertebral body growth (during childhood versus during late adolescence/early adulthood) (Clark 1988, Baker et al 2005). Clark suggests that analysis of the relationship between measurements of these two features may be useful in determining whether growth disruptions are chronic, resulting from generally continuous stress and deprivation throughout the growth period, or whether catch up growth occurred when stressful situations were eventually ameliorated later in childhood.

A Note on Terminology

Throughout this dissertation, the terms *sex, gender, male, female, man,* and *woman* are used frequently. Following Walker and Cook (1997), the term *sex* is used specifically to refer to the biological assignment of individuals into one of two categories: *male* or *female*. *Gender* refers to the variable and dynamic cultural values, ideas, expectations, and social roles collectively

recognized by a culture, based loosely on perceptions of biological sex and sexuality. *Man* and *woman* are gender terms used in Western societies to differentiate people within a binary gender framework. In this dissertation, these gender terms are used only when sex-based biological data has been interpreted within a cultural context provided by mortuary and archaeological studies. In general, then, sex terminology is employed when discussing uncontextualized data and when reviewing the results of statistical analyses, while gender terminology is used when discussing interpretations based on considerations of archaeological perspectives. It is known that many traditional Native American societies recognized three or more genders (Hollimon 2009), and it should be noted that some of the variation seen within male and female categories may, in part, reflect this.

Theoretical Framework

The Case for a Bioarchaeological Approach to Evaluating Prehistoric Social Change

Bioarchaeology refers to the integration of human biological remains and archaeological analysis in order to approach and integrate such topics as burial programs and social organizations, division of labor, paleodemography, diet, and disease. Although the term is used in Europe to refer to the analysis of any biological materials (i.e. faunal and botanical) from archaeological sites, American usage of the term refers specifically to the study of human remains (Buikstra 2006). Larsen (1997) contends that bioarchaeology, as a modern discipline, is inherently interpretive (as opposed to descriptive) and that bioarchaeological analysis takes place at the population level. Although the creation of descriptive osteological reports has long been standard practice in archaeological investigations, the tendency for bioarchaeologists to rigorously

incorporate social theory, analytical techniques, and statistical methods as a significant component of their work is a relatively recent phenomenon.

Bioarchaeological research is uniquely positioned on the cusp of biological and cultural studies of the human past. As such, this research is critical for investigating the interaction between health and the natural/social environment of past populations. The primary goal of the modern bioarchaeological approach is the development of a history of the human condition on local, regional, and global levels, and the methodologies available for accomplishing this goal are diverse and evolving (Larsen 1997, 2002; Knudson and Stowjanowski 2008). However, some have pointed out that progress in anthropological skeletal analysis has been severely hindered by the persistence of historical-typological approaches originating in racialized studies of the late eighteenth and early nineteenth centuries (Larsen 2002, Armelagos 2003, Woploff and Caspari 2000). Armelagos (2003) points out that even researchers such as E.A. Hooton, who are seen as pioneers in the biocultural and populational approaches, were not immune to tendencies toward static, typological constructions and failed to focus on heterogeneity, variability, and change as legitimate bases for osteological research. However, others suggest that, when evaluated within the context of their own historical situations, even the earliest bioarchaeological studies implicitly demonstrate the dynamic and interpretative attributes characteristic of the discipline in its modern iteration (Buikstra 2006, Cook 2006).

Although the modern American approach to bioarchaeological analysis emerged in the wake of the "New Archaeology," the advent of processualism (with its concomitant movement away from the culture-historical categorizations of the early twentieth century) and the availability of advanced statistical software may have done little more than superficially change the typological and static inter-populational comparisons that had previously dominated the field.

For example, Blakely (1998) shows that the continued application of a typological, racialized model of human biology resulted from (and reified) the institutionalized marginalization of minority ethnic groups. Furthermore, reliance on a purely biological model served to remove historic documents and artifactual analysis from the process, essentially hindering the construction of a socially meaningful research agenda and making it impossible to properly reconstruct ethnic identity (Blakely 1998, Goldstein 2006).

Larsen (2002) points to more recent processual studies that have moved away from typologies to address and explain change in human populations over time. He points out that, although critiques of the approach outlined above were increasingly common from the early 20th century onward, it is not until the last 20 years that these criticisms seem to make a real difference in the types of questions being asked by bioarchaeologists. Larsen suggests that the shift is due to 1) changing theoretical perspectives regarding the plasticity (as opposed to the fixity) of the human body, 2) a greater understanding of the biology of the skeleton and its relationship to the non-biological aspects of human existence, and 3) new methodologies for gleaning information from human bones. Furthermore, Knudson and Stowjanowski (2008) demonstrate that postmodern theoretical orientations in the social sciences have recently been melded with the bioevolutionary focus on change and variation to create a new bioarchaeological synthesis that focuses on social identities in the past. They argue that bioarchaeologists are in a unique position to contribute novel ideas regarding a range of social identities in the past, but that they can only do so through more rigorous application of social theory, archaeology, and ethnohistory. They also suggest that it is because of recent methodological advances in excavation, aging, sexing, and chemical and statistical analyses that appropriate data sets can

now be produced and interpreted through the lens of contemporary social science theory on identity (ethnic, gender, age, etc.), embodiment, and disability.

Postmodern social theory is not, however, the only means by which theoretically minded bioarchaeologists might uphold and expand upon the biocultural approach. For example, Smith and Thomas (1998) discuss the ways that biological anthropologists interested in modern and archaeological societies have explicitly incorporated political and economic theory as way to explain the relationship between class and health in modern populations. Explicitly Marxist approaches have led to deeper understandings of the relationship between social situation (including gender) and the body through the application of such concepts as dialectical adaptation, the political economy of human biology, and the development of a critical biological anthropology (Smith and Thomas 1998, Mascia-Lees and Black 2000). This approach allows for the incorporation of a sophisticated social theory while wholly preserving the materialist approach focusing on class and status differentials that many bioarchaeologists find appealing and useful.

One rapidly expanding area of archaeological interest is the analysis of gender in past populations (Hill 1997, Stig Sorenson 2000, Milledge Nelson and Rosen-Ayalon 2002). Walker and Cook (1998) and Armelagos (1998) have both decried the tendency of bioarchaeologists to use the terms sex and gender interchangeably and to treat sex as a direct proxy for gender in the archaeological record. They both insist that more care must be taken in the application of terminology, making it clear that sex refers to the biological differences between males and females, while gender refers to culturally-specific differentiation of social roles, relations, and ideologies, often based loosely on biological sex. Walker and Cook (1998) particularly

emphasize that sex-based bioarchaeological analyses must be nested securely in gender-based archaeology in order to appropriately engender our views of the past.

Gellar (2008) agrees with the above arguments on a general level, but criticizes the generalized and persistent ignorance of these issues in the bioarchaeological literature. Most bioarchaeologists have taken an essentialist view of differences between males and females and have failed to incorporate more than overly simplistic social theory when making gendered interpretations of the past. Her criticisms do not spare Walker and Cook (1998) and Armelagos (1998), who rely on decades-old gender literature rather than incorporating relevant contemporary social theory, resulting in superficial interpretations that serve to justify and naturalize modern western ideas about gender roles and relations. This has resulted at least in part from our reliance on biomedical approaches to sex and gender, which do not incorporate anthropological concepts of sex, gender, and bodies. Biomedical studies generally lead to the production of normative statements that reify assumptions about what men and women do, and how they are constrained by their biologies (Gellar 2005, Sofaer 2006).

Gellar also (2008) laments that many biological anthropologists have not been trained to think in terms of social theory and have been excluded from the interpretive process. She sees this as a result of both their own apprehensions and of the assumptions of theory-makers who operate under the post-modern notion that materialist studies (such as those of the body) have nothing to offer the social sciences on an interpretive level. Identity is often considered conceptually, but it is expressed materially and corporeally and is therefore amenable to both archaeological and bioarchaeological investigation (Gellar 2005, 2008; Sofaer 2006). Gellar insists that the first steps in fixing this problem must be to critically reevaluate our sexing methodologies, our concept of the relationship between sex and gender, and the ways we

implicitly and explicitly make gendered interpretations from incomplete and/or uncontextualized biological data.

Gender is a social construct that does not relate directly to biological sex and, as such, must be approached from an inherently archaeological perspective. It is also important to recognize that social institutions such as kinship, age, and ethnicity intersect with gender to create one's social identity (Gellar 2005, Sofaer 2006). In other words, although gender is one of the primary foci of this dissertation, it cannot be investigated in isolation from intimately linked cultural institutions. I argue that explicit incorporation of multiple social variables will result in a more appropriately gendered interpretation. For example, bioarchaeological analyses that attempt to account for the ways that experiences vary within groups based on biological sex based on the inclusion of social institutions units of analysis like status (Martin 2000, Cucina and Tiesler 2003, White 2005) and ethnicity (Schurr 1992) have greater potential for clearly assessing gender relations in the past. The research proposed here seeks to incorporate data for three other social factors, which provide further cultural context for interpreting osteological data. These factors are social status, kinship, and age.

That subadult skeletons cannot be sexed with a high degree of confidence has proven to be a serious hindrance to the development of an engendered bioarchaeology of childhood (Baker et al 2005). However, the skeletal remains of adults *do* retain information on certain aspects of childhood growth, stress, and health, and analysis of indicators that capture conditions at known points in an individual's life may help to alleviate this problem by providing observable records of childhood growth conditions in sexed adult remains. Specific types of skeletal data which indicate the conditions of early childhood growth were collected and analyzed as part of this study, in addition to cumulative indicators of growth over the life course (these indicators will be

discussed in more detail in the methods chapter). The combination of age sensitive indicators of stress with spatial/artifactual data pertaining to kinship and social differentiation will allow for a more nuanced interpretation of the relationship between gendered social relations, social complexity, and growth/health in late prehistoric West-Central Illinois.

The Case for Mortuary Analysis and the Saxe-Goldstein Approach

Goldstein (2006) examines recent literature to specifically evaluate the level of cooperation and collaboration between physical anthropologists and archeologists in the field of mortuary analysis. Like Gellar (2005, 2008), she finds that there is significant disconnect between skeletal analysis and the interpretation of archaeological data. Physical anthropologists studying remains from archaeological contexts focus on topics such as bone chemistry, pathology, stress, growth disruption, and paleodemography, which require laboratory-oriented approaches. Intense involvement in this type of analysis comes with the risk of further distancing oneself from the archaeological context of the remains. This issue becomes increasingly important as modern mortuary analysis continues to incorporate nuanced social, economic, political, and ideological theory in the interpretation of living people and their treatment of the dead. Literal and figurative disconnect between the two fields can result in interpretive problems, as demonstrated in the issue of sex and gender, as well as more specific critiques (Bice 2003 and Jurmain 1997, for example) regarding the failure of physical anthropologists to rigorously test methods borrowed from the natural sciences before applying them to human remains.

Binford (1971) provides an important treatise on the history of mortuary analysis, and called for a new, processual approach to mortuary studies. He contends that descriptive accounts abound in archaeology, but points to a lack of literature attempting to use burials as a "distinct

class of variable phenomena" (Binford 1971, 58). Early studies of mortuary analysis were attached to general studies of religion and employed an "idealist-rationalist" approach that correlate practices with postulated or observed forms of belief. Binford points out, however, that as early as Hertz (1960), it was recognized that burial rites were related to, and vary with, social institutions other than religious ritual, such as the status of dead within living community and the status of souls in relation to the society. He also summarizes early 20th century functionalist perspectives on mortuary rites as a collective (social) reaction against death as an attack on social solidarity and goes on to argue that, while these approaches attempt to link mortuary practice to social circumstances, they focus on abstract notions rather than studying the distribution of variation within or among sociocultural units.

Binford calls for the development of theory to provide a context for explanation of differences and similarities in mortuary practices, based particularly on status and group affiliation. He used the Human Relation Area Files to argue that, 1) a high degree of isomorphism exists between complexity of status structure and complexity of mortuary ceremonialism, 2) mortuary differentiation is based on personal qualities (age, sex, differential personal capacity) in "minimal complexity" societies, while in complex societies, differentiation is based on abstract notions of social divisions, and 3) a correlation exists between quantitative and qualitative dimensions of social persona (as recognized via mortuary custom) and general level of sociocultural complexity. All of this is in keeping with the neoevolutionary perspective that defined his views of culture and processualist archaeology.

Saxe's (1970) perspective on anthropology as an explanatory tool for addressing similarities and differences within and between sociocultural systems complements Binford's generalization that the form and structure, which characterize mortuary practice in a given

society, are conditioned by form and organizational complexity of the society itself. In an influential dissertation, Saxe proposes eight hypotheses with the goal of explaining "the formal disposal types found in any sociocultural system and, by doing so, shows how the domain formed by these types can elucidate the social organization that produced them (1970, 3)." His original hypotheses have notably been modified and applied to archaeological situations by Goldstein (1976, 1980, 1981) in her work at the Schild site in West Central Illinois (one of the sites studied in this dissertation). The complementary nature of Binford's, Saxe's, and Goldstein's work have led to their ideas being referred to together as the "Saxe-Binford"(Brown 1995) or "Saxe-Goldstein" (Morris 1991) hypotheses.

Of particular interest is Saxe's eighth hypothesis, which states that "to the degree 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 the ancestors), such groups will maintain formal disposal areas for the exclusive disposal of their dead, and conversely" (Saxe 1970). This approach has been criticized by Hodder (1981, 1982) and Shanks and Tilley (1982) as ahistorical, simplistic, and passive. These criticisms have themselves been duly criticized by Brown (1995) who points out that Goldstein's (1980) reformulation of hypothesis eight, linking mortuary ritual, formal structure of cemetery spaces, and corporate rights of lineal groups, has improved the original formulation. This ties directly into the idea of the dead being used/manipulated to serve a specific end within the world of the living. Morris (1991) also defends the approach as useful in both historical and empirical/analytical frameworks, as it is inherently concerned with the interaction between cemeteries/mortuary ritual and socially significant institutions such as the household, class, and kinship. It is argued here that 1) the Saxe-Binford-Goldstein approach to mortuary analysis remains relevant and is

adaptable and amenable to application within various theoretical frameworks, whether more processually or post-processually oriented, and 2) Goldstein's (1980) spatial analysis of the Schild cemetery provides an appropriate sociocultural framework upon which to build a bioarchaeological analysis of intracommunity social differentiation.

Synthesizing Biological and Cultural Perspectives

The above summaries of theoretically-oriented bioarchaeological and mortuary literature are far from comprehensive. However, they provide a general foundation for the study undertaken for this dissertation. Despite the apprehension of many bioarchaeologists to venture into the realm of social theory, modern gender/social identity scholarship can productively inform a scientifically rigorous biological analysis. It is further argued that, not only is social theory amenable to bioarchaeological research, it is an absolutely necessary component.

Furthermore, an in-depth understanding of mortuary analytical theory is necessary to move from stagnant description in bioarchaeology to culturally informed interpretation of the relationship between health and social processes in the past. The Saxe-Binford-Goldstein approach was developed decades ago, yet it has been shown that its basic tenet- the relationship between treatment of the dead and social factors/concerns of the living- provides a sound framework for a range of archaeological studies and is adaptable to diverse cultural, theoretical, temporal, and regional situations and perspectives. The explicit addition of a biological perspective can only serve to complement the strength of this basic model. One goal of this dissertation is to be rooted firmly within a foundation of theoretically rigorous biocultural analysis and a time-tested, adaptable mortuary paradigm. By focusing on the theoretical complexities of social identity and treating archaeological data as primary rather than accessory,

this study attempts to contribute to a dynamic picture of what it meant to be a Mississippian person in West-Central Illinois

Engendering Bioarchaeology

It is the express purpose of this dissertation to contribute to archaeological knowledge of gender as lived experience in Mississippian communities, yet the preceding discussion emphasizes that applying gender theory to interpretations of the archaeological past is inherently complicated. Seeing gender through bioarchaeology is context-dependent and, therefore, not predisposed to formulaic treatment. In other words, there is no singular "correct" way to construct a properly engendered bioarchaeological analysis. Practitioners interested in exploring some facet of gender in the past must consider the available archaeological, historical, and ethnographic data related to their collections in order to design a research strategy that meaningfully engenders their sex based osteological data.

One possible approach (and the approach that is taken in the current study) is to dispose of the essentialist view that the experiences of all men and all women are unitary and invariable. This is a generally accepted perspective when examining gender via cross-cultural comparison, but it should be recognized that there is also a range of variation in the experiences of each gender within communities, based on other aspects of social identity like kinship, status, and age (Gellar 2008, Sofaer 2006, Stig Sorenson 2000). By considering variability in osteological parameters within each sex, bioarchaeological notions of biological maleness and biological femaleness is problematized, de-essentialized, and become prepared to be carefully contextualized.

This approach necessitates that skeletal samples meet two important criteria, both of which are inherently problematic for bioarchaeological studies. First, culturally meaningful units of analysis are necessary to provide a justifiable basis for dividing male and female samples into subsamples for within-sex comparison. In the current study, intensive mortuary analysis, based on spatial and artifactual considerations, is available to provide the necessary sociocultural units (Goldstein 1980). Because these mortuary groupings have been interpreted as representing kinship and status differentiation, bioarchaeologists can explore the ways that variation within each sex each is or is not related to membership in these social categories. In this way, we can see how the biocultural experiences of men and women are variably related to other aspects of their social identity. Second, sample sizes must be adequate to test for significant differences in the osteological data. Sample size is a problem faced by most bioarchaeologists, and the issue becomes even more pressing when the sample needs to be further subdivided as described above. The current study benefited from the relatively large size of the Schild collection, and although sample sizes were still small for many tests, some statistically significant results were indicated.

Based on the above discussion, it is proposed that the current study represents a theoretically and methodologically sound attempt at a gendered perspective on biocultural change and variability because the research design includes multiple social units of analysis for comparison of growth trends within each sex. Division of a skeletal sample into "male" and "female" subsets is standard practice in bioarchaeological studies, and one can tack a gendered interpretation onto the results of their binary data analysis. The current study, however, treats the possibility of within-sex variability as an integral part of the research design and an important way to detect variation in the ways that people experience gender, thereby avoiding, to some extent, the trap of essentialism.

Research Questions

The theoretical arguments provided in this chapter provide a framework for developing several general hypotheses, which are presented here along with summarized results and interpretations. Statistical treatment of the Schild and Yokem long bone, dental, and vertebral data evaluated temporally and by sex provides information about whether or not a change in sex-specific patterns occurred, as well as the direction and the significance of the change. As age is an important factor in gender identity, special attention to the age-sensitive nature of the indicators allowed investigation of changes in growth patterns by sex over the life course. Furthermore, when mortuary data is integrated into the analysis, the nature of the social relations underlying the appearance of the biological data became clearer.

Research Question 1-

Does Clark's (1985, 1988) vertebral approach provide a sound, useful method to growth assessment? One of the primary concerns of this research is a determination of the utility of the vertebral method of growth assessment. This was tested through an assessment of the relationship of vertebral dimensions to widely accepted growth indicators, as well as by making comparisons of the results achieved through vertebral growth assessment with expectation based on other lines of archaeological evidence. Taken together, the various lines of research presented in this dissertation indicate that, although more detailed investigation remains to be done, the vertebral method is, indeed, a potentially useful, and particularly sensitive, indicator of growth conditions. In particular, neural canal diameters (NCD) may reflect the growth conditions experienced during early childhood in a way that is fundamentally different from, and

complementary to, the episodic stressors detected by analyses of LEH. Vertebral body heights (VBH) seem to be related to the same kind of cumulative growth experienced through early adulthood that is indicated by femur length.

Research Question 2-

Are there changes in growth patterns between males and females over the Late Woodland-Mississippian transition in West Central Illinois? If peripheral communities experienced changes not only to their traditional gender *ideologies,* but also to their traditional gender *relations* under Cahokian influence, changes in the patterns of differential growth, stress, and health between males and females from the Late Woodland to the Mississippian period at Schild and Yokem may be observable as quantitative and qualitative changes in biological parameters. Based on trends in linear enamel hypoplasias over the Late-Woodland/Mississippian transition recognized by Cohen and Bennett (1993), one might expect that females in this study would experience decreasing levels of relative early childhood stress with Mississippianization, concomitant with the increasing importance of maize agriculture. According to observations by Cook (2007), previous analyses have shown a surprising lack of significant changes in long bone length with Mississippianization. This could potentially be clarified by the incorporation of Clark's (1988) vertebral method, perhaps indicating that long bone length, as a cumulative indicator, might mask age-specific growth differentials. Age-specificity in the osteological data may show that the relative stress experiences of male and female children changed at some point over the course of childhood, thereby suggesting that changes occurred in the social perceptions of male and female children. This finding could provide clues to the timing of the social construction of gender in Late Woodland versus Mississippian times.

Conversely, sex-based patterns of growth and stress might appear either unchanged or only minimally changed in the transition from the Late Woodland to the Mississippian period at Schild or Yokem. Lack of change would support the position that Late Woodland communities in West Central Illinois adopted Mississippian burial patterns and material culture while resisting some social aspects of Cahokian change, essentially preserving most features of their traditional gendered social relations. An alternative interpretation might be that Mississippianization did not bring significant changes to the lived experiences of men and women, regardless of the extent to which normative ideas about men and women were transformed under Cahokian influence.

This dissertation research indicates that, on a temporal level, and indicated by significantly increased neural canal diameters, female early childhood growth experiences generally improved over the Late Woodland/Mississippian transition in West Central Illinois,. There were no significant differences in vertebral body heights among these females, indicating that improved biosocial conditions of growth in the adolescent period may have allowed Late Woodland females to achieve a similar level of cumulative growth as their Mississippian counterparts, masking early childhood growth differentials. Male growth conditions remained relatively stable over the life course and over the cultural transition, in both early childhood and adolescent growth.

The results of the vertebral analysis is generally consistent with trends observed in comparable measures of skeletal growth at different life stages, namely previously published LEH data (as an indicator of early growth) and femur length data from this analysis (as an indicator of cumulative/late growth), lending support to the vertebral method as a reasonable measure of prehistoric growth patterns. Furthermore, this general trend toward improved early childhood growth conditions for females over the Late Woodland-Mississippian transition in

West Central Illinois suggests that, not only did Mississippianization introduce novel forms of material culture and mortuary patterning to the region, but also brought with it real and significant changes in social perceptions of male and female children in these communities.

Research Question 3-

Is variation in intracemetery growth patterning amonf in Mississippian males and females at Schild related to other social parameters such as kinship, community membership, and status? Explicit incorporation of biological and archaeological data is useful for exploring the way that social identity, as observed as the interaction of sex, kinship, and social differentiation, is related to stress, growth, and dietary experiences. Incorporation of Mississippian mortuary data allowed an evaluation of the ways that social factors (e.g. kinship and status differentiation) interact with sex to affect general health in the Schild community. Taken together, these data may indicate that the changes leading to the adoption of Mississippian mortuary ritual and material culture might also have brought concomitant changes in gendered social relationships affecting diet and health, with the extent and the direction of the change perhaps offering clues to the degree and scope of gendered social transformations. Gender relations therefore are more clearly observable through a combined bioarchaeological and mortuary approach.

The current analysis indicates that a research orientation that emphasizes *combinations* of social factors provides a more culturally sensitive account of the variation in growth data than can be accomplished with sex alone. Although cumulative growth as indicated by femur length and vertebral body height remained stable over the Late Woodland-Mississippian transition for females and males in general, there is some evidence that relatively favorable cumulative growth conditions were not enjoyed equally by all segments of the Schild Mississippian community.

Specifically, vertebral body height and femoral length analyses indicated that cumulative growth conditions were significantly better for specific spatial subsets of the Schild female burial sample compared to other spatial subsets. There was, however, no concomitant differentiation in growth patterning between spatial groups among Schild males. Based on Goldstein's proposition that these spatial groupings may be indicative of kinship or corporate descent groups, this research suggests that Schild women may have experienced more variability in adolescent life/growth experiences than Schild men, based not only on biological sex, but also on their roles as part of socially meaningful kinship or community-based networks. This may be related to particularly strong productive or managerial skills by certain women within the larger Schild community, leading to insipient social inequality and improved biosocial conditions of growth for themselves and their daughters, with whom they likely to work closely. Alternately, the spatial subset of the Schild Mississippian community in which the smallest females were interred may have represented the earliest people at the site who could be said to have been living a Mississippian lifestyle. In this case, growth variability among Schild females may reflect the gendered, biocultural effects of rapid acculturation and/or insipient ethnogenesis.

Research Question 4-

How do the results of the current study compare with other studies of the relationship between Mississippianization, community health, growth patterns, and gender? Comparison with regional reports of the transition to a Mississippian lifestyle generally seem to indicate that the biosocial conditions of female early childhood growth tended to improve relative to males over time (Goodman et al. 1980, Cook 1984, Cohen and Bennett 1993). This evidence suggests that male children were afforded relatively less "protection" (or female children were afforded relatively

more protection) from nutritional and pathological insult in the Mississippian period compared to the earlier periods, possibly reflecting changes in the perceived value of women's work with the rise of agriculture (based on ethnographic and iconographic evidence linking females to agriculture, i.e. Watson and Kennedy 1991). Cook (2007) also points out, however, that the lack of change in long bone lengths over this transition is surprising given the assumption that the transition to a maize heavy diet would likely contribute to poorer cumulative growth.

The results of the current analysis are consistent with interpretations suggesting regional trends of improving conditions of female early childhood growth with Mississippianization, as indicated by significant increases in female lumbar anterior-posterior neural canal diameter (APNCD) without parallel relative increases among males. These results are further reflected and supported when lumbar APNCD and transverse neural canal diameter (TNCD) are compared between males and females within each cultural period, indicating that changes in sexual dimorphism, within each time period, favor statistically significant improvement in female early childhood growth. Furthermore, my analysis confirms Cook's findings regarding lack of significant regional change in femur length over the Late Woodland-Mississippian transition. While Cook points out that this is interesting from a nutritional perspective, the lack of temporal change in cumulative growth is also interesting in that it 1) appears to affect males and females equally on a community level, 2) it appears to mask sex-based early childhood growth differentials shown to occur via other skeletal methods, and 3) may be masking intracommunity differentiation in growth patterning.

Research Question 5-

What do the results of the current investigation contribute to a broader understanding of the nature of Mississippianization? Several archaeological studies of the concepts of tradition, resistance, emulation, acculturation, and ethnogenesis as they pertain to the late prehistoric Midwest provide a critical backdrop for one of the goals of this research, which is to explore the extent to which the adoption of archaeologically visible Mississippian cultural practices, particularly markers of social differentiation indicated by mortuary patterning, is related to the lived biosocial experiences of late prehistoric Lower Illinois River Valley inhabitants. Several archaeological studies have provided evidence for the active maintenance of some aspects of traditional (i.e., rooted in Late Woodland) social relations at otherwise Mississippian peripheral sites (Oteleer 1993, Alt 2002), while others have argued for either active resistance to Mississippianization (Emerson 1997 in the Upper Illinois River Valley) or limited adoption of only certain Mississippian traits (Farnsworth et al. 1991 in the Lower Illinois River Valley).

This dissertation contributes a biocultural perspective to a discussion of the extent of influence of centers over peripheral peoples and the ability of peripheral peoples to selectively incorporate or resist certain aspects of the prevailing cultural. The biological evidence presented in the following chapters, along with previous bioarchaeological analyses, indicates important health transitions associated with Mississippianization in the region. This research supports this interpretation and goes a step further by contextualizing biological change on a finer social scale, showing that certain patterns of health and growth are strongly correlated with specific types of Mississippian intracommunity social differentiation (as indicated by mortuary analysis). Results of this analysis support the interpretation that the adoption of Mississippian sociocultural traits in the Lower Illinois River Valley was not an act of simple, superficial emulation, but were

reflective of demonstrable biosocial effects of Mississippianization on the lived experiences of the late prehistoric inhabitants of this region.

Organization

The chapters that follow will situate and elaborate on the arguments made above in more detail. Chapter two provides background information regarding the Late Woodland and Mississippian traditions, and reviews the literature on sex and gender in the late prehistoric Midwest, while chapter three presents the methods of growth assessment used in this research. Chapter four describes in detail the Schild and Yokem sites and their associated skeletal samples in more detail, and reviews previous bioarchaeological research based on these sample populations. Chapter five describes the osteological measurement techniques, mortuary data, statistical methods, comparative data sets, and hypotheses employed in this research. Chapter six presents the results of the statistical analyses, while chapter seven situates and interprets these results within the proposed theoretical and cultural framework. This dissertation concludes with a summary of the current study and proposes future research questions and directions.

CHAPTER TWO- REGIONAL AND BIOCULTURAL BACKGROUND

The bulk of this dissertation focuses on two distinct but related components. The first is an assessment of community wide changes in human growth patterns between the Late Woodland and Mississippian periods in West Central Illinois. The second is a biosocial investigation of intracommunity differentiation in the Mississippian component of the Schild cemetery. This chapter provides the archaeological and bioarchaeological background necessary for a contextualized interpretation of the results of this study.

Geographic Setting

The vast majority of the previous studies discussed in this dissertation analyzed populations from what is now the Midwest United States, with a particular focus on Illinois. West Central Illinois and the American Bottom are important regions for the investigation of the development of Mississippian culture and its relationship to the preceding Late Woodland period. The American Bottom is the wide floodplain at the confluence of the Mississippi and Missouri Rivers located near modern day St. Louis, Missouri (Figure 1).

The Late Woodland Tradition

Late Woodland is a term referring to both a time period and a cultural tradition identified throughout the Eastern United States, dating generally from AD 400 to 1000. Late Woodland societies were tribal level and semi-sedentary They practiced a mixed economy, and settled near rivers and lake margins (Schroeder 2004, McElrath et al 2000). Archaeological data suggests that, although many Late Woodland groups eventually transitioned to Middle and Upper

Mississippian ways of life, others practiced a Late Woodland lifestyle until the time of European contact.

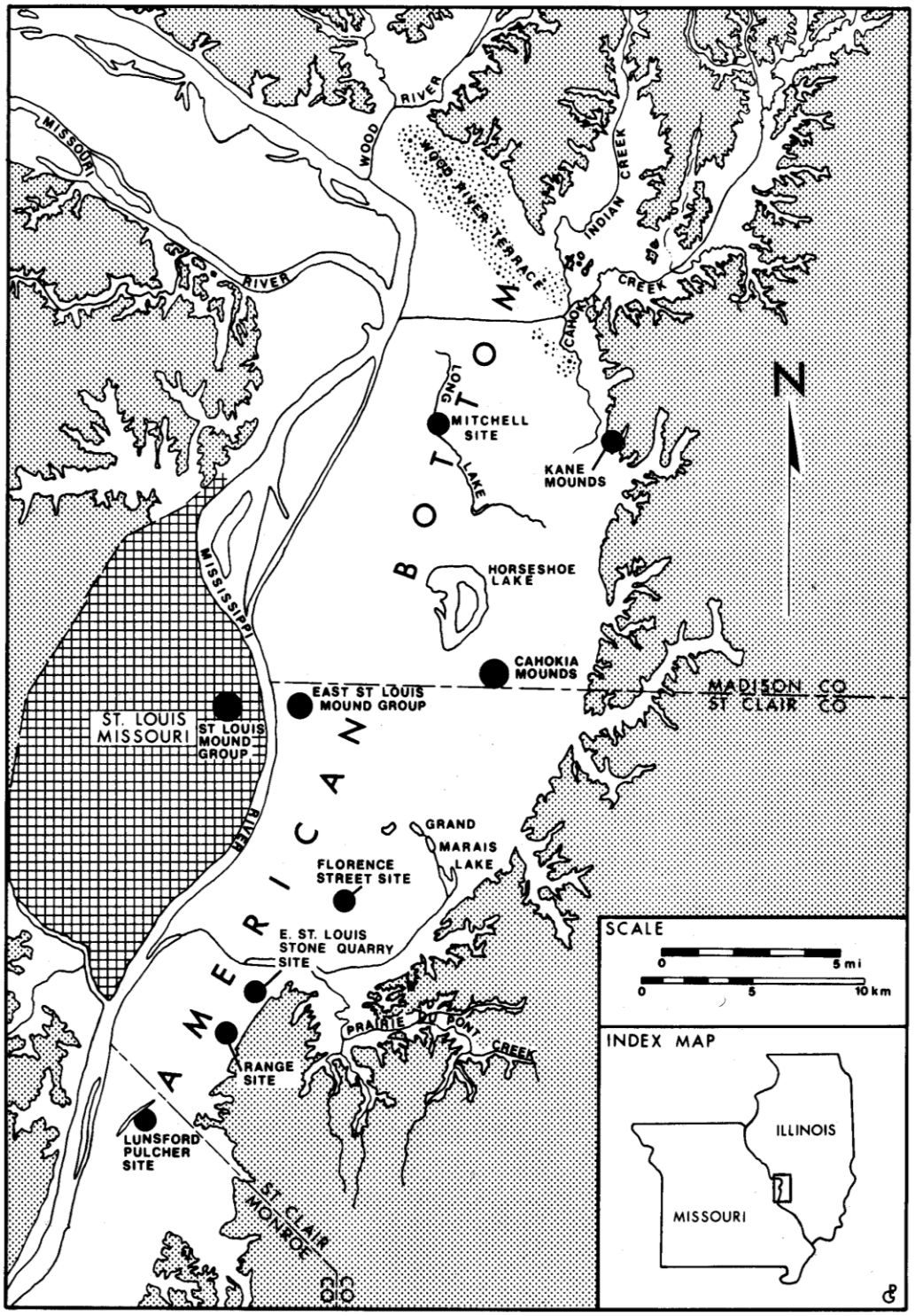

Figure 1- The American Bottom (From Milner 1983)

Late Woodland culture in the midcontinent has been generally characterized by several important transformations, including increased regional variability in settlement patterns, incorporation of bow and arrow technology, and intensification of horticultural practices (MacElrath et al 2000). McElrath et al (2000) suggest that the early Late Woodland is marked by increasing regionalism when compared to the far-reaching, long distance relationships that characterized Hopewell Interaction Sphere. Similarities in ceramic typologies between sites are explained by rapid resettlement into new upland areas (out of river valleys) by segments of established communities rather than extensive trade and interaction between groups. In the American Bottom, the development of bow and arrow technology around AD 700 coincided with the reoccupation of the floodplain and the appearance of patterned, nucleated villages.

Rather than being investigated as an expression of a unique cultural tradition, Late Woodland social organization and regional integration have often been characterized based on the absence of highly visible attributes (such as elaborate mortuary ritual) that were a hallmark of their Hopewell predecessors and Mississippian successors (McElrath et al 2000; Charles 1992). Increasing regionalism is interpreted to have resulted from the breakdown of elite controlled long distance exchange. Decreasing hierarchical social differentiation is evidenced through the simplification of burial ceremonialism. These observations are often cited as evidence for a lack of social complexity and interaction in the Late Woodland Midwest and Southeast (Cobb and Nassaney 1995, Braun and Plog 1983). However, Charles (1992) points out that, during the Late Woodland, new settlement and mortuary patterns indicate a stabilization and localization of the widespread and rapidly changing social and demographic processes that occurred during the Middle Woodland. This set the stage for the eventual development of maize agriculture and, hence, Mississippian social complexity in the American Bottom and West Central Illinois.

Some researchers have suggested that our perceptions of decreasing social complexity and interaction during the Late Woodland are due to application of analytical techniques and interpretative frameworks that are not appropriate for the investigation of a society in which hierarchical relationships are not emphasized. Braun and Plog (1982) suggest that decreasing exchange of supralocal goods, often indicated as evidence for decreasing intercommunity interaction, might actually indicate shift over time in the nature of the interaction from more to less social distance between participating communities. Cobb and Nassany (1995) argue that the lack of hierarchical, vertically-differentiated sociopolitical relations within and between Late Woodland communities does not preclude the existence of complex heterarchical, or horizontally-differentiated, interactions. This should be studied as a unique cultural phenomenon, rather than solely in comparison to other cultural periods. They cite evidence for the movement of utilitarian goods and the rapid diffusion of shell-tempering, maize agriculture, and bow and arrow technology during this period to indicate that regional integration and social complexity existed despite outward appearances of the archaeological record. Although there may have been no institutionalized positions of power to facilitate such interactions, the potential of lineages, clans, age groups, and gender groups to have played important sociopolitical roles should not be ignored. It is important to note that it may be more difficult to recognize these types of relationships without application of a more nuanced mortuary analytical framework (Braun and Plog 1982).

McElrath et al (2000) provide a limited and generalized review of Late Woodland mortuary practices in the midcontinent, suggesting that the homogenous, localized expression of Late Woodland social structure is indicated by variable mortuary practices. The traditional Middle Woodland burial mound, with a centrally located log tomb, was replaced by new Late

Woodland interment styles such as stone lined/paved graves and burials in stone piles within earthen mounds. Aboveground stone mortuary facilities, crematories, and accretional mounds were also built, but patterns varied both regionally and temporally throughout the region.

Late Woodland mortuary practices are relatively well documented (but perhaps under-analyzed) for the Lower Illinois River Valley. Although accretional mounds with flexed burials are common, characterization all Late Woodland mortuary patterning in this matter masks intraregional variability. Previous studies of biological distance have demonstrated significant intercommunity gene flow throughout the Late Woodland Lower Illinois River Valley compared to Mississippian times (Steadman 2001), suggesting that people were moving between communities, which is perhaps related to the ubiquity of some features of the burial program in the area (Conner 1984). Charles (1992) postulates that population saturation in the Lower Illinois Valley in the Early Late Woodland period would have provided a fertile environment for the proliferation of kinship and marriage alliances, affording new opportunities for exchange partners without management, manipulation, or interference on the part of a pan-local elite. Charles contends that this could account for the variability of burial practices during the Late Woodland period, as funerary programs became local affairs with local meanings. Following the critiques of Braun and Plog (1982) and Cobb and Nassany (1995) discussed above, further investigation of the scenario described by Charles (1992) would appear to require an individualized analytical and interpretive framework for deciphering Late Woodland mortuary practices and social relationships on a local or subregional level before making meaningful regional characterizations.

As in the rest of the region, Late Woodland society in the American Bottom and West Central Illinois appears to be horticultural, village-oriented, and egalitarian (Schroeder 2004,

MacElrath et al 2000). In the early Late Woodland, there is little evidence to indicate significant social differentiation within villages, nor does there appear to be hierarchical political relationships between villages (Mehrer 2000). It is during the terminal Late Woodland in the American Bottom region that archaeologists first detect important cultural trends that would later be intensified, forming the basis for Mississippian emergence. Mississippian characteristics and precursors such as courtyard groups, plaza-mound site plans, population nucleation, insipient social differentiation, and maize intensification appear in the archaeological record between AD 700 and 900 (MacElrath et al 2000, Mehrer 2000, Schroeder 2004).

The Mississippian Tradition

Late Woodland populations in the American Bottom appear to have undergone dramatic cultural changes around AD 900, eventually leading to the development of the Mississippian tradition. Although Mississippianization is seen early and most intensely in the American Bottom region, the suite of associated cultural changes were likely the result of widespread interactions and in situ development among different communities following the same basic cultural trajectory (Schroeder 2004). The transition is marked by major changes in 1) ceramic temper and decorative motifs, 2) development of a ranked social structure and hierarchically political organization with ascribed status differentiation, 3) the ubiquity of cleared-field maize agriculture, 4) and a set of common religious institutions and iconography (Schroeder 2004, Scarry 1996). Throughout the region, rural occupations began to decrease in size as people congregated in larger villages and small nodal centers and, by the eleventh century AD, villages began to rely more heavily on maize agriculture to support growing populations. Middle

Mississippian chiefdoms developed internal social differentiation and hierarchical relationships with surrounding villages (Emerson 2002, Schroeder 2004).

Mississippian villages have been identified throughout the area spanning from northern Florida to Illinois and from the Atlantic plain to Eastern Oklahoma. Most notably for this research, Cahokia emerged, peaked, and declined as a major regional center in the Midwest between AD 900-1400, undoubtedly having a considerable impact within the American Bottom and beyond (Fowler 1991, Milner 1998, Pauketat 1997). The Cahokia site covered almost 13 square miles and comprised 104 mounds, a palisaded downtown, and multiple mound precincts and neighborhoods (Fowler 1989). Mounds and structures were clearly layed out in a planned, organized way, which clearly reflected Mississippian social, poiltical, and cosmological worldviews (Fowler 1978).

The spread of Mississippianism out of the American Bottom was instigated by diffusion, migration, and economic/political activity or some combination of these factors, depending on the specific time period and location in question (Stoltman 1991, Farnsworth et al 1991). The nature of Cahokia's influence in West Central Illinois, in particular, has important implications for this study.

Mississippian Social Structure and Site Hierarchy

The establishment of sites of varying size and complexity, ranging from large centers, to lesser centers, to rural farmsteads was a hallmark of Mississippian culture (Emerson 1997, Goldstein 1980). Middle Mississippian social complexity is evident through the integration of permanent towns, hamlets, and farmsteads into a site hierarchy, and Goldstein (1980) shows that variation in mortuary programs is patterned and closely associated with this hierarchy. Specifically, she

proposed several hypotheses for investigating Mississippian social organization through mortuary analysis. First, she hypothesized that social organization at outlying sites should be relatively egalitarian and that bounded cemetery areas are likely indicative of corporate group structure with lineal descent. Second, she suggests that spatial organization within cemeteries should reflect the corporate structure of the society. Her third hypothesis is that rural Mississippian mortuary sites should exhibit a communal, as opposed to an individualized, emphasis. All of these are supported by her analysis of the Mississippian component of the Schild site (described in detail below).

Goldstein also hypothesizes that Mississippian mortuary sites should generally reflect a common set of organizational principles. Although mortuary treatments at Schild and Moss are certainly different from those observed at Cahokia and other large centers, Goldstein shows that the level of social complexity within these small, outlying communities is in keeping with general expectations of a ranked and kin-based Mississippian social system. Larger sites tend to incorporate the basic elements observed at smaller sites, particularly rows/spatial clustering, communal emphasis and charnel features, albeit with a measure of elaboration. The model that she proposes has been instrumental in organizing subsequent analyses (both synthetic and localized) and structuring ideas regarding Mississippian perceptions of mortuary space and social organization.

Southeast Ceremonial Complex Through Time and Space

Although the focus of this dissertation is the lived, gendered experience of Mississippianism and Mississippianization in West Central Illinois, a discussion of analogous processes and phenomena in other parts of the Midwest and Southeast is warranted as a means for preliminary

consideration of the ways that the topics of the current research might be similarly or differentially expressed on a regional level. Mississippian as a concept is more diverse than any sweeping, cursory definition (including the one provided above) can properly convey, and this requires that a critical perspective is employed when speaking of such things as "Mississippian gender relations." But although regional variation in the expression of Mississippian gender relations is high, it can also be argued that regional expressions are rooted in common ideological themes that have their basis in a generalized Mississippian worldview. One way that this worldview has been conceptualized in the Mississippian literature is through studies of the Southeastern Ceremonial Complex (SECC).

The SECC is a diverse set of ritually and spiritually charged themes and images recognized and practiced throughout the Mississippian world. An important attribute of Mississippian societies is the use of rituals and symbols associated with the Southeastern Ceremonial Complex, presumably indicating participation in a characteristic Mississippian belief system that expressed a particular social, political, and religious ideology. Although many researchers have insisted that the SECC is a late Mississippian phenomenon restricted to the Southeastern United States, Brown and Kelly (2000) show that many of the most enduring symbols and items (i.e. long nosed god masks, copper plates, birdman motifs, chunkey player motifs) have their origins in early Cahokia. They conclude that what has classically been perceived as a change in the type of ceremonial complex being practiced in earlier versus later Mississippian times is actually an evolution in the practices associated with a single set of beliefs. They also point out the tripartite division of the complex into distinct complexes, centering on warfare/cosmogony, mounds, and temple statuary. Awareness of these distinctions, in addition to regional and temporal variability, is crucial.

Although primarily investigated for its significance in religious life, Brown (1989) points out that SECC studies can also demonstrate how other aspects of Mississippian social life such as economy and social organization, are simultaneously expressed and unified through the complex. It represents an important unifying theme for a cultural tradition that is not only spatially but also *temporally* expansive, and this provides a justification for the types of regional comparisons that will be made in the interpretation of the data presented in this dissertation. The evolution of the various schools or horizons of SECC symbolism can be seen on a broad regional level as developing along parallel trajectories out of Late Woodland roots (Brown 2004, Muller 1989). In these ways, the SECC concept is recognized as 1) connecting Mississippian peoples across space and time on both socioeconomic and ideological levels, and 2) linking them to Late Woodland roots.

The Nature of Center-Periphery Interactions and Influence

The nature of interaction between Cahokia and its periphery is not fully understood or agreed upon (Anderson 1997, Emerson 1997, Milner 1998). Farnsworth et al (1991) and Stoltman (1991) summarize the range of theoretical perspectives regarding the extent of Cahokia's ideological, social and economic influences. Despite Cahokia's importance on a regional level, however, generalized statements regarding broad Cahokian influences can only superficially approach the intricacies of social relations on a local level within peripheral villages. To better explain variation in social relations on a local level, Mississippianization of the periphery must be conceptualized as an active process of negotiation between traditional practices and new Cahokian ideals (Pauketat 2002).

Alt (2002) comments on the importance of investigating Mississippianization within the context of community identity, social interaction, and political change. Through an analysis of site layout, ceramic production, and house construction, she suggests that, although upland American Bottom villages often adopted Cahokian styles (as in ceramic technology), lack of change in practices more indicative of intra-village social relations (i.e., site layout and house construction), point to more traditional social structures being actively maintained. This suggests that some nearby Mississippianized communities resisted certain Cahokian social ideologies into the period of perceived Cahokian dominance.

Harn (1991) investigates Middle Mississippian emigration to the Central Illinois River Valley region from the American Bottom, proposing that Mississippians essentially replaced and acculturated existing Late Woodland communities, as evidenced through sudden changes in social organization, indicated by mortuary analysis, and the sudden appearance of new religiously- and politically-charged motifs. Based on their review of wall trench structures in Lower Illinois River Valley, Farnsworth et al (1991) and Farnsworth and Atwell (1999) suggest that Late Woodland communities in the Lower Illinois River Valley incorporated Mississippian mortuary ritual while maintaining a predominantly Late Woodland lifestyle.

In contrast, others make strong arguments for true Mississippianization of the region. Goldstein (1980) contends that the Lower Illinois Valley was occupied by dispersed Mississippian farmsteads, as indicated by the presence of Mississippian pottery, mortuary ritual, and architectural styles. Delaney-Rivera (2004) evaluates ceramics, excavation notes, and maps to suggest that 1) Late Woodland (Jersey Bluff phase) groups from the Lower Illinois Valley interacted intensely with early Mississippian groups in the American Bottom and 2) proposes a colony-acculturation model for the spread of Mississippianism into this region. Although

investigating somewhat different phenomena (i.e. *in situ* Mississippianization of Late Woodland communities versus intrusive Mississippian replacement of Late Woodland communities versus a combination of acculturation and colonization), a key issue uniting all of the studies discussed above is a concern with the extent of the economic, social, and ideological influence between Cahokia and peripheral communities. The research presented in this dissertation will build upon these investigations by gauging the biocultural affects of Mississippianization in West Central Illinois, particularly with regard to building a baseline set of data for assessing its affect on traditional gender relations.

Late Woodland/Mississippian Interactions and the Mississippianization of the Periphery

Models for the spread of Mississippian cultural practices out of the American Bottom, following the "Cahokian Big Bang" around AD 1050 (Pauketat 1998), are numerous and theoretically diverse. The initial development of Mississippianism is portrayed by some as having resulted from widespread interactions and evolution among different communities that generally followed the same basic cultural trajectory (Schroeder 2004). Kelly (1991) characterizes this transition more specifically, as having resulted from interactions and exchanges between northern and central American Bottom people with others in the surrounding region. In this conception, the American Bottom occupies a prime central location, but is lacking in raw materials. Population growth during the Late Woodland and Emergent Mississippian periods increased the demand for the importation of such goods, contributing to the rise of Cahokia as a social, political, and religious center (Kelly 1991).

The economic undertones in Kelly's model of the emergence of Mississippian culture is also seen in models for the nature of the relationship between Cahokia and the outlying regions.

Peregrine (1995) provides portrays Cahokia as the center of a Mississippian "World System." However, other researchers have criticized application of this model to situations other than the capitalist and market-oriented economies it was originally developed to explain. For example, Milner (1991) criticizes all exchange-oriented models for Cahokia's regional importance and external relations. He points out that pre-Mississippian long-distance exchange occurs in the absence of social complexity through much of the prehistory of the midcontinent. These exchanges certainly continued to be important into the Mississippian period, but there is little evidence that Cahokia was the center of a regional exchange network, especially considering that most Cahokian goods appear to have been manufactured locally, using local raw materials. Even the few examples of seemingly abundant extralocal raw materials in the American Bottom, such as Mill Creek chert hoes from southern Illinois, are not particularly abundant at Cahokia compared to smaller Mississippian sites when their prevalence is corrected for population. Both Milner (1991) and Mehrer (2000) suggest that political decisions at outlying sites were made by local kin-based elite, based on local concerns rather than with reference to elites at larger centers. Mehrer (2000) however, takes a somewhat more nuanced view of this relationship through an evaluation of site layout, suggesting that community-planning decisions reflected heterarchical relationships between regional leaders, local elites, and individual households.

Outside of the American Bottom, Milner (1998) notes the widespread distribution of Cahokian and Cahokian-style pottery. Aside from distinct forms like Ramey Incised and Powell Plain, he sees no need to consider every instance of cordmarked or shell tempered pottery as evidence for Cahokian exchange. He also notes that the decline of Cahokia during Moorhead and Sand Prairie times did not adversely affect the ability of most communities to continue to access exotic goods, suggesting that Cahokia's role in trade networks was minimal. Similarly, Mehrer

(2000) notes that the general plan of rural Mississippian sites, which certainly developed under the influence of Cahokia, persisted after its collapse.

Like Milner and Mehrer, Pauketat and Emerson (1997) and Pauketat (1998) argue against state-like portrayals of the Mississippian world, and they do not place the American Bottom at the center of a regional trade network. Citing lack of evidence for large-scale trade, they suggest that people in outlying areas strived to rapidly become associated with the Cahokia Mississippian phenomenon via one-way acquisition of Cahokian goods and emulation of Cahokian styles, as Mississippianism was appealing on a supernatural or ideological level. They support this assertion with the observation that, although Cahokian pottery and other indicators of social influence were abundant beyond a 150 kilometer radius around the polity, the most current population estimates for the prehistoric Midwest indicate that population density was simply insufficient for the support of a true mercantilist economy.

Aside from characterizing the low level of economic influence between Cahokia and outlying regions, Pauketat (1998) also investigates matters of social and political influence. He criticizes what he refers to as "minimalist" interpretations of Cahokia's regional importance as denying human agency and internal causality and as ignoring abundant evidence for Cahokia's rapid political centralization and widespread social influence. Pauketat insists that the spread of Cahokian ideas be conceptualized as an active process of negotiation between traditional practices and new Cahokian ideals. He suggests that these phenomena are visible archaeologically, particularly through analyses of household and craft production refuse, symbolic representations of a communal fertility cult, architectural regimes, and site layout. He interprets the available lines of evidence as indicating that Mississippian political consolidation

in the American Bottom occurred rapidly around AD 1050 and that communal symbolism was a medium of political influence that transmitted the "new Cahokian order" to surrounding regions.

Regional Models of Mississippianization

Although the specific archaeological appearance of Mississippian sites is certainly dependent on local idiosyncrasies, Stoltman (1991) and Farnsworth et al (1991) provide useful models for characterizing these local expressions of Mississippianism by reference to the ideological, social, and/or economic relationships between Cahokia and its periphery. Stoltman focuses specifically on the nature of the interactions between Cahokia and outlying Mississippian and non-Mississippian sites, distinguishing between the archaeological correlates of site-unit intrusion, trait-unit intrusion, and emulation and whether these resulted from direct or indirect contact. In their study of the nature of Mississippianization of the Lower Illinois River Valley, Farnsworth et al (1991) propose a similar framework for characterizing the relationship, although they address the issue of ideological versus economic interests in somewhat greater detail. Both indicate that the reasons for site-unit intrusion (purposeful "colonization" as opposed to necessity resulting from sociopolitical fissioning or population growth) are important, but unclear, distinctions. These ideas have obvious implications for interpretations of the archaeological record outside of Cahokia, particularly for understanding the specific nature and archaeological expression of Mississippian culture in individual communities or regions.

Central Illinois River Valley

The Central Illinois River Valley Mississippian groups provide a particularly interesting comparative case study for modeling the spread of Mississippian culture into other regions,

including the Lower Illinois River Valley and broader West Central Illinois. Harn (1991) reviews evidence from the Eveland site and suggests that the Mississippianization of this region resulted from the migration of people from the American Bottom during the Lohman and Stirling phases. This is evident through the sudden appearance of Mississippian pottery, architecture, and mortuary practices in the region, with little evidence for transitional forms. The purpose of the migration is, of course, less clear. Harn proposes several scenarios, including colonization and sociopolitical fissioning. Steadman (2001) detects the introduction of new alleles into the established local community in her analysis of biodistance among individuals interred at Dickson Mounds. Although she cannot definitively track the origins of these alleles to the American Bottom, her interpretation is consistent with Harn's proposition of an influx of Mississippian migrants into the region. Furthermore, her analysis detected only minor perturbations in the population structure of the central valley with the decline of Cahokia.

Armelagos and Hill's (1990) evaluation of Mississippian period skeletal remains from Dickson Mounds reveals a decline in health over the course of the transition from a Late Woodland to Mississippian lifestyle, despite the availability of abundant wild foodstuffs and fertile soils for food production. Although other studies (i.e. Goodman et al 1984) yielded similar results, the thrust of their argument lies in their interpretation of the social meaning of the data. Specifically, they suggest that sociopolitical factors such as trading local subsistence goods for items of social and ritual important could have played a role in declining community health. Although they do, at least superficially, appear to support a trade-oriented model for the nature of interactions between Cahokia and outlying regions, they also point out that it is difficult to make a single unifying statement regarding the health effects of Mississippianization, as analyses at different regional or social scales yield disparate results, a point also emphasized by Cook

(2007). Harn (1991) also entertains this possibility, but notes the lack of archaeological evidence for production of a tradable surplus. In addition, he points out that social stress, rather than drastic nutritional insufficiency, may have contributed to the appearance of the skeletal remains from this site.

Lower Illinois River Valley

Further south, in the Lower Illinois River Valley, local manifestations of Mississippianization appear to have resulted from different sociocultural processes. The late prehistoric Lower Illinois River Valley was occupied by a Late Woodland population that eventually became Mississippianized via diffusion and acculturation with only limited colonization (Delaney-Rivera 2004, 2007; Schroeder 2004). Consequently, these communities began to display mortuary patterns and material culture in keeping with the Mississippian phenomenon elsewhere in the region. However, unlike the Central Illinois River Valley and other outlying regions, the Lower Illinois River Valley seems to be largely devoid of large sites with temple mounds. Instead, small farmstead sites, occupied by one or two families, seems to be more common (Conner 1984, Goldstein 1981).

Connor (1984) reports on Hill Creek, a dual structure Mississippian farmstead in the Lower Illinois River Valley. Although Hill Creek dates to Moorhead or Sand Prairie times in the Cahokian chronology, Connor revisits a previous study of Lower Illinois Valley farmstead settlement by Goldstein and suggests that, while analyses of ceramics from early farmsteads in the region reveal affinities with Cahokian wares, those from later sites like Hill Creek are stylistically related to the Central Illinois Valley, but manufactured using local materials. Farnsworth et al (1991) criticize this work, suggesting that the lack of substantial Mississippian

sites in the region indicates that the Lower Illinois Valley was populated by groups who essentially retained their Late Woodland identities while incorporating some aspects of Mississippian mortuary ritual. However, the presence of Mississippian style pottery, houses, social relations, and subsistence regimes among Mississippian period inhabitants of the region (Connor 1984, Goldstein 1981, Rose 2007) seems to indicate otherwise

Mississippianization in Other Regions

The research presented here focuses on the Mississippianization of West Central Illinois, and as such much of the foregoing discussion centered on that region. A brief exploration of a few other key regions further demonstrates the variety and complexity in the process of Mississippianization on a local level. Sites like Hiawassee Island and Toqua demonstrate a unique expression of the Mississippian phenomenon in Eastern Tennessee. Although first thought to have resulted from immigration and replacement, more recent models for the Mississippianization of this region suggest local development from Late Woodland roots, with movement of ideas into the region having a stronger effect than any movement of actual people (Schroedel et al 1990). However, Sullivan (1995) shows that there existed significant variation in Mississippian households and communities throughout Eastern Tennessee, and used some mortuary based gender studies to demonstrate some of her ideas regarding similarities and difference between sites within the region. This is taken here as an important caveat for considering scale of analysis in studies of the expression of gender ideology.

The Mississippian center of Moundville in West Central Alabama emerged around the same time as Cahokia, and appears to have resulted from social reorganization and cultural change among local Late Woodland populations (Welch 1990). There is some evidence that

Mississippianization of this region occurred relatively abruptly in a Late Woodland environment of increasing population density, intergroup violence, and insipient status differentiation and competition (Knight and Steponaitis 1998). There is little evidence for substantial Late Woodland occupation at the Moundville site, but production of local Late Woodland pottery persists well into the Mississippian period here (Steponaitis 1998), further suggesting an essentially in situ Mississippianization of a local Late Woodland population. Steponaitis (1998) also points out, however, that the recognition of Late Woodland burials at the site is hindered by the preference for interring the dead without diagnostic artifacts. This might make bioarchaeological analyses of the Late Woodland Mississippian transition, such as that presented in the current study, difficult to accomplish for Moundville.

Goldstein (1991) provides an overview of research on Mississippianization at the Aztalan site in southeast Wisconsin in order to propose an organized approach to explaining its relationship to Cahokia and situating it within the larger Mississippian settlement system. Mound construction, subsistence data, and many aspects of the artifact assemblage indicate clear Middle Mississippian influence, but other observations are more difficult to explain. For example, many researchers have noted the physiographic and environmental differences between the American Bottom and the Aztalan landscape, and Goldstein suggests that people from northern Illinois would have been more familiar with, and comfortable settling into, such environments. This scenario might also help to explain the ceramic assemblage, which is dominated by grit-tempered, collared vessels (similar to Northern Illinois varieties) rather than the typical shell tempered varieties associated with most Mississippian sites. Goldstein suggests that an initial influx of northern Illinois Late Woodland peoples around AD 800-900 was followed by a later migration of Middle Mississippians, explaining both the location and the ceramics. Furthermore,

a relatively low population or threat of violence from nearby Oneota populations may have prevented the establishment of smaller, outlying hamlets and farmsteads. She suggests that the abandonment of Aztalan might have been related to the collapse of Cahokia.

At the Mississippian site of Angel, the nature of the Late Woodland-Mississippian transition is less clear. Marshall (2011) suggests three possible scenarios: Mississippian immigration to Angel, continuity between local Late Woodland/Emergent Mississippian peoples and Angel phase inhabitants of the site, and a combination of local and non-local people who came to be united under a common Mississippian ideology. Muller (2009) states that Terminal Late Woodland Yankeetown phase settlements persist into early Mississippian times in the Angel area, but he suggests that this should not be taken as contemporaneity of Late Woodland and Mississippian peoples in the region. Instead, he implies a more complex transitional scenario in which cannot be understood simply by dating the transition from grog to shell temper in pottery. Expanding on this notion and applying it on a broader regional level, it is argued in this dissertation that a complete understanding Mississippian and Mississippianization at any site is contingent on synthesizing diverse archaeological data (i.e. moving beyond artifact typologies) with problem-oriented bioarchaeological analysis.

Tradition and Acculturation on the Mississippian Periphery

Closer to the American Bottom, at the Bridges site in South Central Illinois, Oetelaar (1993) reconstructs community life and situates rural settlements within the larger regional Mississippian framework. He delineates family and communal areas within the site, suggesting that public space was necessary for the development and maintenance of a Mississippian lifestyle by providing venues for ritual, subsistence, and tribute activities. He also points to the

contemporaneous use of wall trench houses and Late Woodland pit features as potential evidence for the maintenance of some traditional practices in spite of overall Mississippianization. Alt (2002) takes a similar approach in her evaluation of Mississippian Richland Complex sites in the uplands surrounding the American Bottom, evaluating ethnicity from the perspective of community identity, social interaction, and political change. She shows that traits such as house construction and ceramic production techniques might indicate acceptance of new Mississippian ideas on the one hand, while other features such as site layout, which may be more indicative of intercommunity social relations, point to the active maintenance of traditional social relations. This might indicate some level of resistance to complete Mississippianization well into the period of perceived Cahokian dominance.

In another take on the issue of resistance, tradition, and emulation, Emerson (1997) suggests that significant cultural changes (ethnogenesis) can indicate a response to cultural intrusion from other groups, a mechanism for defining "otherness," and the act of competing for cultural survival. Framing the development of the Upper Mississippian Langford tradition as a cultural response to Middle Mississippian intrusion in what is now northern Illinois, he suggests that ethnogenesis can be visible archaeologically through things like population aggregations, centralization of leadership, increased violence, limited incorporation of outside cultural practices, and increased territorial boundedness. Through an investigation of subsistence, settlement patterns, and mortuary practices, Emerson shows that each of these things, although clearly rooted in the terminal Late Woodland culture that preceded it, are amplified in the Langford Tradition. These changes are sudden and contemporaneous with the rise of the nearby Illinois River chiefdoms, lending support to the idea that Langford development was in response and resistance to the new social situation.

Some of these ideas might be applied to the situation further to the south, in the Lower Illinois River Valley. Unlike the Central Valley and other outlying regions, the Lower Valley seems to be largely devoid of large sites with temple mounds. Instead, smaller Mississippian farmstead sites appear to be more common. Farnsworth et al (1991) suggest that the lack of typical, substantial Mississippian village sites in the region indicate that the Lower Illinois Valley was populated by groups who essentially retained their Late Woodland identities while incorporating some aspects of Mississippian mortuary ritual. However, the presence of Mississippian style pottery, houses, social relations, and subsistence regimes among Mississippian period inhabitants of the region (Connor 1984, Goldstein 1981, Rose 2008) indicate deep involvement in a Mississippian lifestyle. A more nuanced approach to identity and ethnicity and its relationship to material culture in this region, coupled with discussion of the meaning of these concepts in individual archaeological interpretations, could potentially clarify these issues. This dissertation is intended to contribute a small piece of this puzzle by exploring the extent to which the adoption of archaeologically visible Mississippian cultural practices (i.e. mortuary patterning) in the Lower Illinois River Valley is reflective of real social differentiation and lived biosocial experiences of Lower Illinois River Valley inhabitants.

Sex and Gender in the Late Woodland and Mississippian Worlds

Archaeological Research as a Baseline for an Engendered Bioarchaeology

Gender is a fundamental cultural institution that organizes behavior and social interaction in complex ways, even within relatively egalitarian societies (Hill 1998, Macias-Lees and Black 2000). Specific investigations of changing gender ideologies resulting from Mississippianization are rare, but a few available studies provide a starting point for interpreting the results of this

research. Fritz (1999) and Watson and Kennedy (1991) both report on the origins of cultivation in the Eastern United States, proposing that women were responsible for the technological advances that lead to the development of agriculture in this region. Benn (1995) suggests that changing subsistence regimes had important implications for gender relations in the past, as a change in the importance of collected or cultivated plant foods would be directly related to women's economic power. Pauketat (2004) points to frequent iconographic depictions of Mississippian females engaged in agricultural activities and males engaged in priestly and game-related activities as evidence for the polarization and politicization of gender ideology concomitant with increasing social complexity and regional integration. Alt and Pauketat (2007) elaborate further and propose that the "theatrical" nature of Cahokian political ritual disseminated changing gender ideologies throughout the Mississippian world. As an example of this, Pauketat and Emerson (1991) suggest that decorative motifs on ubiquitous Ramey-incised pottery may have had sexualized and gendered meanings. Furthermore, Emerson et al (2003) observe that Mississippian figurines depicting males are more widely dispersed throughout the periphery than female representations, posing important questions regarding the nature of receptivity and resistance to Cahokian gender ideologies in outlying communities.

Another perspective on Cahokian influence can be seen through an evaluation of ideology and gendered social relations in the Mississippian world. Alt and Pauketat (2007) reevaluate excavation data from Wilson Mound in the American Bottom and propose that the unique burial assemblage might offer clues regarding a gendered component to Mississippian political activities. The central burial feature contained primary interments of several women, infants, and children. One of the females was carrying a full term fetus, which they interpret as a woman who died in childbirth. Bundle burials were also interred in the mound. The authors

suggest that this may represent a transition of power from one powerful lineage to another, with the new leaders ceremonially ending the reign of the old lineage by publically killing and interring their reproductive base. The importance of women in both the productive (i.e. agricultural) and reproductive roles in the Mississippian world certainly had implications for many aspects of culture, but it is unclear how this may have been absorbed by outlying Mississippian communities. In particular, Alt and Pauketat point to evidence for a wider dispersal of Cahokian male warrior/ritual iconography outside of the American Bottom compared to only limited distribution of female iconography. They suggest that peripheral Mississippian communities chose to emphasize some aspects of the Mississippian ideology while downplaying others. This is an interesting interpretation, and one that might have important implications for studies of gender relations in the American Bottom and outlying areas.

Nevertheless, several of these same authors also point out that there is no *a priori* reason to believe that people in outlying sites, with their own local histories, would have passively absorbed and reflected new Cahokian ideas, nor would they have necessarily accepted all new Cahokian social ideologies and practices as a total package (Alt and Pauketat 2007). This observation may be particularly astute when one considers that the exact nature of the relationship between centers like Cahokia and sites located in the periphery, particularly regarding the extent of social and political influence, is not fully understood and likely varies by locality (Anderson 1997, Emerson 1997, Milner 1998, Farnsworth et al 1991, Stoltman 1991). Another complicating issue is that, other than Benn's (1995) suggestion that changing subsistence regimes had important implications for gender relations in the past, there is little gender-oriented research regarding Late Woodland social dynamics. This makes it difficult to evaluate the strength of models that propose revolutionary changes in gender constructs with

Mississippianization or the way that any changes may have affected the experiences of real people, as we are lacking a baseline against which to gauge observed Mississippian patterns. Furthermore, although the studies cited above build strong arguments for a normative ideological shift with Mississippianization, none has adequately approached the way that this shift affected the lived experiences of ordinary Mississippian people. Gender may well have acquired new political and ritual meanings at Cahokia, but the extent to which gender relations in outlying communities were reflective of the Cahokian pattern in not known.

Bioarchaeological Perspectives- Criticisms, Shortcomings, and Sex-based Research

The disconnect between studies of physical bodies and studies of culture and social life has sometimes led to interpretive problems, as demonstrated in the occasional conflation of the terms sex and gender in bioarchaeology (Goldstein 2006, Gellar 2008, Walker and Cook 1998). Although osteological determinations of sex are useful and necessary in mortuary analyses, in isolation, osteological data are insufficient for exploring gender as a cultural phenomenon (Gellar 2008, Walker and Cook 1998). Gellar (2008) points out that bioarchaeology has the unique role of investigating the intersection of body and culture, but she also recognizes that bioarchaeologists have taken an essentialist view of differences between males and females and have failed to incorporate more than overly simplistic social theory when making gendered interpretations of the past. While bioarchaeologists are skilled at discerning biological differences, they are often challenged to interpret these differences within an archaeological framework to produce more nuanced observations about gender in the past.

Several important studies have focused on patterns of health and stress within the context of the Late Woodland/Mississippian transition, although few have done so from an

unequivocally gendered perspective. Some studies have indicated changes in the division of labor by sex with the advent of agriculture based on occupational stress markers and cross-sectional geometry (Bridges 1991, 2000), but studies of this nature have been plagued by both practical and interpretative issues (Jurmain 1998, Bice 2003). Furthermore, when taken on their own, they offer little in the way of social implications of the patterns they are detecting. For this, we must investigate not only to the type of work being done, but also to the changing gender relations indicated by the observed patterns. These data must be collected with careful attention to sex, but interpreted within a larger framework of appropriate archaeological investigations.

A few bioarchaeological studies from the Eastern United States and beyond provide a backdrop for the research questions investigated in this dissertation. Goodman et al (1980) investigated changes in the frequency of linear enamel hypoplasia in males and females interred at Dickson Mounds in West Central Illinois, concluding that during the Late Woodland, males displayed fewer hypoplasias than females, but that these proportions were essentially equal by Mississippian times. Cook (1984) reported that, for a set of Illinois skeletal samples (including Schild), the frequencies of microscopic enamel defects in the first permanent molar were the same in males and females in the Middle Woodland, but that the frequency in males increased in the Mississippian period. No data for the intervening Late Woodland period were available. In reviewing the implications of these and other studies, Cohen and Bennett (1993) suggest that male children were afforded less "protection" from nutritional and pathological insult in the Mississippian than in the Late Woodland period, possibly reflecting changes in the perceived value of women's work with the rise of agriculture. However, other studies have resulted in fundamentally different conclusions. In his analysis of growth and stress in the Dickson Mounds Late Woodland and Mississippian series, Clark (1985) concludes that, while both sexes

experienced early growth disruption in Mississippian times, female growth disruption was chronic while males underwent a period of catch-up growth during adolescence. He interprets this as an increase in male status with Mississippianization, achieved primarily during adolescence. The reason for the discrepancy in the results of these Dickson Mounds studies is unclear, but may be related to the disparate nature of the biological phenomena they are measuring (i.e. episodic versus cumulative growth disruptions). This idea will be explored further in chapter six.

The ways in which Mississippian ideas regarding social organization and status affected the proportion of maize in ones diet is of considerable interest to many archaeologists, including bioarchaeologists. One promising and increasingly popular source of paleodietary information is isotopic studies. Despite some interpretative and methodological problems, stable isotopic analyses have contributed to a wide range of bioarchaeological studies, particularly in light of recent advances in technology and understanding of metabolic and taphonomic issues (Cook 2007, Ambrose et al 2003, Schoeninger and Moore 1992). In the Eastern Woodlands, many isotopic studies have centered on clarifying the timing and impact of maize agriculture, suggesting that maize played only a minor dietary role well into the Late Woodland period (Cook 2007). Intracommunity social relations are investigated by Rose (2007) through an evaluation of variability in diet over time during the adoption of maize agriculture. Stable isotope analysis of bone collagen allowing for estimation of the relative proportion of maize and meat in the diet of Middle Woodland, Late Woodland, and Mississippian individuals from five sites in the Lower Illinois Valley and Central Mississippi Valley in West Central Illinois. Although variable maize intensification is evident at some late Late Woodland sites, the general trends are

nearly identical to those seen in the early Late Woodland, with no correlation between diet and age, sex, or status.

During Mississippian times, maize constituted a major component of the diet of most individuals, regardless of social differentiation. Schurr (1992) used stable isotope analysis to compare dietary variability to mortuary treatment at the Angel site in Southern Indiana. He suggests that social differentiation, as evidenced through mortuary differentiation, is not correlated with the amount of maize in ones diet at this site. Rose (2007) found that only Schild Knoll A showed significant sex differences in carbon isotope ratios and nitrogen values. Females had enriched carbon isotope values and lower nitrogen values, apparently indicating a diet with more maize and less meat than males. Females in mass graves in Mound 72 at Cahokia also appeared to have had a high maize diet, but the nature of this particular deposit, especially the possibly disparate and extraordinary life histories of these women, makes interpretation and relation to the results to the rest of the Mississippian world somewhat problematic (Ambrose and Buikstra 2003). Other authors have also attempted to analyze dietary data from a gender perspective by incorporating status into their interpretation of sex related health differentials in complex societies (Ambrose et al 2003, White et al 2001). An important study by Hedman et al (2002) addresses dietary variability within the American Bottom, indicating possible sex and status-related differences within and between both floodplain and upland sites. As an added component, they also compare their data with previous isotopic studies from Schild Knoll A remains. Both male and female Schild individuals showed dietary similarities with males and females from the American Bottom uplands, but the cultural meanings of these similarities are difficult to ascertain because of small sample sizes, the effects of individualized diets, and the possibility of interregional migration (Hedman et al 2002).

Situating the Current Study Within the Existing Literature

This chapter has provided a basic overview of Late Woodland and Mississippian cultural traditions of the late prehistoric midcontinent, and has specifically emphasized issues of particular relevance to this dissertation. An inherently complicating issue for scholars of gender transformations with Mississippianization is the general lack of gender-oriented research regarding Late Woodland social dynamics. This makes it difficult to evaluate the strength of models that propose revolutionary changes in gender constructs with Mississippianization or the way that any changes may have affected the experiences of real people, as we are lacking a Late Woodland baseline against which to measure proposed changes that lead to Mississippian patterns. This dissertation begins to broach this issue by contributing another component (i.e. changes in growth patterns) to the sex based bioarchaeological literature regarding the Late Woodland-Mississippian transition. However, a truly engendered interpretation of this phenomenon awaits an appropriate rigorous mortuary analytical perspective on Late Woodland intracommunity social dynamics, which is currently lacking.

Ideas about the role of tradition in acculturation are important because they remind us that, although broad regional trends in Mississippianization are of obvious importance, local variation should not be discounted. Pauketat's framework, particularly his emphasis on the role of negotiation between traditional practices and new Cahokian ideals, provides a good starting point for the exploration of Mississippianization on a more local level. Local perspectives are particularly important for exploring the relationship between Cahokia and peripherally located Mississippian sites. Issues of power and social organization at the community level are clearly tied into the types of large-scale, regionally oriented models of political and economic interaction described above. However, it would be an error to assume that cultural change was

homogenously accepted and incorporated by existing communities or that the spread of Mississippian culture was always accomplished through similar mechanisms. Evidence suggesting either maintenance or change of traditional intracommunity social relations, including those associated with gender, might suggest that the Mississippianization of outlying communities was a locally variable phenomena, complicating conceptions of the nature and definition of Mississippian ethnic identity. This dissertation will contribute a West Central Illinois/ Lower Illinois River Valley perspective to this problem.

"Cahokia-centric" notions of Mississippianization may be predisposed to ignoring local trends in the Mississippian periphery that, instead of being somehow less authentically Mississippian, might be more fruitfully considered as equally legitimate variants on a broader cultural theme. Furthermore, publically and ritually focused investigations of gender in religious and political life, which seem to be the norm in Mississippian gender scholarship, are interesting in their own right, but they inherently result in normative statements regarding Mississippian gender ideologies. For example, Emerson et al (2003) observe that Mississippian figurines depicting men and masculine activities are more widely dispersed throughout the periphery than female representations, and this observation might be interpreted as suggesting that Mississippianization may have had a more profoundly transformative effect on the lives of men (as compared to women) in outlying communities. This is something that can and *should* be tested in the archaeological record, but which must be done on a local level. Community-focused archaeological analyses are better positioned to determine the ways in which gender ideologies affected social relations for the average Mississippian person, and this research aims to ascertain the lived experiences of gendered Mississippian peoples through a socioculturally sensitive biological analysis of growth pattern differentials.

Based on iconographic evidence from the archaeological record in addition to ethnohistoric accounts, the ideological association between women, maize agriculture, and fertility is clear, but the way the relationship to traditional gender ideologies (historically rooted in the Late Woodland) or to the *lived lives* of Mississippian women is not entirely clear from the available evidence. Inter- and intracommunity social relations in the Mississippian world had important implications regarding food production and consumption, and studies such as those provided by Rose (2007) and Hedman et al (2002) will certainly continue to come out of isotopic approaches to these problems. However, non-chemical studies of skeletal growth can also contribute to this issue. Agriculture, as the primary means of subsistence in Mississippian societies, may have provided an avenue through which women could gain power and prestige, which can potentially be reflected in various health and growth patterns. This is a basic premise of bioarchaeological research, one that this dissertation is built upon, and one that can complement a wide range of approaches to gender dynamic in the past.

CHAPTER THREE- GROWTH AND STRESS IN BIOANTHROPOLOGICAL ANALYSIS

A basic premise of this dissertation research is that human growth patterns vary in relation to the biological, social, psychological, and environmental circumstances of life, and that such circumstances affect individuals differentially according to various social parameters (i.e. class, gender, etc). Although no single variable provides a perfect proxy for general health (Arora 2001), exploring the relationships between multiple indicators contributes to this study in particular, and to the development of bioanthropological method and theory, in several ways. Testing for relationships between certain indicators (between linear enamel hypoplasia and neural canal diameter, and between femur length and vertebral body height in the current study) can provide a framework for evaluating the general utility of poorly understood methods of growth assessment. Building upon this, interpretation of significant relationships (or lack of relationships) between various growth indices provide a basis for understanding the ways that various measures are reflective of similar or different growth phenomena.

This chapter provides an overview of relevant clinical and bioanthropological literature in order to make a case for studies of human skeletal growth as a valid means of exploring the biological implications of social differentiation in prehistoric communities. The specifics of the growth variables chosen for this study are reviewed and assumptions regarding the relationships between them explained.

Understanding Stress

A basic tenet underlying much bioanthropological research holds that unmitigated physiological and psychosocial stress is related to growth stunting, compromised immune response, and relatively reduced levels of health in affected individuals. Goodman et al (1988) incorporate a biomedical concept of stress and associated psychosocial and physiological processes into an anthropological understanding of biological and cultural adaptations. The Selyean approach to stress, which forms the foundation of their model, emphasizes two key issues: 1) A wide variety of stressors can manifest themselves via a small number of indicators, and 2) Perceived stressors have an important impact by providing new sources of psychosocial stress and exacerbating stress resulting from biotic sources (e.g. pathogens, conditions in the natural environment). These concepts allow for the integration of biobehavioral responses to stress into anthropological models, accounting for stress-mitigating and stress-exacerbating affects of cultural behaviors.

Growth and Heritability in Living Populations and Historic Data

Notions of plasticity of the human phenotype in relation to social and environmental conditions can be seen in the anthropological literature as far back as Boas's (1912) research on growth among American born children of immigrants. That growth/body dimensions are a reflection of the health and well-being of living individuals and populations is well supported by research focused on living communities (WHO 1995, Himes 2004). The clinical literature on growth typically focuses on stature and/or body mass in general, rather than emphasizing skeletal growth per se. Still, the establishment of a solid relationship between body growth and generalized health status is fundamental to the current study.

Stature is one of the most heritable of all anthropometric growth indices, with heritability reaching 0.92 in some populations (Czerwinski and Towne 2004). In a literature review, Silventoinen (2003) shows that in modern Western societies, about 20% of total adult stature attainment can be attributed to environmental (rather than genetic) factors, the most important of which are childhood nutrition and disease status. She also suggests that the average proportion of body height under environmental control in developing countries may be even higher, with lower general heritability and greater discrepancies between status groups.

Beard and Blaser (2002) suggest a direct relationship between pathogenic growth disruptions and decreased adult stature across time and space based on both historic and experimental analyses, and Steckel (1995) makes a particularly strong historically, contextualized argument for a general and significant correlation between economic standard of living and adult stature in modern developed nations. In an evaluation of historic penitentiary records, Tatarek (2006) finds that geographic origin and occupation better explain variation in height data for male inmates than do other factors such as race and birth cohort, although she suggests that unevaluated factors (such as education level) may also have had a strong effect. Because occupation and geographic are proxies for natural and social (i.e. economic) conditions, her analysis supports the hypothesis of a strong relationship between environment (both social and natural) and attained adult stature. Steckel's (1987) analysis of African slave height records documents the extraordinary ability of catch up growth, during the adolescent growth period, to virtually obliterate evidence of significant early childhood growth disruption related to disease load, poor nutrition, and poor prenatal health.

The above discussion emphasizes that the relationship between generalized cultural and environmental conditions and growth patterns can be ascertained for past populations using an

approach that combines historic records with modern biosocial growth models developed from living communities. These studies provide a theoretical and methodological bridge between studies of living groups (as discussed above) and studies of skeletal remains from archaeological sites lacking written records. Prehistoric bioarchaeological analyses are clearly hindered by lack of documentation. However, incorporation of appropriate archaeological data can largely compensate for the lack of written sociocultural records.

Stress and Growth Patterns in Prehistoric Populations

Prehistoric studies of the effects of stress on skeletal biology yield insights regarding generalized, long-term patterns of stress throughout space and time, despite the fact that they are not well suited to identifying the proximate cause(s) of stress in individuals and, in many cases, have difficulty incorporating the concept of perceived stress (Armelagos et al 1988). Larsen (1997) emphasizes that the skeletal expression of stress and deprivation must be understood as the result of the synergistic effects of multiple factors, including genes, hormones, physiological stress, environment, nutrition, sanitation, hygiene, disease, and degree of sedentism. Goodman et al (1984) summarize the uses of skeletal stress indicators in determining health patterns in prehistoric populations, emphasizing a culturally-oriented, multiple indicator approach. Skeletal stress indicators are discussed within three categories: 1) general, cumulative indicators, 2) general, episodic indicators, and 3) specific indicators. The particular qualities and utility of each of these categories have important implications for the interpretation of ancient health patterns, and will be discussed in this dissertation where appropriate.

Social Meaning of Intragroup Variation in Growth Experience

Patterned variability in growth experiences among living humans, as indicated by various types of anthropomorphic measures including skeletal growth and height, can be seen not only across populations, but also within communities and even within households (WHO 1995). The nature of contemporary populations allow for the development of directly testable hypotheses regarding the specific biological, social, and environmental correlates of intracommunity health discrepancies. In general, the nature of bioarchaeological samples precludes such detailed levels of analysis, although it should be noted that advances in the recognition of certain specific diseases in the bioarchaeological record, detailed mortuary analyses, and the historic documentation pertaining to social and biological status of the deceased can help to address this problem.

It is not the express intention of the current research to identify specific causes or explanations for the growth patterns detected. However, a general correlation between growth differentials and socioeconomic status differentials has been firmly established in bioanthropological literature regarding living peoples (Bogin 1988, Leatherman 1998, Bogin et al 2007). Goodman (1998) contends that ideology and economy should inform studies of intercommunity studies of growth in the past, and, building on this, it is suggested here that bioarchaeologists should also be concerned with 1) the ways that ideology and economy inform *intra*community social relations and, 2) that those relationships might become more visible in studies of growth. As such, intracommunity social parameters like status and kinship should be given as much credence in bioarchaeological studies as the biological categories of sex and age.

It is argued here that this can be accomplished through the integration of the results of osteological analyses with the results of other archaeological and bioarchaeological analyses (i.e.

mortuary patterning, nutritional analyses, epidemiology and paleopathology, trauma analyses, etc.). This approach can contribute to a more complete understanding of biosocial processes and, hence, quasi-proximate causality for changes in health patterns. In any case, exploration of the nature of the relationship between multiple stress indicators and multiple biocultural categories, combined with a recognition of the strengths and weaknesses of various methods and levels of analysis in bioanthropological studies of growth, will contribute to more complete interpretations of the concept of stress within the scope of a broader understanding of human adaptability.

Osteological Parameters Used in the Current Study

Vertebral Dimensions in Anthropological Analyses

Several authors have noted potential sensitivity of the vertebral column to growth disruptions (Clark et al 1986, Larson 1998, Hoppa and Fitzgerald 1999), but few have applied this knowledge to bioarchaeological situations. Clark (1988) developed a vertebral morphometric method for growth assessment and used it to investigate the relationship between social complexity, sex, and growth in Mississippian and Pre-Mississippian skeletal remains from Dickson Mounds. A detailed review of his vertebral growth model and his method are provided in his dissertation (Clark 1985).

Clark's vertebral method goes beyond traditional methods of evaluating stress (e.g. long bone length) by distinguishing between chronic and acute growth disruptions, the recognition of which has culturally significant implications. Individualized and generalized curves for four broad, physiologically based categories of bodily growth first described by Scrammon (1930) are still cited as reliable qualitative depictions of human growth trends (Molinari and Gasser 2004). Of particularly interest for the current study are 1) the general type, which comprises most

skeletal growth, including the femur, and 2) the neural type, which comprises the brain, spinal cord, and associated structures. Clark et al (1986) cite vertebral growth data and suggest that, just as skull growth occurs based on the neural curve in order to accommodates rapid brain development during early childhood, vertebral arch growth progresses according to a similar growth trajectory due to its association with the spinal cord. General growth increases gradually until puberty, when more rapid, exponential growth begins to occur. Neural growth, on the other hand, progresses exponentially through early childhood, tapering off prior to puberty (Figure 2) . This means that the ultimate size of the neural canal is achieved during early childhood, long before the completion of general body growth (Figure 3).

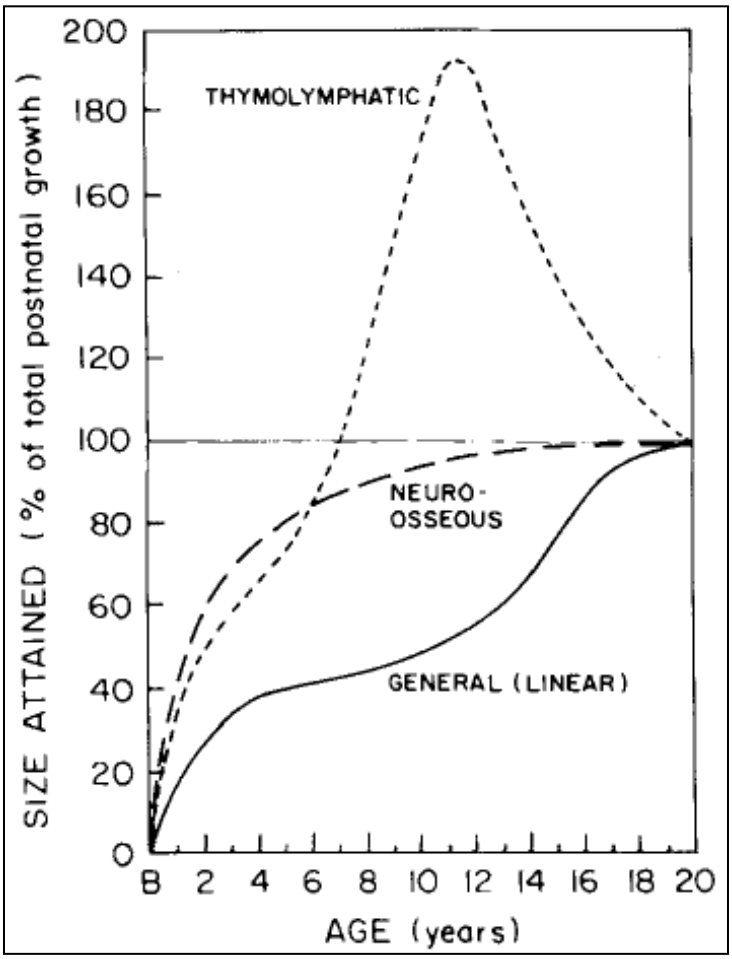

Figure 2- Growth Curves (from Clark 1986)

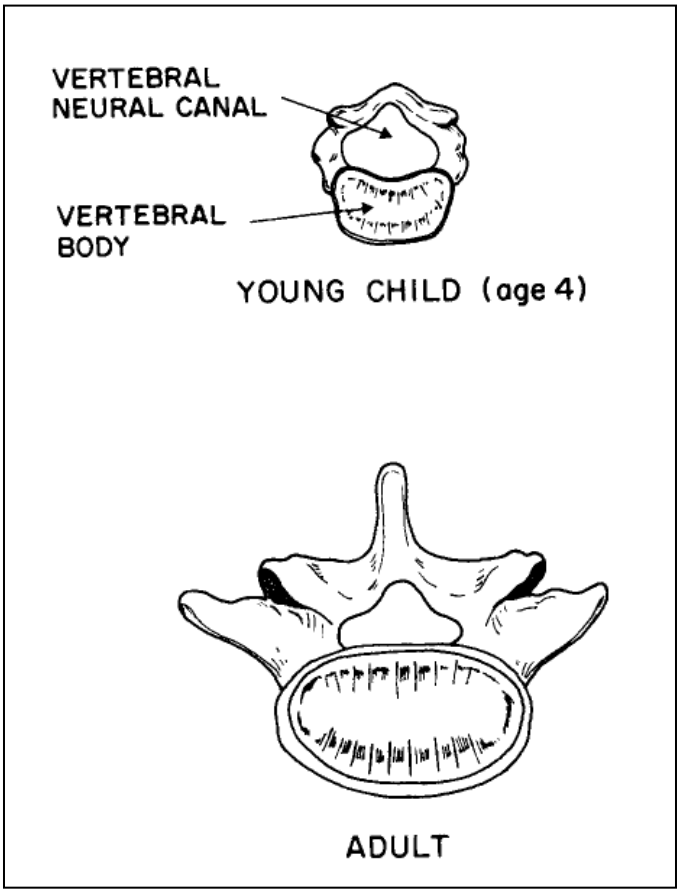

Figure 3- Vertebral neural canal size in children and adults (from Clark 1986)

Because vertebral arch growth ceases before vertebral body growth (during childhood versus during late adolescence/early adulthood), Clark suggests that analysis of the relationship between measurements of these two features may be useful in determining whether growth disruptions are chronic, resulting from generally continuous stress and deprivation throughout the growth period, or whether catch up growth occurred when stressful situations were eventually ameliorated during the later adolescent period. Clark's interpreted vertebral growth patterning in the Dickson Mounds skeletal series as indicating that Mississippian females were smaller than their pre-Mississippian counterparts, but that Mississippian females experienced

chronic growth disruption. Mississippian males, on the other hand, experienced early growth disruption followed by periods of catch up growth. This has important implications regarding differential treatment of male and female children in Mississippian society, and Clark interprets his results as indicating an increase in male status with Mississippianization.

The current study provides new data on the relationship between generalized health/stress and vertebral growth patterns, and contributes to the limited body of anthropological research on the subject. Clark's (1985) analysis, upon which the current study is largely based, is discussed throughout this dissertation, but Tatarek (1999) offers another important analysis that warrants detailed discussion. She used the Hammond Todd collection to analyze the relationship between spinal stenosis in the cervical spine and various health parameters, many of which are only available by virtue of documentation and records that are inherently lacking in a prehistoric analysis. Tatarek provides a detailed account of morphological variability throughout the spinal column and offers biomechanical, genetic, and ancestry-related explanations for the variation. The current study did not test the same hypotheses as Tatarek, and therefore comparison with many of her results is not possible at this time. Additionally, she dedicated much attention to vertebra-by vertebra analysis. In contrast, this research focused more on the means based analysis, as this research is modeled largely on Clark's study. However, future research will focus on reanalyzing the data collected for the current study so that it might be more directly comparable to Tatarek's analysis.

Tatarek (1999, 2005) found that sex was more highly correlated with cervical neural canal diameter than age or ancestry, although interactions between sex and ancestry were also found to be significant. These associations were not observed in the thoracic or lumbar segments. She suggests that transverse diameters in the cervical spine may continue to grow until the age of

10, and are thereby more subject to environmental perturbation. Tatarek does not find a correlation between LEH occurrence and decreased canal diameters (contra Porter 1986), but she recognizes that vertebral canal diameter is likely dependent on more than genetics and sexual dimorphism, concluding that more research is necessary before the relationship between neural canal diameter and environmental factors can be understood. Further investigation of the relationship between vertebral neural canal growth and early childhood growth disruption is required.

Timing of Vertebral Growth

Successful application/testing of Clark's method requires a detailed understanding of vertebral growth. Unfortunately, the clinical literature is sparse, and what is available focuses heavily on reviews of abnormal development. The bioanthropological literature provides the basic framework for the timing of bone growth used in this study, and complementary information from the clinical literature is cited when necessary and available.

At birth, vertebrae typically consist of three primary centers of ossification: the body and two (left and right) arch components. The posterior aspects of the arches generally fuse at the spinous process during the first and second year of life in the thoracic region, progressing from the lower to the upper elements. In the lumbar segment, posterior fusion starts in the upper elements at approximately one year of age, progressing downward to L5, which fuses by age five. Fusion of the neural arch to the body occurs earliest in the lower thoracic elements, starting at approximately three to four years of age and progressing superiorly through the sixth year. In the lumbar region, fusion of the arch to the body occurs in the upper elements around two to three years of age, and culminates with the fusion of L5 around age five (Baker et al 2005).

Supplementary information from clinical literature complements the growth model presented above. Gepstein et al (1991) find that the anterior-posterior canal diameter is significantly correlated with overall neural canal area ($p=.05$) in the second through fifth lumbar vertebrae, while neither transverse diameter nor vertebral body height measurements are significantly correlated with canal size. Ursu et al (1996) shows that, in the lumbar region of the spinal column, transverse neural arch diameter in L1 through L4 reach 70% of adult size by the time of birth, but L5 has generally attained only 50% of its adult size by then. This suggests that growth disruption in infancy might have a more stenotic effect on L5 compared to the rest of the lumbar spine.

While the vertebral arch growth data cited above pertains specifically to the conditions of early childhood growth, vertebral body growth continues throughout childhood and into early adulthood, making it a potential indicator of cumulative growth conditions over the entire growth period. Sarwark and Aubin (2007) calculate that, on average, each vertebral body grows by about one millimeter (0.5 mm per epiphysis) in height per year, with accelerated growth during the early (0-2 years old) and prepubescent period. Song and Little (2000) note that growth in height had ceased in 61% of their study sample by the time participants reached age 17, although they did not distinguish between differential growth between various body segments (i.e. limbs versus trunk). Baker et al (2005) note that thoracic vertebral body height growth ceases with epiphyseal fusion by early adulthood, while the same process occurs somewhat earlier in the lumbar region.

Beyond his original analysis, Clark's vertebral method has not been retested in a bioarchaeological context. Explicit comparisons between vertebral growth patterns and patterns of growth observed using methods that have been more widely applied will help in assessing its validity in bioarchaeological contexts. Comparative methods that record growth occurring at

approximately the same time as those observable in vertebral canal and body height (specifically early childhood and late adolescence) will be useful for assessing the validity of the vertebral method. Two traditional methods of bioarchaeological growth assessment, LEH and long bone length, were chosen for evaluation.

Long Bone Length

Human growth models are typically developed from living populations with both skeletal and soft tissue intact. Long bone proportionality, as proxy for adult stature, is an established and standard practice in bioarchaeology. Long bone length can be used as a cumulative, non-specific indicator of stress and growth (Goodman et al 1984), although it must be recognized that final adult length is the net result of a number of factors, including genetics and nutrition (Larson 1998).

The femur comprises five centers of ossification, but for the purposes of recording data pertaining to adult stature, only the fusion of the proximal and distal epiphyses to the femoral diaphysis is of concern. The proximal epiphysis first appears within a year of birth, and does not fuse to the diaphysis until between 12 and 16 years of age in females and 14 to 19 years of age in males. The distal epiphysis is present before birth and fuses between the ages of 14 to 18 in females and 16 to 20 in males. Of particular interest in the current study is the relationship between femoral length and vertebral body height, both of which are hypothesized to record general, cumulative growth through early adulthood.

Linear Enamel Hypoplasia (LEH)

Enamel hypoplasia is an episodic stress indicator commonly cited in bioarchaeological literature as the premier marker of early childhood stress events, with particular utility in discerning the timing of stress within the early childhood growth period. However, like long bone growth, LEH is a non-specific stress indicator and cannot, on its own, be used to determine proximate causality. Nonetheless, the non-adaptive nature of LEH is suggested by the general correlation between the exhibition of these characteristics and reduced life expectancy throughout time and space. This observation suggests that these factors are indeed useful for making inferences regarding quality of life in prehistoric populations (Larsen 1997, Cook 1981). LEH etiology, factors contributing to their appearance and distribution, and implications for archaeological studies have been thoroughly reported by Goodman and Rose (1990) and Goodman and Armelagos (1985).

Developmental enamel defects represent disruptions to normal amelogenesis and result from a wide variety of biological insults, including dietary insufficiency, trauma, and infections. Goodman and Rose (1990) provide a review of amelogenesis and specific enamel structures, such as lines of retzius, Wilson bands, and enamel prisms. Reference to normal dental development, including differential development and chronology, can assist in gauging the timing and severity of these defects. Because all dental development occurs during childhood, bioarchaeologists can use both microscopic and macroscopic enamel defects to explore the connection between poor early childhood health and broader community health.

Several sources recommend collecting LEH data for the central maxillary incisors and mandibular canines in the permanent dentition (Goodman and Rose 1990, Ubelaker and Buikstra 1994). Maxillary incisor crown development generally occurs between ages two months and four

years, while mandibular canine crown development typically occurs between ages four months and six years (White and Folkens 2005). It is suggested here that the established relationship between LEH and early childhood stress make this indicator comparable to neural canal measurements collected using Clark's method, as both are hypothesized to reflect conditions of early childhood growth.

CHAPTER FOUR- SITES AND SAMPLE DESCRIPTIONS

This study evaluates human skeletal remains from two West Central Illinois mortuary sites: Schild and Yokem. These collections are part of a large, temporally and culturally expansive set of mortuary and skeletal series from the Lower Illinois Valley, and their importance for investigations of the prehistory of the midcontinent is clearly demonstrated by their prominence in the regional archaeological and bioarchaeological literature. This chapter provides an overview of the mortuary contexts of the skeletal remains and briefly review pertinent previous research focusing on these collections.

West Central Illinois- Cultural Setting

The Lower Illinois River Valley is commonly demarcated as the area surrounding the southernmost 110 kilometers of the Illinois River (Delaney-Rivera 2007). It is widely recognized in the literature as possessing distinct regional manifestations of both Late Woodland and Mississippian cultural traditions, recognized primarily on the basis of ceramic sequences (Perino 1971, 1973), and is sometimes conceived of as a cultural extension of the American Bottom (Brown et al 2007). Regional similarities in cultural practice reach beyond the boundaries of the Lower Illinois River Valley proper to encompass a somewhat broader area that includes the Yokem site, which is located outside of the Lower Illinois River Valley proper, on a bluff overlooking the Mississippi River floodplain. Intercommunity gene flow has also been demonstrated within this more inclusively defined region of West Central Illinois (Droessler 1981, Conner 1984, Steadman 2002). Based on these cultural and biological relationships, some archaeological and bioarchaeological analyses have considered Yokem and Schild to be part of

the same regional expressions of Late Woodland and Mississippian traditions. As such skeletal samples from these sites were combined in the current study when necessary for sample size.

The Sites

Use of the Schild and Yokem cemeteries spanned the Late Woodland-Mississippian transition, providing researchers with a good skeletal series for investigating the biological effects of social change over time. Schild and Yokem are located approximately 105 and 240 kilometers (respectively) north of Cahokia. The Schild site is located near the town of Eldred in Greene County, Illinois, while the Yokem site is near Quincy in Pike County (Goldstein 1980, Perino 1971 and 1973). Both the Late Woodland and Mississippian components of Schild and Yokem were excavated by Gregory Perino in the early and mid-1960s (see Table 1 for radiocarbon dates and Figure 4 for site locations). Skeletal remains from both sites are curated at Indiana University.

Site	Component	Date
Schild	Late Woodland	AD 1200-1300
	Mississippian	AD 1100-1200
Yokem	Late Woodland	AD 900-1100
	Mississippian	AD 800-900

Table 1- Radiocarbon dates and phases for study sites (from Steadman 2002)

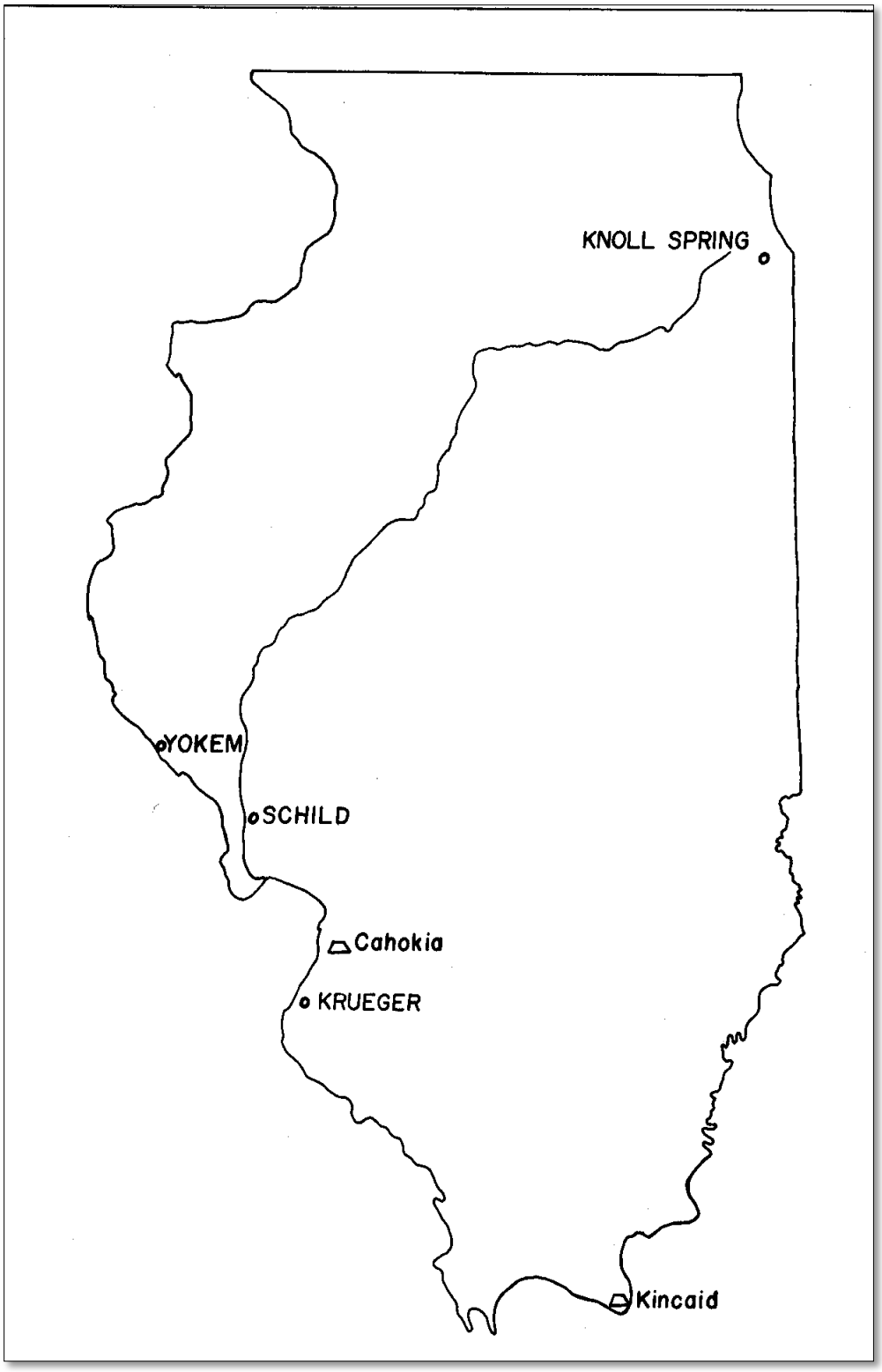

Figure 4- Site locations (From Perino 1971a)

Late Woodland Components

Schild (Perino 1973)

Nine Late Woodland mounds were excavated at the Schild site, with approximately 230 individuals represented in the series (Figure 5). Schild Late Woodland mound nine directly abuts knoll A of the Schild Mississippian Cemetery (Figure 6). The majority of the burials were single interments in circular graves with few or no grave goods. Although flexed burials were the most frequently encountered, semiflexed and bundle burials were also common. The graves were generally excavated into the ground surface prior to mound construction, with only few added after the mound was completed. The Schild graves were subsequently refilled with the excavated soil, in contrast to Late Woodland graves at sites like Koster, which appeared to be refilled with clean loess. Stone lined graves and individuals covered with limestone slabs are also found at Schild, although this type of burial is more common at the Yokem site.

Rectangular pits associated with the Late Woodland mounds were interpreted as potential charnel structures, from which processed bodies were periodically removed and interred in the immediate vicinity. The subfloor tombs likely served a similar purpose, a proposition that is supported by the scatter of isolated human bones around the immediate vicinity. Perino discusses the "crematories" located in several of the Schild mounds,. These 7x9 foot rectangular structures were similar in size and shape to stone tombs found at Yokem, but at Schild they were presumably constructed of some perishable material. As was the case at Yokem, these structures were clearly burnt, but whether the burning event was accidental or purposeful is unclear.

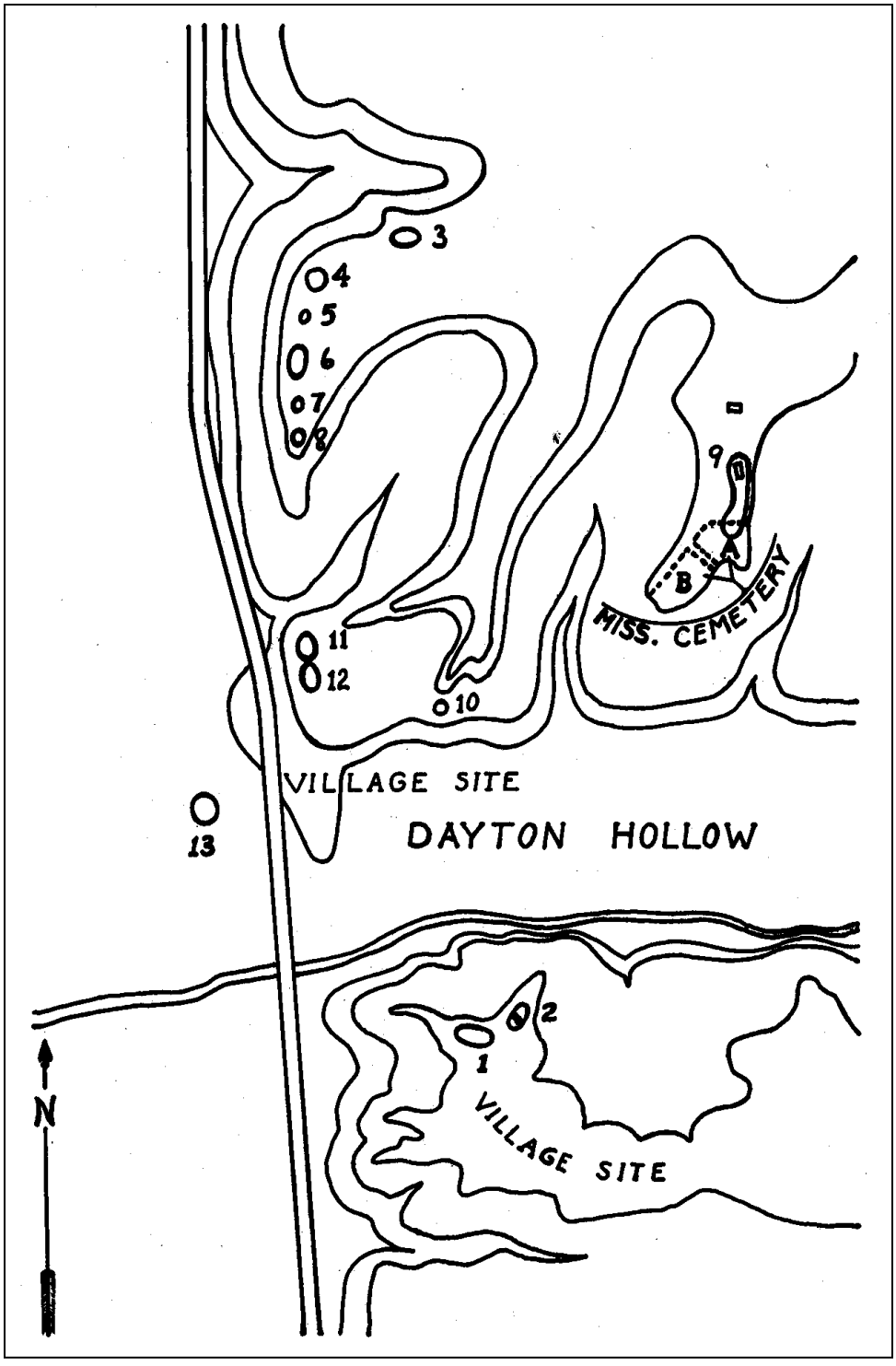

Figure 5- Map of Schild Site (From Perino 1971)

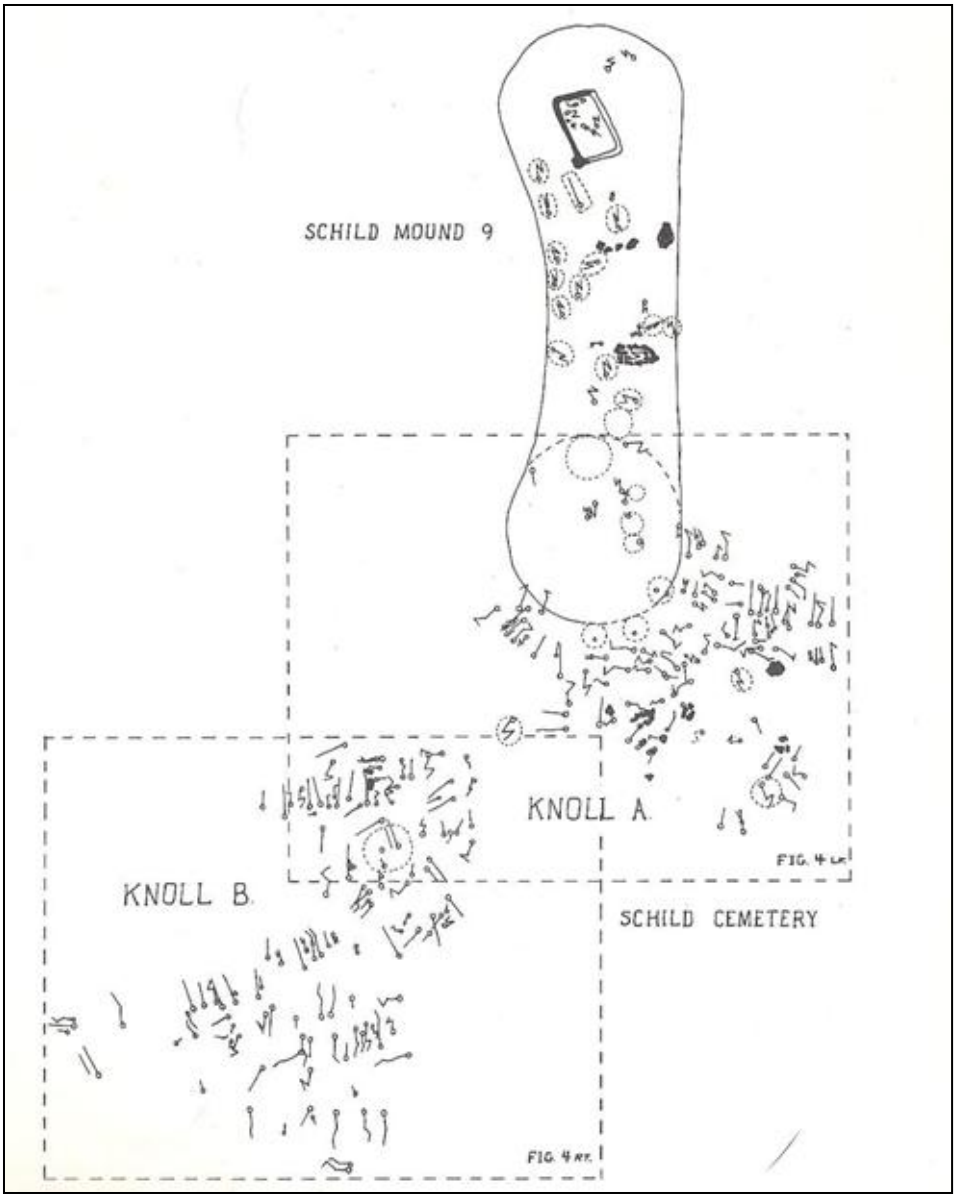

Figure 6- Schild Late Woodland Mound Nine, showing spatial relationship to Mississippian Knoll A (From Perino 1971)

Yokem (Perino 2006)

The Late Woodland component of the Yokem site consists of five burial mounds (numbered 4 through nine) constructed upon naturally occurring knolls (Figure 7). Several of the mounds contained tombs made of limestone slabs and logs. The above ground tombs had doorways and the floors were prepared so that the surface was about six inches deeper than the outside ground

level. Others were constructed by excavation of a subsurface crypt, which was subsequently lined with stone slabs and roofed with logs. At nearby, contemporaneous sites (such as Koster), remains were periodically removed from wooden charnel structures and reinterred in the vicinity. At Yokem, however, it appears that remains were allowed to accumulate. Some of the tombs show evidence for burning, although it is unclear whether this burning was intentional or accidental. Regardless, , the tombs were filled with soil after the burning event. At the nearby Joe Gay site, two similar structures are interpreted as charnel houses, and there is evidence that bodies were cremated within this structure and subsequently interred in surrounding mounds (Cook and Palcovich 2006).

Other Late Woodland mounds at Yokem did not contain stone tombs and may date to a slightly later period. Stone remained an important part of the burial program, as evidenced by the presence of limestone and shale slabs over many burials. Individual and multiple burials were excavated into the natural ground surface, while others were incorporated into the mound fill. Like many Late Woodland mortuary sites in the region, few contained any durable grave accompaniments. The most common inclusions were Anculosa shell beads, presumably as jewelry or clothing embellishments. Several of the mounds contained charnel pits, each of which contained disarticulated remains. Perino interprets the charnel pit associated with Yokem Mound four as the initial mortuary event for the mound. He also mentions the presence of charred bone fragments that appeared to have been scattered over the central region of two mounds at the site, a phenomenon he observed at other Late Woodland mounds (he specifically mentions Koster). Also notable in mound four at Yokem is the interment of an older male, accompanied by a pipe, a bone tool, and covered with a series of deer antlers. This individual may have had a unique social role, or his interment may have been ritually meaningful in some other way. Citing the

progression of smaller (younger deer) to larger (older deer) antler racks as one moved from head to feet, Perino suggests that deer ceremonialism may have played a role in this arrangement.

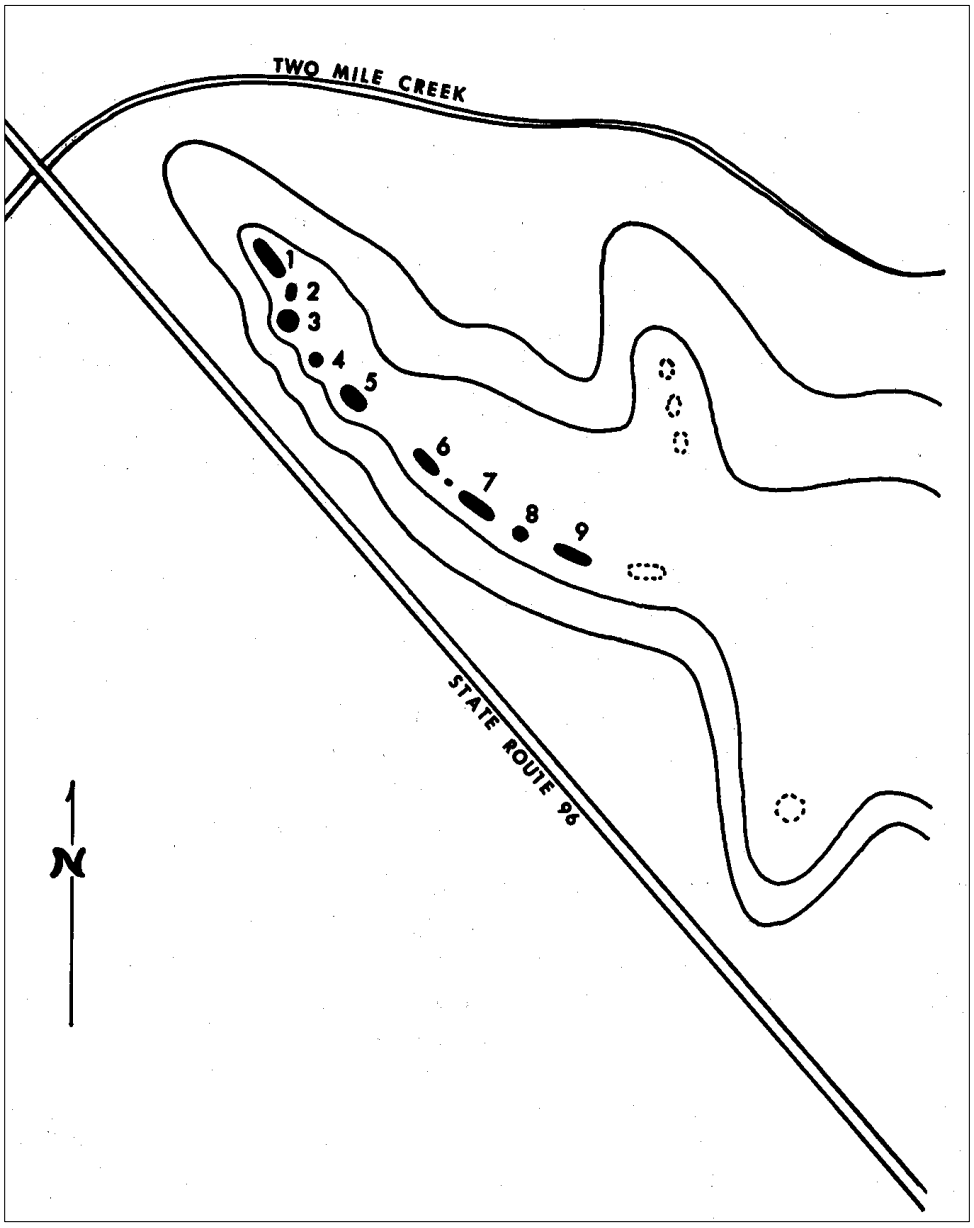

Figure 7- Map of Yokem Site (From Perino 1971)

Mississippian Components

Schild

The Schild Mississippian component was originally excavated by Perino in the 1960's (along with the Late Woodland component) and likely dates to Stirling and Moorhead phases (Perino 1971a, Goldstein 1980). Over 300 burials were recovered from two distinct burial areas (Figure 8). Perino's field observations indicate his suspicion that apparent spatial grouping and artifact associations were related to social roles and that fire and/or cremation may have played important part of mortuary ritual at this site.

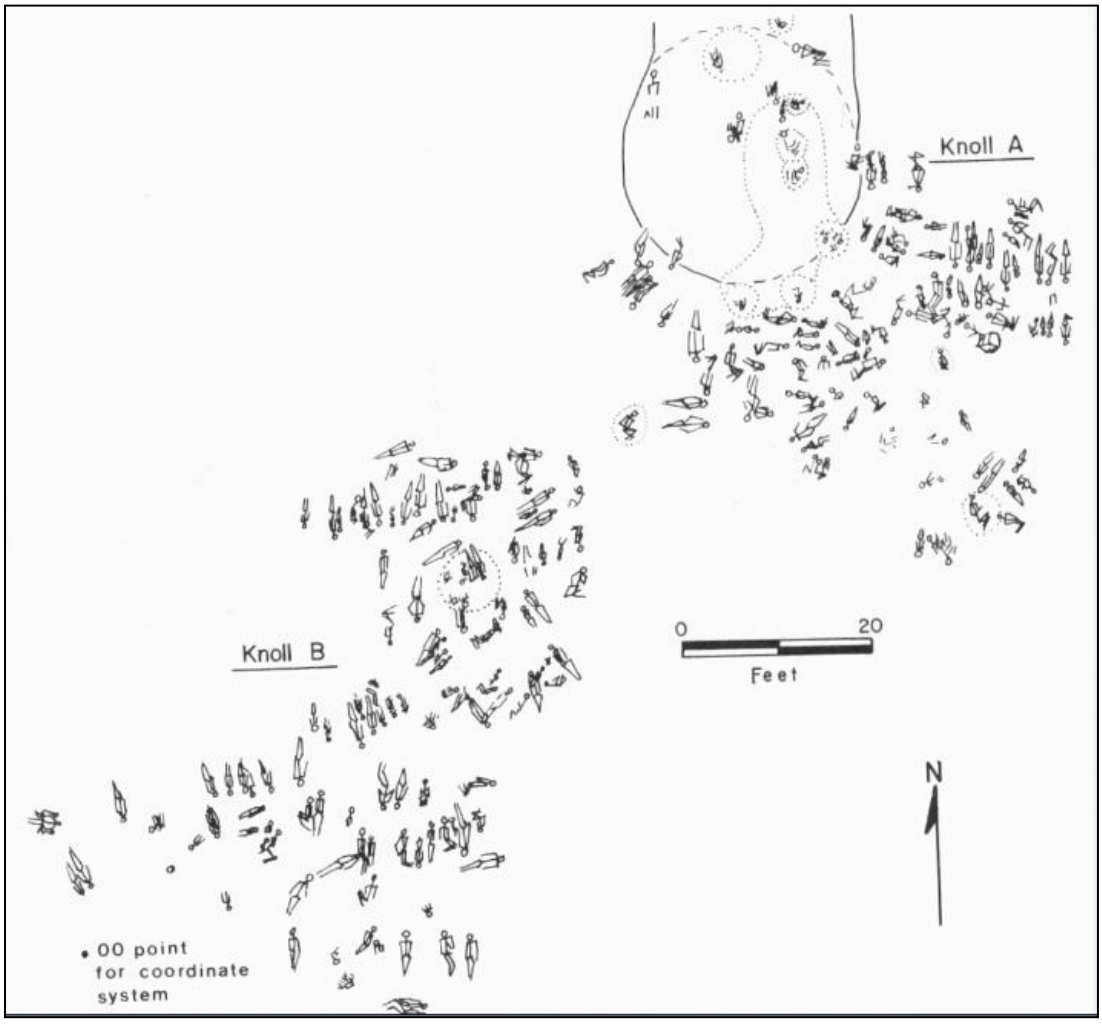

Figure 8- Schild Mississippian Component (From Goldstein 1980)

Goldstein (1980), in her study of Mississippian mortuary practice at Schild and the nearby Moss Cemetery (not part of the current analysis), hypothesized that bounded cemetery areas are likely indicative of corporate group structure with lineal descent. Initial artifact analysis indicated some differentiation in burial treatment, based loosely on sex and age, with the most restrictive associations limited to a few individuals. Distinct rows of burials, as indicated by spatial analysis, further defined more restrictive versus more inclusive burial treatments within the cemeteries, while also allowing for investigations of group membership (i.e. kinship) beyond that which is indicated by the artifact analysis alone (Figure 9).

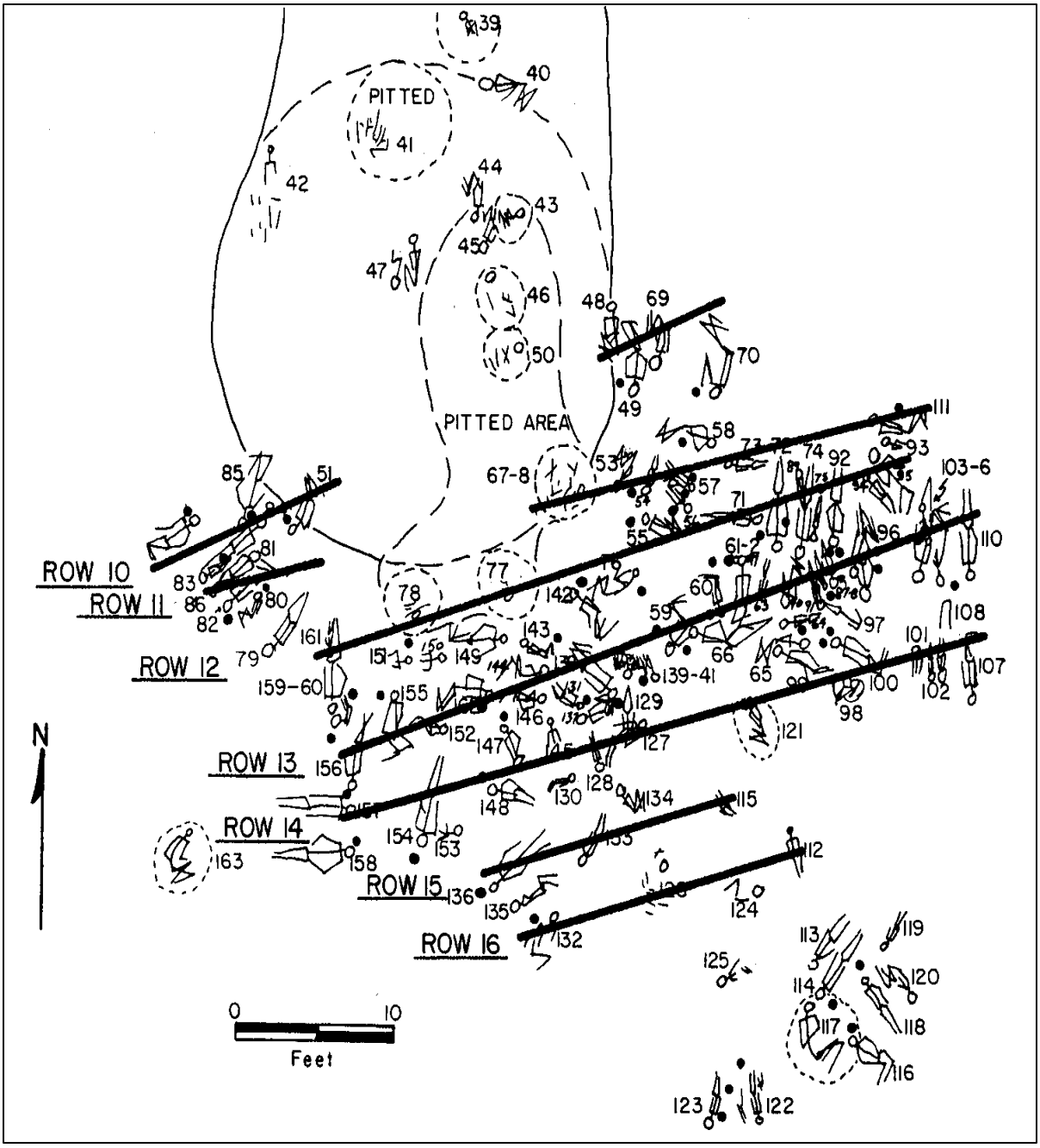

Figure 9- Schild Knoll A rows (from Goldstein 1980)

Although traces of a structure were not clearly visible during excavations, the discrete arrangement of certain burials and the presence of charred plant materials and limestone set two groups of individuals off from the prevailing row-based arrangement of the site. Based on this evidence, Goldstein suggests that a charnel facility is indicated (Figure 10). For Knoll A, it appears that the charnel structure served as a focus around which a group of burials were arranged. It is unclear which bodies were processed through the charnel house before interment, although Goldstein points out that articulated burials that were afforded the most exclusive burial treatments were often interred with parts of individuals who may have been processed through the facility. The structure was eventually burnt and scattered, with some bundled individuals and charred plant remains deposited on top before the area was covered with a low mound of earth. The Knoll B structure appeared to go through the same general sequence, although it did not appear to have been capped with a mound upon burning (Figure 11). It is important to note that not all of the burials in either knoll seem to be directly related to the charnel facilities, and Goldstein suggests that this may be an important clue to social divisions within the communities that used the site.

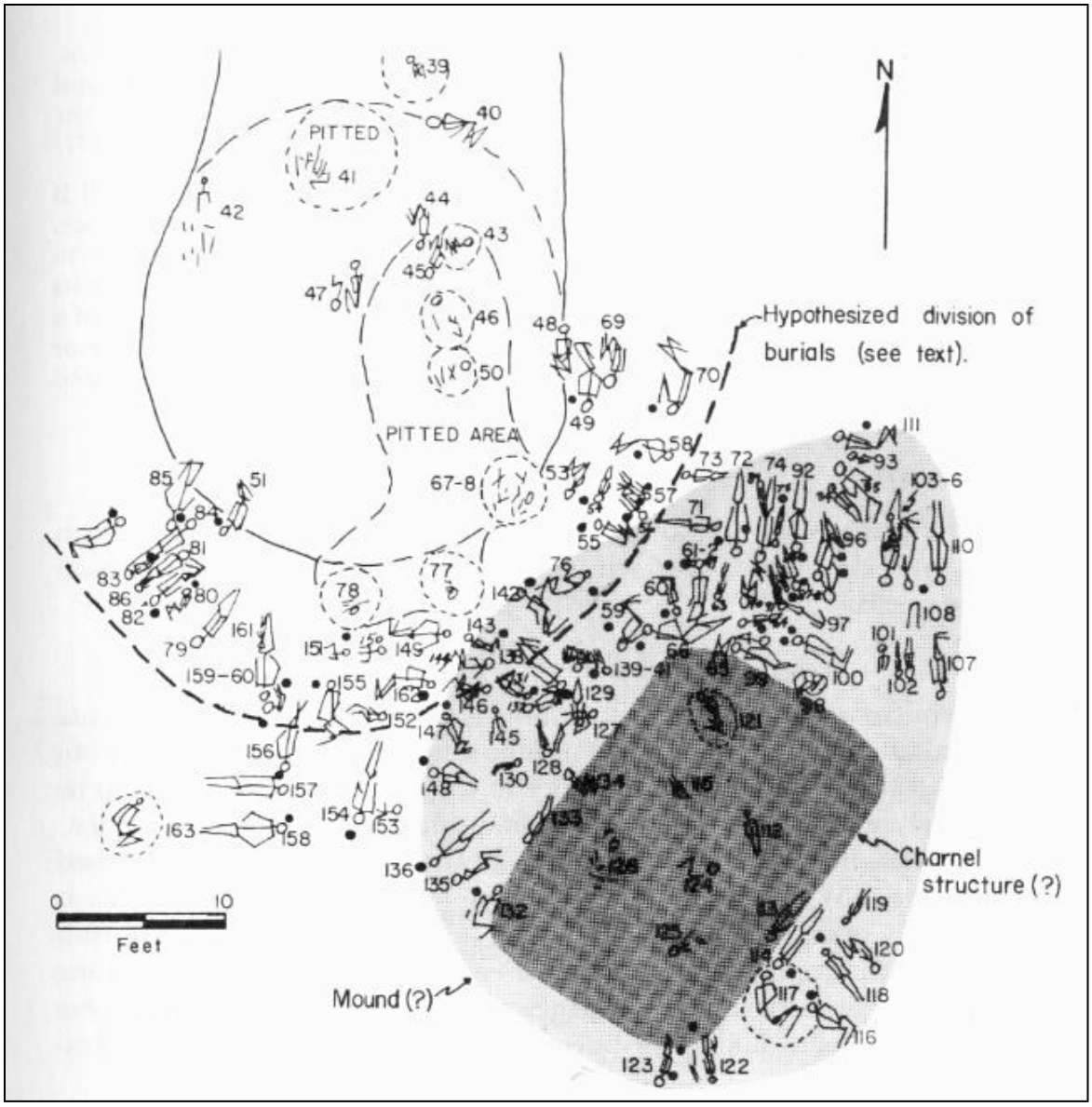

Figure 10- Charnel structure and hypothesized burial divisions in Schild Knoll A (from Goldstein 1980)

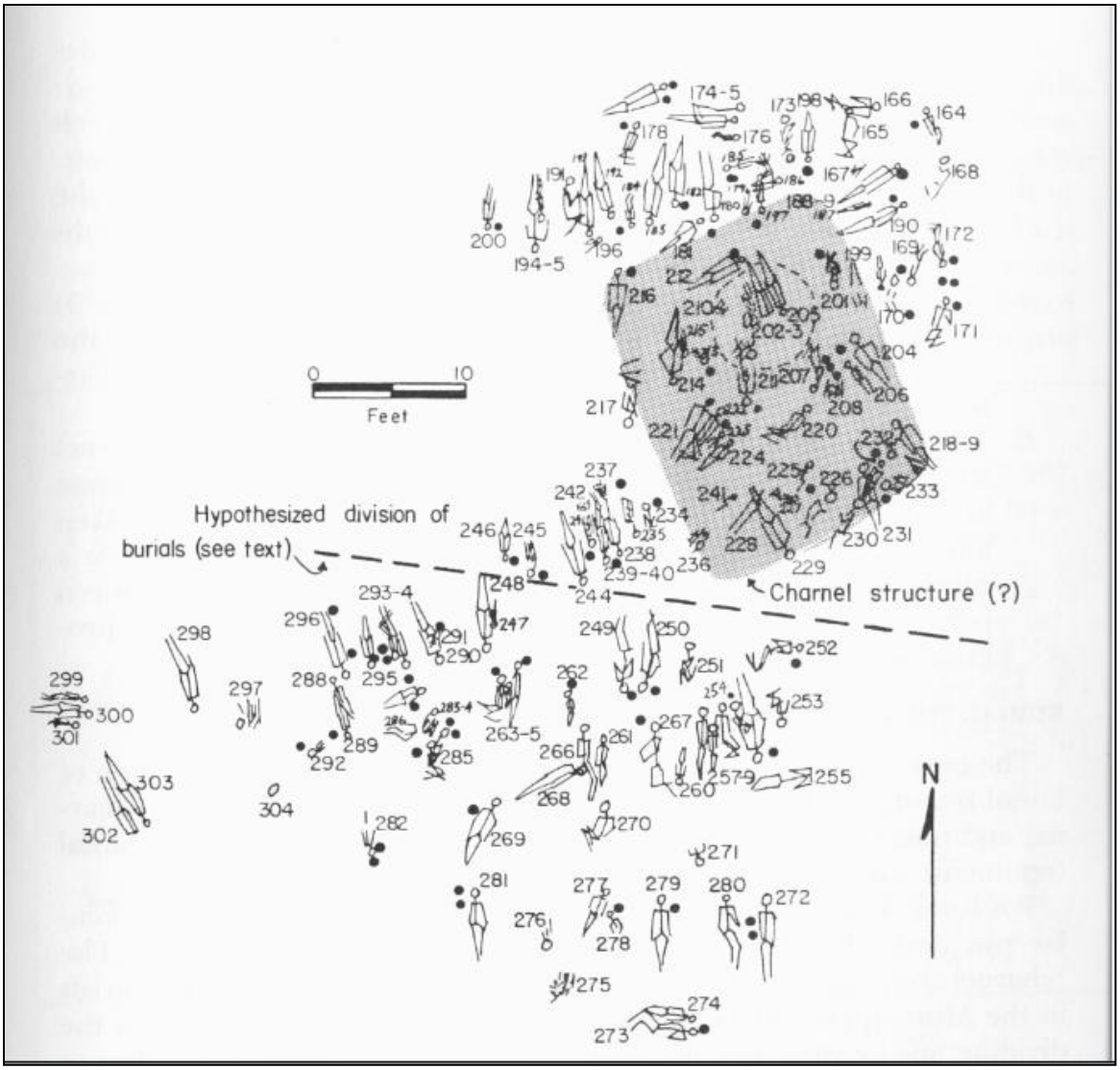

Figure 11- Charnel structure and hypothesized burial divisions in Schild Knoll B (from Goldstein 1980)

Mortuary treatments at Schild are certainly different from those observed at Cahokia and other large centers, but Goldstein's analysis indicates that the level of social complexity within these small, outlying communities is in keeping with general expectations of a ranked and kin-based Mississippian social system. Larger sites tend to incorporate the basic elements observed at smaller sites. Goldstein's model for Mississippian mortuary practices emphasizes spatial

arrangement as an important indicator of social differentiation and constitutes a critical component of the research outlined in this dissertation.

Yokem

Like Schild, the Yokem site has both Late Woodland and Mississippian components (Perino 1971b). Over 100 burials at this site were attributed to the Mississippian occupation of the area, which likely dates to slightly later than the Mississippian component at Schild. The Mississippian mounds at Yokem are numbered 1, 2, and 3 (Figures 7 and 12)

Although Yokem has not been subject to the same type of rigorous spatial analysis as Schild, Goldstein (1980) notes several key features of this site in her model of Mississippian mortuary practice. Natural knolls and an existing Late Woodland mound at the site were accentuated with additional earth to construct three low mounds. She suggests that each of the three mounds may represent a corporate or descent group and that the Yokem mounds seem to be used by a more localized community compared to Schild, which likely represents the cooperative mortuary activities of several dispersed communities.

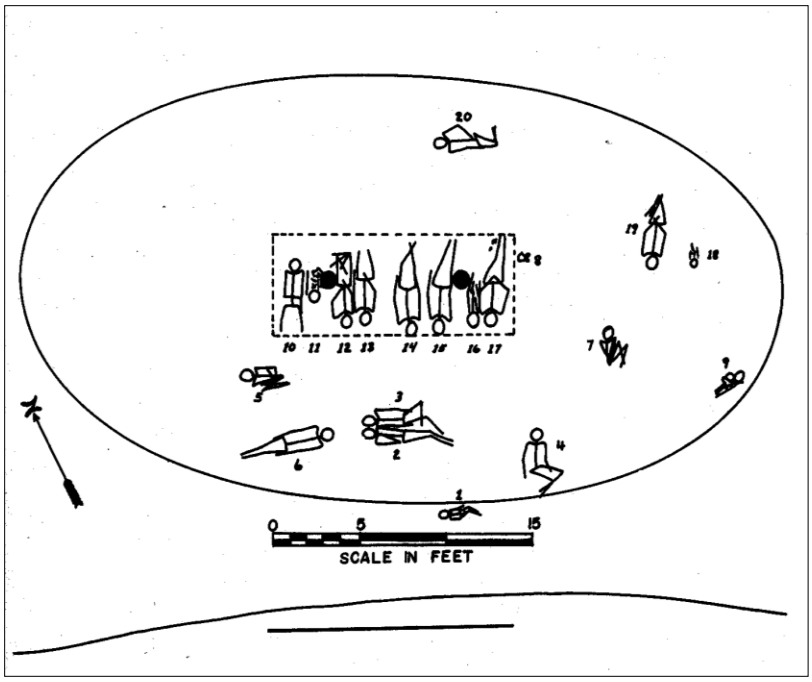

Figure 12- Yokem Mississippian Mound 2 showing charnel structure (from Perino 1971b)

Unlike Schild, Yokem has preserved structural evidence for charnel facilities, specifically post molds and delineated floors (Perino 1971b). Charnel features were built upon original surfaces that had been prepared prior to the main mound construction events. Two of these buildings showed evidence of burning. Rows of graves containing both primary and bundled interments were placed around these charnel structures as well as throughout the rest of the mounds. One of the mounds contained a row of articulated and bundled individuals, while the other two contained scattered human bones. One of the structures contained the partially disarticulated remains of an adult, which Perino interprets as a burial that had been disturbed by subsequent charnel activity (Perino 1971b).

Previous Bioarchaeological Research

Several important bioarchaeological studies have incorporated data from the Schild and Yokem series and will be considered when interpreting the results of this study. Cook, Buikstra, and their colleagues have extensively studied the Lower Illinois Valley series from the periods in question to better understand the origins of diseases such as tuberculosis and syphilis in the New World (Braun et al 1998; Buikstra 1992; Buikstra and Cook 1978, 1981; Cook 1976, 1994, 2005). These studies have obvious implications for evaluating the general health of the populations that are part of this study, but these specific pathologies have not been directly incorporated into the current analysis. It is important to note, however, that disease processes associated with tuberculosis can affect the vertebral column; such affected individuals were excluded from the current analysis.

Other studies have more direct implications for this dissertation, particularly those that explicitly address sex and status based differences in the expression of various biological indicators of stress, growth, health, and activity. Bridges et al (2000) suggest that Schild Mississippian females had decreased arm strength as compared to their Late Woodland predecessors, perhaps indicating advances in harvesting and food processing technologies. Although these types of cross sectional geometry studies have been criticized from both methodological and interpretive perspectives (Jurmain 1992, Bice 2003), the basic association between women and agricultural pursuits in the prehistoric Eastern Woodlands is generally agreed upon. Also related to agricultural perspectives is Buikstra et al's (1986) use of the Schild sample to show increasing fertility rates over time, suggesting that Mississippian women were consciously making decisions regarding birth-interval based in part on access to adequate weaning foods.

Rose (2007) contributes an isotopic perspective to this literature in her broad temporal analysis of dietary trends in West Central Illinois. She notes that members of the Schild Late Woodland community seems to have consumed somewhat less maize than their contemporaries throughout the region, including those individuals interred at Yokem. Regarding the Mississippian components, only Schild Knoll A showed significant sex differences in carbon isotope ratios and nitrogen values (females having enriched carbon isotope values and lower nitrogen values), apparently indicating a diet with more maize and less meat than their male counterparts.

Hamilton (1982) shows that sexual dimorophisms in several skeletal features decreases from the Late Woodland to the Mississippian at Schild and other West Central Illinois sites, suggesting a relative increase in female nutritional or health status. Cook (1984) evaluates femur length relative to dental age in a sample that includes juveniles from both Schild components, and concludes that there is a general trend toward improving growth conditions for children with Mississippianization. However, because juveniles cannot be sexed, it is impossible to determine whether male and female children were differentially affected. She also notes a relative decrease in the prevalence of microscopic enamel defects among Schild Mississippian females compared to males when Schild is compared to earlier Middle Woodland samples in the broader region. Furthermore, LEH frequency among Schild Mississippians does not appear to be related to social status. Cook also points out, however, that there appears to be a bias toward females in the Schild Mississippian cemetery, perhaps indicating that higher status males were interred elsewhere.

Genetic analyses are also important for this research; the general consensus on temporal and regional biological continuity adds an important level of genetic control for the comparisons made in this study. Conner's (1990) analysis of non-metric cranial traits indicated significant

intercommunity gene flow in his West Central Illinois sample, which included both Schild and Yokem. Steadman's (2001) craniometric data, interpreted within a more sophisticated population genetics framework, suggests that, while there was significant gene flow among Late Woodland communities in the Lower and Central Illinois Valleys, the Mississippian pattern indicated that gene flow was more restricted within each region. Droessler's (1981) investigation of biological distances, based on Lower Illinois Valley cranial measurements, also indicated genetic continuity between Late Woodland and Mississippian populations in this region.

Recent mtDNA analysis suggests that there may have been limited immigration into the Lower Illinois Valley, possibly from the American Bottom, with Mississippianization (Raff 2008). In a related analysis, Raff (2008) shows that rows and spatial groups at Schild do not seem to be based on biological matrilineal descent. However, Raff also notes that notions of kinship or other ways of relating oneself to (or differentiating oneself from) other segments of a community (i.e. clans, moieties, sodalities, etc.) are not purely biological, and DNA analyses alone cannot preclude kinship as an organizing principle in the use of mortuary spaces.

CHAPTER FIVE- ANALYTICAL METHODS, MATERIALS, AND HYPOTHESES

In order to address the research questions proposed in chapter one, a set of hypotheses must be developed in a way that provides a framework for simultaneously testing the vertebral method and addressing the bioarchaeological concerns of this research given the available skeletal samples. Data on four specific indicators of stress and growth are used in this analysis: vertebral body height, vertebral canal diameter, linear enamel hypoplasia, and long bone length. The nature of this study requires limiting the sample to only those adult remains for whom sex could be accurately determined. The usable sample size will therefore vary between the different components of the analysis; general summary tables are included at the end of this chapter. Sample sizes for specific statistical tests are provided in chapter six and in the appendix.

A diachronic analysis is used to determine whether changes in growth patterns within either sex occurred over the Late Woodland-Mississippian transition. The osteological data are further analyzed with reference to mortuary data to determine whether sex- and age-related biological growth patterns vary with burial treatments and spatial patterning, allowing for a more specific assessment of Mississippian gender phenomena at Schild. For this portion of the analysis, of particular interest is the extent to which variation in the osteological data is correlated with sex, status, and kinship, or community membership. Results are interpreted within the framework of contemporary gender scholarship and existing archaeological and bioarchaeological reports from the region. Temporal trends are compared to published reports from the American Bottom (Milner 1982) and Dickson Mounds (Clark 1985, Goodman et al

1984) in order to identify any temporal (Late Woodland versus Mississippian) or regional (center versus periphery) trends in stress/growth discrepancies by sex.

Data Collection Methods

Sexing Methods

Accurate sexing methods are critical for making appropriate interpretations of biological and cultural data. Sex is a basic unit of bioarchaeological analysis and is of particular importance when attempting a properly engendered bioarchaeological analysis. There are no reliable techniques for sexing subadult skeletal remains, as the most commonly employed qualitative methods for sexing skeletal remains are based on secondary sexual characteristics of the pelvis and cranium. This is a significant limitation, resulting in a notable lack of engendered bioarchaeological studies of childhood, as well as a disregard for subadult analysis in general (Baker et al 2005). One limitation inherent to ascertaining sex from adult skeletons is that the extent of sexual dimorphism varies by population, which limits the applicability of methods developed on modern, documented samples and introduces a significant source of error. Despite these concerns, osteologists routinely assign sex to prehistoric skeletonized remains with a high level of reported accuracy (Ubelaker and Buikstra 1994, Phenice 1969).

For the samples involved in this study, sex determinations were previously made by Dr. Della Cook and her colleagues at Indiana University. Genuinely indeterminate cases were not included in the current analyses, however those individuals categorized as “probable females” and “probable males” were included.

Vertebral Measurements

To evaluate vertebral growth, measurements of vertebral body heights and neural canal diameters were taken on all available thoracic and lumbar vertebrae. Measurement standards are provided by Clark (1985). Clearly pathological vertebrae (i.e., collapsed or particularly arthritic) were excluded from analysis. Body height measurements were taken on the anterior and posterior aspects, and both anterior-posterior and transverse neural canal diameters were recorded (Figure 13). A more detailed explanation for each dimensional measure is provided below.

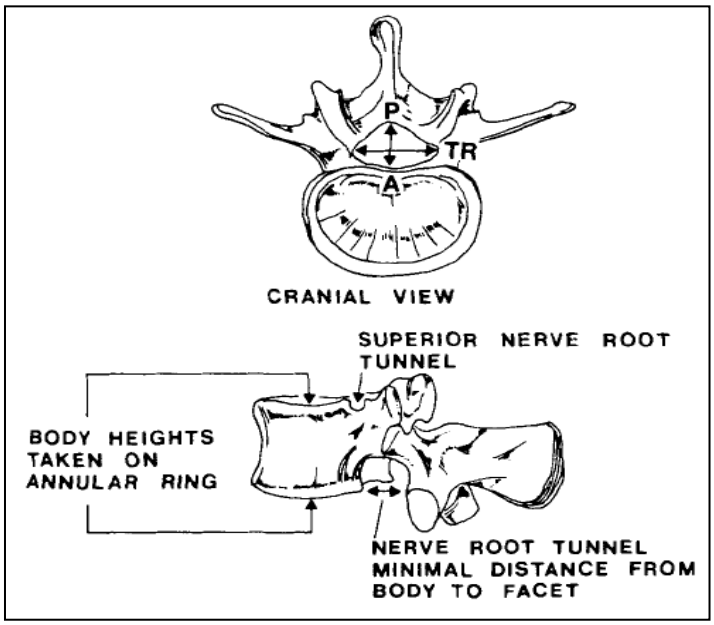

Figure 13- Vertebral dimensions (from Clark 1986) (Note that nerve root tunnel measurements were not part of the present study)

Anterior vertebral body height (AVBH): AVBH is defined as the maximum height at the anterior border of the vertebral body, as taken on the superior and inferior annular rings. Using the outside jaws of the vernier caliper, measurements were taken by placing the body of one jaw

along the anterior aspect of the superior annular ring and moving the other jaw to meet the most anterior aspect of the most inferior annular ring. Osteophytic growths were avoided.

Posterior vertebral body height (PVBH): PVBH is the maximum height at the posterior border of the vertebral body, as taken on the superior and inferior annular rings. Using the outside jaws of the vernier caliper, measurements were taken by placing the body of one jaw along the posterior aspect of the superior annular ring and moving the other jaw to meet the posterior aspect of the inferior annular ring. Osteophytic growths were avoided.

Transverse Neural Canal Diameter (TNCD): TNCD is the maximum transverse diameter at the widest point of the neural canal as taken from the superior aspect, measured using the inside jaws of the vernier calipers. The locus at which this measurement is taken varies anteriorly-posteriorly based on the specific location of the particular vertebra in the spinal column (i.e. lumbar vertebral canal diameters are widest more anteriorly than are those of thoracic vertebrae). Calipers were gently "wiggled" around so that maximum diameter could be recorded.

Anterior-Posterior Neural Canal Diameter (APNCD): APNCD is the maximum anterior-posterior diameter of the neural canal as taken from the superior aspect, measured using the inside jaws of the vernier calipers. This distance is typically at the midline, between the center point of the posterior vertebral body and the point where the right and left laminae fuse to form the base of the spinous process. Care must be taken to hold the calipers so that the sliding horizontal portion is parallel with the superior aspect of the vertebral body, as irregular angulations produce inconsistent measurements.

Linear Enamel Hypoplasia (LEH)

LEH were observed under a 100 watt incandescent desk lamp. LEH was recorded as present when a clearly observable line was apparent on the labial surface. Non-linear abnormalities (i.e. pits) were not recorded. Additionally, the number of hypoplasias per tooth was recorded, as was distance of each LEH from the cemento-enamel junction. This distance was measured in millimeters using a graduated hand lens.

Femur Length

Maximum femur length was measured to the nearest half centimeter for all left and right femora using a standard osteometric board according to standard osteological data collection methods (Ubelaker and Buikstra 1994).

Controlling for Error

All continuous measurements were taken at least twice. For femur length, measurements were taken to the nearest half centimeter. A random sample of 20 femora were remeasured to test for intraobserver error, and no inconsisitencies were detected. Vertebral measurements proved to be more problematic than femoral measurements. Clark (1984) provided methods for all vertebral measurements, which were taken to the nearest tenth of a millimeter (see descriptions above for measurement details). To develop proficiency and intraobserver consistency, unrecorded practice measurements were taken. During actual data collection, two measurements were initially taken. If the first two measurements were not in agreement, the skeletal element in question was set aside and remeasured at a later time. In cases of continued measurement problems where three

measurements did not yield consistent results, the average of three measurements was recorded. At the start of each day, the last specimens from the previous day were remeasured to achieve consistency in placement and pressure of the calipers.

To test for error in LEH assessment, a random sample of 25 individuals was evaluated, and then reevaluated. This test revealed one case in which an LEH was originally marked as present, but was subsequently marked as absent.

Schild Mortuary Data

As one of the key methods by which archaeologists study social differentiation, mortuary analysis is an important line of evidence for interpreting sex-based biological data from a gendered perspective. Incorporation of mortuary data was more readily accomplished for the Mississippian component of the analysis. Mortuary data from the Late Woodland component is presently limited to Perino's field observations. Comparison of Late Woodland and Mississippian mortuary samples allow for investigation of change over time in patterns of stress/growth by sex and age and will be useful from a general interpretive perspective, but the more socially in-depth portion of this analysis of limited to the Schild Mississippian component.

Goldstein's (1980) spatial analysis of mortuary practices provides critical information regarding the level of social differentiation in the Mississippian component of the Schild site. She showed that the Schild Mississippian burials displayed a generally egalitarian, group-oriented (rather than individualized) mortuary pattern. Although the overall Schild Mississippian pattern can be characterized as egalitarian, both Goldstein (1980) and Rothschild (1990) point to a pattern of restricted access to certain burial treatments, often based on age and sex, in Mississippian mortuary practices throughout the broader region. Some of the burial treatments

detected in Goldstein's cluster analysis were more restrictive than others in terms of the proportion of the population afforded them. Goldstein's (1980) work on the Schild Mississippian component also detected spatially discrete units (rows), which she interpreted as representing kin groups. Although a similar analysis is not available for the Yokem Mississippian sample, Goldstein (1980) pointed out that row patterning is also evident at that site and that each of the three mounds may represent a corporate group.

Analysis of the relationship between biological data and archaeologically-derived spatial data is complicated by sample size concerns. To maximize cell counts and increase statistical amenability, the original rows and clusters proposed by Goldstein (1976, 1980, 1981) as indicated in Table 2 and the descriptions below.

Mortuary category	Subcategories	Description
Knoll	A	Burials in northern knoll at Schild Mississipian cemetery as defined by Perino (1971) and Goldstein (1980)- See figure
	B	Burials in southern knoll at Schild Mississipian cemetery as defined by Perino (1971) and Goldstein (1980)- See figure
Artifact only clusters	0	Burials assigned to the least exclusive clusters in Goldstein's (1980) analysis. This category includes all clusters except for cluster 6.
	6	Burials assigned to cluster 6, the most exclusive of the Schild Mississippian artifact only clusters
Artifact and Positioning cluster	1	Burials assigned to the four clusters separated by the primary division in Goldstein's (1980) cluster analysis, based on arm extension.
	2	Burials assigned to the four clusters separated by the primary division in Goldstein's (1980) cluster analysis, based on arm non-extension.
Burial Area	1	Non-charnel associated burial area defined by Goldstein's (1980) hypothesized division of knoll B burials- see figure
	2	Charnel associated burial area defined by Goldstein's (1980) hypothesized division of knoll B burials- see figure
	3	Charnel associated burial area defined by Goldstein's (1980) hypothesized division of knoll A burials- see figure
	4	Non-charnel associated burial area defined by Goldstein's (1980) hypothesized division of knoll A burials- see figure
Charnel Association	Yes	Charnel associated burial areas (burial areas 2 and 3)
	No	Non-charnel associated burial areas (burial areas 1 and 2)

Table 2- Mortuary category descriptions

Artifact-Only Clusters- Goldstein's analysis indicated eight clusters based on similarities in grave accompaniments. Sample size issues precluded an analysis based directly on these clusters, therefore they were collapsed into two groups- cluster six was maintained, but all others were collapsed into a single group. Most burials were assigned to cluster six, and can therefore be considered the least exclusive group. The other, more exclusive clusters comprised the other group. These groups are referred to as *six* (6) and *zero* (0), respectively.

Artifact and positioning clusters- Goldstein's analysis by artifact and body position indicated 10 clusters. The primary division was based on extension versus non-extension of arms, with subsequent divisions based on other positional and artifact parameters. For the current analysis, the results of this cluster analysis were collapsed into two groups of roughly equal size, based on the primary positional division. These groups are referred to as group one (1) (Goldstein's original cluster numbers 1,8,3,5, and 7) and group two (2) (Goldstein's original cluster numbers 2,4,6,9, and 10) in tables and statistical output.

Areas and Charnel Associations- The spatial portion of Goldstein's mortuary analyses indicated 16 rows, but sample size issues precluded a by row analysis of this data. However, Goldstein recognized other spatial divisions within the site (see map), and these "burial areas" correspond well with both the burial areas recognized in Perino's excavations, as well as clusters of the original rows from Goldstein's analysis.

For Knoll A, Goldstein's hypothesized division of the burials essentially separated one curvilinear row from the other burials, most of which were associated with the charnel structure and capping mound. The curvilinear row is referred to as group four (4) in this analysis, while

the charnel/mounds associated burials are referred to as group three (3). The few burials that were not associated with either the curvilinear row or the charnel structure/mound were considered to be part of group four (4) (Figure 14).

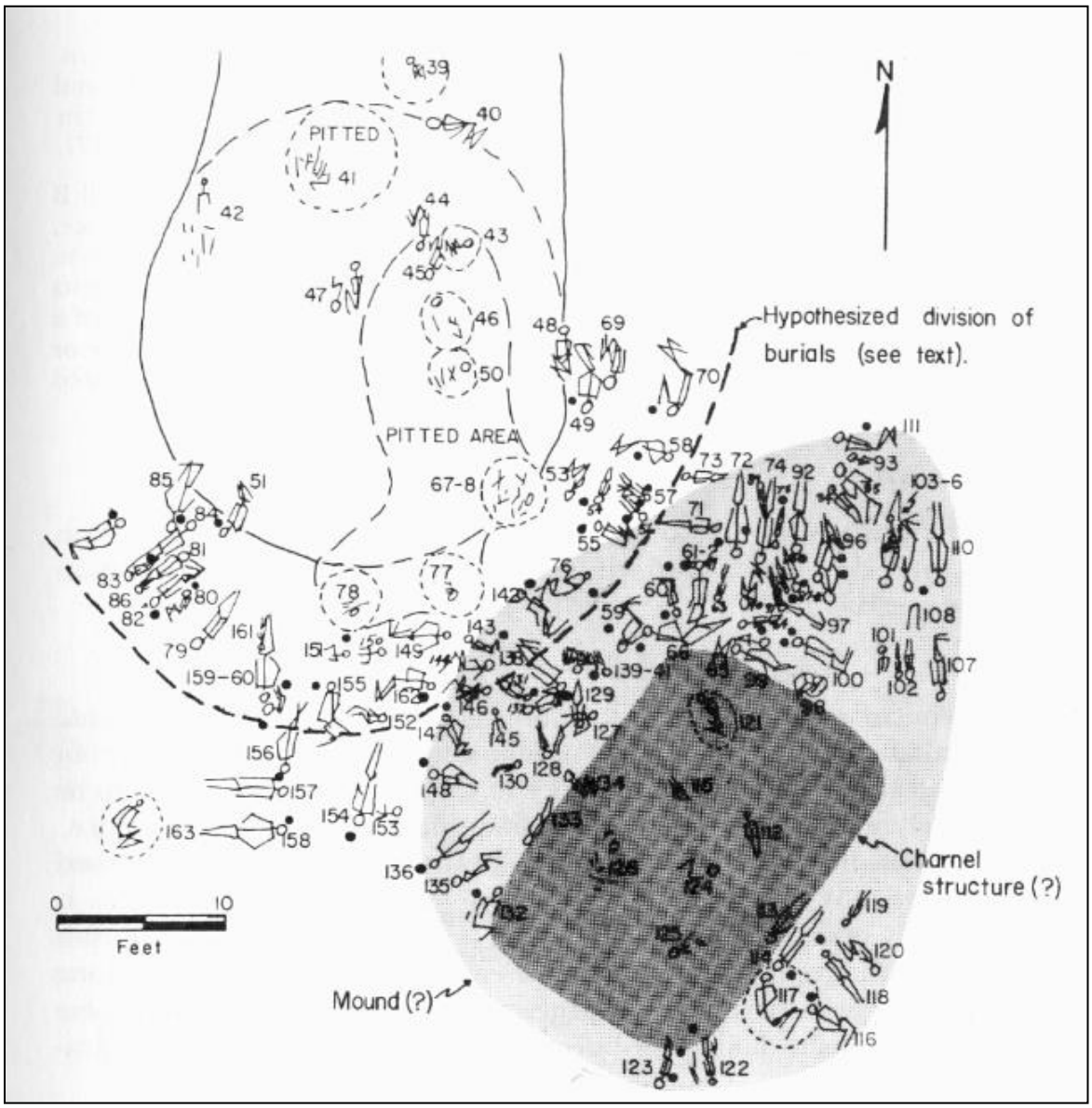

Figure 14- Schild Burial Areas 3 and 4 (from Goldstein 1980)

For Knoll B, Goldstein's hypothesized division also delineated a separation between charnel and non-charnel areas (Figure 15). The charnel associated area (group 2) is not capped

with a mound as is the case in Knoll A. However, the burials not directly associated with the charnel area in Knoll B are strongly aligned with the structure, and therefore considered to be part of the same group. In both knolls, burial areas delineated by Goldstein inherently correspond to groups of rows, presumed charnel structure, and Perino's original groupings, and it is suggested here that the spatial groupings used in this study account for all of these spatial consideration in a culturally meaningful way.

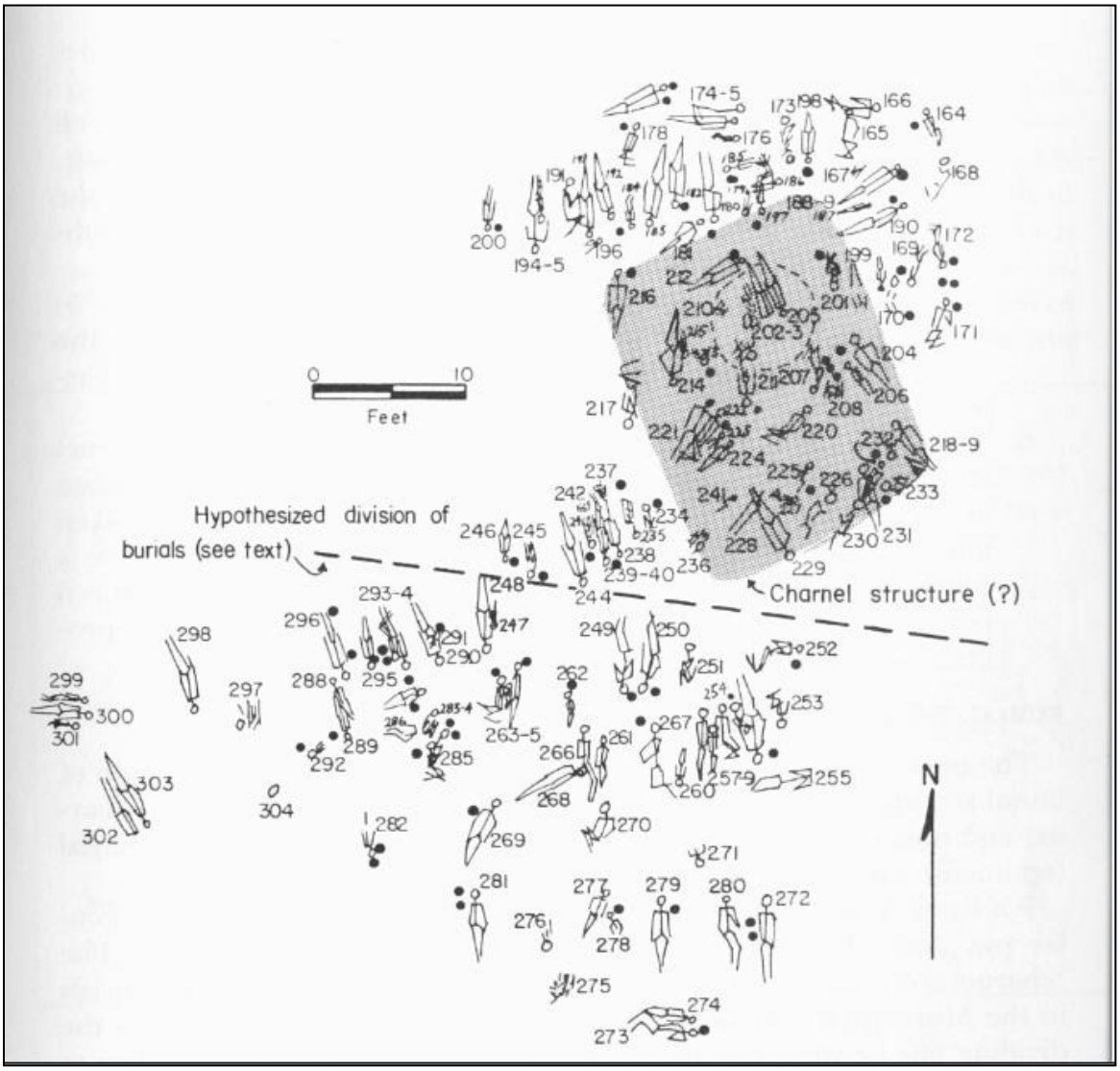

Figure 15- Schild Burial Areas 1 and 2 (From Goldstein 1980)

Statistical Methods for Incorporating Osteological and Archaeological Data

This study involves both continuous and categorical data. Investigation of the interrelationships between growth patterns drawn from the osteological data and mortuary data drawn from the archaeological literature involves both types of data to be analyzed simultaneously. All tests are performed using the SPSS 19 statistical package.

Cronbach's Alpha

In his original analysis, Clark (1985,1988) used a coefficient alpha test for intrasegment relaibaility to show that vertebral dimensions within each segment were related to each other in a regular pattern (i.e. increase in size predictably as one moves downward), justifying use of the intrasegmental mean for evaluating changes in size over time (Clark 1988). SPSS allows for Cronbach's Alpha testing to provide a measure of intrasegment reliability. A high alpha score indicates that measurements of any one vertebral dimension (thoracic AVBH, for example) in any one vertebra (The first thoracic vertebra (T1), for example) is predictably related to all other thoracic AVBHs (T2 through T12). An alpha score is obtained by comparing intrasegmental patterns in individuals to intrasegmental patterns in the sample as a whole. In standard practice, an alpha score over 0.7 is acceptable, over 0.8 is good, and over 0.9 is excellent, on a scale from 0 to 1 (George and Mallery 2003).

Use of this technique requires exclusion of individuals with missing thoracic or lumbar vertebrae, i.e., fewer than 12 or five, respectively. Throughout this dissertation, the term "segment-based" refers to tests in which measurements for each vertebrae in a segment were averaged for each individual, and a single mean value used for statistical comparison between time periods and mortuary groups. For hypothesis testing, using segmental means based analysis

limits sample sizes. However, the benefit is that each individual is represented by one variate rather than many, and that may reduce overall noise in the data resulting from individual idiosyncrasies or error. Alpha scores were also useful for finding and correcting data input errors.

Linear Regression

Linear regression analyses are used to gauge the relationship between vertebral dimensions and femur length. One of the premises of the vertebral method is that vertebral body height is a measure of cumulative growth in the same way femur length has been traditionally used in bioarchaeological studies, so there should exist a significant, positive linear relationsip between these measures. Because neural canal diameter (NCD) measurements are hypothesized to be indicative of early childhood (as opposed to cumulative) growth conditions, there may or may not be a linear relationship between femur length and neural canal diameters. If NCD is not significantly correlated with femur lengths, these two measures may be measuring growth conditions experienced during different time periods (i.e. early childhood-only versus cumulative). If NCD is positively and significantly correlated with femur length, this does not necessarily prove that the two measures are not measuring growth conditions covering different time periods, as it may alternatively indicate that there was not a general trend toward differential growth trajectories between the early childhood and late adolescence periods.

T-tests

Standard t-tests are used for the majority of the vertebral and femur length comparisons, both over time and between Mississippian mortuary groupings. Femur tests were relatively simple and

straightforward, as each individual was represented by only one measurement. However, the multiplicity of vertebrae and the more complex nature of statistical investigation of the vertebral data made for a more complicated scenario. For each vertebral segment, the mean of each dimension (AVBH, PVBH, TNCD, APNCD) was calculated for each sex within each cultural period and t-tests were used to evaluate change over time between the Late Woodland and Mississippian periods. Low sample sizes for the Late Woodland materials preclude separate temporally based analysis of the two sites, so Yokem and Schild were considered together for this portion of the study. Comparisons of segmental means are also performed to compare individuals based on Goldstein's mortuary parameters where there were only two categories (knolls, clusters, charnel association).

After segment-based testing, tests were performed for each individual vertebral dimension (e.g. comparing T1 AVBH's only to other T1 AVBH's, L2 TNCD's only to other L2 TNCD's, etc). This allowed me to isolate the combinations of vertebral elements that were responsible for significant results yielded by the more general average comparisons described above. Both of these analytical techniques are useful and necessary for investigating the utility of vertebral measurements as growth indicators because 1) they address both generalized and specific patterns of spinal development, 2) comparison between the two might allow for isolation of vertebrae that are more or less sensitive to growth disruption, complementing the available clinical literature on the timing of vertebral growth. This may also be useful for developing an analytical technique that can be applied in situations where taphonomic and cultural processes may result in a skewed or incomplete vertebral sample.

As the other biological parameters were less complicated from an analytical perspective (one LEH measurements and one femoral length measurement for each individual as opposed to

up to 68 vertebral measurements per individual) they did not require the same level of reorganization and retesting. For these measures, each test (for change over time and the various differences between Schild Mississippian mortuary categories) was performed only once for males and once for females.

Results were considered significant at the α=.05 level, but because of small sample sizes, results that approached significance are also noted, briefly discussed, and cautiously interpreted.

ANOVA

Two-way ANOVA was used to explore the nature of differences in growth indicators between different burial areas. Multiway ANOVA tests are used to evaluate interactions between multiple categorical mortuary parameters (factors) and continuous growth indicators, and significant combinations were plotted.

Results were considered significant at the α=.05 level, but because of small sample sizes, results that approached significance are also noted, briefly discussed, and cautiously interpreted.

Pearson's Chi-square

Because LEH is considered only as a categorical/nominal measure (present or absent) in this analysis, contingency tables and chi-square analyses are used to identify differences in frequency by sex over time and between mortuary groupings. As with tests described above, results were considered significant at the α=.05 level, but because of small sample sizes, results that approached significance are also noted, briefly discussed, and cautiously interpreted.

Hypotheses

Seven specific hypotheses were tested in this study. These were based in part on much of the West Central Illinois bioarchaeological literature already discussed in preceding chapters. Hypotheses one through four are related to change over the Late Woodland-Mississippian transition, while hypotheses five addresses expectations of differentiation in growth patterns based on social categories among the Schild Mississippians.

Intrasegmental Reliability to Justify Segmental Means Testing

Hypothesis One- As a preliminary test, it must be determined whether the vertebral measurements within either segment (thoracic or lumbar) are reliabably and predictably related to one another to a statistically significant extent (see discussion of Cronbach's alpha above). The hypothesis is stated as follows:

Hypothesis 1: H0: Intrasegmental reliability is not significant at the α=.7 level

H1: Intrasegmental reliability is significant at the α=.7 level.

Testing the Vertebral Method

Hypothesis Two- In order to test whether the vertebral method is a useful indicator of early childhood and vertebral growth, a series of hypotheses will be tested. These are based on an assumption that, if VBH can be used as an indicator of cumulative growth, there should be a significant linear relationship between femur length and VBH. Furthermore, if NCD is a growth indicator that reflects a growth period restricted to early childhood only, there will not necessarily be a linear relationship between femur length and NCD. Also, if NCD is a growth indicator that reflects a growth period restricted to early childhood growth before sexually

dimorphic characteristics develop, one would not necessarily observe a typical pattern of sexual dimorphism whereby males will be larger than females, as this feature develops prior to the onset of genetically controlled, sex specific growth differentials. As such, the level of sexual dimorphism in neural canal diameter is expected to change to reflect improving female growth conditions as we move from Late Woodland to Mississippian times. The hypotheses can be stated as followed:

Hypothesis 2a: H_0- A linear relationship does not exist between VBH and femur length.

H_1- A linear relationship exists between VBH and femur length.

Hypothesis 2b: H_0- There is no linear relationship between NCD and femur length.

H_1- There is a linear relationship between NCD and femur length.

Hypothesis 2c: H_0- There is no difference between male and female NCD measurements within cultural periods.

H_1- Male NCD is consistently larger than female NCD within cultural periods.

Trends in LEH Frequency Over Time

Hypothesis Three- Hypothesis two is designed to test whether there is temporal change in LEH frequencies over time for either males or females over the Late Woodland- Mississippian transition. Based on literature that points increased reliance on maize agriculture facilitated primarily by women, which may have lead to female children being more valued in society and hence afforded better care and improved growth conditions (Cook 1984, Cohen and Bennet 1993, Goodman et al 1980), there may be a temporal change in LEH frequencies among females in the study sample, with frequencies decreasing from the Late Woodland to the Mississippian period. Lack of corresponding changes in LEH frequency over time among the males has been

interpreted as indicating that increased reliance on maize agriculture disproportionally affected women in Mississippian society. The hypotheses to be tested to investigate this phenomenon are stated below.

Hypothesis 3a: H_0- Male Late Woodland LEH frequencies are equal to male Mississippian LEH frequencies.

H_1- Male Late Woodland LEH frequencies are unequal to male Mississippian LEH frequencies.

Hypothesis 3b: H_0- Female Late Woodland LEH frequencies are equal to female Mississippian LEH frequencies.

H_1- Female Late Woodland LEH frequencies are unequal to female Mississippian LEH frequencies.

Trends in Femur Length Over Time

Hypothesis Four- Based on Cook's (1984, 2007) observations, there was no statistically significant difference in femur length among either males or females between the Late Woodland Mississippian periods. Statistical analyses will test the following set of hypotheses to address this issue.

Hypothesis 4a: H_0- Male Late Woodland femur length measurements are equal to male Mississippian femur length measurements.

H_1- Male Late Woodland femur length measurements are unequal to male Mississippian femur length measurements.

Hypothesis 4b: H_0- Female Late Woodland femur length measurements are equal to female Mississippian femur length measurements.

H_1- Female Late Woodland femur length measurements are unequal to female Mississippian femur length measurements.

Vertebral Growth Trends Over Time

Hypothesis Five- Clark (1985, 1988) suggests that neural canal diameter dimensions capture early childhood growth conditions. If increased status of women associated with the transition to Mississippian lifestyle may result in changes in growth patterning for men and women. Like LEH (discussed above) improved early childhood growth conditions for women over the Late Woodland Mississippian transition might become visible as a change in female neural canal dimensions over time, with relative female neural canal diameter measurements increasing from the Late Woodland to the Mississippian period. There may or may not be corresponding changes in neural canal dimensions among the males in this study, depending on whether they were differentially affected by the cultural changes associated with this transition. Clark (1985, 1988) also suggests that VBH measures cumulative growth, a parameter that is more traditionally measured using long bone lengths (see hypothesis four above). As such, VBH and femur length may be measuring the same cumulative growth phenomenon.

These ideas will be tested using the following set of hypotheses:

Hypothesis 5a: H_0- Male Late Woodland VBH measurements are equal to male Mississippian VBH measurements.

H_1- Male Late Woodland VBH measurements are unequal to male Mississippian VBH measurements.

Hypothesis 5b: H_0- Male Late Woodland NCD measurements are equal to male Mississippian NCD measurements.

H_1- Male Late Woodland NCD measurements are unequal to male Mississippian NCD measurements.

Hypothesis 5c: H_0- Female Late Woodland VBH measurements are equal to female Mississippian VBH measurements.

H_1- Female Late Woodland VBH measurements are unequal to female Mississippian VBH measurements.

Hypothesis 5d: H_0- Female Late Woodland NCD measurements are equal to female Mississippian NCD measurements.

H_1- Female Late Woodland NCD measurements are unequal to female Mississippian NCD measurements.

Intracommunity Variation in Growth Patterns in the Schild Mississippian Component

Hypothesis six- Mississippianization of West Central Illinois brought with it clear changes in mortuary patterning (Goldstein 1980) and although community/household life has proven difficult to investigate archaeologically due to the nature of the Mississippian presence in this region (Farnsworth et al 1991), the introduction of new Mississippian ideals must have had a significant effect on intracommunity social relations. New types of social differentiation can be inferred from mortuary analysis, and the research outlined in this dissertation can help to detect the ways that new ideas about social differentiation affected biosocial life experiences within the community. Specifically, it is hypothesized that that analysis of skeletal data according to archaeologically defined mortuary groupings (artifact clusters, artifact-positioning clusters, and burial areas) will new yield insights regarding biological growth patterning, indicating whether or not certain subsets of the Schild Mississippian community enjoyed higher status and, thus, better growth conditions.

This set of hypotheses specifically addresses the ways in which those individuals of either biological sex may have had different life experiences based on cultural perceptions of the interaction between sex *and* other (non-sexual) facets of social identity. This is important because it removes the unfounded *a priori* assumption of a simplistic, unitary gender phenomena

and forces a consideration of the range of experiences of gendered social identity within a community. When the intersection of sex, kinship, and status are investigated with regard to growth experiences, the ways in which various social factors combine to contribute to gender identity at this place and time will become more clear.

By Knoll-

Hypothesis $6a_1$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between males in knoll A and males in knoll B.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between males in knoll A and males in knoll B.

Hypothesis $6a_2$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between females between females in knoll A and females in knoll B.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between females in knoll A and females in knoll B.

By Burial Area-

Hypothesis $6b_1$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between males based on burial area.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between males based on burial area.

Hypothesis $6b_2$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between females based on burial area.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between females based on burial area.

By Charnel Association-

Hypothesis $6c_1$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between males based on charnel association.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between males based on charnel association.

Hypothesis $6c_2$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between females based on charnel association.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between females based on charnel association.

By Artifact only Cluster-

Hypothesis $6d_1$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between males in artifact only cluster 0 and males in artifact only cluster 6.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between males in artifact only cluster 0 and males in artifact only cluster 6.

Hypothesis $6d_2$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between females in artifact only cluster 0 and females in artifact only cluster 6.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between females in artifact only cluster 0 and females in artifact only cluster 6.

By Artifact and Positioning Cluster-

Hypothesis $6e_1$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between males in artifact and positioning cluster 1 and males in artifact and positioning cluster 2.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between males in artifact and positioning cluster 1 and males in artifact and positioning cluster 2.

Hypothesis $6e_2$: H_0- There will be no difference in VBH, NCD, LEH frequency, or femur length between females in artifact and positioning cluster 1 and females in artifact and positioning cluster 2.

H_1- There will be a difference in VBH, NCD LEH frequency, and/or femur length between females in artifact and positioning cluster 1 and females in artifact and positioning cluster 2.

Hypothesis 7- This hypothesis is designed to test for a relationship between each growth indicator and all possible combinations of one spatial variable and one cluster variable for each sex using two way ANOVAs. A significant relationship would suggest that spatial and cluster variables interact in a way that is related to sex-based intracemetery growth patterns. In order to maximize cell size, only binary spatial categories (knoll and charnel association) will be used. The main hypotheses guiding this portion of the research can be stated as follows:

Hypothesis 7: H_0- There is no significant interactions between spatial categories, cluster categories, or growth parameters for Schild Mississippian males or females

H_1- There are significant interactions between spatial categories, cluster categories, and growth parameters for Schild Mississppian males and/or females.

Sample Sizes

For the Schild site, a total of 138 Late Woodland and 175 Mississippian numbered and sexed adult individuals are available for this analysis. The Yokem sample consists of 115 Late Woodland and 72 sexed Mississippian adults. Several factors limit the number of usable individuals for any particular test, and sample sizes for specific tests are therefore highly variable. Not all observations (left and right femur lengths, four teeth used for LEH, and 68 total vertebral measurements) were observable in every individual, therefore, sample sizes varied for each of the statistical tests presented in the results chapter. General sample size tables are

provided in Tables 3 through 8 below, and sample sizes for specific tests can be found in the following chapter as well as in the appendix.

Site	Period	N
Schild	Late Woodland	46
	Mississippian	130
Yokem	Late Woodland	37
	Mississippian	42

Table 3- Overall sample sizes. N=number of individuals with at least one measurement/observation in the current study

Burial Area	Sex	N
1	M	18
	F	16
2	M	13
	F	11
3	M	9
	F	18
4	M	13
	F	14

Table 4- Sample sizes for Schild burial areas. N=number of individuals with at least one measurable/observable indicator

Knoll	Sex	N
A	M	28
	F	35
B	M	32
	F	37

Table 5- Sample Sizes for Schild Knolls. N=number of individuals with at least one measurable/observable indicator

Charnel Association	Sex	N
Yes	M	27
	F	29
No	M	31
	F	30

Table 6- Sample sizes for Schild charnel association. N=number of individuals with at least one measurable/observable indicator

Cluster	Sex	N
0	M	31
	F	42
6	M	31
	F	30

Table 7- Sample sizes for Schild artifact only clusters. N=number of individuals with at least one measurable/observable indicator

Cluster	Sex	N
1	M	28
	F	25
2	M	32
	F	47

Table 8- Sample sizes for artifact and positioning clusters. N=number of individuals with at least one measurable/observable indicator

Preservation was generally good for both series, and this is particularly true for the Schild Mississippian component. However, some remains were too taphonomically damaged for confident measurement, and those were excluded. Some of the youngest adults could be sexed with a reasonable degree of confidence, but were excluded if the epiphyseal rings of their vertebrae were not completely fused. Likewise, a few of the oldest individuals who experienced the most extensive arthritic and other pathological changes were also excluded. In general, mild to moderate osteophystic lipping did not interfere with taking vertebral measurements.

CHAPTER SIX- RESULTS

In this chapter, results of the data analysis are presented and organized by hypothesis. Each hypothesis is referenced, and summary data is provided. The results of the statistical analysis are presented concisely, and hypotheses are explicitly accepted or rejected. Interpretation and contextualization is presented in the following chapter.

Hypothesis One- Internal Consistency for Segmental Mean Analysis

Cronbach's Alpha scores indicate that there is a relatively constant relationship between the various measurements within both the thoracic and lumbar vertebral segments (Tables 9 and 10). This is not surprising, as even cursory macroscopic observation clearly indicates that vertebral body height (VBH) and neural canal diameter (NCD) measurements do not vary randomly but rather increase as one moves down the spinal column. The null hypothesis is accepted, and subsequent vertebral tests are performed using both segmental means and individual vertebral comparisons. .

Sex	Dimension	N	Cronbach's Alpha
Males	AVBH	45	.921
	PVBH	59	.942
	TNCD	53	.950
	APNCD	41	.953
Females	AVBH	96	.943
	PVBH	122	.952
	TNCD	108	.966
	APNCD	96	.967

Table 9- Thoracic Intrasegment Reliability

Sex	Dimension	N	Cronbach's Alpha (with L5)	Cronbach's Alpha (without L5)
Males	AVBH	56	.905	.884
	PVBH	65	.893	.903
	TNCD	57	.917	.939
	APNCD	46	.730	.794
Females	AVBH	115	.876	.921
	PVBH	129	.897	.902
	TNCD	135	.781	.787
	APNCD	105	.876	.907

Table 10- Lumbar Intrasegment Reliability

Hypothesis Two- Utility of the Vertebral Method of Growth Assessment

Hypotheses 2a and 2b

The results of the linear regression analysis indicate a statistically significant (or near statistically significant) relationship between vertebral body height measurements and femur length. The low R-square values, however, indicate that the relationship between the two measures is not exceptionally strong. The statistically insignificant p-values for TNCDs and APNCDs indicate that neural canal diameter measurements are independent of femur lengths (Tables 11 and 12).

Vertebral Dimension	P	R-square
AVBH	.035	.124
PVBH	.003	.208
TNCD	.274	.030
APNCD	.473	.017

Table 11- Linear Regression for Schild Female Lumbar Vertebral Measurements and Femur Length

Vertebral Dimension	P	R-square
AVBH	.070	.105
PVBH	.051	.117
TNCD	.486	.019
APNCD	.881	.003

Table 12- Linear Regression for Schild Male Lumbar Vertebral Measurements and Femur Length

The null hypothesis 2a is rejected, because there is a significant linear relationship between femur length and VBH. This indicates a weak association between increased vertebral body height and increased femur length.

The null hypothesis 2b is accepted, because there is no significant relationship between NCD and femur length. This suggests that the two measures are reflecting fundamentally different growth phenomena, which may be related to differentiation between growth restricted to early childhood (as indicated by NCD) and cumulative growth (as indicated by femur length).

Hypothesis 2c

Male and female TNCDs and APNCDs were compared directly to one another as an additional test of the hypothesis that NCDs can be used as indicators of early childhood growth experiences (Tables 13 and 14). The underlying assumption behind this test is that significant sexual dimorphism in the size of most skeletal elements generally does not occur until later in the growth period, and that it is therefore possible that males and females could lack sexual dimorphism in neural canal diameter if this measure does, indeed, reflect early childhood growth as opposed to cumulative growth.

Vertebral Dimension	Sex	N	Mean	SD	P
TNCD	Male	17	23.18	1.68	.006
	Female	31	21.85	1.45	
APNCD	Male	12	15.21	1.10	.514
	Female	23	14.93	1.19	

Table 13- Lumbar NCD T-Tests between Late Woodland Males and Late Woodland Females

Vertebral Dimension	Sex	N	Mean	SD	P
TNCD	Male	55	22.87	1.44	.154
	Female	77	22.48	1.61	
APNCD	Male	51	15.18	1.06	.0502
	Female	69	15.58	1.12	

Table 14- Lumbar NCD T-Tests between Mississippian Males and Mississippian Females

The null hypothesis 2c is accepted. The results indicate that there was no sexual dimorphism in APNCD measurements during the Late Woodland. Male APNCD was greater, but the difference was not statistically significant. However, during the Mississippian period, female APNCD was greater than male APNCD, and the result was statistically significant. For TNCD, there was a statistically significant difference between males and females in the Late Woodland, with males being larger. However, by the Mississippian period, the difference was no longer significant. Although the results for TNCD and APNCD do not exactly parallel each other, both cases indicate an increase in female NCD over time.

Hypothesis Three- Temporal Trends in LEH Frequency

Hypothesis 3a- Temporal Trends in Male LEH Frequency

Chi-square analysis of the LEH frequencies collected for this study indicated that Mississippian males were significantly less likely to experience episodic stressors in early childhood growth when compared to their Late Woodland counterparts (Table 15).

Period	N	LEH present	Fisher's Exact
Late Woodland	40	27	.006
Mississippian	51	19	

Table 15- Male LEH Frequency Chi-square test between Late Woodland and Mississippian

Based on the results of this analysis, the null hypothesis 3a is rejected. There is a statistically significant difference between LEH frequencies in males between the Late Woodland and Mississippian periods. Late Woodland males were more likely to have at least one LEH than their Mississippian counterparts

Hypothesis 3b- Temporal Trends in Female LEH Frequency

A similar analysis of the female component of the sample did not indicate any significant difference in the experiences of episodic early childhood growth disruptions (Table 16).

Period	N	LEH present	Fisher's Exact
Late Woodland	50	21	.699
Mississippian	61	23	

Table 16- Female LEH Frequency Chi-square test between Late Woodland and Mississippian

Based on these results, hypothesis 3b is accepted. There is no significant difference between the number of Late Woodland females with at least one LEH compared with the number of Mississippian females experiencing at least one LEH.

Hypothesis Four- Temporal Trends in Femur Length

Hypothesis 4a- Temporal Trends in Male Femur Length

A T-test between Late Woodland male femur length and Mississippian male femur length indicated no statistically significant difference (Table 17).

Period	N	Mean	SD	P
Late Woodland	26	45.31	1.85	.942
Mississippian	59	45.27	2.24	

Table 17- Male Right Femur Length T-Test between Late Woodland and Mississippian

Based on this result, the null hypothesis 4a is accepted. There is no evidence of a change in male femur length over the Late Woodland- Mississippian transition.

Hypothesis 4b-Temporal Trends in Female Femur Length

A T-test between Late Woodland female femur length and Mississippian female femur length indicated no statistically significant difference (Table 18).

Period	N	Mean	SD	P
Late Woodland	34	42.559	2.06	.607
Mississippian	78	42.353	1.90	

Table 18- Female Right Femur Length T-Test between Late Woodland and Mississippian

Based on this result, the null hypothesis 4b is accepted. There is no evidence of a change in female femur length over the Late Woodland-Mississippian transition.

Hypothesis Five- Temporal Trends in Vertebral Growth

The results of the vertebral growth analysis are presented here. Tables are divided by sex and vertebral segment, and individual hypotheses are addressed in the text.

Hypothesis 5a- Temporal Trends in Male VBH

There is no statistically significant difference in AVBH or PVBH for either the lumbar or the thoracic segment in the male portion of the sample (Tables 19 and 20). Based on these observations, the null hypothesis 5a is accepted. There is no detectable change in male VBH over the Late Woodland-Mississippian transition.

Hypothesis 5b- Temporal Trends in Male NCD

There is no statistically significant difference in TNCD or APNCD for either the lumbar or the thoracic segment in the male portion of the sample (Tables 19 and 20). Based on these observations, the null hypothesis 5b is accepted. There is no detectable change in male NCD over the Late Woodland-Mississippian transition.

Dimension	Period	N	Mean	SD	P
AVBH	Late Woodland	8	20.55	1.13	.812
	Mississippian	41	20.47	.831	
PVBH	Late Woodland	9	23.713	0.65	.470
	Mississippian	50	23.147	2.31	
TNCD	Late Woodland	7	18.011	1.52	.351
	Mississippian	44	17.609	1.00	
APNCD	Late Woodland	4	15.310	0.79	.845
	Mississippian	37	15.220	0.88	

Table 19- Male Thoracic Dimensions Means T-Tests between Late Woodland and Mississippian

Dimension	Period	N	Mean	SD	P
AVBH	Late Woodland	12	26.600	1.36	.585
	Mississippian	46	26.816	1.17	
PVBH	Late Woodland	18	29.199	1.07	.198
	Mississippian	27	28.796	1.17	
TNCD	Late Woodland	17	23.175	1.67	.471
	Mississippian	55	22.874	1.44	
APNCD	Late Woodland	12	15.208	1.10	.935
	Mississippian	51	15.180	1.06	

Table 20- Male Lumbar Dimension Means T-Tests between Late Woodland and Mississippian

Hypothesis 5c- Temporal Trends in Female NCD

There is no statistically significant difference in AVBH or PVBH for either the lumbar or the thoracic segment in the female portion of the sample (Tables 21 and 22). Based on these observations, the null hypothesis 5c is accepted. There is no detectable change in female VBH over the Late Woodland-Mississippian transition.

Hypothesis 5d- Temporal Trends in Female NCD

Among females in this portion of the analysis, significant or near significant results were indicated for the two neural canal dimensions within the lumbar segment, with the lumbar APNCD making the strongest case for an increase in neural canal growth in the Mississippian

period when compared to the Late Woodland (Tables 21 and 22). The homologous measurements in the thoracic segment were not statistically significant. Based on this observation, the null hypothesis 5d is partially rejected, as there is some evidence suggesting a change in female NCD over the Late Woodland-Mississippian transition, with APNCD increasing significantly with Mississippianization, and TNCD increasing nearly significantly with Mississippianization.

Dimension	Period	N	Mean	SD	P
AVBH	Late Woodland	14	19.132	0.80	.504
	Mississippian	51	18.965	0.83	
PVBH	Late Woodland	15	21.176	0.80	.812
	Mississippian	61	21.293	1.85	
TNCD	Late Woodland	14	16.252	0.82	.110
	Mississippian	52	16.737	1.04	
APNCD	Late Woodland	13	14.828	0.55	.449
	Mississippian	47	15.042	1.00	

Table 21- Female Thoracic Dimensions Means T-Tests between Late Woodland and Mississippian

Dimension	Period	N	Mean	SD	P
AVBH	Late Woodland	20	26.202	1.24	.902
	Mississippian	54	26.160	1.35	
PVBH	Late Woodland	29	27.353	1.37	.770
	Mississippian	77	27.434	1.23	
TNCD	Late Woodland	31	21.848	1.46	.059
	Mississippian	77	22.483	1.61	
APNCD	Late Woodland	23	14.935	1.19	.021
	Mississippian	69	15.579	1.12	

Table 22- Female Lumbar Dimensions Means T-Tests between Late Woodland and Mississippian

Temporal Trends in Growth Disruption: Individual Vertebrae

The following analyses regarding individually-based vertebral tests are provided as supplementary information, intended to assist in interpreting the results presented in the segmental-based hypotheses testing presented in the above temporal analyses. This is particularly important for providing a starting point for a recognizing potentially useful patterns in vertebral growth.

Temporal Trends in Males

For the male sample, the only significant differences were in some PVBHs, with Late Woodland male measurements being larger than their Mississippian counterparts (Table 23). This trend held true for all vertebrae with few exceptions, although only those listed yielded statistically significant results. Only two out of 12 (17%) of thoracic vertebrae showed significant change in PVBH over time (T1 and T3), while 3 out of 5 lumbar PVBHs (60%) showed significance changes (L1, L2, and L5). These differences in PVBH were apparently not strong enough to affect the means-based PVBH comparison (discussed above).

Dimension	Period	N	Mean	SD	P
T1 PVBH	Late Woodland	20	21.350	1.19	.005
	Mississippian	60	20.395	1.30	
T3 PVBH	Late Woodland	20	21.605	1.04	.011
	Mississippian	61	20.852	1.14	
L1 PVBH	Late Woodland	23	29.843	1.42	.035
	Mississippian	64	29.131	1.35	
L2 PVBH	Late Woodland	26	29.604	1.18	.053
	Mississippian	65	28.897	1.68	
L5 PVBH	Late Woodland	22	26.655	1.92	.003
	Mississippian	59	25.319	1.67	

Table 23- Male Individual Vertebra T-Tests between Late Woodland and Mississippian (Unlisted results were not significant at the α=.05 level)

Temporal Trends in Females

Significant differences in APNCDs over time were indicated in a number of female vertebrae, all of which were in the direction of increased diameter among Mississippians over their Late Woodland counterparts (Table 24). The trend generally held true for most vertebrae with few exceptions, although only those listed on the table yielded statistically significant results. Out of 12 thoracic vertebrae, 4 (33%) showed significant changes in APNCD over time (T1, T2, T11, and T12), but this effect was apparently not strong enough to cause significant results in the analysis of thoracic APNCD means discussed above. However, of the five lumbar APNCD measurements that were part of the means-based analysis, four (or 80%) were significantly different, with the Mississippian females having larger measurements in all cases. This correlates well with the significant results in lumbar APNCD means over time. Two out of 5 (40%) female lumbar TNCDs (were also significantly different between the Late Woodland and the Mississippian, and this dimension approached significance in the means-based analysis.

Dimension	Period	N	Mean	SD	P
T1 APNCD	Late Woodland	25	13.692	1.20	.004
	Mississippian	85	14.389	1.00	
T2 APNCD	Late Woodland	20	13.765	0.84	.001
	Mississippian	80	14.701	1.08	
T11 APNCD	Late Woodland	26	15.135	0.92	.004
	Mississippian	79	15.956	1.31	
T12 APNCD	Late Woodland	24	16.408	1.13	.057
	Mississippian	75	16.915	1.11	
L1 APNCD	Late Woodland	32	16.384	1.18	.046
	Mississippian	80	16.901	1.24	
L2 APNCD	Late Woodland	30	15.273	1.40	.015
	Mississippian	83	15.959	1.27	
L4 APNCD	Late Woodland	35	14.171	1.65	.016
	Mississippian	80	14.895	1.36	
L5 APNCD	Late Woodland	32	14.608	2.28	.010
	Mississippian	66	15.781	1.97	
L2 TNCD	Late Woodland	35	21.511	1.58	.035
	Mississippian	85	22.194	1.60	
L3 TNCD	Late Woodland	38	21.805	2.15	.012
	Mississippian	82	22.685	1.55	

Table 24- Female Individual Vertebra T-Tests between Late Woodland and Mississippian- Unlisted results were not significant at the α=.05 level

Hypothesis Six- Growth Patterns and Social Differentiation among the Schild Mississippians

Because of relatively high sample size and availability of previous mortuary studies (Goldstein 1980), the Mississippian component of the Schild site can be subjected to more specific and culturally sensitive types of analyses. By analyzing growth patterns among Schild Mississippians on a finer level, subtler patterns of growth differentials related to intracommunity social differentiation can be detected. The spatial groupings and their hypothesized social significance are described in detail in chapter four, and the results of the archaeologically-based growth analysis are presented in this section.

Hypotheses $6a_1$ –Male Growth Patterns by Knoll

There are no significant differences in the mean thoracic or lumbar dimensions between males in knoll A compared to knoll B, nor were there significant differences in femur length or LEH between knoll A and knoll B males (Tables 25, 26, 27, and 28). Based on these observations, the null hypothesis $6a_1$ is accepted. There are no observable differences in Schild Mississippian male growth and stress indicators based on knoll.

Dimension	Knoll	N	Mean	SD	P
AVBH	A	13	20.59	1.01	.531
	B	17	20.39	0.69	
PVBH	A	15	22.31	0.96	.560
	B	21	22.80	3.17	
TNCD	A	16	17.48	0.94	.551
	B	20	17.69	1.12	
APNCD	A	14	15.20	0.71	.454
	B	17	15.43	0.93	

Table 25- Schild Male Thoracic Vertebral Dimensions T-test by Knoll

Dimension	Knoll	N	Mean	SD	P
AVBH	A	16	27.19	1.44	.904
	B	22	27.24	1.02	
PVBH	A	16	28.24	1.37	.679
	B	26	28.08	1.05	
TNCD	A	17	23.41	1.12	.305
	B	18	23.92	1.74	
APNCD	A	12	15.12	0.99	.540
	B	19	15.37	0.74	

Table 26- Schild Male Lumbar Vertebral Dimensions T-test by Knoll

Knoll	N	Mean	SD	P
A	20	45.18	2.00	.833
B	26	45.31	2.18	

Table 27- Schild Male Right Femur Lengths T-test by Knoll

Knoll	N	LEH Present	Fisher's Exact
A	15	5	.732
B	21	9	

Table 28- Schild Male LEH frequency Chi-square test by Knoll

Hypotheses $6a_2$ -Female Growth Patterns by Knoll

There are no significant differences in the mean thoracic or lumbar dimensions between females in knoll A compared to knoll B, nor were there significant differences in femur length or LEH between knoll A and knoll B females (Tables 29, 30, 31, and 32). Based on these observations, the null hypothesis $6a_2$ is accepted. There are no observable differences in Schild Mississippian male growth and stress indicators based on knoll.

Dimension	Knoll	N	Mean	SD	P
AVBH	A	19	19.03	0.90	.611
	B	15	19.16	0.55	
PVBH	A	24	21.05	1.04	.112
	B	17	22.15	3.06	
TNCD	A	20	16.54	1.18	.096
	B	16	17.20	1.13	
APNCD	A	19	15.08	1.09	.935
	B	13	15.05	0.84	

Table 29- Schild Female Thoracic Dimensions T-tests by Knoll

Dimension	Knoll	N	Mean	SD	P
AVBH	A	20	26.53	1.33	.796
	B	20	26.62	0.82	
PVBH	A	23	26.92	1.15	.878
	B	24	26.87	0.96	
TNCD	A	26	22.96	1.51	.349
	B	24	23.35	1.37	
APNCD	A	22	15.54	1.10	.982
	B	16	15.55	1.05	

Table 30- Schild Female Lumbar Dimensions T-tests by Knoll

Knoll	N	Mean	SD	P
A	28	42.46	2.20	.545
B	27	42.80	1.82	

Table 31- Schild Female Right Femur Length T-tests by Knoll

Knoll	N	LEH Present	Fisher's Exact
A	19	8	.533
B	22	7	

Table 32- Schild Female LEH Frequency Chi-square test by Knoll

Hypotheses 6b$_1$- Male Growth Patterns by Burial Area

There were no significant differences in the mean vertebral dimensions between males based on which burial area they were interred in, nor were there significant differences in femur length or LEH between burial areas (Tables 33, 34, and 35). Based on these observations, the null hypothesis 6b1 is accepted for both vertebral segments and all growth indicators.

Dimension	P
AVBH	.949
PVBH	.640
TNCD	.931
APNCD	.179

Table 33- P-values for Schild Male Lumbar Dimensions by Burial Area ANOVAs

Burial Area	N	Mean	SD	P
1	15	45.83	2.38	.384
2	11	44.59	1.72	
3	5	45.90	2.67	
4	15	45.93	1.75	

Table 34-Schild Male Right Femur Length ANOVA by Burial Area

Burial Area	N	LEH Present	Fisher's Exact
1	13	7	
2	8	2	.254
3	7	1	
4	8	4	

Table 35- Schild Male LEH frequency Chi-square by Burial Areas

Hypotheses $6b_2$- Female Growth Patterns by Burial Area

P-values for the burial area ANOVAs for each vertebral dimension are presented in Tables 36 and 37. These results indicate a strong significant result for lumbar AVBH between females by burial area at Schild, with group four females had the smallest measurements, while group three were the largest (Table 38). Although there was no overall significant difference in femur length by burial among Schild females in the one way ANOVA, further testing revealed that females in burial area four had significantly smaller femur measurements when compared to the rest of the sample (Tables 39 and 40). This pattern held true for AVBH (Table 41) No significant differences were detected for LEH, but sample sizes were very small (Table 42). The results of the burial area analysis indicated that 1) females in group four had significantly smaller AVBH and femur lengths than Mississippian females in other burial areas, and 2) females in group three may have had somewhat better growth experiences than other females in the community. Based on these observations, the null hypothesis $6b_2$ is only accepted in part. For both LEH and NCD, the null hypothesis $6b_2$ is accepted. For VBH, the null hypothesis $6b_2$ is rejected, as ANOVA detected a statistically significant difference in lumbar AVBH by burial area. For femur length the null hypothesis $6b_2$ is rejected in part- the ANOVA did not detect statistically significant differences by burial area, but a t-test revealed that burial area four femur lengths were smaller than all others to a statistically significant extent. The possibility that this pattern in

femur length and lumbar AVBH was related to burial area associations with charnel structures is explored in the next section.

Dimension	P
AVBH	.141
PVBH	.380
TNCD	.429
APNCD	.780

Table 36- P-values for Schild Female Thoracic Dimensions by Burial Area ANOVAs

Dimension	P
AVBH	.028
PVBH	.182
TNCD	.743
APNCD	.537

Table 37- P-values for Schild Female Lumbar Dimensions by Burial Area ANOVAs

Burial Area	N	Mean	SD	P
1	8	26.73	0.75	.028
2	12	26.55	0.90	
3	11	27.17	1.21	
4	9	25.75	1.05	

Table 38- Schild Female Lumbar AVBH Descriptive Statistics by Burial Area

Burial Area	N	Mean	SD	P
1	11	42.50	1.90	.146
2	16	43.00	1.80	
3	17	43.11	2.18	
4	11	41.45	1.90	

Table 39- Schild Female Right Femur Length ANOVA by Burial Areas

Burial Area	N	Mean	SD	P
1,2,and 3 combined	44	42.90	1.95	.029
4	11	41.45	1.90	

Table 40- Schild Right Femur Length T-test by Burial areas (4 versus all others)

Burial Area	N	Mean	SD	P
1, 2, and 3 combined	31	26.82	1.00	.008
4	9	25.75	1.05	

Table 41- Schild Female Mean AVBH T-test by Burial Areas (4 versus all others)

Burial Area	N	LEH Present	Fisher's Exact
1	9	3	.859
2	13	4	
3	16	7	
4	2	1	

Table 42- Schild Females LEH frequency Chi-square by Burial Area

Hypotheses $6c_1$ - Male Growth Patterns by Charnel Association

There were no significant differences between charnel associated and non-charnel associated males for AVBH or femur length (Tables 45 and 46). LEH frequencies were not quite statistically significant between males based on charnel association (Table 47), but given the small sample size, the trend toward charnel associated males having a lower incidence of LEH should be noted. Therefore, the null hypotheses $6c_2$ is cautiously rejected as it pertains to LEH frequencies, and accepted as it pertains to femur length and lumbar vertebral dimensions.

Dimension	Charnel	N	Mean	SD	P
AVBH	Yes	15	27.38	1.15	.516
	No	23	27.11	1.24	
PVBH	Yes	19	28.30	1.36	.458
	No	23	28.02	1.01	
TNCD	Yes	16	23.77	1.77	.731
	No	19	23.59	1.22	
APNCD	Yes	11	15.52	0.60	.283
	No	20	15.18	0.93	

Table 43- Schild Male Lumbar Vertebral Dimensions T-tests by Charnel Association

Charnal	N	Mean	SD	P
Yes	16	45.00	2.08	.558
No	30	45.38	2.10	

Table 44- Schild Male Right Femur Length T-test by Charnel Association

Charnal	N	LEH present	Fisher's Exact
Yes	15	3	.083
No	21	11	

Table 45- Schild Male LEH Frequency Chi-square by Charnel Association

Hypotheses $6c_2$- Female Growth Patterns by Charnel Association

Tests to compare females from groups associated with charnel structures to females from those groups not associated with charnel structures revealed that charnel associated females had nearly significantly larger lumbar AVBHs, as well as significantly larger femur lengths (Tab;es 48 and 49). There was not a statistically significant difference in LEH frequencies between charnel and non-charnel associated females (Table 50). Therefore, the null hypotheses $6c_2$ is cautiously rejected as it pertains to lumbar vertebral dimensions, rejected as it pertains to femur length, and accepted as it relates to LEH frequencies among Schild Mississippian females as analyzed by charnel association.

Dimension	Charnel	N	Mean	SD	P
AVBH	Yes	23	26.85	1.08	.066
	No	17	26.20	1.02	
PVBH	Yes	27	27.07	1.08	.202
	No	20	26.68	0.98	
TNCD	Yes	29	23.23	1.33	.804
	No	20	23.12	1.61	
APNCD	Yes	23	15.34	1.02	.137
	No	15	12.87	1.10	

Table 46- Schild Female Lumbar Vertebral Dimensions ANOVA by Charnel Association

Charnal	N	Mean	SD	P
Yes	33	43.06	1.97	.049
No	22	41.98	1.93	

Table 47- Schild Female Right Femur Length T-test by Charnel Association

Charnal	N	LEH present	Fisher's exact
Yes	29	11	.188
No	12	4	

Table 48- Schild Female LEH Frequency Chi-square test by Charnel Association

Hypotheses $6d_1$- Male Growth Patterns by Artifact Only Cluster

There were no significant differences in the mean vertebral dimensions between males in artifact-only cluster 6 compared to males who were in cluster 0 (Tables 51 and 52), nor were there significant differences in femur length or LEH between cluster 0 and cluster 6 males (Tables 53 and 54). Based on these observations, the null hypothesis $6d_1$ is accepted, as there are no observable differences in male growth patterns when analyzed by artifact-only clusters.

Dimension	Cluster	N	Mean	SD	P
AVBH	0	19	20.62	0.95	.227
	6	11	20.23	0.53	
PVBH	0	23	22.19	0.96	.197
	6	13	23.31	3.93	
TNCD	0	22	17.65	1.12	.659
	6	14	17.50	.090	
APNCD	0	19	15.36	0.94	.785
	6	12	15.30	0.67	

Table 49- Schild Male Thoracic Dimensions T-tests by Artifact-Only Clusters

Dimension	Cluster	N	Mean	SD	P
AVBH	0	22	27.28	1.18	.705
	6	18	27.13	1.28	
PVBH	0	24	28.06	1.24	.896
	6	18	28.26	1.11	
TNCD	0	26	23.04	1.35	.647
	6	19	22.84	1.51	
APNCD	0	22	15.13	0.88	.151
	6	19	15.54	1.08	

Table 50- Schild Male Lumbar Dimensions T-tests by Artifact-Only Clusters

Cluster	N	Mean	SD	P
0	25	45.72	1.56	.095
6	21	44.69	2.49	

Table 51- Schild Male Right Femur Length T-test by Artifact-Only Clusters

Cluster	N	LEH Present	Fisher's Exact
0	20	9	.501
6	16	5	

Table 52- Schild Male LEH Frequency Chi-square by Artifact Only Clusters

Hypotheses $6d_2$- Female Growth Patterns by Artifact Only Cluster

There were no significant differences in the mean vertebral dimensions between females in artifact-only cluster 6 compared to females who were in cluster 0 (Tables 55 and 56), nor were there significant differences in femur length or LEH between cluster 0 and cluster 6 males (Tables 57 and 58). Based on these observations, the null hypothesis $6d_2$ is accepted, as there are no observable differences in female growth patterns when analyzed by artifact-only clusters.

Dimension	Cluster	N	Mean	SD	P
AVBH	0	24	19.16	0.84	.450
	6	10	18.94	0.52	
PVBH	0	27	21.77	2.61	.291
	6	14	21.00	0.64	
TNCD	0	22	16.98	0.99	.373
	6	14	16.61	1.46	
APNCD	0	20	15.31	0.95	.071
	6	12	14.67	0.93	

Table 53-Schild Female Thoracic Dimensions T-Tests by Artifact-Only Clusters

Dimension	Cluster	N	Mean	P
AVBH	0	26	26.72	.254
	6	14	26.03	
PVBH	0	35	27.67	.253
	6	18	27.28	
TNCD	0	33	23.30	.316
	6	17	22.86	
APNCD	0	25	15.60	.704
	6	13	15.45	

Table 54- Schild Female Lumbar Dimensions T-tests by Artifact-Only Clusters

Cluster	N	Mean	SD	P
0	36	42.67	1.80	.844
6	19	42.55	2.40	

Table 55- Schild Female Right Femur Length T-test by Artifact Only Clusters

Cluster	N	LEH Present	Fisher's Exact
0	25	8	.517
6	16	7	

Table 56- Schild Female LEH Frequency Chi-square Test by Artifact-Only Clusters

Hypotheses 6e$_1$- Male Growth Patterns by Artifact and Positioning Clusters

There were no significant differences in the mean thoracic or lumbar dimensions between males in artifact and positioning cluster 1 compared to males who were in cluster 2 (Tables 59 and 60),

nor were there significant differences in femur length or LEH between cluster 1 and cluster 2 males (Tables 61 and 62). Based on these observations, the null hypothesis $6e_1$ is accepted, as there are no observable differences in male growth patterns when analyzed by artifact and positioning clusters.

Dimension	Cluster	N	Mean	SD	P
AVBH	1	16	20.70	0.89	.319
	2	14	20.31	0.76	
PVBH	1	19	23.13	3.26	.173
	2	17	22.00	0.92	
TNCD	1	18	17.70	1.01	.569
	2	18	17.49	1.06	
APNCD	1	17	15.46	0.68	.323
	2	14	15.16	0.99	

Table 57- Schild Male Thoracic Vertebral Dimensions T-tests by Artifact and Positioning Clusters

Dimension	Cluster	N	Mean	SD	P
AVBH	1	18	27.35	1.26	.528
	2	20	27.10	1.16	
PVBH	1	21	28.15	1.42	.981
	2	21	28.14	0.90	
TNCD	1	19	23.82	1.52	.529
	2	16	23.49	1.44	
APNCD	1	15	15.42	0.96	.424
	2	16	15.19	0.74	

Table 58- Schild Male Lumbar Vertebral Dimensions T-tests by Artifact and Positioning Clusters

Cluster	N	Mean	SD	P
1	24	45.52	2.19	.576
2	22	45.66	2.06	

Table 59- Schild Male Right Femur Length T-test by Artifact and Positioning Clusters

Cluster	N	LEH Present	Fisher's Exact
1	15	5	.731
2	21	9	

Table 60-Schild Male LEH Frequency Chi-square test by Artifact and Positioning Clusters

Hypotheses $6e_2$- Female Growth Patterns by Artifact and Positioning Clusters

Vertebral results are listed on Tables 63 and 64 below. The only significant results of the female artifact and positioning cluster based analysis occurred in the lumbar AVBHs, with cluster two females being significantly larger. Female lumbar PVBH results approached statistical significance. There were no significant differences in femur length or LEH between cluster 1 and cluster 2 females (Tables 65 and 66). Based on these observations, the null hypothesis $6d_1$ is cautiously rejected as it applies to female VBH. It is rejected for all other growth indicators, as there are no observable differences in female NCD, LEH or femur length patterns when analyzed by artifact and positioning clusters.

Dimension	Cluster	N	Mean	SD	P
AVBH	1	12	19.05	0.70	.825
	2	22	19.11	0.81	
PVBH	1	14	20.91	0.92	.206
	2	27	21.82	2.54	
TNCD	1	12	16.43	1.16	.153
	2	24	17.03	1.17	
APNCD	1	11	14.89	0.91	.455
	2	21	15.17	1.03	

Table 61- Schild Female Thoracic Vertebral Dimensions T-tests by Artifact and Positioning Clusters

Dimension	Cluster	N	Mean	SD	P
AVBH	1	15	26.05	1.00	.017
	2	25	26.89	1.04	
PVBH	1	16	26.51	1.00	.067
	2	31	27.10	1.03	
TNCD	1	18	22.84	1.07	.269
	2	32	23.32	1.60	
APNCD	1	14	15.57	1.15	.927
	2	24	15.54	1.04	

Table 62- Schild Female Lumbar Vertebral Dimensions T-tests by Artifact and Positioning Clusters

Cluster	N	Mean	SD	P
1	21	42.55	1.84	.820
2	34	42.68	2.16	

Table 63- Schild Female Right Femur Length T-test by Artifact and Positioning Clusters

Cluster	N	LEH Present	Fisher's Exact
1	17	8	.328
2	24	7	

Table 64- Schild Female LEH Frequency Chi-square by Artifact and Positioning Clusters

Intracemetery Trends in Growth Disruption: Individual Vertebrae

As was provided for the temporal analysis, the following analyses regarding individually-based vertebral tests is provided as supplementary information. It is intended to assist in interpreting the results presented in the segmental-based hypotheses testing in the intracemetery analyses above, particularly insofar as providing a starting point for a recognizing potentially useful patterns in vertebral column growth.

By Knoll

There were no significant differences between vertebral dimensions for males in knoll A versus knoll B. However, analysis of females revealed statistically significant results in two thoracic TNCDs (16% of TNCDs- T5 and T6), with knoll B females being larger in all significant cases (Table 67). This pattern generally held true for other thoracic vertebrae, approaching significance in several cases. However, these results taken together were not strong enough to result in a significant difference in the means based analysis, as discussed above.

Vertebral Dimension	Knoll	N	Mean	SD	P
T5 TNCD	A	29	15.42	1.27	.037
	B	24	16.15	1.19	
T6 TNCD	A	28	15.51	1.25	.038
	B	24	16.24	1.20	

Table 65- Schild Female Individual Vertebral T-tests by Knoll (Unlisted results were not significant at the α=.05 level)

By Burial Areas

Significant results for the Schild male individual vertebrae tests by row are listed in Table 68. In general, group three had the largest VBH measurements in all significant dimensions (see appendix for more specific results, including means for all groups). When AVBHs are considered, only five out of 12 (41.6%) thoracic vertebrae yielded significant results (T1, T3, T5, T6, and T8), while only one out of 12 thoracic PVBHs (8.3%) yielded significant results (T2). In significant NCD dimensions, group two tended to be the largest, with three out of 12 (25%) thoracic APNCDs (T8, T9, and T10), one out of five (20%) lumbar APNCDs (L3), and one out of five (20%) lumbar TNCDs (L4) significant at the α= .05 level. None of these results were strong enough to affect the means based analysis, for which no significant results were obtained for the male portion of the Schild sample.

Vertebral Dimension	P
T1 AVBH	.011
T2 PVBH	.032
T3 AVBH	.051
T5 AVBH	.034
T6 AVBH	.005
T8 AVBH	.017
T8 APNCD	.023
T9 APNCD	.028
T10 APNCD	.027
L3 APNCD	.035
L4 TNCD	.009

Table 66- P-values from Schild Males Individual Vertebrae ANOVAs by Burial Area (Unlisted results were not significant at the α=.05 level)

A different pattern is evident when Schild females are considered. Only three significant results were obtained in the row based individual vertebral analysis, and all of these were lumbar AVBHs (Table 69). Overall, three out of five (60%) of lumbar AVBHs were significant (L1, L2, and L4). In all of these cases, group three females were the largest, and in two of the three cases group two females were the second largest.

Vertebral Dimension	P
L1 AVBH	.014
L2 AVBH	.011
L4 AVBH	.057

Table 67- P-values from Schild Females Individual Vertebrae ANOVAs by Burial Area (Unlisted results were not significant at the α=.05 level)

By clusters

No strong patterns emerged when Schild male vertebral measurements were analyzed by artifact-only clusters. One significant result (T12) indicated that APNCD was larger among cluster six males when compared to males in all other clusters (Table 70), but this discrepancy only

constituted one out of 12 (8.3%) vertebral dimensions and was not indicative of a broader pattern.

Vertebral Dimension	Artifact Only Cluster	N	Mean	SD	P
T12 APNCD	0	28	17.12	0.99	.005
	6	19	17.96	0.94	

Table 68- Schild Male Individual Vertebral T-tests by Artifact Only Cluster (Unlisted results were not significant at the α=.05 level)

When Schild male vertebral measurements were analyzed by artifact and positioning clusters, cluster one males had larger VBH and NCD measurements in all three significant cases (Table 71).

Vertebral Dimension	Artifact and Positioning Cluster	N	Mean	SD	P
T4 AVBH	1	22	18.81	1.04	.027
	2	23	18.11	0.99	
T5 PVBH	1	23	21.61	0.93	.013
	2	21	20.79	1.35	
L4 TNCD	1	25	24.18	1.91	.030
	2	27	23.00	1.93	

Table 69- Schild Male Individual Vertebral T-tests by Artifact and Positioning Clusters (Unlisted results were not significant at the α=.05 level)

Statistically significant VBH and NCD measurements were detected at several vertebral levels among Schild females, but there was no clear patterning to the results (Table 72). However, in all of these cases, cluster six females were significantly smaller than those who were not in cluster six.

Vertebral Dimension	Artifact Only Cluster	N	Mean	SD	P
T3 AVBH	0	34	17.24	0.93	.032
	6	16	16.64	1.59	
T7 TNCD	0	30	16.06	1.12	.038
	6	19	15.25	1.54	
T8 PVBH	0	37	20.90	1.08	.050
	6	21	20.35	0.83	
T8 APNCD	0	36	15.35	1.09	.032
	6	19	14.65	1.18	
T9 AVBH	0	34	20.31	1.01	.043
	6	24	19.76	0.98	
T9 PVBH	0	36	21.20	1.11	.022
	6	24	20.58	0.82	
T9 APNCD	0	36	21.20	1.08	.037
	6	24	20.58	1.15	
T11 PVBH	0	36	25.05	1.43	.039
	6	22	24.29	1.15	
T11 APNCD	0	34	16.27	1.31	.031
	6	23	15.48	1.37	
T12 APNCD	0	33	20.57	0.90	.027
	6	20	20.14	1.13	
L1 APNCD	0	35	17.23	0.94	.003
	6	21	16.34	1.22	
L2 AVBH	0	34	26.25	1.58	.043
	6	18	25.40	1.00	

Table 70- Schild Female Individual Vertebral T-tests by Artifact Only Clusters (Unlisted results were not significant at the α=.05 level)

When analyzed by artifact and positioning clusters, female vertebral measurement comparisons yielded only one significant result, with T1 PVBHs being significantly larger among cluster 2 females (Table 73).

Vertebral Dimension	Artifact and Position Cluster	N	Mean	SD	P
T1 PVBH	1	22	18.98	1.30	.035
	2	38	19.77	1.41	

Table 71- Schild Female Individual Vertebral T-tests by Artifact and Positioning Clusters (Unlisted results were not significant at the α=.05 level)

Hypothesis Seven- Multifactor Approaches

Multifactor approaches (comparing biological indicators to multiple social indicators simultaneously) are inherently more complicated than the single factor approaches above, as the addition of more factors decreases cell counts. Using the broadest categories available (i.e. binary categories only, which excludes the burial area category) allowed for maximization of cell counts, but the availability of other binary spatial factors (knolls and charnel associations) allowed for an investigation of the interactions between spatial organization and artifact/positioning attributes. Despite the issue of sample size, several significant interactions were discovered (Table 74).

Measurement	**Factors**	**P**
Female lumbar APNCD	Artifact and Positioning clusters, Knoll	.028
Female lumbar APNCD	Artifact and Positioning clusters, charnel association	.053
Female lumbar AVBH	Artifact only clusters, Charnel association	.048
Male lumbar AVBH	Artifact only clusters, Knoll	.012
Male Femur Length	Artifact Only Clusters, Charnel Association	.038

Table 72- P-values from Two-way ANOVAs (Unlisted results were not significant at the α=.05 level)

Except for the significant relationship between charnel association and female AVBH, the one way ANOVA's between the osteological measurements and individual factors listed above did not yield statistically significant results. When a spatial and an artifactual factor were considered together, however, some interesting patterns emerge. Notably, the multifactor results for male lumbar AVBH and male femur length were the only significant results for males in the entire analysis. Because statistically significant patterns were found, hypothesis seven is rejected.

CHAPTER SEVEN- DISCUSSION AND INTERPRETATION

In previous chapters, it was suggested that 1) traditionally employed bioarchaeological indicators of early childhood stress (LEH) and cumulative growth (femur length) would provide a framework for testing the vertebral method of growth assessment, and 2) a nuanced perspective on temporal changes and intracommunity differentiation in growth patterns could be achieved through application of nontraditional osteological methods and the use of finer scale, mortuary based units of analysis. A set of specific hypotheses were provided in chapter five, upon which the statistical tests presented in chapter six were based.

In the first part of the current chapter, results of the statistical testing of each hypothesis will be interpreted. It will be argued that, although the vertebral methods tested here do not correspond perfectly with the LEH and femur length results, there *is* evidence that vertebral metrics may provide meaningful insights into growth patterns in the past, and that the vertebral method may provide unique information that complements traditional methods. Statistical tests of the temporal and intracemetery growth trends for males and females will be interpreted within the archaeological framework presented earlier in this dissertation. The overall results of this analysis suggest that growth differentials between individuals are related to archaeologically-derived mortuary groupings at the Schild Mississippian site, and that this is particularly true for the female portion of the sample. This chapter will also summarize comparable data from other Late Prehistoric sites, suggesting that that there may be regional variation in temporal growth trends and intrasite patterns of differential growth.

It is proposed that the Late Woodland- Mississippian transition in West Central Illinois was characterized by improving conditions of in generalized/cumulative early childhood growth

for females, decreasing incidence of episodic growth disruption for male children, and no change in cumulative growth through early adulthood for either males or females. Within the Schild Mississippian community, women may have experienced more variability in biocultural growth experiences than men, based not only on biological sex, but also on the roles they played as part of socially meaningful kinship or village networks, or based on finer scale temporal variation within the Mississippian component. In either case, variability in the growth experiences of Mississippian women related to cultural parameters is indicated. It will further be argued that correlations between Mississippian mortuary patterning and biological growth experiences at Schild suggest that the adoption of Mississippian mortuary attributes in the Lower Illinois River Valley were not acts of simple, superficial emulation, but were reflective of the demonstrable biosocial effects of Mississippianization on the lived experiences of the late prehistoric inhabitants of this region.

Intrasegment Reliability

Hypothesis one tested for intrasegment reliability in vertebral measurmnts in order to justify a segment-based approach to subsequent tests. All Cronbach's Alpha tests yielded results that were sufficiently high (greater than .7) to justify segment-based testing of vertebral data. This is not surprising, as visual observation of vertebral dimensions reveals that they do not vary randomly in relation to one another- there is a clear progression in size/shape variation in a sequence of vertebrae.

The results for the fifth lumbar vertebra NCDs are noteworthy and warrant more detailed discussion, as the alpha scores indicate that L5 measurements were (except in male AVBH) consistently the most variable and, subsequently, the least statistically "reliable" of all vertebrae.

This may be because the L5 neural arch grows for a longer period of time than the other lumbar vertebrae (Ursu et al 1996), and often does not complete its growth until age five (Baker et al 2005). In the analyses presented here, all lumbar vertebral dimensions (L1-L5) were used to compute means. In future research where sample size is perhaps more problematic, omitting L5 from averages may serve to increase both sample sizes and intrasegment reliability scores. However, this comes with the trade off of limiting averages to the first four lumbar vertebrae, which are restricted to an earlier period of postnatal growth. Alternately, because L5 seems to be indicative of childhood growth for a longer postnatal period than all of the other vertebrae, trends in L5 neural canal diameters as analyzed on their own may also be informative.

Utility of Vertebral Method

This section specifically interprets the results of statistical testing of hypothesis two. It also draws on observations of the relationship between NCD and LEH (as indicators of early childhood growth) and VBH and femur length (as indicators of cumulative growth through early adulthood) to bolster an argument for the vertebral method as a potentially sensitive indicator of growth trends.

Relationship Between NCD and Femur Length

One of the basic premises of this dissertation was that traditionally utilized indicators of growth and stress could be used to test the efficacy of the vertebral method for studies of growth in the past, as has been suggested by Porter (1986) and Tatarek (1999). Linear regression analysis revealed that neither TNCD or APNCD were significantly correlated with femur length. This suggests that NCD is independent of cumulative growth as indicated by femur length and may

lend credence to an assertion that NCD are reflective of early childhood rather than cumulative growth experience. However, this finding is in contrast to a similar analysis in Tatarek's (1999) study of the Hammond Todd collection, and the reason for this discrepancy must be explored in future research. Possible explanations may be attributable to between-population variation in growth patterning, or differences in the natures of the two skeletal collections (i.e. one represents a genetically-related community, while the other is a collection of genetically dissimilar individuals).

Another issue that must be addressed is the fact that, in the current analysis, more strongly significant results (among females over the Late Woodland-Mississippian transition) were obtained with APNCD than with TNCD. This phenomenon was also recognized in Clark's (1988) original study. He cites several previous studies in addition to providing new evidence (using an age-graded sample of the Dickson Mounds collection) that APNCD and TNCD were not measuring the same period of growth, and that TNCD likely corresponds to growth continuing into a later period of childhood, while the APNCD is limited specifically to early childhood (prior to age 4). Furthermore, and as discussed in chapter four, Gepstein et al (1991) found that APNCD was the only vertebral dimension to be significantly correlated with total vertebral canal size, so it is not entirely surprising that it was this dimension, rather than TNCD, that yielded the strongest statistically significant results and seemed most useful for differentiating between groups.

Sexual Dimorphism in NCD Over Time

The NCD data merits further discussion here, as one of the basic assumptions underlying this study- that NCD's reflect early childhood growth experiences- has implications for a facet of sexual dimorphism that is less well understood. Sexual dimorphism in skeletal features typically

develops after puberty, which is the primary reason that subadult remains cannot be sexed. Therefore, it would be reasonable to hypothesize that any skeletal element completing growth during the early childhood years (i.e. neural canal) would not inherently display sexual dimorphism, and that any significant difference between males and females would therefore be more fully explained with a consideration of social or environmental factors.

In statistical testing of hypothesis 2c, lumbar APNCD showed no sexual dimorphism during the Late Woodland period (α=.514). However, during the Mississippian period, female APNCD were significantly larger than males (α=.051). Lumbar TNCD's were significantly larger in males compared to females in the Late Woodland period (α=.006), but the difference between male and female TNCD was no longer statistically significant in the Mississippian (α=.924).

Interpretation of these results is facilitated by keeping in mind two key issues. First, although the specific nature of change in the two dimensions is different (i.e. females surpassing males in one measure, and females catching up to males in the other measure), it should be noted that both scenarios indicate an improvement in the conditions of female early childhood growth over time. Second, APNCD may be indicative of an earlier period of early childhood growth than TNCD, and so the differences may indicate a more complex pattern of differential treatment of male and female children in which 1) female Mississippian children had better growth conditions early on as indicated by APNCD, and 2) a slight later childhood advantage among Late Woodland male children had disappeared by Mississippian times, as indicated by TNCD.

All of these issues considered together lend support to a hypothesis that neural canal diameter (APNCD in particular) is a potentially sensitive indicator of early childhood growth, although further investigation is necessary before this can be said with certainty.

Comparing Neural Canal Diameter and LEH Results

The relationship between APNCD, LEH, and early childhood growth disruption can be further explored by comparing results for changes in LEH frequency to changes in canal diameters over the Late Woodland-Mississippian transition. Temporal analysis revealed that female APNCD increased significantly with Mississippianization (see next section for further discussion) which, according to the basic assumptions of the vertebral method, indicates improving early childhood growth conditions for females over this cultural transition. However, this analysis *did not* indicate a concomitant decrease in LEH frequency over time, which would have offered an excellent corroboration of APNCD as a sensitive indicator of early childhood growth conditions. Exacerbating this issue is the fact that there *was* a statistically significant difference in LEH frequencies for males over the Late Woodland-Mississippian transition, with Mississippian males experiencing fewer early childhood growth disruption episodes than their Late Woodland counterparts. However, there was no concomitant change in neural canal diameter.

A possible explanation for the observed discrepancies between vertebral canal data and LEH data may be related to the nature of stress being recorded by each measure. Although LEH is traditionally relied upon as an indicator of early childhood stress and growth disruption, it represents *episodic* stress while the vertebral method represents more *generalized, cumulative* growth over the entire early childhood period (Goodman et al 1984). Occasional, episodic perturbations would not necessarily have an effect on total, cumulative growth, so there is no reason that the two different analyses would necessarily yield the same results. It may be, therefore, that LEH and NCD are measuring inherently different phenomena, albeit during the same growth period.

Previous bioarchaeological studies of macroscopic and microscopic enamel defects with Mississippianization in Illinois have revealed patterns different from those reported here. Goodman et al (1980) investigated changes in frequencies of linear enamel hypoplasia in males and females interred at Dickson Mounds in West Central Illinois, concluding that during the Late Woodland, males displayed fewer hypoplasias than females, but that these proportions were essentially equal by Mississippian times. The discrepancy between the results of the current study and the results of the Goodman et al (1980) study may be due to regional variation in sex-based patterns of growth disruption. More locally, Cook's (1984) analysis of microscopic enamel defects in in Lower Illinois River Valley samples (including Schild) indicated a trend toward decreasing frequencies of LEH in females relative to males between the Middle Woodland and the Mississippian. However, Cook's (1984) results are not directly comparable to the LEH results presented here because her study used 1) different teeth (she used first molars), 2) different methodologies (she used dental microdefects) and 3) a different temporal framework (she compared Middle Woodland frequencies to Mississippian frequencies).

Scale of Difference

It should also be noted that the discrepancies in segment-based neural canal diameters in this study are very small (on the scale of .5 millimeter), even when compared to the seemingly small discrepancies demonstrated by Clark (1985) using the Dickson Mounds collection. The biological and cultural meaning of this discrepancy is not known, and warrants further research.

One possible explanation is that, despite their apparent phenotypic sensitivity, vertebral size is still under a significant amount of genetic control and is very population specific. If this is the case, one might expect the scale of differences to not be directly comparable across

populations, particularly when one population seems to have experienced an influx of new alleles from a foreign source over the Late Woodland-Mississippian transition (as was the case in the Dickson Mounds sample) while the other population was *relatively* genetically stable over time, with no significant biological discontinuity (as was the case at Schild and Yokem).

Another explanation for the may lie in slight differences in measurement techniques (i.e. one observer holding the calipers slightly differently, or squeezing the jaws together with somewhat different amounts of pressure). These types of interobserver error are difficult to control for, and as such it is argued here that while statistical trends may be comparable between studies, direct comparison of measurements taken by different observers is not.

A special case is also presented by L5. As pointed out earlier, the L5 vertebral canal measurements may eventually prove to be a better indicator of early childhood growth than the other vertebral arches by virtue of its relatively extended growth period (although further investigation is required). The segment-based analysis averaged the results for the entire lumbar segment, but the individually-based analysis revealed that the change in APNCD over the Late Woodland-Mississippian transition in L5 this measure was nearly 60% larger than the change in the other lumbar vertebrae that yielded significant results in the individual-based analysis.

Despite the small scale of the observed differences in vertebral dimensions, several were strong enough to achieve statistical significance and their potential biocultural significance is considered.

Comparing Vertebral Body Height and Femur Length Results

It was hypothesized that the reliability of vertebral body heights as an indicator of cumulative growth could be evaluated by looking at its relationship with femur length, a more traditionally

employed indicator. Linear regression analysis indicated that both AVBH and PVBH were significantly correlated with femur length, lending support to the hypothesis that vertebral body height is a good measure for cumulative growth experiences. This is not in agreement with Tatarek's (1999) results based on cervical body heights. R-square values for the strength of the association were relatively low, suggesting that although the measures were positively correlated, there are some other factors determining differential cumulative growth between these elements.

It is surprising that, in this study, all significant results indicating change in vertebral body heights were in lumbar AVBH, despite the facts that both AVBH and PVBH were significantly correlated with femur length and that those correlations were of equal strength. It may be that AVBH is a more reliable measure of cumulative growth in the lumbar region than PVBH because the lordodic lumbar curvature would put more compressive force on the posterior aspect of the lumbar vertebrae, resulting in enough subtle collapse over time to obliterate the difference that are preserved in AVBH. However, it also must be considered that intervertebral disc morphology (specifically the position of the nucleus pulposus) contributes more to the development of secondary spinal curvatures than do vertebral bodies themselves (Taylor 1975). In any case, this phenomenon needs to be explored more thoroughly.

The relationship between vertebral body height, femur length, and cumulative growth patterns is further complicated when one evaluates the pattern of significant results in the mortuary based analysis if the Schild Mississippian cemetery. Cook (2007) points out that there is no evidence for a decrease in cumulative growth patterns over the late Woodland-Mississippian transition as indicated by femur length. Likewise, the vertebral body height data presented here does not indicate a statistically significant difference in VBH over this cultural

transition for either sex. In several tests involving Schild females by charnel association, nearly statistically significant lumbar AVBH data seemed to correlate well with statistically significant femur length data in several instances, indicating that certain segments of the Schild Mississippian female sample experienced better cumulative growth. However, in other cases, the relationship between the two indicators was less clear. For example, in one case (Schild females by burial area), lumbar AVBH yielded significant results while femur length did not, although retesting the smallest group (group four) against all others did yield significant results in both femur length and AVBH. There were no cases where femur length was statistically significant without concomitant significant (or very near significant) difference in lumbar AVBH. This may suggest that vertebral body heights are somewhat more sensitive to growth disruption than femur length, but this cannot be known for certain without further research.

All of this, considered with the weakly significant correlation between VBH and femur length, suggests that vertebral body height should cautiously be considered as an indicator of cumulative growth. However, the intricacies of the involved relationships between the two measures requires further investigation, and it may be that femur length provides the same growth information in a more accessible manner.

Thoracic versus Lumbar Sensitivity to Growth Disruption

Although not formulated as a specific hypothesis, it is important to recognize that significant results in the means-based analyses were limited to the lumbar vertebrae, despite the fact that significant results were obtained for several thoracic vertebrae in the individual vertebral analyses. Several factors are suggested to explain this discrepancy.

First, the thoracic vertebrae are, quite obviously, smaller than their lumbar homologues. Larger vertebrae simply "grow more" than smaller vertebrae, perhaps giving them more opportunity to be affected by growth disruptions. This issue was also addressed by Clark (1985) who suggests that lumbar NCDs in particular have a longer period of postnatal growth than do thoracic vertebrae, thereby providing a larger window during which cultural factors can affect growth differentials. Second, larger vertebrae might also simply be easier to measure without error. Because there are more thoracic vertebrae (n=12) than lumbar vertebrae (n=5) significant differences in, for example, three thoracic vertebrae might get lost in a segment-based analysis, while significant differences in three lumbar vertebrae might be strong enough to affect the segment-based analysis. This would be particularly true if thoracic growth trajectories are significantly different between the upper and lower portions, indicating that subdivision of the thoracic segment may be called for.

Individual-based vertebral testing indicated some support for the proposed explanations. Patterning of the significant results sometimes indicated that sequences of thoracic vertebrae yielded significant results, or that a strong pattern of sequential significant results in the lumbar vertebrae were sometimes continued into the lowermost thoracics. However, in both cases, non-significant results in the rest of the thoracic segment negated their significance in the segment-based testing. Future research will involve subdividing the thoracic segment into anatomically appropriate subsets for segment-based testing.

All of these propositions should be investigated more fully, but based on preliminary observations, it is suggested that the lumbar segment of the vertebral column may be the better choice for growth studies of the kind attempted in this dissertation. This is in agreement with

Tatarek (1999), who also suggests that thoracic segment displays much more variability in growth patterning than either the cervical or lumbar segments.

Interpretation of Growth Data within Temporal Framework

In this section, results of statistical testing of hypotheses four and five are integrated and discussed. A generalized picture of growth trends for males and females is interpreted within a diachronic archaeological context, with particular reference to the increasingly important role of maize agriculture over the Late Woodland-Mississippian transition.

Late Woodland-Mississippian Transition

The analysis of femur length data collected for this study corroborates Cook's (2007) observation that there did not seem to be a change in stature with Mississippianization. This was true for both the males and the females in this study. Furthermore, there were no statistically significant differences in vertebral body height data for either males or females between the Late Woodland and Mississippian periods, which complement the femoral analysis.

Analysis of vertebral canal dimensions yielded some significant differences. There were no significant changes in vertebral canal growth among males, but females APNCD measurements were found to increase significantly with Mississippianization (TNCD's were also very close to significantly different, with a p-value of $\alpha = .059$). This would seem to suggest that early childhood growth experiences (as indicated by APNCD) were ameliorated for females with the transition to a Mississippian lifestyle, and that this advantage may have lasted into later childhood (as indicated by TNCD). The preponderance of ethnographic, archaeological, and iconographic evidence link agriculture in this region to women. As maize agriculture became

increasingly important with the advent of Mississippianization, it makes sense that women could gain social status through their productive and reproductive potentials (Fritz 1999, Watson and Kennedy 1990, Alt and Pauketat 2007, Thomas 2000), and that female children would thereby become more socially valued. The lack of concomitant changes in APNCD among males with Mississippianization suggests that the biosocial circumstances of early childhood growth for male children were not different between the two periods, or at least were not different enough to affect change in neural canal growth in a statistically detectable way given the limitations of the sample.

However, accounting for the LEH trends complicates this interpretation. The data collected for this study showed a significant decrease in the frequency of LEH in males with Mississippianization, but no temporal difference in female LEH frequencies. This suggests that Mississippian male children experienced fewer episodes of early childhood stress and illness than their Late Woodland counterparts, and also that the female early childhood stress/illness experience did not change with Mississippianization. As discussed above, several explanations can be offered and evaluated to account for this apparent contradiction with the vertebral analysis. The first is that LEH is a measure of episodic stress, while neural canal diameter is a measure of cumulative growth during early childhood, so the very nature of the data may preclude them from being directly comparable. Instead of one being used to validate the other, perhaps the information they provide should be interpreted as representing different and complementary perspectives on early childhood growth conditions. Second, previous studies (Cook 1984, Goodman et al 1980) suggest trends toward improved female early childhood conditions in Mississippian samples compared to earlier samples from elsewhere in the regions, without a concomitant similar trend in male frequencies.

Overall, there is much to consider when interpreting the sex-based growth data collected for the temporal portion of this study. Because of the evidence discussed in the previous section (*Utility of the Vertebral Method*), it is suggested that the lack of change in VBH, as well as the significant changes in female APNCD toward larger canal size with Mississippianization, reflect meaningful changes in the biosocial conditions of growth during this transition. Females experienced improved early childhood growth patterns compared to their Late Woodland counterparts, while the male early childhood growth experience remained largely unchanged with Mississippianization. This pattern may be related to ethnographic and iconographic evidence for the importance of females in the development and intensification of maize agriculture, which played an important socioeconomic and ideological role in Mississippian life.

Further Contextualizing Temporal Trends

There is a clear tendency to refer to the female association with agriculture and increased importance of agricultural pursuits with Mississippianization as an explanation for the improvement in female early childhood growth conditions suggested above. However, to continue to do this relegates the Late Woodland results to simple "baselines" against which to measure Mississippian growth differentials rather than treating the nature of Late Woodland sexual dimorphism as a phenomenon worthy of interpretation in and of itself. The detailed intracommunity interpretations that follow for the Schild Mississippian component are simply not possible for the Late Woodland component at this time, as we are lacking adequate mortuary data to use as units of analysis for the osteological data. Until such analyses are available, an exploration of the literature on Late Woodland social dynamics may offer cursory explanations for the apparent equity of Late Woodland male and female early growth experiences, as

indicated by comparison of APNCD between Late Woodland males and females when testing hypothesis two.

As discussed in chapter two, the Late Woodland tradition is characterized by heterarchical relationships between communities (Cobb and Nassany 1995), and this may have been the prevailing theme in intracommunity social relations (including gender relations) as it was for intercommunity interactions. The social distance, then, between Late Woodland men and women may have been somewhat more horizontal than vertical in nature. Authors like Pauketat and Alt (2007) seem to implicitly suggest this type of gender relations in the Late Woodland when they argue for increased polarization and politicization of gender roles with Mississippianization. If early childhood growth experiences were equitable between males and females in the Late Woodland, it may be because there were fewer sociocultural forces (like agricultural intensification, for example) to compel inequitable treatment during this period. However, if we take TNCD to represent a somewhat later period of childhood growth (following Clark 1985 and Tatarek 1999), we need to account for an apparent late childhood improvement of male growth relative to females, which also suggested by testing of hypothesis 2. This may have been related to the young boys becoming more involved in hunting with their adult male kin as they got older. However, none of these ideas can be tested until more rigorous Late Woodland mortuary and gender studies begin to come out of archaeology.

Growth Patterns and Social Differentiation among Schild Mississippians

The second part of this study focused specifically on the Mississippian component of the Schild site, as substantial mortuary data is available for incorporation into the osteological analysis. This section integrates, interprets, and contextualizes test results for hypotheses five and 6.

No significant associations were found between male growth data and any of the mortuary parameters in single factor analyses. No significant associations were found for either the knoll-based or the artifact only clusters, nor were any significant differences in NCD detected. However, several statistically significant associations between female cumulative growth patterns (AVBH and femur length) and other Schild mortuary parameters (artifact and positioning clusters, burial area, and charnel association) were discovered and are discussed below.

Artifact and Positioning Clusters

T-tests based on artifact and positioning clusters revealed that females in cluster two had significantly larger lumbar AVBH compared to their cluster one counterparts. There was no concomitant difference in femur length.

Interpreting the meaning of the statistically significant difference between females in these two clusters is somewhat complicated. Goldstein (1980) points out that burial positioning (extension versus non-extension, in particular) seems to have been an important attribute in differentiating the Schild burials, although variation in artifact assemblages is also significant. Because the primary division in Goldstein's cluster analysis was one of burial positioning (extension versus non-extension), there is significant variability in artifact assemblages within each collapsed cluster. The significant results in the vertebral body height data may be highlighting subtle differences in cumulative growth experiences of females related to the type of social differentiation indicated by burial positioning, which may be a status related (Goldstein 1980).

Burial Areas

Interesting patterns of differentiation in growth experience among females seem to be indicated by the tests based on burial areas. ANOVA indicated statistically significant differences in AVBH, with group four females having the smallest measurements and group three having the largest. For femur length, group four was once again the smallest while group three was once again the largest, but this difference was not reflected in the femur length ANOVA. However, upon further investigation, t-tests revealed that group four females had significantly smaller measurements in both AVBH and femur length when compared to the rest of the female sample (groups 1, 2, and 3 combined).

As with the cluster-based analysis, it would have been ideal to perform ANOVAs on the growth data based on the original rows provided by Goldstein (1980). However, sample size issues prevented this. The groupings referred to as "burial areas" that were used in this analysis roughly correspond to sets of rows in Goldstein's analysis, and correspond almost directly to spatial divisions recognized by both Goldstein (1980) and Perino (1972). Goldstein (1980) provides a strong argument for a relationship between kinship groups and row-based mortuary patterning, and although the rows do not perfectly correspond to the burial areas defined by Goldstein (1980, pp. 107 and 109) and used for this portion of the current analysis, it is cautiously suggested here that these groupings may represent kinship groups, community based corporate descent groups, or some similar manner of intracommunity social differentiation.

However, Goldstein also raises two other important issues that should be discussed here. First, she suggests that the individuals considered to be part of group four in this analysis may be the earliest burials at the site. Therefore, the fact that females in this group have significantly smaller AVBHs and femur lengths may reflect their experiences under a very early version of

Mississippianism at the site. Furthermore, the issue of community membership must also be considered. Specifically, Goldstein (1980) points out that there is no Mississippian village site in the region with a population large enough to be solely responsible for the number of burials at Schild. It is likely that multiple Mississippian smaller communities interred their dead at Schild, and therefore each of these spatial groups may represent separate communities. However, enough social unity was recognized between these groups to compel them to inter their dead in at the same site. In this scenario, females from the community or communities represented by group four seem to have less favorable cumulative growth experiences than females from other communities, while group three females may have been somewhat better off. In any case, the results of this analysis indicate that growth experiences among Schild females were differentiated and patterned in a way that is related to socially-significant spatial clustering, which may represent kinship, corporate descent groups, community membership, cultural change over time, or some combination of these factors. This suggests that Mississippian women in this region may have experienced more variability in cumulative growth experiences than Schild men, based not only on biological sex, but also on their cultural experiences over time and/or the roles they played as part of socially meaningful kinship or community networks.

Charnel Association

The descriptive statistics from the analysis discussed above indicate not only that group four females were significantly smaller in both femoral and vertebral body height measures, but also suggested that there may be some discrepancies in growth patterns based on charnel structure association. Groups two and three generally correspond with charnel structures while groups one and four generally do not. For the charnel association based analysis, the results for the male

subsample were not statistically significant. For the females, however, both AVBH measurements and femur lengths were significantly greater for those associated with a charnel facility when compared to those who were not.

Many of the same caveats regarding the cultural meaning of mortuary patterning discussed in the previous section also apply here, specifically regarding the relationship between time, community membership, and kinship in regards to access to a charnel related burial. Goldstein (1980) points out, however, that the knoll B charnel and non-charnel areas were likely used simultaneously, while the knoll A charnel and non-charnel areas may have been used either sequentially or simultaneously. If the sequential scenario were correct, then one might make an argument for excluding group four from this analysis because, although it is indeed a non-charnel group, these individuals should not be considered to have been "excluded" from charnel association in the same way that group one individuals were, and it might therefore be inappropriate to lump the two together. However, assuming that charnel associated interment was available in some way to group four individuals is not completely unfounded, as charnel ceremonialism was not a Mississippian innovation that simply had not been invented yet.

In this analysis, the biological patterns observed are meaningful regardless of the timing of the introduction of charnel ceremonialism, and the charnel/noncharnel groupings were retained for component of this analysis. The two non-charnel areas had lower mean AVBH and femur length then the two charnel areas, but it should also be recognized that the non-charnel female results may have been disproportionately skewed by group four measurements. The results of the growth pattern analysis suggest that Schild women may have experienced variability in cumulative growth patterns (as indicated by vertebral and femoral measurements) based not only on their biological sex, but also on their membership in social groups (kinship or

community associated) that either entitled or excluded them from charnel associated burial treatment.

Multifactor Analyses

The two way ANOVAs simultaneously comparing osteological measurements with two categorical factors (one spatial, one artifactual) yielded five significant results. The meaning of any one of these results is difficult to interpret specifically, but what seems particularly apparent is that seemingly insignificant relationships between a biological dimension and any individual factor may be masking more complicated multifactor interactions between artifact assemblages, space, and biology. This is not surprising, as mortuary programs are complicated cultural phenomena, and human decisions regarding these programs and their implementation are concerned with multiple levels of sociocultural meaning. It is likely that a *suite* of mortuary characteristics is more meaningful than any one parameter on its own. However, sample size problems will often preclude this level of investigation of skeletal remains from archaeological mortuary contexts.

Nevertheless, the results of the two way ANOVAs presented in this research further support Goldstein's contention that both spatial and artifactual attributes were important components of the Mississippian burial program and reflect meaningful sociocultural divisions, as (at least to some extent) the interactions of these traits are significantly associated with the life experiences of the interred individuals (as indicated by growth trends). More research is needed in order to more meaningfully interpret the significant results presented in this study, as well as to fine tune the units of analysis and statistical tests used in order to detect hidden trends in the biocultural data.

Engendered Interpretations

In the above sections, it is suggested that apparent improvement in female early childhood growth experiences over the Late Woodland/Mississippian transition is likely related to women's roles in agricultural production. Furthermore, some Mississippian women enjoyed better overall biosocially significant health and growth conditions through their membership in certain status, kin, or community groups. An alternate interpretation is that the biosocial experiences of Mississippian women changed over time, improving as Mississippianization of the region progressed and women became more adept at agricultural practices. These suggestions (particularly the latter) require further contextualization within the limited literature on late prehistoric gender relations in the Midwest.

Late Prehistoric Women, Domestic Economies, and Social Power

O'Gorman (1995, 2001) investigates gender, domestic economies, and insipient social inequality at Tremaine, an Oneota site in southwest Wisconsin. Through an investigation of storage feature distributions, mortuary ritual, and artifact assemblages among Tremaine longhouses, she suggests that certain women at the site were able to gain, maintain, and exercise social power through the production and management of surpluses. She explains,

> "Using Johnson's (1982) proposed mechanisms for dealing with scalar stress, I suggest that social inequalities emerged at the household level as simultaneous or vertical hierarchies were needed to coordinate and regulate the utilization of some resources. Less permanent, short-term sequential hierarchies probably occurred whereby short-term decisions were made by consensus. However, as some households became more successful at acquiring resources (subsistence or labor), it is possible that social inequalities between households and between women also developed. Surpluses of food and other items may have been used by women to gain and demonstrate social position by providing the necessary provisions and wealth to undertake socially enhancing ventures, such as warfare, hunting, or religious ceremonies." (O'Gorman 2001, 26)

This model of insipient social inequality among Oneota women provides a potentially helpful perspective for interpreting the results of the current analysis, which indicate socially patterned variability in growth experiences among females at Schild. There are, of course, certain caveats. The Oneota tradition is an expression of Upper Mississippian culture that is distinct from the Middle Mississippian cultural tradition practiced by the communities who interred their dead at Schild. However, Oneota and Middle Mississippian cultural traditions are known to have shared several key characteristics, including the practice of maize agriculture. Iconography clearly demonstrates an ideological link between Mississippian women and agriculture. O'Gorman cites ethnographic literature to support her assertions, which she can do because of the established archaeological links between the prehistoric Oneota and historically known tribes. Although direct archaeological links have yet to be made between prehistoric Mississippian groups in Illinois to historically known tribes, ethnohistoric interpretations of early Euroamerican encounters with native peoples of the Southeast are helpful, as several of these tribes continued to practice a Mississippian lifestyle into historic times. Nearly all of the accumulated evidence, archaeological, ethnohistoric, or iconographic, suggests that Mississippian women were responsible for agricultural pursuits.

Furthermore, although men may have been more active in political and public life in a normative sense, ethnohistoric accounts of native women in the southeast and beyond demonstrate that there were definite avenues through with industrious women could influence political decisions. Furthermore, women and/or their matrilines were said to own the fields that they worked in and the houses that they lived in (Hudson 1976). It is not a particularly risky leap of faith to suggest that some Middle Mississippian women may have been able to manipulate

their productive and reproductive power to the social benefit of themselves and their female kin, whom they presumably worked closely with and passed on practical skill sets, both subsistence and social in nature. Thomas (2000) suggests that Mississippian women in Illinois may have gained social power through their role in salt production and exchange and, based on O'Gorman's model, it is suggested here that they may have done the same at Schild by manipulating their roles as producers, reproducers, and managers of domestic economies.

Acculturation, Ethnogenesis, and Gender Transformations

Another explanation offered for the variation in female growth patterns between burial areas considers time and acculturation. Goldstein points out that Knoll A is earlier, and that the individuals interred in what has been categorized as burial area four in the current study may represent the earliest burials at the site. Delaney-Rivera (2007) evaluates hybrid vessel forms from the Schild Mississippian cemetery, and suggests that:

> "The changing nature of the ceramic assemblage, with a lower percentage of hybrid vessels recovered in Knoll B (40% compared to 51% from Knoll A), may be evidence of the acculturation of the local Late Woodland population to a Mississippian way of life. Through time, fewer Late Woodland individuals from a Late Woodland culture were brought into the Mississippian one because the local population from Lower Illinois River valley had already acculturated, thus fewer hybrid vessels. The percentages of vessels may also support the relative use of the cemeteries, with Knoll A assumed to have been older. The hybrid vessels, therefore, represent attempts by culturally Late Woodland individuals to demonstrate their new affiliation. Through time fewer Late Woodland individuals were present in the surrounding region, hence the lower quantity of hybrid vessels from Knoll B. (Delaney-Rivera 2007, 320)

This line of reasoning supports Goldstein's (1980) contention of an earlier use-period for Knoll A, while indirectly bolstering a hypothesis that the group of individuals from burial area four may have been the earliest at the site. A future study may look specifically at the ceramics

interred with the group four females to determine whether a disproportionate number of the hybrid pots were interred with them. In any case, Delaney-Rivera's (2007) contention of archaeologically visible, active acculturation in Schild Knoll A provides an interesting platform from which to explore the meaning of growth discrepancies among females observed in the current study. Based on this, it is suggested that the growth patterning among females at Schild may be related to changing gender roles through time with insipient Mississippianization and continued ethnogenesis at this site. Further on this point, and related to the ideas presented by O'Gorman (2001), Delaney Rivera continues:

> "Although Late Woodland women were familiar with maize (the archaeological data support an increase in the use of maize among Late Woodland populations through time), Late Woodland women marrying into Mississippian families had to learn to manage crops differently, as well as engage in new types of community activities and other social obligations associated with the Mississippian worldview." (Delaney-Rivera, 2007)

As Mississippianization occurred, local women adapted their life skills to accommodate and thrive in a new cultural context. Growth differentiation between group four females and other females interred at the site may represent the biological expression of this temporally-based cultural phenomenon. What we may be seeing then, with improved growth conditions in other burial areas compared with those observed in group four, is the way that active process of Mississippianization is expressed through women gradually becoming pre adept at an agricultural lifestyle through the time period represented at Schild, which Delaney-Rivera (2007) suggests may be as little as 100 years.

Women and Power in Mississippian Society

The unique nature of particular female burials in the Schild Mississippian might be interpreted as emphasising the special and powerful social roles that certain women played within this

community. For example, burial 66 from area three in knoll A was initially assumed to be male based on grave inclusions traditionally interpreted as symbolizing masculine power, such as knives, an antler staff, bird wings, and the disarticulated remains of other individuals. Osteological analysis later revealed, however, that the remains were that of a female (Cook 1980). Furthermore, the data presented in this dissertation reveals that the female represented by burial 66 may have experienced somewhat better growth conditions than her Mississippian female counterparts at Schild, as burial 66 values were higher than average in femur length and all vertebral dimensions. This case generally holds true for burial 96, who was also interred with and also mistakenly identified as a male based on these artifacts. These examples underscore the fact that women did, in fact, obtain roles of significant social power in Mississippian societies, while also highlighting traditional archaeological biases toward associationing men with political power.

Explicitly engendered Mississippian mortuary analysis with which we might contextualize osteological data presented here are rare, but Sullivan's (2001, 2006) work with Mississippian data from the Toqua site in Tennessee offers a reasonable starting point for interpreting that patterns seen at Schild. The mortuary situation at Toqua is inherently different from that seen at Schild, as there is a clear spatial differentiation- between mound burials and village burials- which appears to be related in some manner to gender differentiation. Specifically, Sullivan points out that traditional interpretations rely on assumptions that men dominate the public realm and are therefore more powerful than women, and that this indicated by the preponderance of males interred in mound contexts and females interred in village contexts. Sullivan's analysis demonstrates, however, that a multifactoral mortuary perspective that incorporates age and grave goods as variables results in a more nuanced perspective on

Mississippian gender relations. The level of variation indicated by burial treatments among males and females when multiple lines of mortuary evidence are incorporated shows that gendered Mississippian social identity may have varied with age over the lifecourse, and that individual achievement may have played a larger role in social identity than most archaeologists have previously considered.

In light of such a perspective on Mississippian gender/sociopolitical dynamics, it might be suggested that the females identified here as Schild burials 66 and 96 may have achieved positions of considerable sociopolitical power within the Schild community. As these are only two individuals, the osteological evidence cannot be presented with statements of statistical significance. However, disparate age-sensitive growth patterning between these two females, as indicated by the current analysis suggests, that positions of female social power are not necessarily related to relatively improved growth conditions throughout life, as burial 66 appears to have experienced improved conditions throughout her life as indicated by higher than average NCD and femur length measurements, while burial 96 may have experienced relative improvement (i.e. catch up growth as indicated by higher than average femur length without concomitant high NCD values) during the adolescent years of her life. Perhaps these osteobiographies are indicating a bioarchaeological method for differentiation ascribed (burial 66) versus achieved (burial 96) female power.

What About the Men?

As was indicated by LEH analysis, Mississippian males seem to have experienced fewer episodic growth disruptions than their Late Woodland counterparts. Although it appears that males in the most exclusive Mississippian artifact only clusters (cluster 0 in the current analysis) experienced

fewer episodic growth disruptions as indicated by LEH, this result was not quite statistically significant (α=.083).

Despite these examples, one of the most obvious patterns to have emerged in this analysis is that statistically significant results were, in most cases, associated with females. As was pointed out in several of the interpretations outlined above, Schild women seem to have had disparate growth experiences related to their membership in one or more intra or intercommunity social and status groups. As interesting as this fact may be, the lack of similar variability among Schild males is also noteworthy in and of itself, and warrants further exploration.

One obvious interpretation that would constitute a natural extension of the interpretation proposed for the female data would be that, for Schild men, the biosocial conditions of growth were more regular across different social groups when compared to Schild females. It may be that Mississippianization and its focus on maize agriculture brought with it opportunities for certain Schild women to advance their social position and improve the quality of life for themselves and their daughters. This is not to say that female children were necessarily treated better than their male counterparts, or that these the observed patterns were necessarily the result of conscious decisions. But this research indicates that certain female children were provided significantly better conditions of cumulative growth, that those differences seem to be correlated with membership in certain social subsets of the Schild community, and that the differentiation in growth conditions may have occurred during adolescence as opposed to early childhood (as there were not concomitant differences in neural canal diameters). It may be that very young female children who were not yet active contributors to their communities were all viewed equally, and on equal terms with their male siblings. As male children aged and spent more time with their fathers, female children would have remained with their mothers and aunts, who

would continue to teach them the social and technical skills necessary to manage village activities, including managing agriculture pursuits. As they came to be viewed as contributing adult women, certain among them may have been treated somewhat preferentially, perhaps due to their association with household, kin, or community networks who exercised particularly noteworthy managerial or productive prowess within the broader region. The conditions of growth among male children, either in early childhood or later adolescence, did not seem to vary based on group membership, and this may mean that Mississippian boys and young men at Schild were afforded similar biosocial conditions of growth in spite of status or kinship differentiation.

However, it must also be noted that, although cell sizes in ANOVAs were also small for females, the problem was somewhat exacerbated for males. In fact, many of the statistically significant patterns observed for females (variation in cumulative growth indicators by burial area, for example) were reflected in the male data, but not to a statistically significant extent. Furthermore, Schild Mississippian sample is skewed toward females and it is possible that a certain subset of the Mississippian community (presumably skewed toward males) was interred elsewhere (Cook 1984). These may have been individuals of higher or lower social status, or higher or lower ranking kin or community groups, but this cannot be said for certain unless the other group was to be located and analyzed. Goldstein (1980) points out that some of the variation in mortuary patterning at Schild seems to be related to sex, with many of the clusters (artifact only as well as artifact and positioning clusters) dominated by one sex or the other. This suggests that, although a segment of the male population seems to be missing from the Schild sample, at least some portion of male social differentiation is represented within this skeletal series and we should still be able to make some cursory conclusions regarding the lived

experiences of Schild men. Based on the analysis presented here, there seems to be less variation in the growth experiences of Schild males when considered in relation to females at the site, and this may be related to 1) the ability of women to exercise social mobility related to the role they play as producers (of maize) and reproducers (of humans), and/or 2) the biocultural results of Schild women actively acculturating and adapting to a new set of sociocultural circumstances with Mississippianization.

The multifactor two way ANOVAs, on the other hand, did reveal some significant interactions between space, artifact assemblages, and growth indicators for the male subsample. In particular, male lumbar AVBH varied significant depending on artifact cluster and knoll, while male femur length varied significantly based on artifact cluster and charnel association. As was mentioned above, these results indicate the complexity of mortuary phenomena and generally suggest that spatial and artifactual parameters considered together may indicate something about the social lives of Schild individuals that is related to biocultural patterns of growth. However, it is difficult to comment about what these patterns specifically mean regarding men and women at this site.

Regional Perspectives on Mississippianization, Health, Growth, and Social Identity

Broader regional comparisons are helpful for more completely understanding variability in the biocultural effects of Mississippianization on intracommunity social relations. The non-traditional methods used in this study preclude direct comparison to most of the comparative literature. However, the primary goal here is to contextualize the interpretations provided in this chapter within a regional framework of Mississippianization, health, and gender transformations. Studies from the American Bottom, Dickson Mounds, and Moundville are discussed.

Dickson Mounds

Much of the growth data provided in Dickson Mounds reports is based on juvenile skeletal remains, which cannot be reliably sexed. This means that some of this information cannot be directly compared to the current analysis. However, certain aspects of these reports are useful for contextualizing the findings of the current study within a regional framework. For example, Goodman (1980) reports that his analysis of tibial growth patterns in subadult skeletal remains indicates increasing childhood stress with Mississippianization, with the years between two and five being the most stressful. This likely coincides with "weaning stress" reported by Blakely and Armelagos (1985) and Goodman et al (1984), the effects of which are seen earlier and expressed more strongly during Mississippian times, when nutritionally poor maize gruel could be used as a transitional food for very young children.

It could be reasonably hypothesized that this decline in overall childhood health and growth conditions would similarly manifest itself in vertebral growth as a decrease in neural canal diameters. And, indeed, Clark's (1985) analysis *does* indicate a statistically significant decrease in APNCD in both males and females over the Late Woodland-Mississippian transition. This observation seems to lend further credence to the utility of APNCD as an indicator of early childhood growth. However, Clark (1985) also points out that TNCD decreased in females and increased in males over time. This fact, combined with the complicated statistical results regarding TNCD in this dissertation, indicate that the meaning of this vertebral parameter requires further exploration. Based on this, it would appear that the biocultural circumstances of early childhood growth in the Central Illinois River Valley seems to generally decline over the Late Woodland-Mississippian transition

Overall, Clark interprets and contextualizes his vertebral data as follows: Over the Late Woodland-Mississippian transition, both Mississippian males and Mississippian females experienced stunted early childhood growth compared to their Late Woodland counterparts, as evidenced by decreased APNCD (significant only in females). Later early childhood growth and adolescent growth (as evidenced through TNCD's and PVBH's respectively) improved significantly for males with Mississippianization. Clark suggests that all of this, taken together, likely reflects an increase in social status for Mississippian males, coinciding with the adolescent years.

Application of similar methodologies to Lower Illinois River Valley samples in this study, however, paints a different picture of gendered growth experiences than that observed in the Central Illinois River Valley. In the Schild and Yokem samples, male growth patterns remain statistically unchanged over the Late Woodland-Mississippian transition. For females, however, early childhood growth improves over the transition, as evidenced by APNCD's and, to a lesser extent, TNCD's. This may indicate better treatment of female children over time as agriculture becomes more important in this region, perhaps to the extent that female children were (consciously or unconsciously) provided preferential treatment. However, as indicated by lack of statistically significant change in vertebral body height and femur length data, this amelioration of growth conditions did not last throughout the entire growth period. Perhaps this means that female productive (i.e. agricultural) potential was emphasized and recognized in a particularly notable manner during early childhood and that, by adolescence, both males and females were seen as equal contributors to the community. However, the cumulative growth data from the Schild-only analysis forces us to recognize that not all Mississippian females interred at this site experienced this sustained, favorable cumulative growth conditions equally, as some had better

cumulative growth conditions based on certain intracommunity social parameters (see above discussion). Unfortunately, we cannot know the extent to which the Mississippian pattern at Schild is a departure from the Late Woodland situation (without further mortuary analysis) and, furthermore, similar mortuary-based analyses among the Dickson Mounds population are not available for direct comparison with this segment of the current study.

American Bottom

Rigorous bioarchaeological studies of American Bottom skeletal samples are sparse and tend to be limited by poor preservation and small sample sizes. Furthermore, much of this literature deals more with high status burials than it does with general, community level changes over the Late Woodland-Mississippian transition, which may inherently result from the lack of large Late Woodland mortuary sites in the region (Emerson et al 2003). This may be partially due to preservational factors, but Carter (2003) points out that poor preservation alone cannot account for the lack of Late Woodland interments in this region. Isolated interment and scattered human remains in village deposits is the most widely documented context for human remains in this area (McElrath et al 2000). Other reports have indicated that mortuary treatments at this time and place were highly variable and complex and that the nature of these practices may require unconventional methods in order to detect, let alone interpret, these processes.

Ambrose et al (2003) present a discussion of status and gender related dietary variation among the Mound 72 burials at Cahokia. Individuals afforded particularly ornate burial treatments are considered to be high status, while those in mass graves are considered to be of lower social status. They present isotopic evidence that the higher status individuals consumed significantly larger amounts of meat compared to the lower status individuals, yet consumed only

slightly more maize. However, low status females in Mound 72 (interred in a mass grave) consumed significantly more maize than any of the other burials. These presumably low status females also suffered from increased incidence of stress and poor health (Fowler et al 1999).

Based on this analysis, one might suggest that low status Mississippian women experienced significantly less favorable biocultural conditions than either their low status male counterparts or high status individuals of either sex, which is not congruent with the trends detected in the current analysis. However, the nature of the Mound 72 sample complicates interpretation. First, Mound 72 is likely part of a complex, theatrical mortuary ritual that does not represent "typical" Mississippian burial treatments (Porubcan 2000, Goldstein 2000, Brown 2003). Second, it is unclear whether the individuals interred in the mound, particularly the low status females, were from Cahokia or elsewhere in the Mississippian world, nor do we know whether they were slaves, captives, or members of some other non-representative social group (Ambrose et al 2003).

Although the status and gender differentials seen in the Mound 72 burial sample are intriguing and may provide clues to a normative, ideological basis for Mississippian intracommunity social/gender differentiation and concomitant biocultural circumstances of health, they contribute little to an elucidation of the lived experiences of the general Mississippian population. Non-elite Cahokian cemeteries have been excavated, but the remains are typically poorly preserved, presumably complicating biological analyses. Fingerhut, for example, is an early Mississippian cemetery at the Cahokia site (Klepinger 1978, 1993, Witty 1993). Bone preservation was poor, but it was clear that all age and sex groups are represented. The few graves goods recovered did not appear to be associated with any particular demographic. Males, females, and children were sometimes interred as bundle burials. This

indicates that secondary treatment was accessible to a segment of this community, likely based on status differentials more than age or sex alone. This is similar to mortuary phenomena seen at Schild, but the lack of detailed bioarchaeological reports preclude biocultural comparison. Although we are unable to link these social parameters to stress/health experiences, it does suggest that both males and females qualified for somewhat elaborate mortuary ritual within the general Cahokian population.

Milner (1982) provides what might be considered the most comprehensive account of Mississippian health in the American Bottom, but most of the data is presented in a way that does not facilitate comparison to the study presented here. His analysis of LEH among Kane Mound individuals is not explicitly presented or interpreted in regard to sex differentials. He does discuss sexual dimorphism to some extent, but not in a way that is comparable to how it was approached in the current study. Future research may focus on applying Milner's analytical methodologies to the Schild and Yokem femur data so that levels of sexual dimorphism can be directly compared.

Moundville and the Late Prehistoric Southeast

Powell (1991) provides status-based summary data on the Mississippian skeletal series from Moundville that is reasonably comparable to the results of the current study, as maximum femur length is among the parameters she explores. She divides the sample into groups based on cluster analyses by Peebles and Kus (1977) although the presumed highest status burials (from the mounds) were unavailable. The "higher status" clusters were collapsed into two categories, based primarily on cemetery type (cemetery near a mound or cemetery near a village), with those interred near mounds being considered of higher status. The third group, referred to as

"residual," consisted of those remains that had no grave goods, regardless of cemetery type. No assumption regarding relative rank was made for the residual group.

Powell's analysis of pathology, trauma, and dental wear yields no statistically significant differences between status groups. Of particular interest is her discussion of adult body size, for which she also determines that there were also no statistically significant differences (although she does point out that mean male body size, based on femur length and measures of robusticity, were slightly larger for the elite group, but not significantly so). She concludes that status differentiation at Moundville did not seem to translate into biosocial differentiation in health, diet, or growth experience, but cautions that exclusion of the highest status mound burials may have biased the results.

This provides an interesting comparative case for the research presented in this dissertation. Although she does not explicitly frame it as such, Powell's research design incorporates, *a priori*, a mechanism for detecting within-sex variation. This is one way of addressing the problem of essentialism when characterizing the experiences of men and women in the past. As argued in chapter one, bioarchaeological analyses that attempt to account for the ways that experiences vary within groups based on biological sex based on the inclusion of social institutions units of analysis like status (White 2005, Martin 2000, Cucina and Tiesler 2003, White 2005) and ethnicity (Schurr 1992) have greater potential for clearly assessing gender relations in the past. Although variable growth experiences attributable to social differentiation within each sex were not detected (as they were in the current study), this result does not preclude the possibility that social differentiation might be expressed in some way other than cemetery type. Furthermore, as Powell stresses, inclusion of high status mound burials could have affected the result. Although she does not contextualize her results within the gender

literature, it should be emphasized that this study was published in 1991, when gender archaeology was in its infancy and had not yet begun to have a measurable influence on bioarchaeological interpretation. Overall, Powell's analysis provides as solid example of a research design that incorporates multiple units of analysis and has the potential for beginning to approach the intricacies of gender in the past. Furthermore, when compared to the results of the current study, Powell's results indicate that females had less variable growth experiences at Moundville than they did at Schild, although the mortuary units of analysis are not necessarily directly comparable.

Mississippian Identity, Gender, and Health

Based on the their review of wall trench structures in the Lower Illinois River Valley, Farnsworth et al (1991) suggest that Late Woodland communities in this region adopted Mississippian mortuary ritual while maintaining a predominantly Late Woodland lifestyle. However, Goldstein (1980) contends that the Lower Illinois Valley was occupied by dispersed Mississippian farmsteads, as indicated by the presence of Mississippian pottery, mortuary ritual, and architectural styles. Furthermore, Delaney-Rivera's (2004) analysis of Schild ceramics indicate that Late Woodland communities in the Lower Illinois River Valley rapidly adopted a Mississippian lifestyle. Both Goldstein and Delaney-Rivera contend that the "Mississippianization" of the Lower Illinois River Valley was a case of full acculturation rather than selective emulation.

The research presented in this dissertation lends some level of further support to the Goldstein/Delaney-Rivera position. The mortuary patterning observed at Schild was clearly Mississippian in nature, but proponents of emulation-oriented hypotheses might be unconvinced

that this new mortuary program was reflective of true Mississippian-style social differentiation in the lived experiences of these people, or that these burial groupings meant much as far as intracommunity social relations are concerned. In the above discussions, I have asserted that, to some extent, variation in the biological conditions of growth among Schild females is correlated with social differentiation as indicated by mortuary patterning. Noteworthy are six key observations/arguments: 1) There is biological evidence for sex-based differences in growth experiences in Schild and Yokem communities with Mississippianization, 2) a particularly well-studied Mississippian burial program existed at Schild, 3) mortuary programs likely reflect ideas about social structure in living communities, as expressed through treatment of the dead, 4) discernable patterns in biocultural experiences of Schild females correlated significantly with these social categories 5) Mississippian women likely exercised new types of managerial and social power and roles as agriculturalists 6) The overall cultural picture at Schild is that the burial program reflects, to some extent, a social structure that had real effects on the lives of community members, and Mississippian social structure and gender relations were established in community life.

If Schild people were burying their dead according to a Mississippian mortuary program, and that mortuary program reflected social differentiation within communities in a way that becomes more apparent in analyses of health and stress, then it would seem difficult to contend that these people were essentially Late Woodland people with a superficially Mississippian burial program. Of course, bioarchaeological analyses alone cannot settle this question, and much more work needs to be done regarding habitation sites in the region. But it is suggested that that the current research contributes important, if limited, data for exploring the nature of Mississippianization in the Lower Illinois River Valley.

CHAPTER EIGHT- CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

The previous chapters present specific results and discussions of data analysis and contextualized interpretations. In this chapter, conclusions are presented succinctly and future research directions are proposed. The contributions of this research to investigations of the utility of the vertebral method for growth assessment will be stated, and interpretations summarized. This chapter concludes with future research questions that build upon the study presented here, and are predominately centered on two major themes 1) clarifying remaining uncertainties regarding the nature of human vertebral growth, and 2) expanding gendered perspectives on growth to new skeletal collections.

Summary

Utility of Vertebral Method

The literature regarding the utility of vertebral dimensions as indicators of growth conditions across the life span is limited (Clark 1985, 1988; Tatarek 1999, 2005), and the current analysis provides supplementary data interpreted within a unique context of cultural change and intracemetery variation. In the mortuary-based testing, significant results were limited to the lumbar segment. The explanation for this may be anatomical in nature, as the timing of growth cessation of certain subsets of the thoracic segment (i.e. upper thoracics versus lower thoracics) may skew thoracic segmental mean-based results. Cursory observation of the vertebra-by-vertebra analysis lends some support to this hypothesis, which should be further tested through

experimentally dividing the thoracic data into anatomically-based subsets and subsequently recreating the tests performed in the current analysis.

Clark (1985) suggests that TNCD may represent *later* early childhood growth while APNCD may be indicative of *early* early childhood growth. That significant results were obtained for APNCD and not TNCD in the current study is, therefore, not entirely surprising, and so it is possible that these two measures are capturing the growth conditions of somewhat different time periods. NCD was not correlated with femur length, suggesting that these measures are recording a kind of growth that is fundamentally different from one another. This fundamental difference is likely an issue of timing, with NCD representing only the early childhood period of growth, which is not inherently related to conditions of cumulative growth through adolescence and early adulthood. Diachronic change in the nature of sexual dimorphism in NCD in the study samples examined here indicate that some non-genetic, non-sex linked factor affects canal size, and it is suggested that this may be due to conditions in social or natural environments. However, the unclear relationship to the cumulative picture of early childhood growth provided by NCD and the episodic perturbations detected through LEH requires further exploration through application of this research design to new skeletal samples.

This research demonstrates a reasonably strong relationship between VBH and femur length. These measures were significantly correlated with one another, suggesting that they are both measuring a similar phenomenon. However, R-square values for the strength of the association were low, indicating that there might be some other factors determining differential cumulative growth between these elements. Furthermore, it is unclear why both AVBH and PVBH were both correlated with femur length, yet only AVBH yielded any significant results in

the mortuary-based analyses. Anatomical explanations regarding the effects of spinal curvatures were suggested, but this is a problem that requires further exploration.

The mortuary-based portion of this research also showed that femur length and VBH seem to be measuring similar, but not identical, growth phenomena. In the mortuary-based analyses, there were some instances where AVBH indicated growth differentiation between groups that was *not* detected by femur length. However, there were *no* cases where femur length was statistically significant without concomitant significant (or very near significant) difference in lumbar AVBH. This may suggest that vertebral body heights are somewhat more sensitive to growth disruption than femur length, but the specific biological and cultural meaning of this pattern cannot be known for certain without further research.

Overall, it is suggested that the vertebral method is a potentially sensitive indicator of both early childhood and cumulative growth conditions. Although the exact nature of the growth and how it related to social conditions requires further investigation, the results of this study suggest that it cannot be rejected as a useful tool for bioarchaeological analysis. The analysis and interpretations outlined in this dissertation show that vertebral measurements are a potentially useful tool for the assessment of stress and growth that can complement more traditionally employed methods, such as LEH and long bone length.

Growth Trends Over the Late Woodland- Mississippian Transition

When applied to a bioarchaeological analysis of the Late Woodland-Mississippian transition at Schild and Yokem, NCD data suggest that females experienced improvement in early childhood growth conditions, which is in keeping with traditional archaeological and ethnohistoric

interpretations of women's increasing social status as agriculturalists. Analysis found that female lumbar APNCD increased significantly with Mississippianization. Lumbar TNCD increased among females as well, and was very nearly significant. This supports the hypothesis that rowth conditions for young females improved over the Late Woodland-Mississippian transition, as women's roles as agricultural producers became more highly valued in an increasingly food-producing society. Although analyses of LEH frequencies did not reflect the same trend, it is suggested that this does not necessarily negate the vertebral results, as LEH and NCD may be measuring fundamentally different growth processes (i.e. episodic versus cumulative stress).

Male Mississippian children appear to have experienced fewer episodic growth disruptions during early childhood than did their Late Woodland counterparts, as suggested by a statistically significant decrease in LEH frequency. There were no significant changes in NCD over the transition for the male sample. The reason for the incongruent results of the LEH and NCD portions of the temporal analysis may be due to the disparate nature of the growth phenomena being recorded, as explained above for the opposite discrepancy in the female sample.

Gender and Growth Among Schild Mississippians

There was no statistically significant improvements in cumulative growth through early adulthood for either males or females in the temporal analysis, as indicated by either VBH or femur length. However, the intracemetery component of this analysis suggests that not all members of the Schild Mississippian community enjoyed this apparent stability in cumulative growth to the same extent. This portion of the analysis was designed specifically to engender the

analysis through an investigation of culturally meaningful, within sex variation in growth patterning. Gender categories are not unitary, stagnant phenomenon, and within the broad groupings of "men" and "women", there exists much potential for variable biosocial experiences based on the interaction of one's gender with other facets of social identity, such as status, kinship, age, ethnicity, etc. Clear mortuary groupings and clusters emerged in Goldstein's spatially and artifactually based analyses of the Schild Mississippian cemetery, and these groupings were likely reflective of significant social differentiation within the community represented by this skeletal series. Hypothesis five recognizes the potential for there to be variation in the biosocial conditions of growth for men and women based on these socially significant groupings, and the research design was created in a way that allowed for potential detection of this variation.

More detailed, gender-oriented analysis of the Mississippian component of the Schild Cemetery yielded within-sex variability in cumulative growth patterning correlated with social differentiation, as indicated by mortuary analysis. Vertebral body height data provides limited evidence for slight discrepancies in cumulative growth patterns in females depending on which artifact and positioning clusters they belonged to, and this may be related to their social status within the Schild community. Stronger evidence based on both vertebral body heights and femur length suggest that females interred in certain burial areas, and particularly those associated with charnel-focused activity, experienced better cumulative growth conditions than females in other, non charnel areas. Because the spatial patterning of these areas corresponds to sets of rows recognized in Goldstein's (1980) analysis, it is suggested that access to specialized burial treatment may have been related to membership in certain kin or community networks, or some similar manner of intracemetery differentiation. Women in some of these groups may have been

able to exercise more or less social power through their particular social circumstances, perhaps through managing productive and reproductive activities. As young women came of age and worked closely with their female kin, those who were members of particularly successful households or lineages would have benefitted from their success, perhaps becoming visible bioarchaeologically through improved growth.

Despite increasingly small sample sizes as tests became more complex, two-way ANOVAs simultaneously comparing osteological measurements with two categorical factors (one spatial, one artifactual) yielded five significant results, indicating that seemingly non-significant relationships between a biological dimension and any individual factor may be masking more complicated multifactoral interactions between artifact assemblages, space, and biology. It is suggested that these results indicate that that a *suite* of mortuary characteristics is may be as meaningful than any one parameter on its own.

Overall, the data suggest that women at Schild experienced variable cumulative growth conditions based not only on their biological sex, but on their membership in certain status or kinship, or community groups, represented archaeologically through artifactually and spatially based mortuary differentiation. Some Mississippian women enjoyed better overall growth conditions related to their membership in certain status, kin, or community groups. An alternate interpretation, based on the proposition that burial area four (where females experienced the least favorable conditions of growth as evidenced through VBH and femur length) is that the biosocial experiences of Mississippian women changed over time, improving as Mississippianization of the region progressed and women became more adept at agricultural practices. Preliminary multifactoral analysis indicate that both spatial and artifactual/positional categories were important components of the Mississippian burial program and reflect meaningful sociocultural

divisions, as (at least to some extent) the interactions of these traits are significantly associated with the life experiences of the interred individuals (as indicated by growth patterns). Hypothesis five is therefore accepted. More research is needed in order to more specifically interpret the significant results presented in this study, as well as to fine tune the units of analysis and statistical tests used in order to detect hidden trends in the biocultural data.

Future Research Directions

The research presented in this dissertation generated several new research directions, which will be further explored using the data collected for this project, as well as new growth data from skeletal collections in West Central Illinois and beyond. The collection of new data on vertebral dimensions and other growth indicators will provide more data for the further exploration of vertebral growth and its relationship to stress and growth disruption. More specific descriptions of potential research projects are described below.

Further Methodological Research

NCD as Maternal Health- Ursu et al (1996) show that in the lumbar region of the spinal column, transverse neural arch diameter in L1 through L4 reach 70% of adult size by the time of birth. The intrauterine environment is generally thought of as offering a high level of protection to the unborn fetus, buffering it from physiological stresses in all but the most extreme cases of maternal illness or malnutrition (Cook and Buikstra 1979). In a study of juvenile skeletal remains from Middle and Late Woodland Illinois contexts, Cook and Buikstra (1979) show that the age at

death distributions of juveniles with a prenatal enamel defect was significantly different than the age at death distribution of juveniles without prenatal defects. The nature of differential survival shows that those individuals who suffered the effects of physiological stress prior to birth were at increased risk of dying earlier than those who did not experience prenatal stress.

Future research will investigate neural canal diameters in subadult remains in a similar manner. The relationship between age at death and neural canal diameter can be tested using linear regression, and it is hypothesized that there will be a positive correlation between age at death and NCD. Subadult remains can typically be aged with relatively high accuracy, which will contribute a certain level of detail to this analysis. Because adult remains cannot be aged as precisely, broader categories such as *young*, *middle-aged*, and *old* adults are sometimes used. While this does not completely preclude a similar analysis among adults (i.e. one that tests for a relationship between neural canal diameter and age at death), it may require statistical analysis like ANOVA rather than linear regression, as age would be treated as a categorical variable in this instance.

Another approach may be to measure the NCDs of subadults and compare those measurements to those individuals who survived into adulthood (i.e. those measured for this study). Because juvenile skeletal remains cannot be sexed, a sex balanced sample of the adult remains would likely provide the soundest comparisons, assuming that the childhood mortality sample is not skewed toward one sex or the other (which is difficult to assess). In this scenario, one would expect NCD in the subadult sample to be smaller than the adult sample if NCD is indeed a good measure of early childhood growth disruption.

Similar analyses have been done using adult remains, and the results have been mixed. Clark et al (1985) found a statistically significant relationship between spinal stenosis and earlier age at death using the Dickson Mounds series, but Tatarek (1999) found no such relationship using the Hammond Todd collection. The nature of this discrepancy is presently unclear, but may be due to disparate nature of the two collections. In any case, such an investigation using the Schild and Yokem data can contribute to this research area. Furthermore, and aside from paleodemographic concerns, detailed statistical investigation of the relative proportion of early versus later childhood death, prenatal enamel defects, and neural canal diameters may provide a picture of change or stability in maternal health over the Late Woodland-Mississippian transition.

Focus on L5 APNCD- Ursu et al (1996) point out that, at the time of birth, the fifth lumbar vertebral canal has approximately 50% of its adult size, while the other lumbar vertebral canals are already 70% complete. This means that the fifth lumbar has an extended opportunity to be affected by environmental factors compared to the other lumbar vertebrae, as more L5 growth occurs postnatally, when there is no protection by the intrauterine environment. Furthermore, APNCD is perhaps focusing in more specifically on the *early* early childhood period (Clark 1985) and is the only vertebral measure consistently and significantly correlated with actual canal size (Gepstein et al 1991), perhaps making it a better choice for investigating early childhood neural canal growth when compared to TNCD.

Several results from the current study seem to reflect this phenomenon. Cronbach's Alpha testing indicated that, for most vertebral dimensions, internal reliability was improved when L5 was removed from analysis, suggesting that L5 dimensions were more variable and less predictable than the same dimension in the other lumbar vertebrae. This was particularly true for

APNCD. Additionally, the only significant result for APNCD in the mean-based analysis was between Late Woodland and Mississippian females, with Mississippian females being significantly larger. Individual vertebral analysis indicated that most of this difference came from the L5 APNCD, which makes sense considering Ursu et al's (1996) observation. Similar research on new skeletal collections will isolate and focus on L5 in order to determine whether it is a better indicator of early childhood growth disruption on its own rather than measuring all five lumbars and combining them into a means based analysis. Not only may L5 be a more sensitive indicator than a lumbar means-based analysis, but it is also far less time consuming to measure APNCD in one vertebra rather than five or more.

Subdivision of Vertebral Segments- The vertebral column is traditionally conceptualized as having three distinct segments, which are based on real functional and morphological differences. However, visual observation of variation in the size and shape of vertebral bodies and neural canals reveals that the change is gradual as one moves up or down the column, even over the transition from one segment to the next. In this way, the division of the current study sample in to thoracic and lumbar segments is somewhat arbitrary. This, coupled with patterns in the individual, vertebra by vertebra analysis indicate that further division of the vertebral column, and the thoracic segment in particular, might provide for a more valuable method of investigating vertebral growth and assessing growth disruption, or that careful scrutinization of individual vertebral results may serve to fine tune or otherwise inform the results of the segmental mean based analysis.

For example, analysis revealed that APNCD was significantly different between Late Woodland and Mississippian females, and in the segmental mean based analysis, this result was only significant in the lumbar. Table 24 shows that APNCD was significant in the first and second thoracic vertebrae, which may be related to the timing of NCD growth cessation in this particular reason. Perhaps more informative, though, are the significant APNCD results for the 11^{th} and 12^{th} thoracic vertebrae. If we consider the entire sequence of significant APNCD results throughout the lower vertebral column, regardless of segment, nearly the entire lower third of the vertebral column (except L3) yielded significant results in APNCD. Similar cases are provided when other patterns of significant results are observed, such as with male AVBH by burial area in table 68 and female APNCD by artifact only cluster in 72. This may indicate that either 1) further subdivision, based on growth timing rather than morphological/functional segment) may be a better means of investigating growth disruption, or 2) the overall pattern of significant, vertebra-by-vertebra results should be more intensively investigated and interpreted in studies such as that presented here. The latter suggestion seems difficult to accomplish objectively without further investigation via the former suggestion. In any case, more research regarding patterning in the vertebra-by-vertebra analysis is necessary.

Future Applied Research Directions

Two-way ANOVA for Sexual Dimorphism- One of the more interesting details to emerge from the current study was that the nature of sexual dimorphism in NCD is poorly understood. Tatarek (1999) notes that cervical NCD seems to be closely correlated with ancestry and sex. The explanation for the former is likely genetic, as genetically similar individuals are more likely to

be phenotypically similar, while those individuals who are less genetically similar may be more phenotypically different from one another. This line of reasoning is essentially, one of the explanations that was provided in the previous chapter when discussing the issue of scale of differentiation between the current study and the original study by Clark (1985, 1988). In the current analysis, there was a change in the level of sexual dimorphism in NCD over time. Specifically, there was no sexual dimorphism in APNCD during the Late Woodland, but sexual dimorphism was evident by Mississippian times, with female APNCD being larger. The case was somewhat different for TNCD, with males being significantly larger during Late Woodland times and being statistically equal to females by the Mississippian. It was argued that this variability by sex offers support to the contention that NCD is fixed in early childhood, long before sexual dimorphism develops in other skeletal elements during adolescence. If one takes this argument a step further, it is suggested that if there is no genetic predisposition for sexual dimorphism in this characteristic, environmental or sociocultural explanations for observed differences is necessary. This is, of course, a basic premise of the Clark method and, as such, was tested on the Schild and Yokem collections.

In addition to the basic exploration included as part of this study, the bioarchaeological literature provides other means of further exploring the meaning of sexual dimorphism, specifically ones that address temporal changes in the degree of sexual dimorphism in populations. For example, Lallo (1973) used two-way ANOVA to assess changes in sexual dimorphism between the Late Woodland and Mississippian series at Dickson Mounds. *Sex* and *culture* are used as factors, while continuous measurements of pelvic and femoral dimensions were used as the continuous variable. A significant interaction would indicate that there was a change in the amount of sexual dimorphism over time.

Lallo did not detect any changes in the amount of sexual dimorphism in femur or pelvic measures over the Late Woodland/Mississippian transition. The current study did not test for sexual dimorphism in this way, but future reanalysis will involve analyzing femur lengths as well as all vertebral measures following Lallo's methods, hence quantifying change in the amount of sexual dimorphism over time and making them more directly comparable to Lallo's Dickson Mounds data.

American Slave Samples- As discussed in chapter three, Steckel's (1987) analysis of African slave height records documents the extraordinary ability of adolescent catch up growth to virtually obliterate evidence of significant early childhood growth disruption related to disease load, poor nutrition, and poor prenatal health. The skeletal remains of the individuals used in Steckel's analysis are, of course, not available for analysis. If they were, they would provide an excellent additional test of the vertebral method. Application of the vertebral method of growth assessment of other collections of slaves, from American contexts or otherwise, might provide a useful comparative assessment of the biosocial growth experiences of enslaved peoples.

Moundville- Powell's (1991) provides an interesting intracommunity assessment of growth patterns by sex at using skeletal remains from the Moundville site in Alabama (see chapter seven for discussion). She found no significant differences between status groups (as determine by cluster analysis) for either males or females. Assessment of NCD for these individuals, and according to the same social groupings, would complement this analysis by adding a dimension of early childhood growth that complements that already investigated by Powell using LEH.

Late Woodland Mortuary Analysis- The bulk of the engendered bioarchaeological analysis in the study presented here was limited to the Mississippian component of the Schild site, as formal,

multifactor mortuary units of analysis were available. Such detail is rare in mortuary archaeology, and much of what is available for Late Woodland mortuary sites (as well as other Mississippian sites) is largely descriptive in nature. Although sample size is always a primary concern, formal mortuary analyses of more sites would allow for detailed biocultural analyses of intracommunity social differentiation. A pending dissertation by King evaluates ideology, biological relatedness, and mortuary treatment at a number of Late Woodland mortuary sites in West Central Illinois, and it is anticipated that such analyses will provide useful social units for further biocultural analyses, including gender oriented ones such as that presented in this dissertation.

Ceramic Hybridity, Growth Trends, and Gender at Schild: The gendered interpretation of the Schild female data presented in this dissertation relied heavily on Delaney-Rivera's (2004, 2007) analysis of ceramic trends at Schild. Future bioarchaeological research will focus on more explicitly and completely integrating Delaney Rivera's ceramic trend data as a critical variable, focusing on the relationship between growth trends over time and Mississippianization vis á vis the transition from Late Woodland, to hybrid, to Mississippian ceramic forms.

APPENDIX

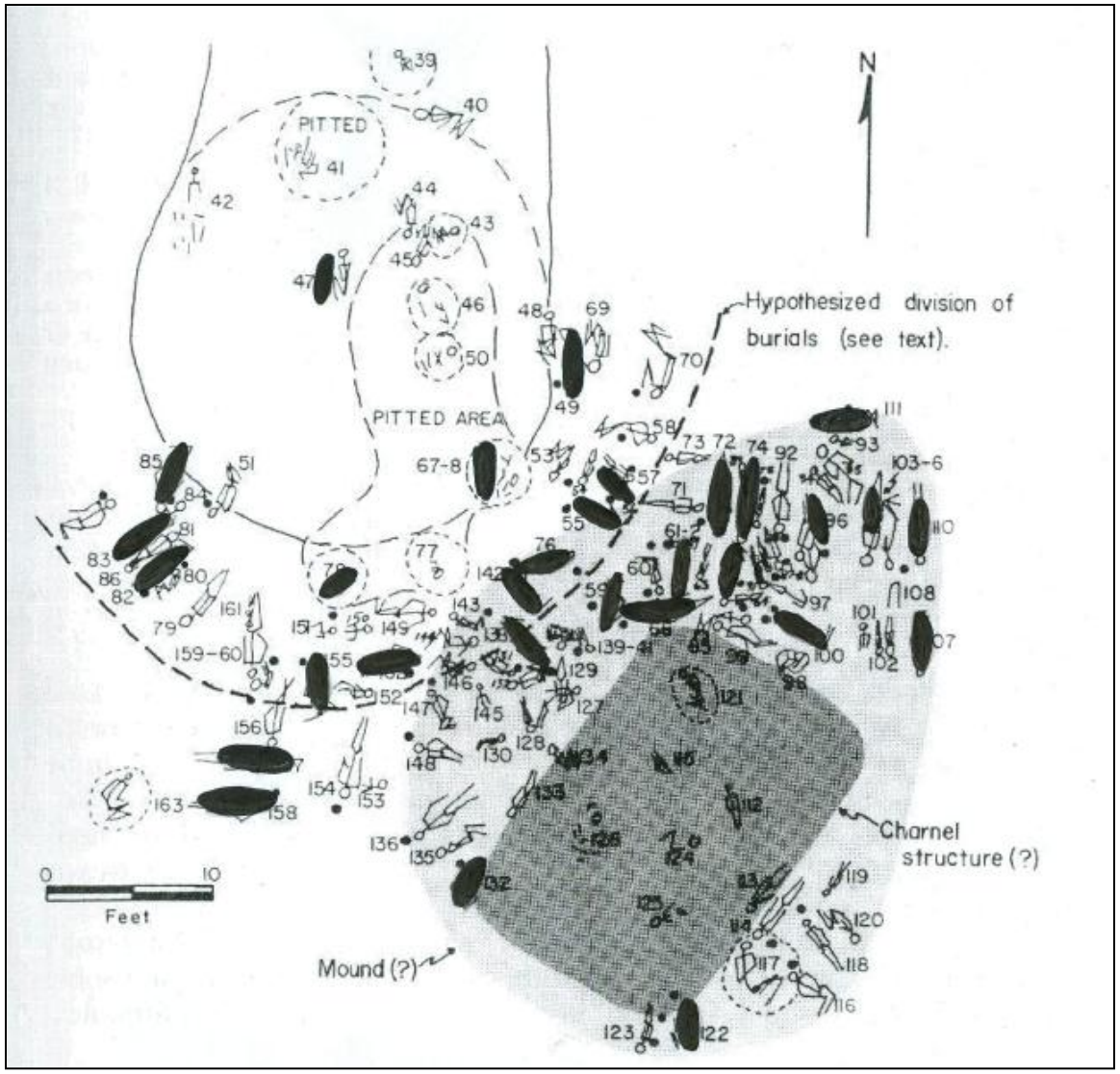

Figure 16- Spatial distribution of Schild Knoll A females used in the current study (adapted from Goldstein 1980)

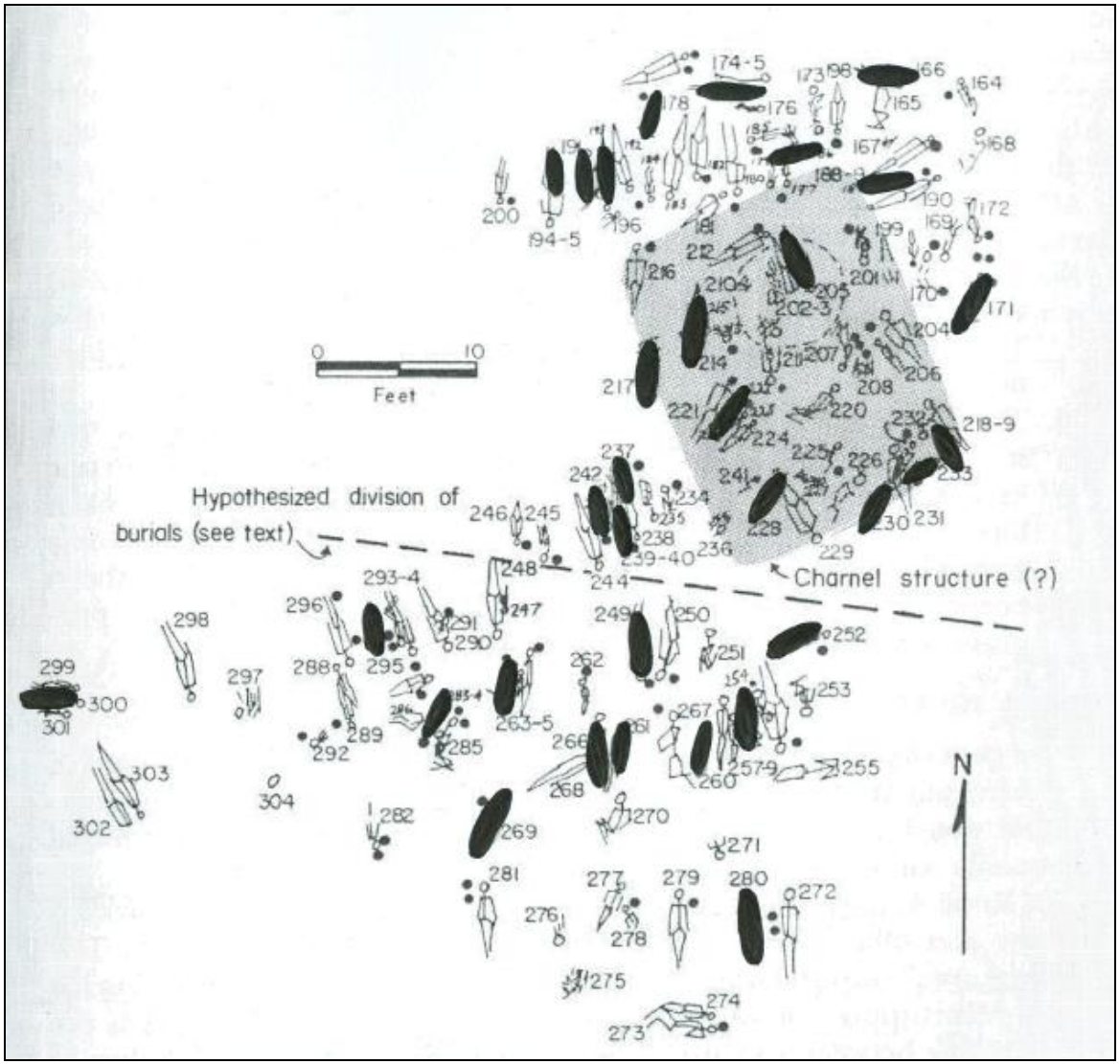

Figure 17- Spatial distribution of Schild Knoll B females used in the current study (adapted from Goldstein 1980)

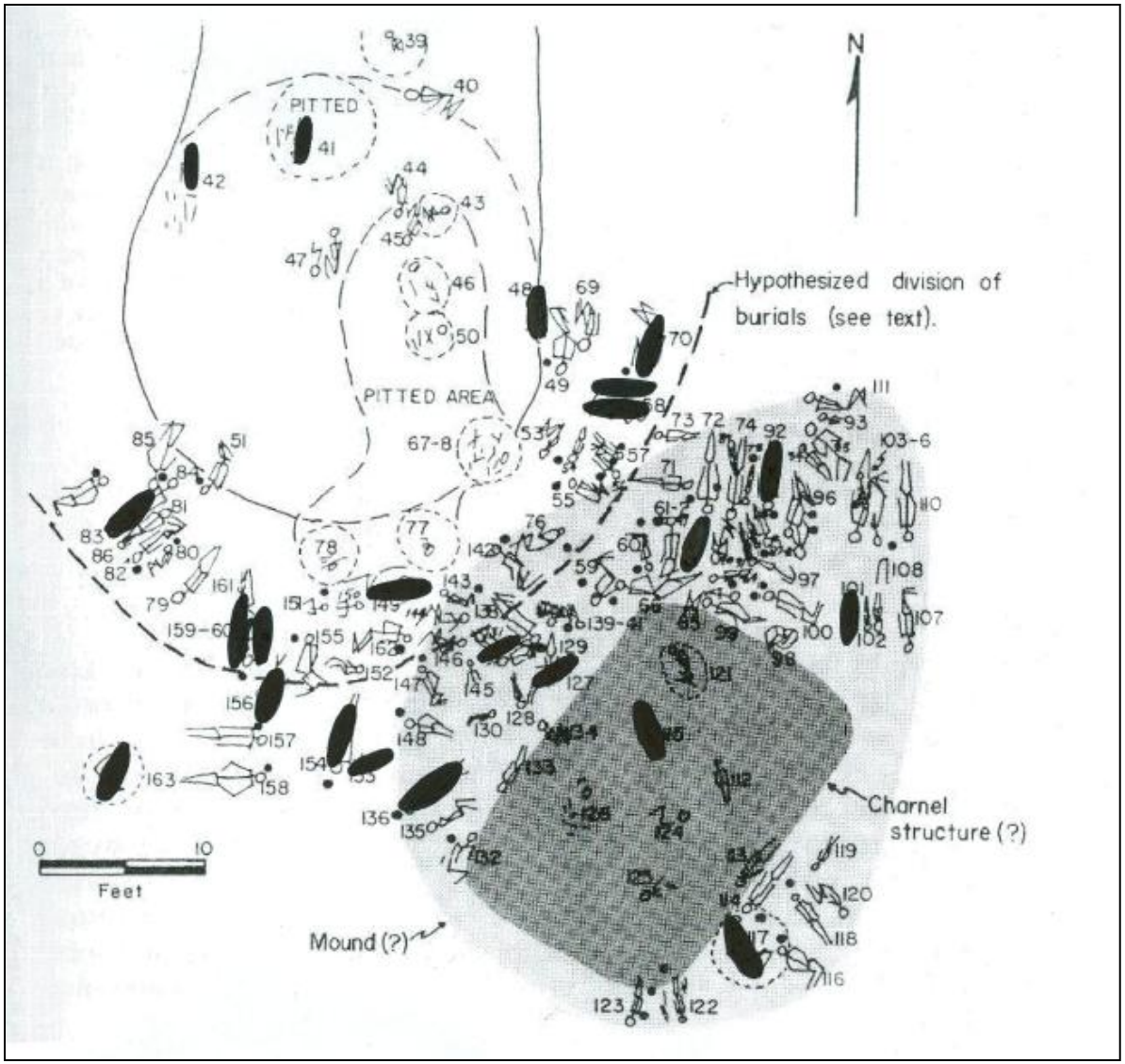

Figure 18- Spatial distribution of Schild Knoll A males used in the current study (adapted from Goldstein 1980)

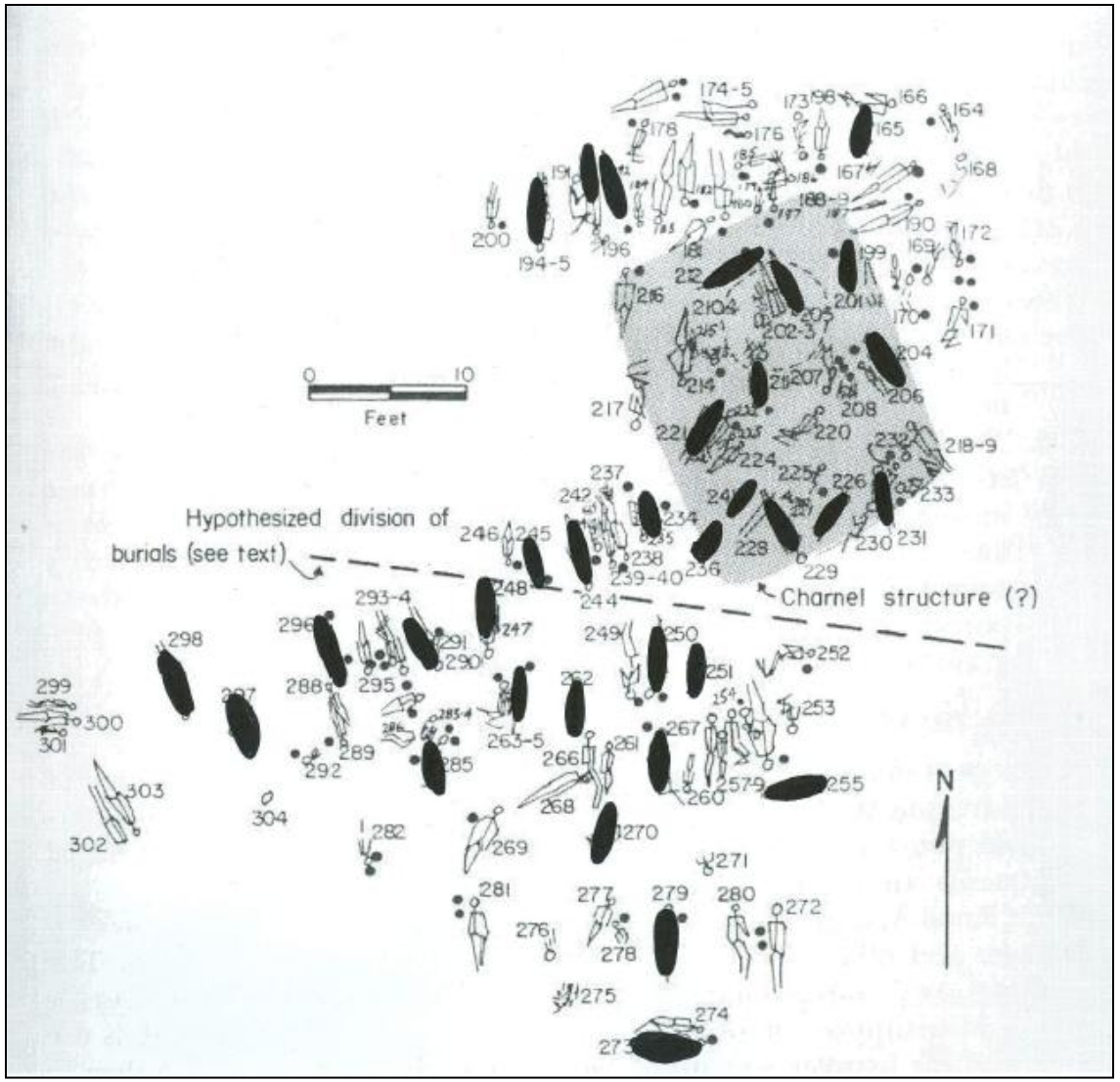

Figure 19- Spatial distribution of Schild Knoll B males used in the current study (adapted from Goldstein 1980)

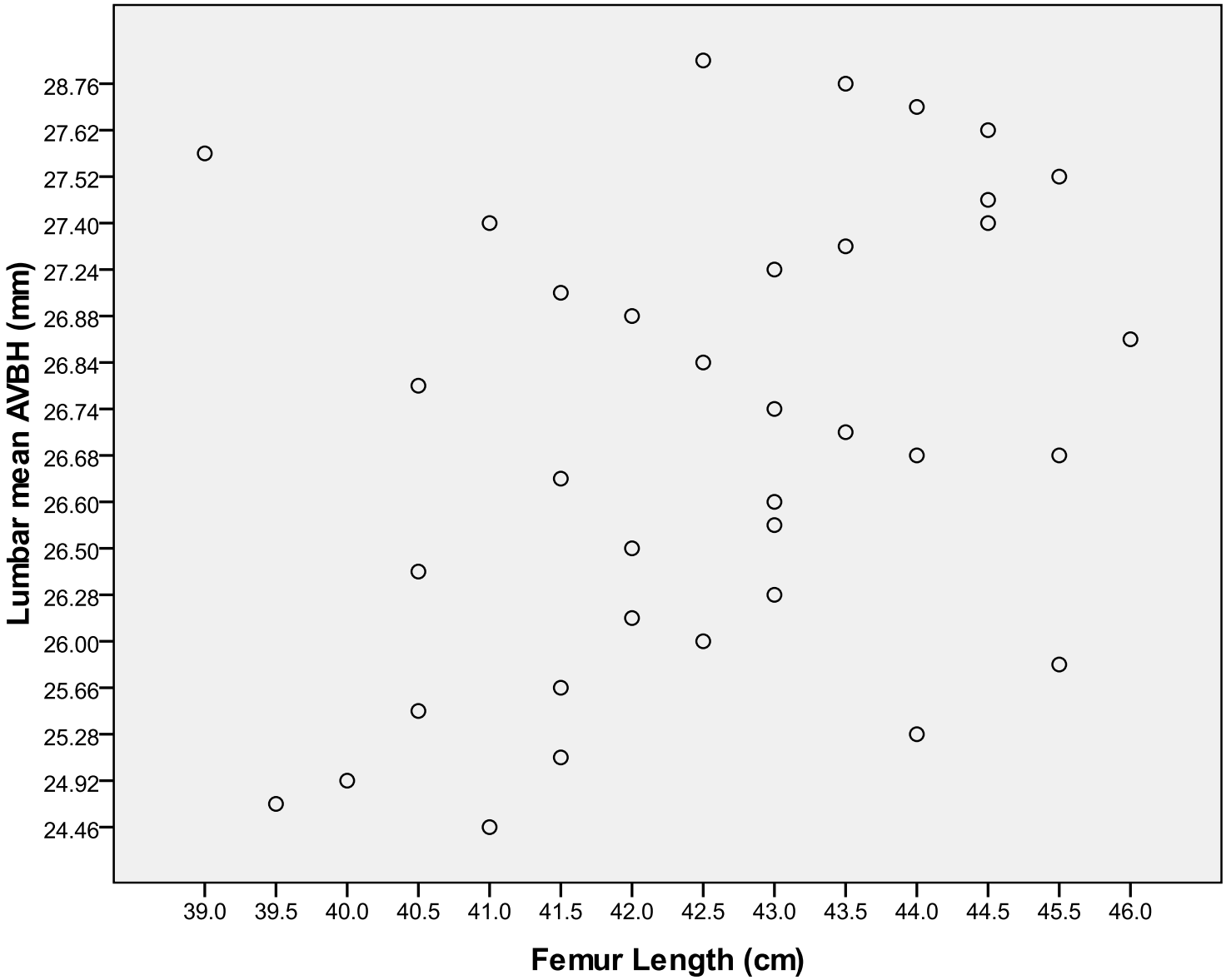

Figure 20- SPSS scatterplot of Schild female lumbar AVBH and femur length

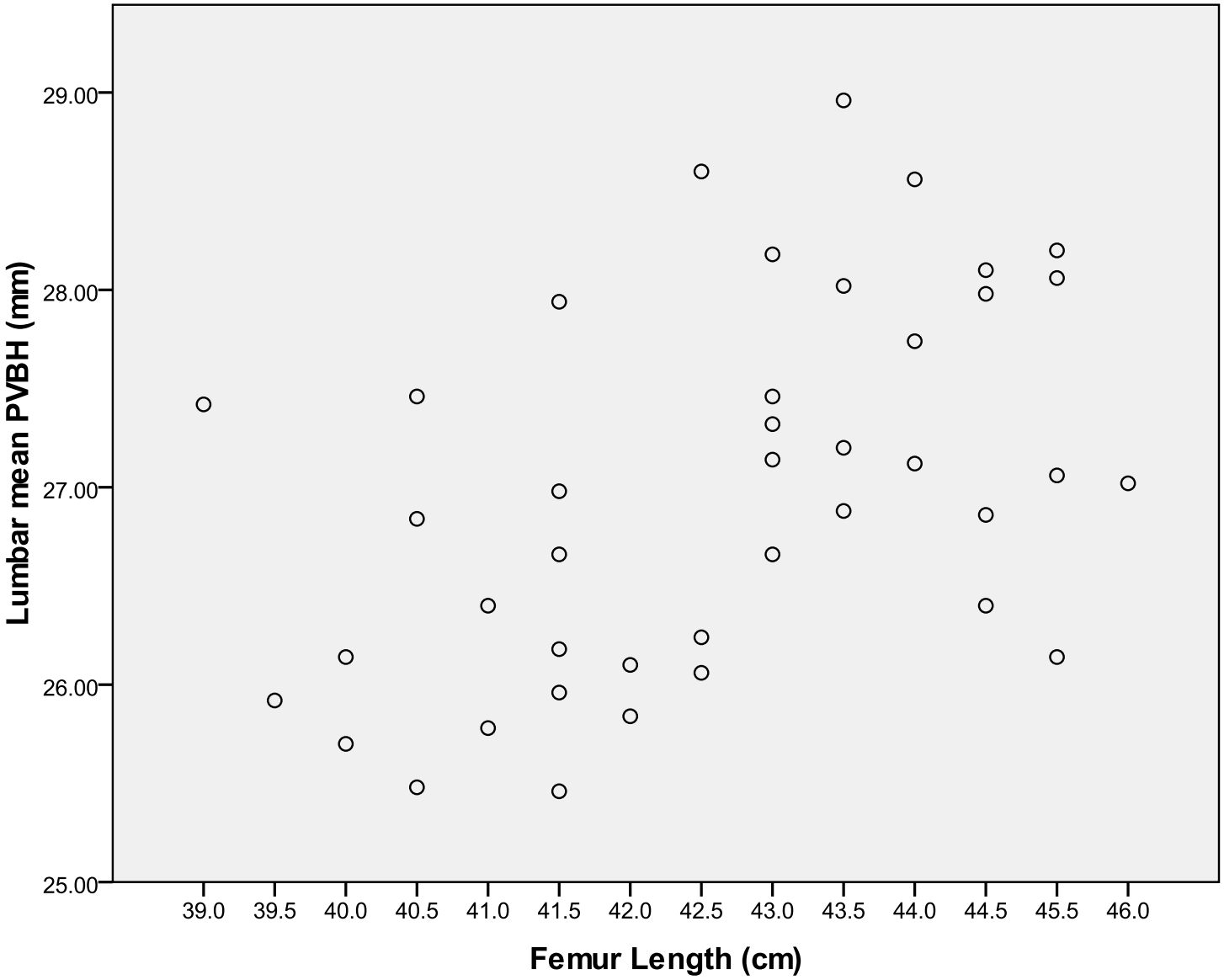

Figure 21- SPSS scatterplot of Schild female lumbar PVBH and femur length

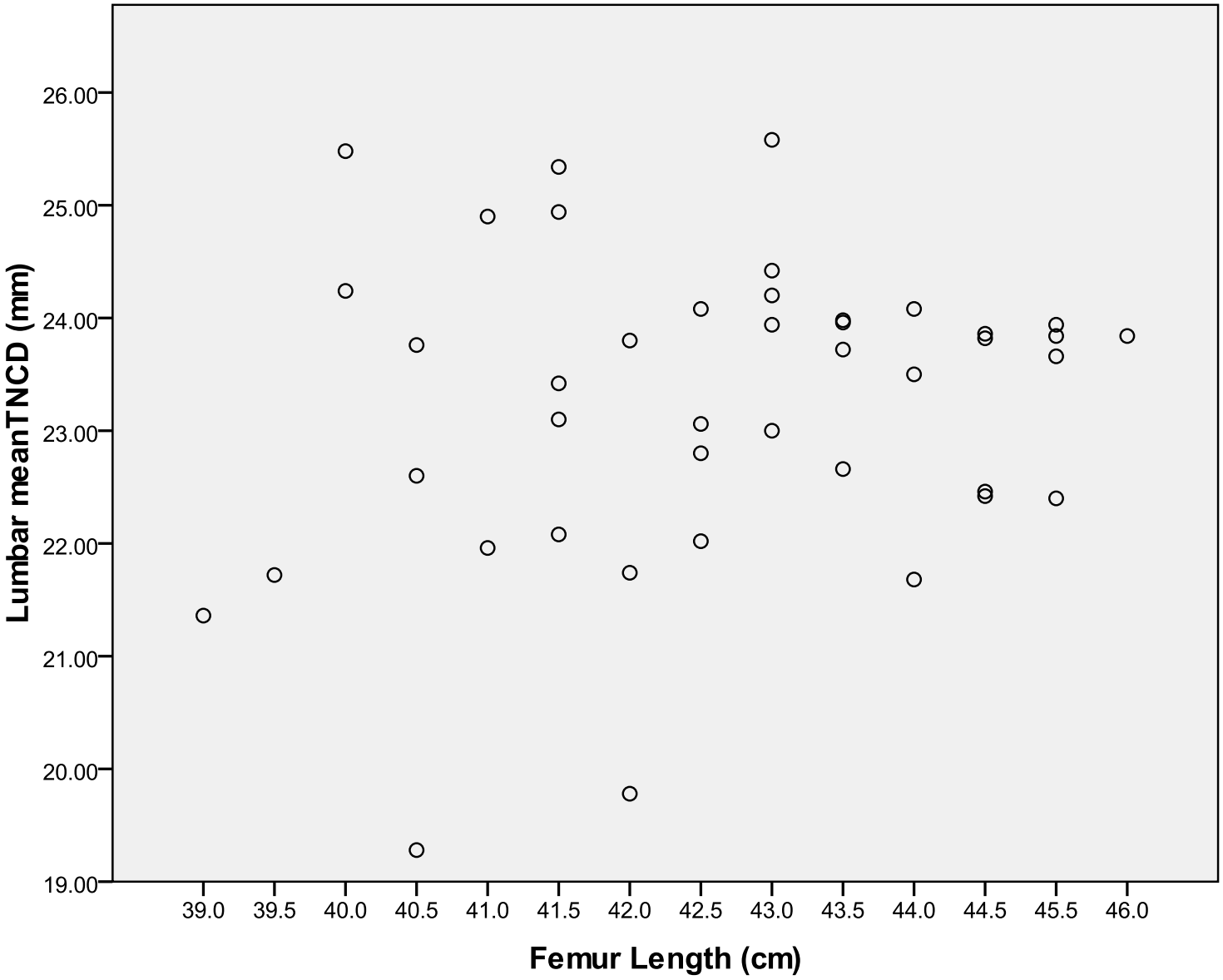

Figure 22- SPSS scatterplot of Schild female lumbar TNCD and femur length

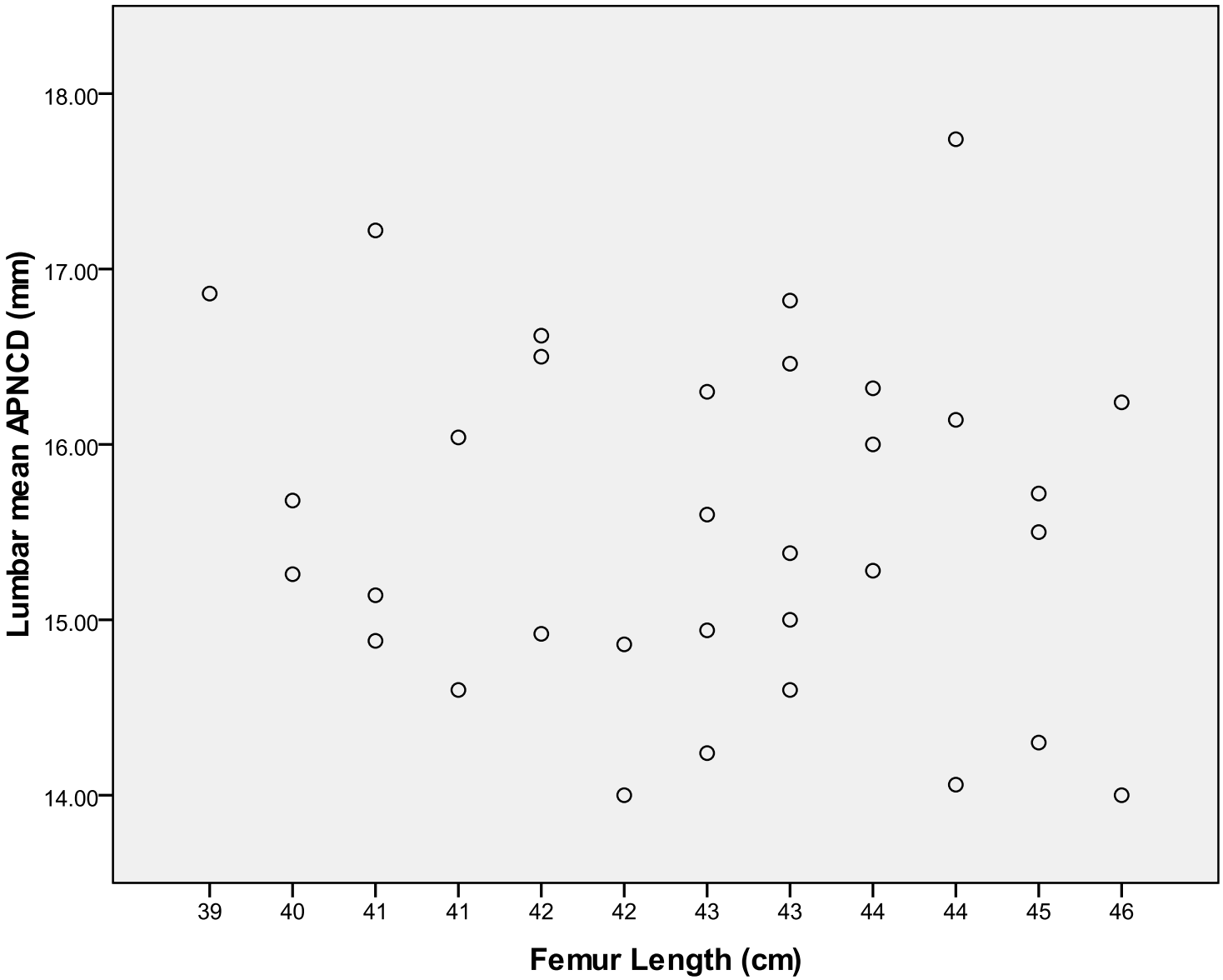

Figure 23- SPSS scatterplot of Schild female lumbar APNCD and femur length

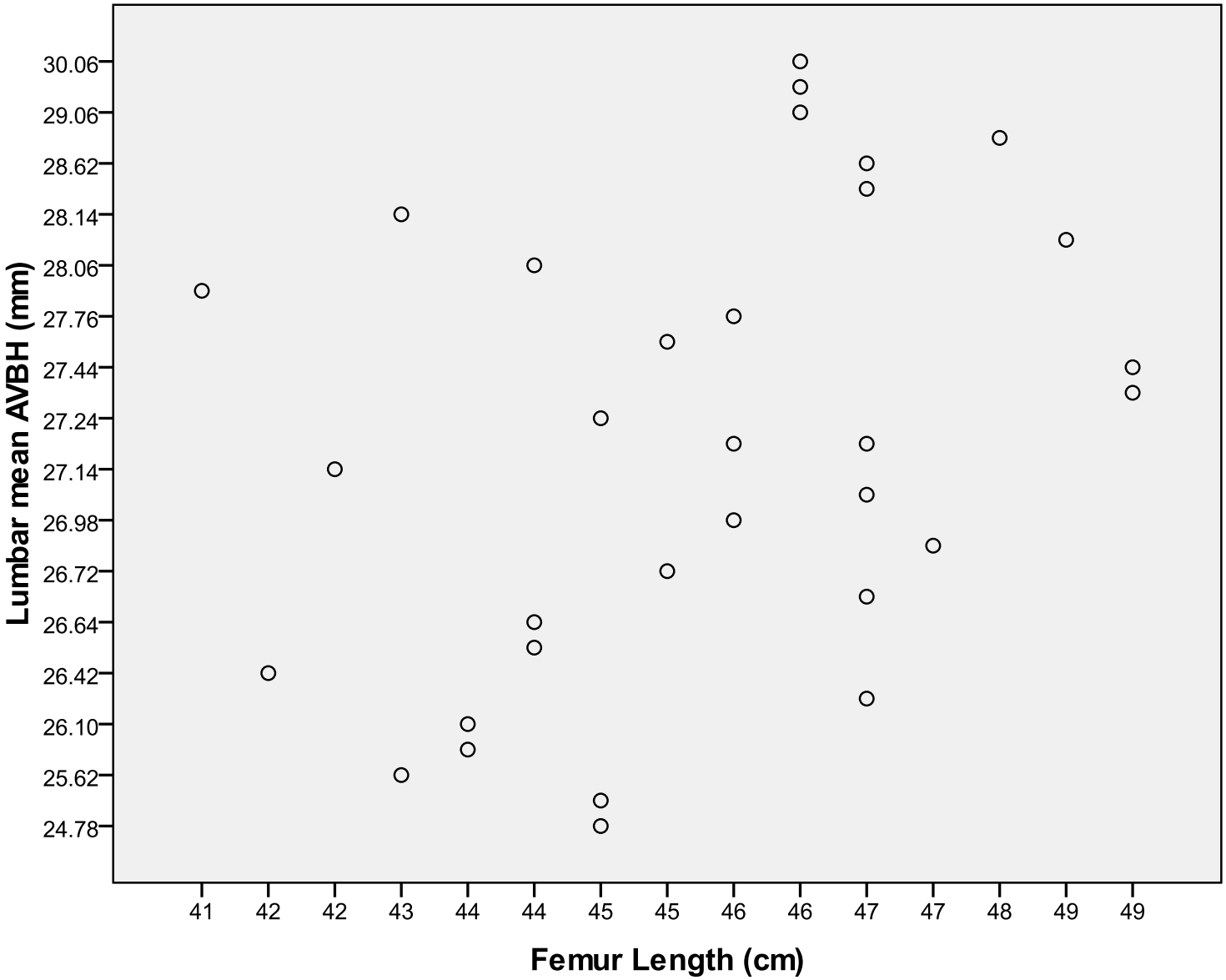

Figure 24- SPSS scatterplot of Schild male lumbar AVBH and femur length

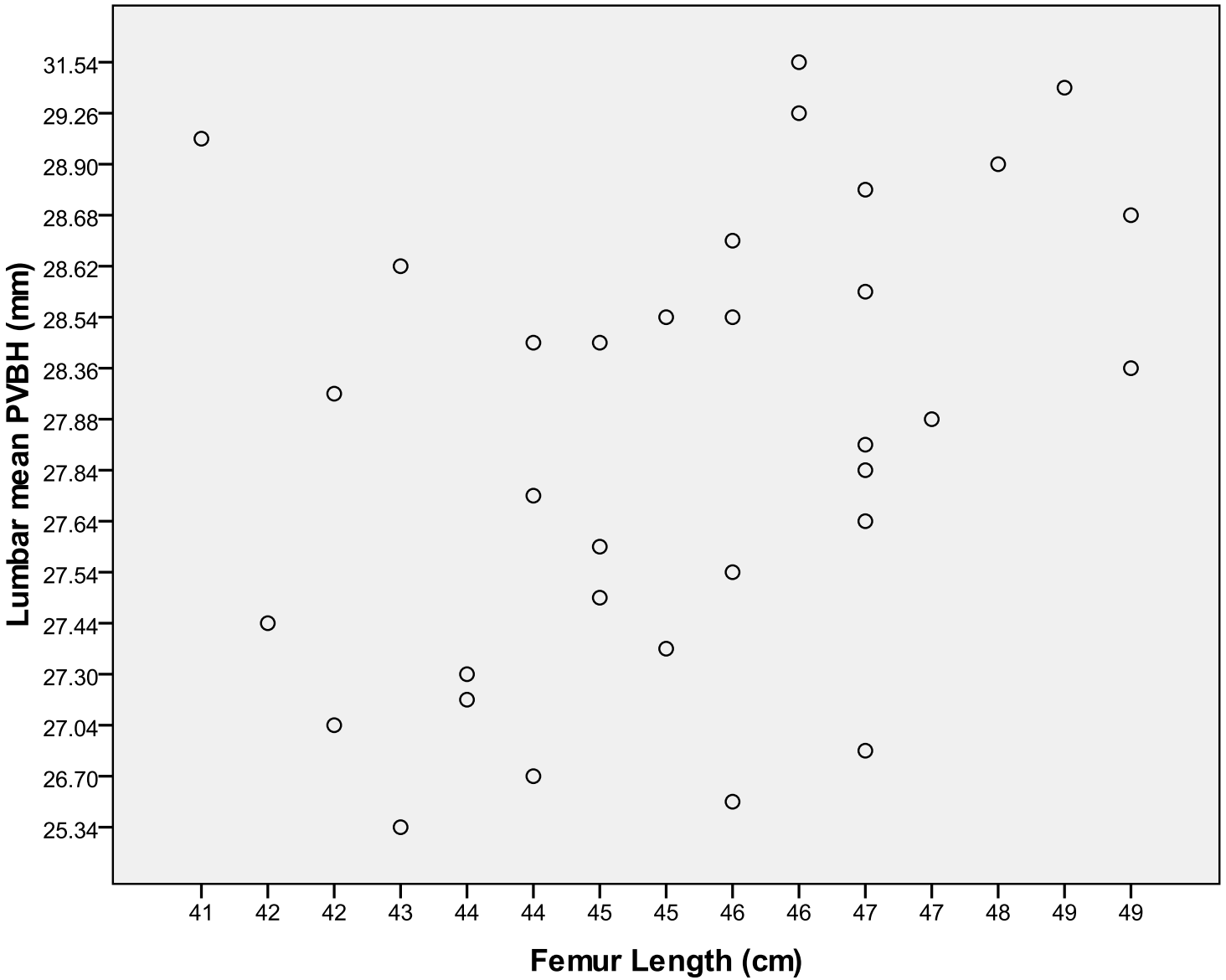

Figure 25- SPSS scatterplots of Schild male lumbar PVBH and femur length

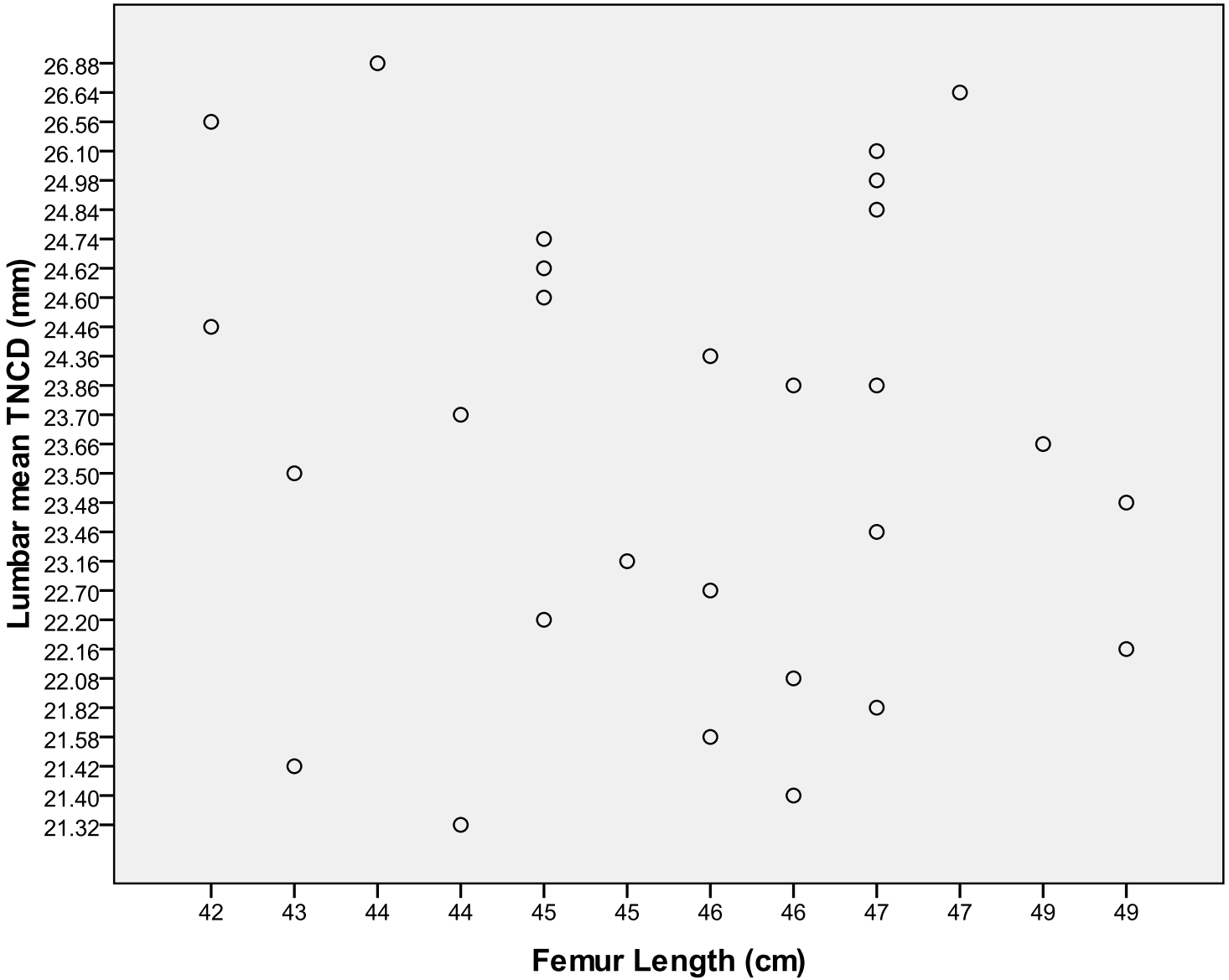

Figure 26- SPSS scatterplot of Schild male lumbar TNCD and femur length

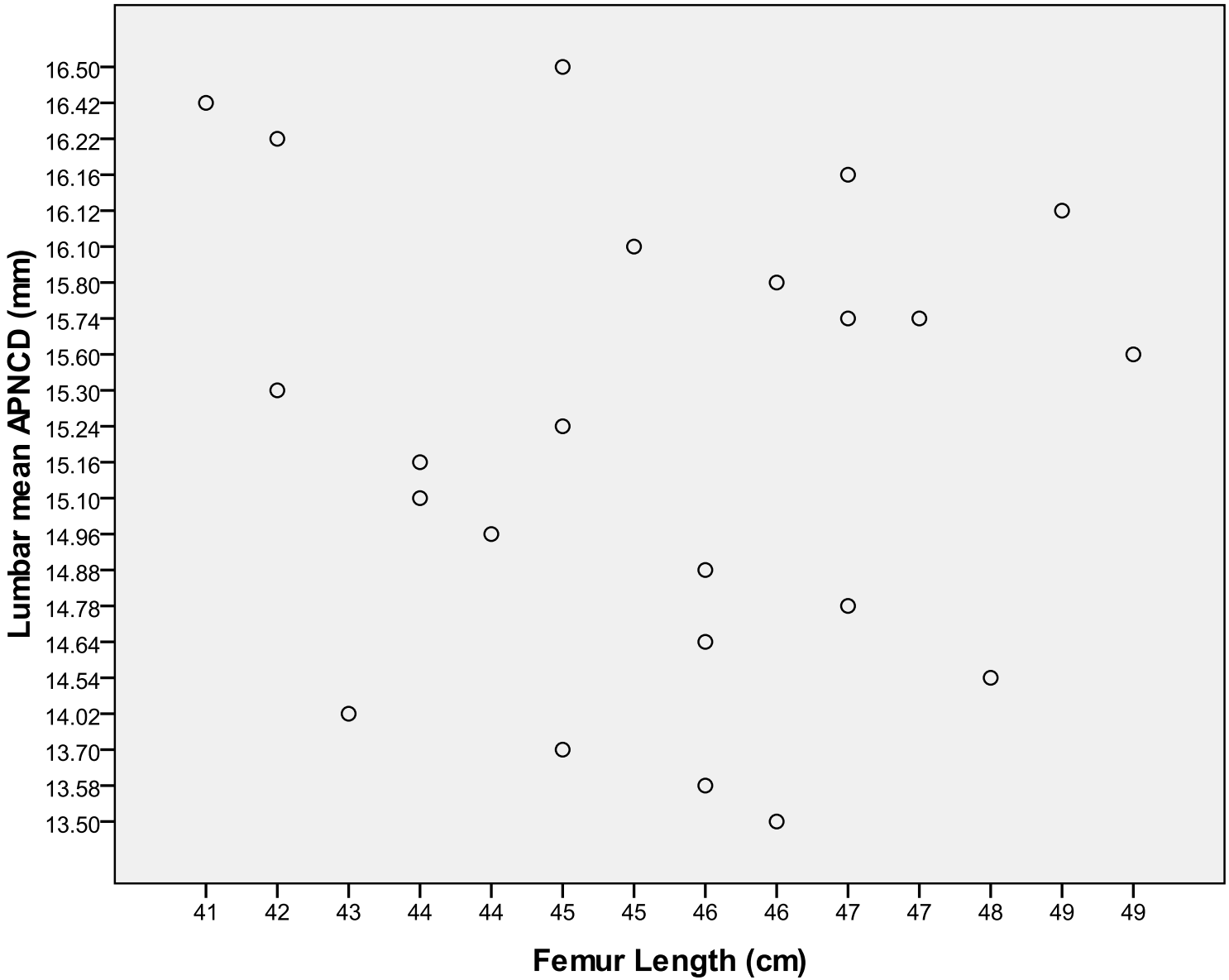

Figure 27- SPSS scatterplot of Schild male lumbar APNCD and femur length

Vertebral Dimension	Burial Area	N	Mean	SD
T1 AVBH	1	16	17.11	0.71
	2	12	16.31	1.01
	3	11	17.52	0.71
	4	10	16.83	0.98
T2 PVBH	1	17	20.71	1.01
	2	12	20.34	0.75
	3	12	21.43	0.78
	4	10	20.44	1.04
T3 AVBH	1	16	18.48	1.19
	2	11	17.58	0.90
	3	11	18.81	1.00
	4	10	17.94	1.23
T5 AVBH	1	15	19.19	0.90
	2	12	18.70	0.67
	3	10	19.97	1.09
	4	6	18.65	1.55
T6 AVBH	1	15	20.14	0.94
	2	12	19.23	0.98
	3	10	10.76	0.83
	4	7	19.24	1.65
T8 AVBH	1	15	21.53	0.94
	2	13	21.05	0.96
	3	10	22.25	1.35
	4	9	20.70	1.18
T8 APNCD	1	14	15.08	0.86
	2	12	16.13	0.87
	3	9	15.42	0.85
	4	9	15.12	1.00
T9 APNCD	1	15	14.83	1.00
	2	12	15.86	0.83
	3	10	15.66	1.19
	4	9	14.83	1.03
T10 APNCD	1	16	15.14	0.98
	2	10	16.10	0.78
	3	11	15.76	0.85
	4	9	15.16	0.71
L3 APNCD	1	16	14.00	1.24
	2	15	15.03	1.22
	3	14	14.02	1.23
	4	9	13.67	1.31

Table 73- Descriptive statistics for significant Schild male individual vertebral dimensions by burial area

Vertebral Dimension	Burial Area	N	Mean	SD
L4 TNCD	1	15	23.55	1.67
	2	13	24.41	2.26
	3	14	23.11	2.25
	4	10	23.14	1.51

Table 73 (cont'd)

Vertebral Dimension	Burial area	N	Mean	SD
L1 AVBH	1	11	25.07	1.28
	2	16	25.16	0.77
	3	16	25.77	1.24
	4	12	24.20	1.22
L2 AVBH	1	13	25.32	1.33
	2	14	26.15	1.18
	3	15	26.81	1.61
	4	10	25.24	1.07
L4 AVBH	1	12	27.28	1.57
	2	17	26.79	1.31
	3	16	280.2	1.65
	4	11	26.55	1.56

Table 74- Descriptive statistics for significant Schild female individual vertebral dimensions by burial area

Vertebral Dimension	Burial area	N	Mean	SD
AVBH	1	12	27.36	1.07
	2	90	27.07	1.00
	3	6	27.84	1.29
	4	10	26.80	1.44
PVBH	1	14	28.25	0.98
	2	12	27.90	1.14
	3	7	28.98	1.50
	4	9	27.67	1.00
TNCD	1	8	23.82	1.29
	2	10	24.01	2.10
	3	6	23.37	1.09
	4	11	23.42	1.19
APNCD	1	12	15.32	0.79
	2	7	15.47	0.70
	3	4	15.62	0.45
	4	8	14.97	1.14

Table 75- Descriptive statistics for Schild male mean lumbar vertebral dimensions by burial area

Vertebral Dimension	Burial area	N	Mean	SD
AVBH	1	8	26.72	0.75
	2	12	26.55	0.90
	3	11	27.17	1.21
	4	9	25.75	1.06
PVBH	1	9	26.97	0.93
	2	15	26.82	1.00
	3	12	27.38	1.14
	4	11	26.43	1.00
TNCD	1	9	23.28	1.27
	2	15	23.39	1.47
	3	14	23.04	1.20
	4	11	23.90	1.89
APNCD	1	6	15.85	1.10
	2	10	15.38	1.05
	3	13	15.31	1.04
	4	9	15.89	1.16

Table 76- Descriptive statistics for Schild female mean lumbar vertebral dimensions by burial area

Factor	Category	N
Charnel Association	no	15
	yes	23
Artifact/position cluster	1	14
	2	24

Table 77- Sample sizes for multiway ANOVA- mean female lumbar APNCD by charnel association and artifact/position clusters

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.738[a]	3	2.246	2.153	.112
Intercept	8300.678	1	8300.678	7956.391	.000
Charnel Association	4.167	1	4.167	3.994	.054
Artifact/position cluster	.153	1	.153	.147	.704
Charnel Association * Artifact/position cluster	4.193	1	4.193	4.019	.053
Error	35.471	34	1.043		
Total	9232.570	38			
Corrected Total	42.209	37			

Table 78- Multiway ANOVA table for mean female lumbar APNCD by charnel association and artifact/position clusters (a. R Squared = .160 (Adjusted R Squared = .085))

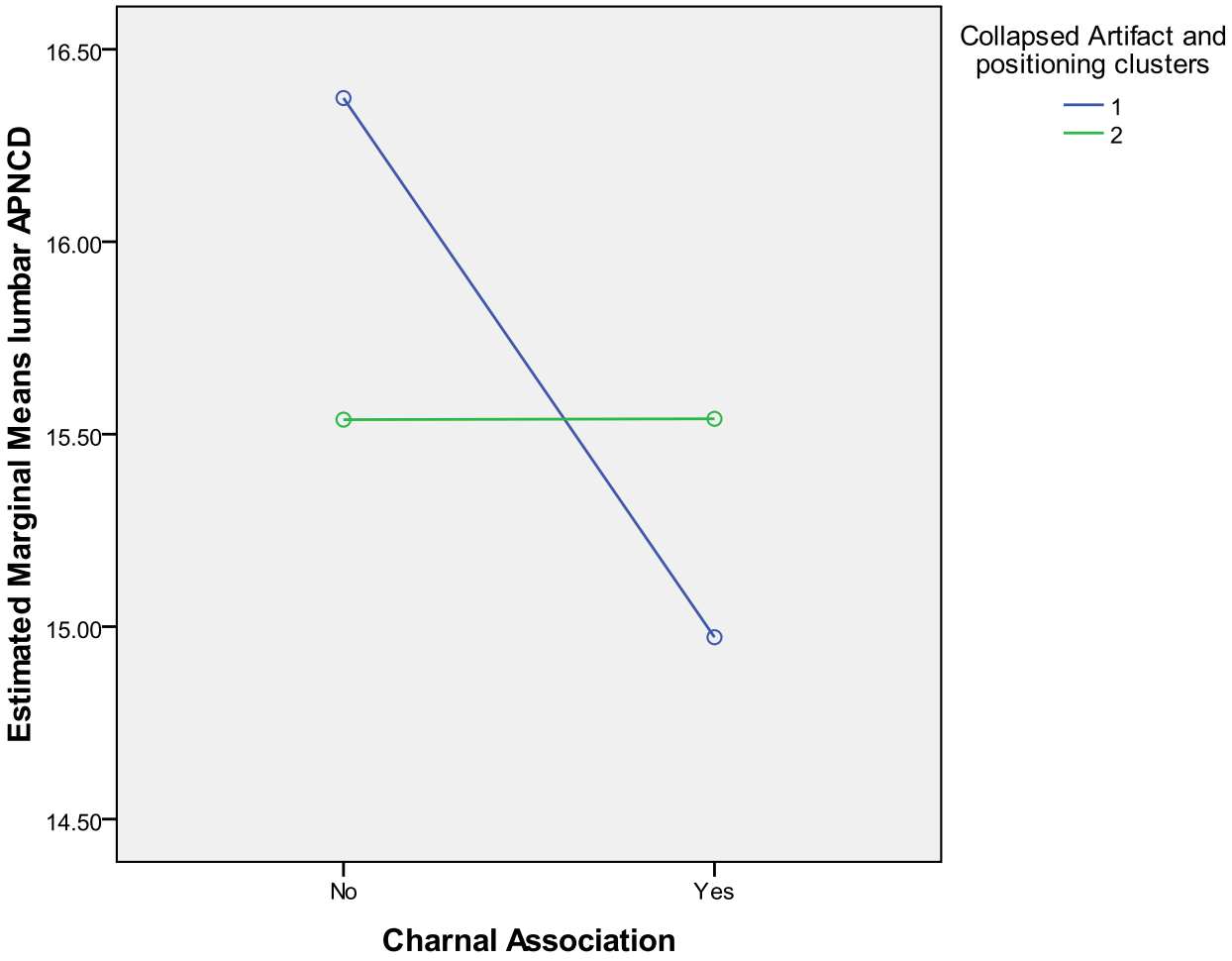

Figure 28- Multiway ANOVA plot for mean female lumbar APNCD by charnel association and artifact/position clusters. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

Factor	Category	N
Mound	1	22
	2	16
Artifact/position cluster	1	14
	2	24

Table 79- Sample sizes for multiway ANOVA- mean female lumbar APNCD by mound and artifact/position clusters

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.682[a]	3	1.894	1.763	.173
Intercept	8018.373	1	8018.373	7463.643	.000
Mound	.462	1	.462	.430	.517
Artifact/position cluster	.169	1	.169	.157	.694
Mound * Artifact/position cluster	5.671	1	5.671	5.279	.028
Error	36.527	34	1.074		
Total	9232.570	38			
Corrected Total	42.209	37			

Table 80- Multiway ANOVA table for mean female lumbar APNCD by mound and artifact/position clusters (a. R Squared = .135 (Adjusted R Squared = .058))

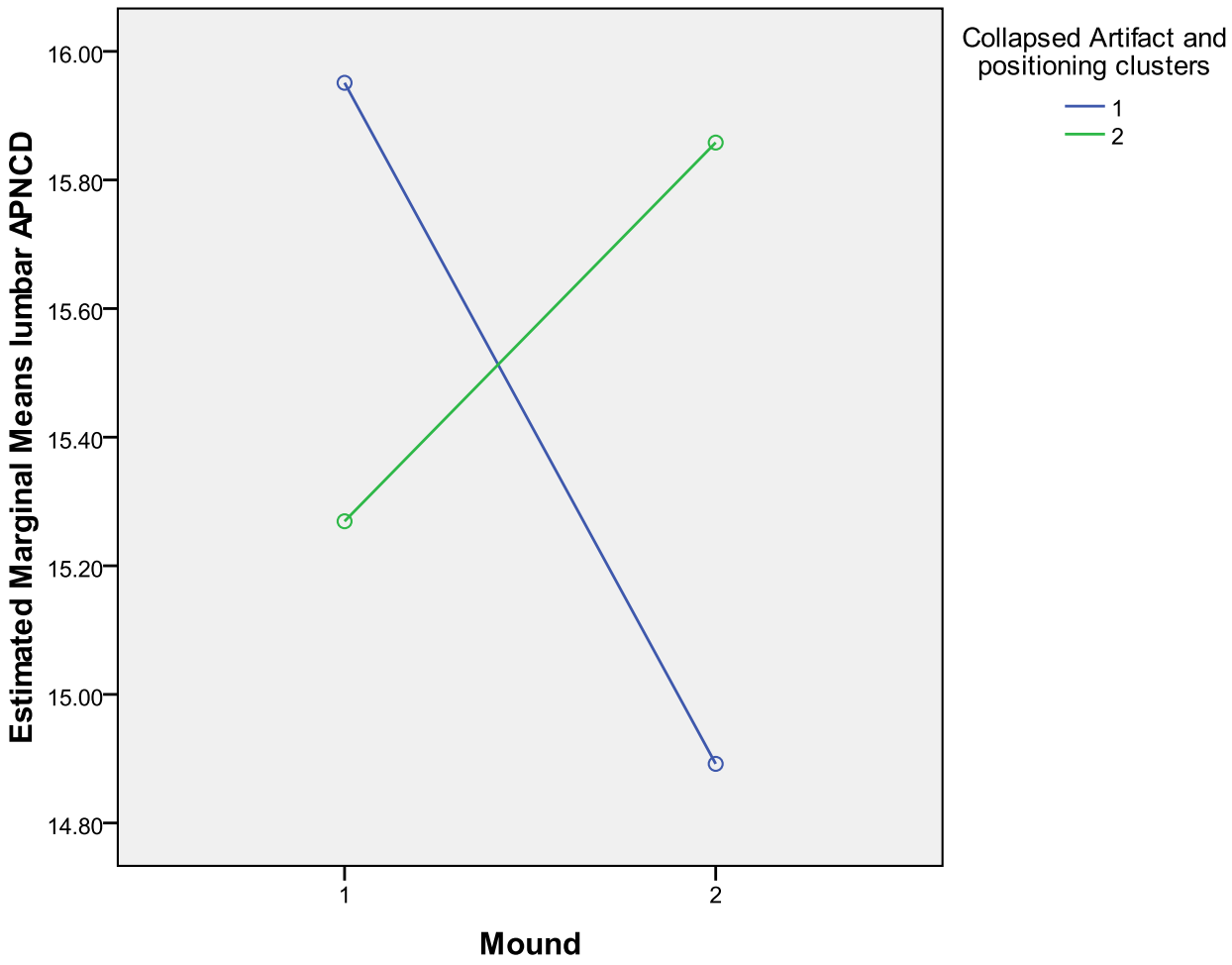

Figure 29- Multiway ANOVA plot for mean female lumbar APNCD by mound and artifact/position clusters

Factor	Category	N
Charnel Association	0	23
	1	23
Artifact only cluster	0	25
	6	21

Table 81- Sample sizes for multiway ANOVA- Schild male femur length by charnel association and artifact only clusters

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	30.873[a]	3	10.291	2.635	.062
Intercept	88162.000	1	88162.000	22577.808	.000
Charnel Association	.304	1	.304	.078	.782
Artifact only cluster	11.231	1	11.231	2.876	.097
Charnel Association * Artifact only cluster	17.855	1	17.855	4.573	.038
Error	164.002	42	3.905		
Total	94382.750	46			
Corrected Total	194.875	45			

Table 82- Multiway ANOVA table for male femur length by charnel association and artifact only clusters (a. R Squared = .158 (Adjusted R Squared = .098))

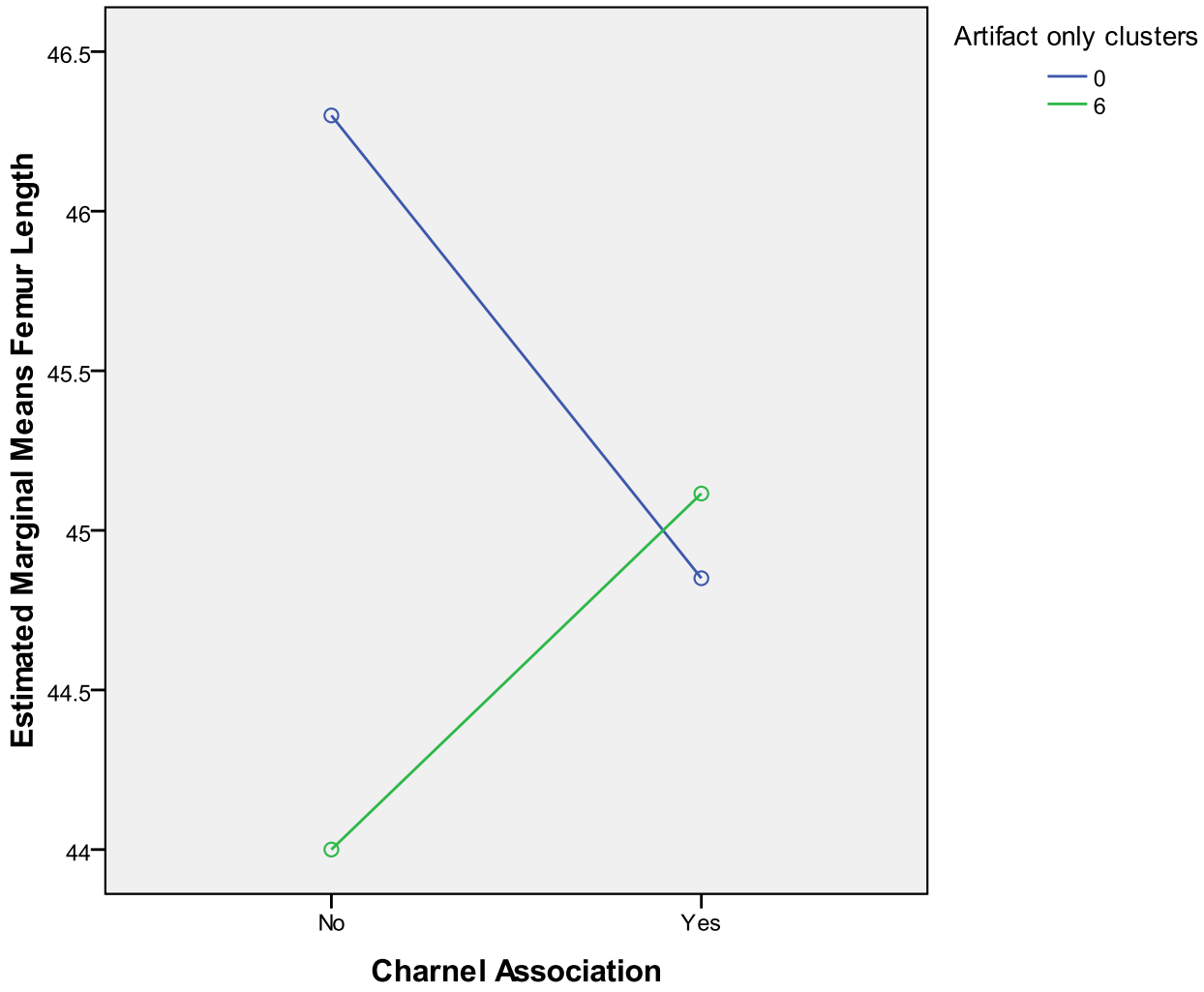

Figure 30- Multiway ANOVA plot for male femur length by charnel association and artifact only clusters

Factor	Category	N
Charnel Association	no	23
	yes	23
Artifact only cluster	1	25
	2	21

Table 83- Sample sizes for multiway ANOVA- mean female lumbar AVBH by charnel association and artifact only clusters

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10.413[a]	3	3.471	3.449	.027
Intercept	24136.633	1	24136.633	23983.58	.000
Charnel Association	1.775	1	1.775	1.763	.193
Artifact only cluster	.984	1	.984	.978	.329
Charnel Association * Artifact only cluster	4.217	1	4.217	4.191	.048
Error	36.230	36	1.006		
Total	28301.183	40			
Corrected Total	46.643	39			

Table 84- Multiway ANOVA table for mean female lumbar AVBH by charnel association and artifact only clusters (a. R Squared = .223 (Adjusted R Squared = .159))

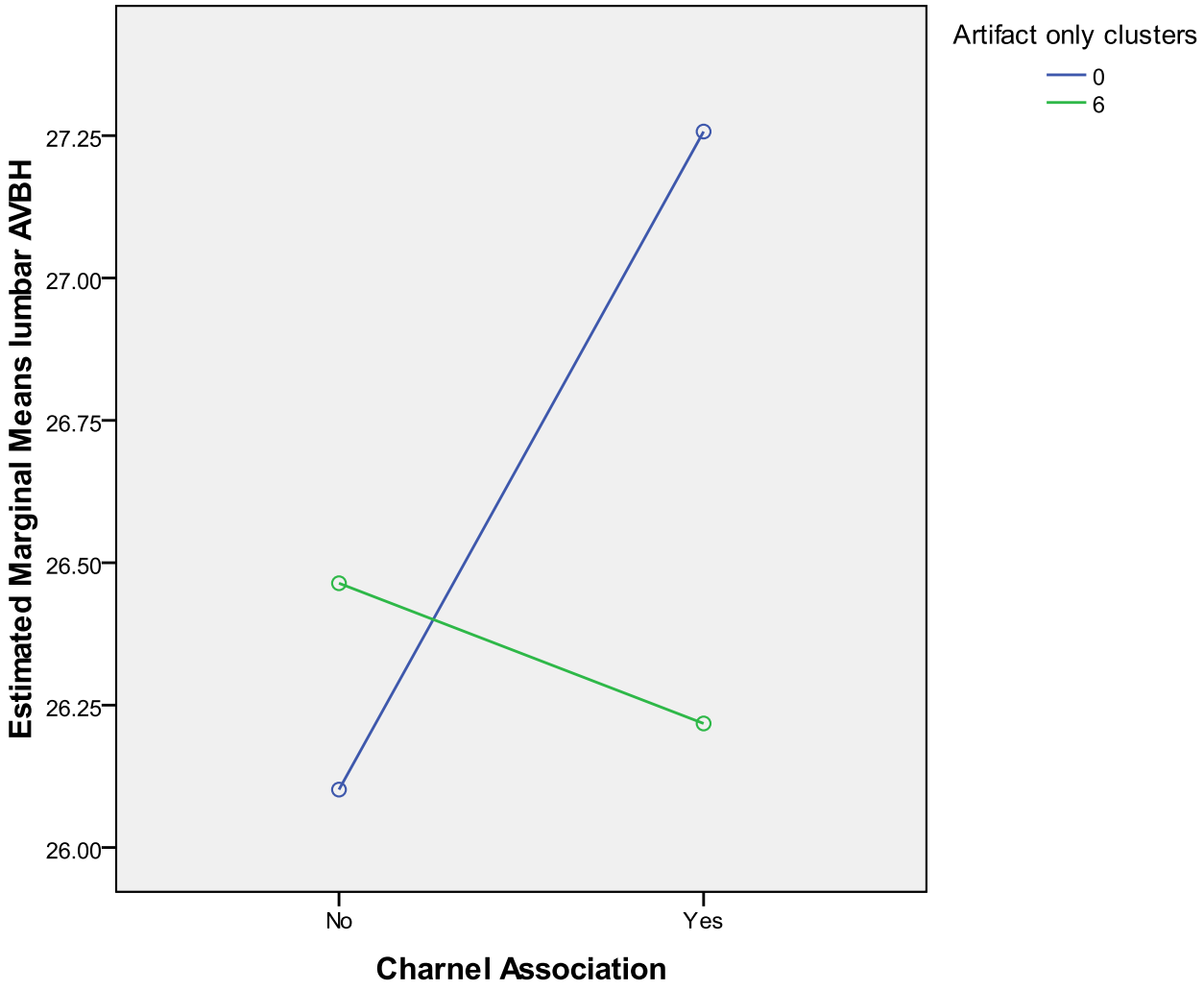

Figure 31- Multiway ANOVA plot for mean female lumbar AVBH by charnel association and artifact only clusters

Factor	Category	N
Mound	1	16
	2	22
Artifact only cluster	0	22
	6	16

Table 85- Sample sizes for multiway ANOVA- mean male lumbar AVBH by mound and artifact only clusters

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9.398[a]	3	3.133	2.428	.082
Intercept	26796.985	1	26796.985	20769.376	.000
Mound	.341	1	.341	.265	.610
Artifact only cluster	.819	1	.819	.635	.431
Mound * Artifact Only Cluster	9.166	1	9.166	7.104	.012
Error	43.867	34	1.290		
Total	28209.633	38			
Corrected Total	53.265	37			

Table 88- Multiway ANOVA table for mean male lumbar AVBH by mound and artifact only clusters (a. R Squared = .176 (Adjusted R Squared = .104))

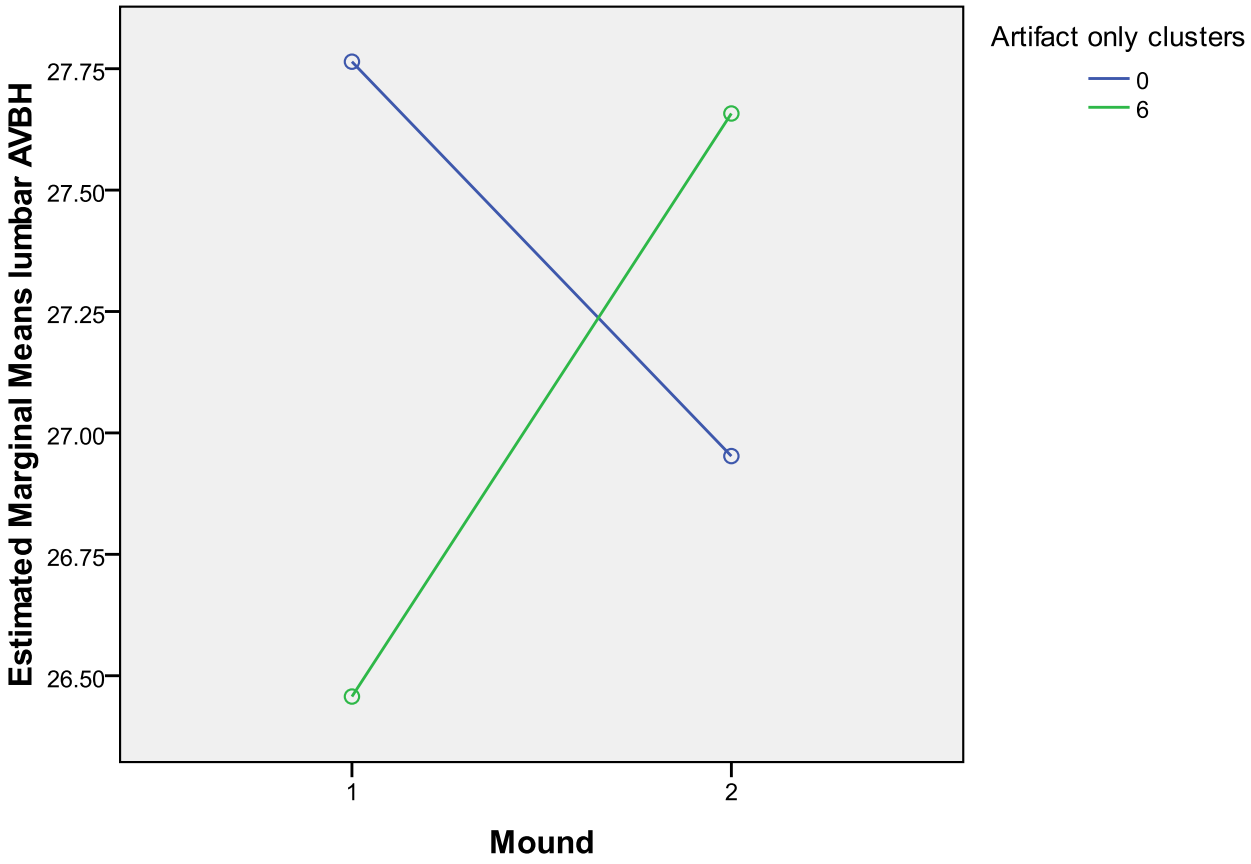

Figure 32- Multiway ANOVA plot for mean male lumbar AVBH by mound and artifact only clusters

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